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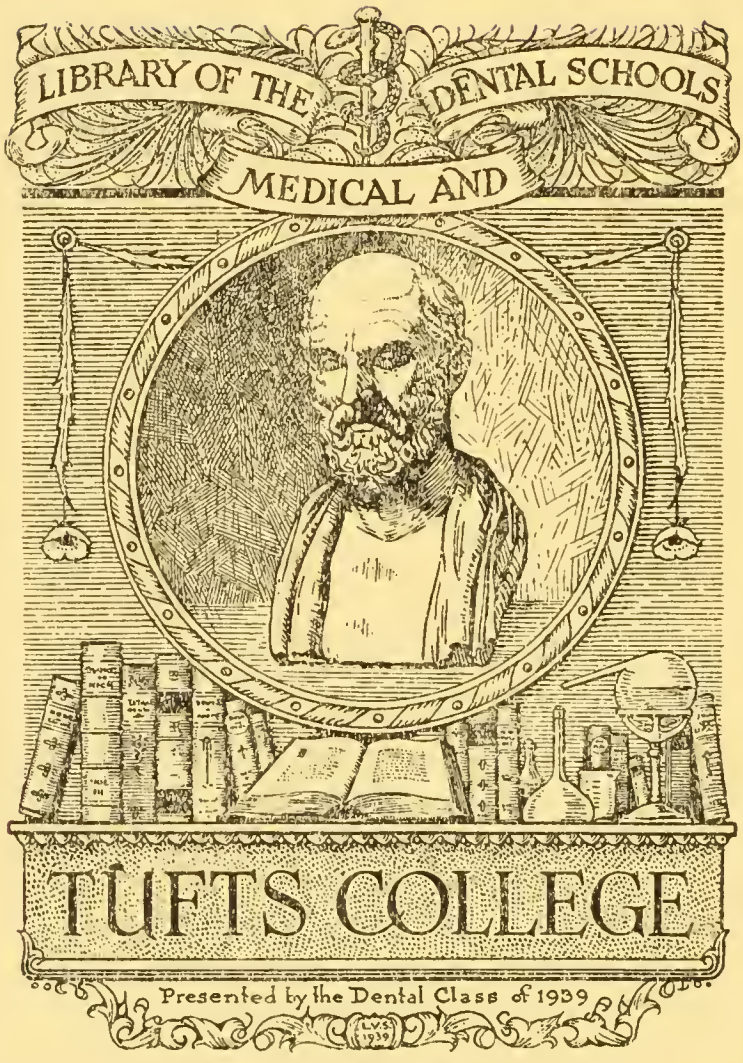

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THE

NATIONAL DISPENSATORY.

CONTAINING THE

NATURAL HISTORY, CHEMISTRY, PHARMACY,
ACTIONS, AND USES OF MEDICINES.

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NATIONAL DISPENSATORY.

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NATURAL HISTORY, CHEMISTRY, PHARMACY, ACTIONS, AND USES OF MEDICINES.

INCLUDING THOSE RECOGNIZED IN THE

PHARMACOPŒIAS OF THE UNITED STATES, GREAT BRITAIN, AND GERMANY, WITH NUMEROUS REFERENCES TO THE FRENCH CODEX.

BY

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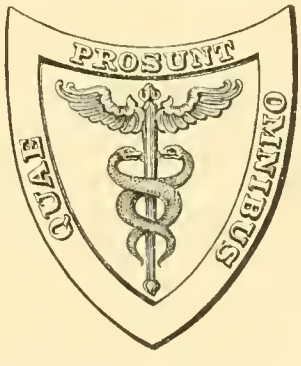
FIFTH EDITION,

ENLARGED AND REVISED IN ACCORDANCE WITH THE SEVENTH DECENNIAL REVISION OF THE UNITED STATES PHARMACOPŒIA.

WITH THREE HUNDRED AND TWENTY ILLUSTRATIONS.



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PREFACE TO THE FIFTH EDITION.

In presenting the fifth edition of The National Dispensatory the survivor of its associate authors (and editors) would be wanting in duty, as well as in personal feeling, did he fail to record his impression, however inadequately, of the character of his late colleague, Professor John Michael Maisch, Phar. D. This is not the most suitable place, nor is he the fittest person, to describe Prof. Maisch's long, arduous, and fruitful career in a profession for which he was eminently fitted by the scientific bent of his mind, his lifelong habits of accurate observation, and the singular sobriety of his judgment. His substantial qualities as a man of science, and the esteem in which he was held for his unflagging industry and his devotion to the highest interests of his profession, are attested not only by the many positions of honor and responsibility which he held, but also by the honorary and other rewards he received for his original researches. It will be remembered that in August, 1893, the "Hanbury Memorial," a valuable gold medal, was awarded to him for his original researches in the natural history and chemistry of drugs, and that it was the first time this honor had been conferred on this side of the Atlantic.

The present writer is incompetent to trace the steady rise of Prof. Maisch to the eminence he had reached when death cut short his uncompleted career as an investigator and teacher and as a wisely conservative guide of opinion in the pharmaceutical world. As his associate and collaborator in producing *The National Dispensatory* from 1879 until his death in 1893, his survivor learned the strength and richness of his learning and felt the charm of his sincere and earnest character. Few men have united as he did the personal qualities of cheerfulness, patience, natural courtesy, kindliness, and self-sacrifice with such wide and accurate knowledge of the sciences which he cultivated and in which he had no superior. It was always a pleasure to confer with him in the interests of the work to which he gave the ripest and best of his knowledge and experience, and which must long remain a monument of his industry and skill as well as of his technical knowledge and critical sagacity.

In regard to the Action and Uses of medicines as set forth in the present edition, it is proper to state, so numerous are the articles, including natural products and artificial compounds, which of late years have been introduced into the practice of medicine, that the true value of many among them remains undetermined. Yet they cannot for the present be excluded from the Dispensatory, whatever may be the final determination in regard to them. To make room for their due consideration it has been found necessary to omit from the work a portion of the detailed and illustrated accounts of the physiological and toxicological actions of many medicines which were amply considered in previous editions. In all articles of real importance, however, more recent illustrations have been adduced.

In preparing a work under the conditions imposed on the present one it is impossible, even with scrupulous vigilance, to prevent a certain commingling of fact and speculation, for the most cautious reporter cannot always avoid mistaking the one for the other. The present writer claims only to have striven

assiduously to maintain a separation between facts and theories, believing that, whatever fate may await the latter, the former are in their nature indestructible: "*Opinionum commenta delet dies; naturæ judicia confirmat.*" The deplorable results of following physiological experiment and chemical composition, instead of clinical experience, as the chief teacher and guide in therapeutics, have led to the rejection by practical physicians of many medicines which not long before were introduced with loud acclaim. It follows that in the long list of such medicines it becomes difficult at a given moment to assign to each its real value, and therefore, in a work like the present, to be sure of admitting all that deserve recognition or of excluding all that are worthless or injurious.

It is desired once more, and urgently, to direct the attention of those who consult this work for its practical medical uses to the Index of Therapeutics, where under the name of each disease will be found a list of all the medicines employed in its treatment, and in the articles relating to each medicine the conditions that call for its employment. This is the empirical as contrasted with the dogmatic method; it is the method of experience, upon which alone the practical physician can securely depend.

A. S.

From a pharmaceutical and botanical standpoint a complete revision of *The National Dispensatory* has been required by the appearance of the new U. S. Pharmacopœia, in order to adapt the text to the present standard, to embody the numerous changes made therein, and to embrace as well all the new official drugs and preparations. The revision, however, has by no means been confined to this; the most recent issues of foreign pharmacopœias have been exhaustively consulted, and all new material of value which they furnished will be found incorporated. Many of the older articles have been completely rewritten, and a large number of new ones introduced, descriptive of all the latest synthetic remedies and unofficial preparations now in use. The pharmacist will find a full discussion of chemical and pharmaceutical processes with descriptions and explanations of the most approved apparatus and tests.

The pharmacopœial formulas for galenical preparations have been freely commented upon, and improvements have been suggested wherever such appeared desirable. To accommodate pharmacists not yet supplied with the metric weights and measures now ordered by the Pharmacopœia, separate formulas in customary weights and measures have been added for convenient quantities of all official preparations. A number of very complete tables taken from the new U. S. Pharmacopœia, together with all the official reagents and solutions for both qualitative and quantitative tests, have been placed in the Appendix, and for the convenience of physicians and pharmacists an alphabetical list of official drugs has been added, showing at a glance the preparations of the United States and British Pharmacopœias containing them. Another valuable feature of the present volume is the introduction of a list of over four hundred formulas and molecular weights of chemical compounds, which will prove valuable for reference.

In its present form, therefore, those who have taken a part in the revision of *The National Dispensatory* earnestly trust that the work will be found to maintain the high position held by previous issues, and that it will receive the commendation of all those who have occasion to consult its pages.

C. C.

January, 1894.

PUBLISHERS' NOTE TO THE FIFTH EDITION.

On the appearance of *The National Dispensatory*, fifteen years ago, it was at once recognized by the medical and pharmaceutical professions as satisfying the need for a work affording all necessary information upon its comprehensive subject with authoritative accuracy, and uniting completeness with convenience by the exclusion of obsolete matter. So marked was the public appreciation of these peculiar characteristics that six months sufficed to exhaust the large first edition. Successive revisions at frequent intervals have maintained each issue fully abreast of the science and practice of its time, and the work has accordingly been one to which the physician and pharmacist could always look with confidence for complete and trustworthy information in answer to any inquiry.

With the rapid advance of science the field to be covered by such a volume has so greatly increased that prior to his death Professor Maisch had confided a large share of the revision to Professor Charles Caspari, Jr., of the Maryland College of Pharmacy. The sad event which deprived American pharmacy of one of its foremost authorities occurred, however, after Professor Maisch had practically completed the portion of the work which he had reserved for himself. Readers of *The National Dispensatory* may be congratulated upon receiving the benefit of his latest and ripest knowledge.

The therapeutical portion of the volume has been revised with equal thoroughness, and it will be found to contain the real advances, gleaned from the vast literature of its department, and set forth with all the clearness and critical acumen of Professor Stillé. This great body of important knowledge is arranged not only alphabetically under the various drugs, but it is also placed at the instant command of those seeking information in the treatment of special diseases by the recommendations under the various Diseases in the Therapeutical Index. The extent of the information contained in the following pages is indicated by the twenty-five thousand references in the two indexes at the end of the volume.

In no previous edition have the alterations and additions been so great. The sweeping changes in the new U. S. Pharmacopœia are included with official authorization of the Committee on Revision, and full use has been made of valuable information appearing in foreign pharmacopœias. The new synthetic remedies, and those drugs which are largely in use, though unofficial, are thoroughly considered. Full explanations are given of chemical and pharmaceutical processes, with descriptions of new apparatus and tests. All weights and measures are stated in both the ordinary and metric systems. Many new tables and lists have been inserted for the purpose of placing before the reader a vast amount of important knowledge in a form combining compactness with ease of reference to the utmost degree. In short, no element of utility to the physician or pharmacist has been overlooked, and it is therefore believed that the new edition of *The National Dispensatory* will prove more than ever valuable to those for whom it has been prepared.

Acknowledgment is due the following gentlemen and business firms for their kindness and courtesy in loaning cuts for many of the new illustrations: Dr. F. Hoffmann, Dr. C. Curtman, Whitall, Tatum & Co., J. M. Maris & Co., Anderson Mfg. Co., A. H. Wirz, Jos. G. Taite's Sons, J. Michael, Fox, Fultz & Webster, and the American Triturate Mould Co.

ABBREVIATIONS.

B. or *Br. P.*, British Pharmacopœia, 1885.

Br. Add., Additions to the British Pharmacopœia, 1890.

Cc., Cubic centimeter.

Cm., Centimeter.

E., English.

F. Cod., Codex Medicamentarius; Pharmacopée Française, 1884.

F. It., Farmacopea d'Italia, 1892.

Fr., French.

G., German.

Gm., Gram.

M., Meter.

Mgm., Milligram.

Mm., Millimeter.

N. F. or *Nat. Form.*, National Formulary.

Nat. Ord., Natural Order.

Off. Prep., Official Preparations.

P. A., Pharmacopœa Austriaca, 1889.

P. G., Pharmacopœa Germanica (Arzneibuch), 1890.

Sp., Spanish.

Sp. gr., Specific gravity.

U. S. or *U. S. P.*, the Pharmacopœia of the United States of America, 1893.

The titles of many books and periodicals to which reference is made in the text are abbreviated, but not to such an extent as to necessitate their addition to this list.

THE

NATIONAL DISPENSATORY.

ABRUS.—Abrus.

Indian Liquorice, Wild Liquorice, E.; *Liane réglisse, Réglisse indienne*, Fr.; *Indisches Süssholz*, G.

The root and seeds of Abrus precatorius, *Linné*. Bentley and Trimen, *Medicinal Plants*, 77.

Nat. Ord.—Leguminosæ, Papilionaceæ, Vicieæ.

Origin.—This is a twining shrub indigenous to India, where it is known as *gunja*, *goontch*, or *gurginja*, and now naturalized in all tropical countries. The leaves are abruptly pinnate, and have from 20 to 30 linear or oblong, obtuse, entire, smooth, and pale-green leaflets, about 15 Mm. ($\frac{5}{8}$ inch) long, and having a sweet liquorice-like taste. The rose-colored flowers are clustered in one-sided long-stalked racemes, and the oblong-rhomboidal, short-beaked legumes contain from 4 to 6 seeds.

Description.—Radix abri. The root is seen in commerce in more or less twisted pieces, varying in length, and about 5 to 20 Mm. ($\frac{1}{5}$–$\frac{4}{5}$ inch) thick. It has a thin, pale reddish-brown bark, containing near the middle layer a circular zone of sclerenchyma-cells, and in the inner layer strong bast-fibres, which are scattered without regularity through the liber parenchyma. The wood is yellowish, porous, breaks with a short fibrous fracture, and is composed of circles of wood-fibres containing rather large ducts and alternating with circles of parenchyma, the whole radially traversed by medullary rays, some of which are narrow, others much broader. The root has a slight not agreeable odor and a bitterish, mucilaginous taste, with a somewhat acrid and sweetish after-taste resembling that of liquorice root.

Semen abri; Prayer-beads, Jumble-beads, Crab's eyes, *E.*; Pois d'Amérique, *Fr.*; Paternoster-Erbsen, *G.* The seeds are globular-ovate, about 5 Mm. ($\frac{1}{5}$ inch) long, scarlet-red, glossy, and have a black spot surrounding the grayish hilum; the testa is hard, and encloses a whitish fleshy embryo consisting of plano-convex cotyledons and an accumbent radicle. The seeds are inodorous and have a slight bean-like taste. They have been introduced under their Brazilian name, *jequiriti* or *guequiri*.

Composition.—Berzelius ascertained that the leaves and branches contain a principle closely resembling glycyrrhizin. The same principle is also present in the root, which in addition contains sugar; but nothing is known of the remaining constituents. Prof. Warden (1882) isolated from the seeds crystalline *abric acid*, which is slightly soluble in cold water and contains nitrogen. An alkaloid, most likely a decomposition product, was obtained by Rigaud and Dusart (1883), and fixed oil with cholesterin and lecythin by Heckel and Schlagdenhauffen (1886). The physiological properties of the seeds were shown by Warden and Waddell (1884) to be due to *abrin*, a mixture of protein compounds which are rendered inactive by moist heat. This is probably identical with the *jequiritin* of Bruylants and Vinneman (1885), and consists mainly of a paraglobulin and an albumose, of which the former is soluble in a 15 per cent. solution of sodium chloride, and is coagulated at 80° C., while the latter is not coagulated by heat, but with nitric acid yields a precipitate redissolved on heating and reappearing on cooling.

Allied Drug.—Cassia Absus, *Linné*, has oval-oblong, flat, glossy-black seeds, which are used in Eastern countries in purulent conjunctivitis and as an application to sores.

Action and Uses.—In the Punjab sharpened cones of a dried paste made from abrus-seeds are thrust into cattle to poison them (*Amer. Jour. Pharm.*, May, 1885, p. 242). Warden and Waddell of Calcutta declare that "poisonous symptoms are

not developed when the seeds are given by the mouth. They are eaten in large quantities by the Hindoos to prevent fecundity" (*Therap. Gaz.*, ix. 646). Bufalini's experiments showed that abrus infusion injected into the veins of animals arrested the heart in diastole (*Centralbl. f. Therap.*, vii. 379). The seeds are said to have been used for centuries in Brazil as a popular remedy for granular lids and pannus. In 1862 attention was called to abrus in Europe, but it was soon forgotten, and it was not until 1882 that renewed interest was awakened in it by the reports of De Wecker. An infusion, of the strength of one to twenty, applied to the eye of a rabbit produced violent inflammation of the organ, with œdema and false membrane, ulceration of the cornea, swelling of the parotid and submaxillary glands, and finally internal suppuration of the eyes and maxillary glands, and gangrene of the eyelids. It is said that the drug is much abused in Brazil, and that "one often sees violent inflammation of the lids which extends to the face, neck, and upper part of the thorax, the submaxillary glands often taking on an intense inflammation which ends in suppuration" (*Med. News*, xlii. 412). In experiments upon animals Cornil and Berlioz determined that when injected under the skin or into the blood it produces in the former situation abscess or gangrene, and in the latter virulent toxical phenomena, with an enormous generation of bacilli in the blood and lymph (*Archives gén.*, Nov. 1883, p. 623).

The use of abrus is limited at present to those obstinate cases of *granular ophthalmia*, *trachoma*, *cicatricial degeneration*, and *pannus* which are notoriously rebellious to treatment, and which some surgeons have not scrupled to attempt to cure by the application of gonorrhœal pus. Its action is chiefly substitutive, removing an existing inflammation by the action of a stronger but temporary one. But it is also to some extent destructive or caustic. De Wecker described the effects of its application thus: The infusion is applied several times a day until its action begins to be felt. Within a few hours after the first use of the lotion the conjunctiva becomes strongly irritated, and on the following day severely inflamed; the eyes cannot be opened, the lids are œdematous, and a watery liquid escapes from between them. This period of irritation lasts for about three days, and is attended with fever, pain, and sleeplessness. On the third day suppuration begins, and for five days continues copiously, and then gradually declines until about the fifteenth day, when the patient finds himself free from both inflammation and granulation, while the cloudiness of the cornea subsides (*Centralbl. f. Therapie*, i. 200). In this description no allusion is made to the striking peculiarity mentioned by most other reporters, the formation of a false membrane upon the conjunctiva, which, indeed, was originally described by De Wecker and by various other observers as a yellowish-white membrane adhering firmly to the upper, but less so to the lower, lids (Gruening *Med. Record*, xxiii. 288; Brown, *Med. News*, xlii. 412). De Wecker also asserted that the cornea is not at all endangered by the artificial inflammation (*loc. sup. cit.*), a statement also made by Peck (*Med. Record*, xxiv. 30). Dr. E. Smith, on the other hand, claims that it cures inflammations, provided they are not sthenic (*Therap. Gaz.*, xi. 640); but Sattler makes the very opposite declaration, saying that not only may the application cause existing ulcers to spread, but also create new ones (*Centralbl. f. Therap.*, i. 335); and Standish admits that this result is not unusual (*Boston Med. & Surg. Jour.*, June, 1883, p. 609). It seems to be agreed that chronic catarrhal ophthalmia with mucoid or puruloid secretion, but without thickening or infiltration of the conjunctiva. is not favorably influenced by jequirity. Chronic suppuration of the middle *ear* is curable by jequirity; and Bordé makes a similar statement in regard to chronic metritis (*Bull. de Therap.*, cxi. 376). Dr. Shoemaker has employed a paste or emulsion made from the red hulls of the seeds as a semi-caustic in chronic epithelial and lupoid *ulcers* of the skin. This method, it is said, "should be applied with caution, as it may give rise to alarming symptoms, erysipelatous inflammation, and, if used on weak and irritable patients, to great constitutional disturbance" (*Practitioner*, xxxiii. 364). A similar method was pursued by Hawies (*Jour. Am. Med. Assoc.*, v. 321). Haranger claims to have "found in an infusion of jequirity, as in the pus of gonorrhœa, micrococci, corpuscles, and granules" (*Bull. de Thérap.*, civ. 42). Cornil and Berlioz declare that "the bacteriæ of jequirity are its only active principle" (*Archives gén.*, Nov. 1883, p. 618). But this doctrine is contradicted by the following facts: 1. The inflammation may be reproduced an unlimited number of times; 2. Its action on all mucous membranes is the same; 3. Its effects may be closely imitated by an infusion of common peas (Tangemann). Klein demonstrated that a sterilized infusion of jequirity produced the so-called characteristic inflammation, as well as one swarming with bacteria. Many observers have confirmed most of these conclusions; and Warden and Waddell claim that the active principle is "a proteid body,

acting with greater rapidity in proportion to the completeness of its solution at the time of administration (*loc. cit.*). The latter statement has been confirmed by Bruylants and Vinneman, and partially so by Bechamp and Dujardin (*Thérap. Gaz.*, ix., p. 617).

In Brazil the seeds were soaked for several days in cold water, their kernels removed, reduced to a fine powder, macerated for two hours, and filtered. If the envelope, or testa, is employed along with the kernels, intenser effects are produced. The mode of using this remedy is described by De Wecker as follows: "Powder 32 jequirity beans, and macerate them for 24 hours in 500 Gm. (a pint) of cold water; then add an equal quantity of hot water, and filter when cool. The patient should bathe the eyes with this infusion several times a day until inflammation sets in." Others advise the liquid to be applied with cotton or a camel's-hair pencil, and the most judicious rule appears to be to allow twenty-four hours to elapse between the first and second applications, and that on no account should the infusion be applied to the eye on compresses. Sattler directs that the envelope of from 10 or 12 seeds (Gm. 1) should be removed with hot water before the infusion is made; the seeds should then be powdered and 200 Ccm. (f℥vj) of hot water added. This infusion should, after standing for 24 hours, be filtered. Its strength is reckoned as ½ per cent. The excessive action of the infusion, it is said, may be moderated by a weak solution of corrosive sublimate; and some prefer to use the powder of the seeds as more manageable than the infusion.

The seeds of *Cassia absus*, or *C. auriculata*, were anciently used in powder or in emulsion by the Greeks and Egyptians in the treatment of *ophthalmia*, and are said to be still employed by the latter as a domestic remedy. Long ago introduced by V. Graefe into European practice, they fell into disuse on account of the unfavorable reports of some observers. The dried seeds, finely powdered and mixed with an equal quantity of white sugar, were strewn upon the conjunctiva, especially after the acute inflammation had subsided. An ointment containing the powdered seeds was likewise used, and in acute cases an infusion was employed as a collyrium (Richter, *Ausführl. Arzneim.*, ii. 267).

ABSINTHIUM, *U. S.*—Absinthium.

Herba s. Summitates absinthii, P. A., P. G.; *Wormwood*, E.; *Absinthe commune, Grande absinthe, Aluine*, Fr. Cod.; *Wermuth, Alsei*, G.; *Assenzio*, F. It.; *Ajenjos*, Sp.

The tops and leaves of Artemisia Absinthium, *Linné;* s. Absinthium vulgare, *Lamarck.* Bentley and Trimen, *Med. Plants*, 156.

Nat. Ord.—Compositæ, Anthemideæ.

Description.—This perennial plant is indigenous to hilly and mountainous regions of Northern Africa, of the greater portion of Europe, and of the northern part of Asia; it is frequently cultivated for medicinal purposes both in Europe and in this country, where it has become naturalized in some localities, and grows wild in waste places and along roadsides. The root produces several stems, which are about 1 M. (3¼ feet) high, woody at the base, nearly round, somewhat furrowed, and branching above. The radical leaves attain a length of 15 to 20 Cm. (6 to 8 inches); the stem-leaves are 25 to 75 Mm. (1 to 3 inches) long, petiolate, the upper ones sessile; their outline is roundish-triangular; they are twice or thrice pinnatifid, the segments lanceolate, the terminal one spatulate. The bracts are merely three-cleft or simple and lanceolate. The very numerous nodding heads of yellow flowers are in paniculate racemes, hemispherical in shape, with the involucre imbricate; the receptacle small and hairy, the marginal florets pistillate, and not ligulate, the numerous disk-florets perfect and five-toothed, and the ovary obovoid and crowned with a disk, but destitute of pappus. The entire plant, with the exception of the stouter portions of the stem, has a hoary appearance from the numerous appressed white silky hairs, intermixed with oil-glands, leaving merely the upper surface of the leaves of a dark-green color.

Wormwood should be gathered while flowering, during July or August, the coarse stems being rejected. On careful drying the fresh herb loses from 75 to 80 per cent. of its weight. The wild-grown herb has a strong aromatic not very agreeable odor, and a persistent and intensely bitter taste; in cultivation the bitter taste is somewhat decreased.

Constituents.—The odor of wormwood is due to a limpid volatile oil, of which from .4 to 1.5 per cent. is obtained from the dry herb. According to Zeller, wormwood grown in a warm climate yields less volatile oil, and cultivation appears to decrease it. Its color varies between dark-green and yellowish-brown, but by careful rectification it

may be obtained colorless. On exposure to light and air it acquires a dark-brown color and a somewhat viscid consistence. Its specific gravity varies between .90 and .973; it dissolves in 1 part of 85 per cent., and in all proportions of absolute, alcohol; has a rotating power to the right in the polariscope, and possesses the pungent aromatic odor and taste of the herb. It consists mainly of *absinthol*, the composition of which is $C_{10}H_{16}O$, which boils at 200° C. (392° F.), and splits with zinc chloride into water and cymene, $C_{10}H_{14}$; it contains also 2 per cent. of terpenes boiling at 150° and above 120° C., and a few per cent. of blue oils boiling at 300° C. and upward (C. R. A. Wright, 1874). The volatile oil is the chief constituent of the liquor which is largely consumed in Western Europe under the name of *absinthe*, and which is prepared either by distilling wormwood, melissa, anise, and other aromatics with whiskey, or by dissolving in the latter the corresponding volatile oils.

The intensely bitter taste resides in *absinthin*, which is precipitated from the infusion by tannin (Kromayer, 1861). Since 1827 the bitter principle had been repeatedly obtained in an impure condition, until Mein (1834) succeeded in preparing it in a somewhat crystalline condition. Senger (1892) found the best process for its preparation to be by agitating the ethereal tincture of the herb with water, removing coloring matter from the aqueous solution with aluminum hydroxide, again treating the liquid with ether, and evaporating this solvent. It forms a faintly yellowish, glass-like mass, yielding a white powder, melts at 65° C., is soluble in water, alcohol, and ether, and is a glucoside, yielding dextrose, a volatile compound, and a resinous acid. Composition, $C_{15}H_{20}O_4$ (Senger). Wormwood contains also some tannin (green with iron salts), resin, starch, albumin, potassium nitrate and other salts, succinic (Braconnot's absinthic acid, 1815), malic, and acetic acids.

Other Medicinal Species of Artemisia.—A. PONTICA, *Linné;* Roman wormwood, *E.;* Petite absinthe, *Fr.;* Römischer Beifuss, *G.* Indigenous to Southern Europe and Central Asia. Hoary tomentose, leaves decompound pinnatifid, segments narrow linear; odor strong, rather pleasant; taste pungent, aromatic, and bitter; smaller and less esteemed than wormwood.

A. ABROTANUM, *Linné;* Southernwood, Old Man, *E.;* Aurone mâle, *Fr.;* Eberraute, *G.;* Abrotano, *It., Sp.* Western Asia and Southern Europe; cultivated in U. S. Minutely hairy, segments of the pinnatifid leaves capillaceous; odor lemon-like; taste aromatic and bitter.

A. VULGARIS, *Linné;* Mugwort, *E.;* Couronne de Saint-Jean, Armoise commune, *Fr.;* Beifuss, *G.;* Artemisa, *Sp.* Northern Africa, Europe, and Siberia; cultivated and spontaneous in U. S. Stem often purplish; leaves subsessile, green above, white tomentose beneath, pinnatifid, segments linear lanceolate, often incised; odor aromatic, agreeable; taste aromatic, bitterish, and somewhat acrid. The root, *radix artemisiæ*, is also medicinally employed in Europe. It is about 20 Cm. (8 inches) long, woody and beset with numerous thin and tough radicles, which are the parts used; they are 5 to 10 Cm. (2 to 4 inches) long, and about 2 Mm. ($\frac{1}{12}$ inch) thick, are light brown, internally whitish, and have an angular wood and a thick bark, with a thin bast-layer, and, outside thereof, with 5 or 6 groups of resin-cells. The root has a slight not very pleasant odor, a sweetish and slightly acrid taste, and contains, according to Hummel and Jænicke (1826), Bretz and Eliason (1826), and Hergt (1830), a little butyraceous volatile oil, acrid resin, tannin, etc.

A. DRACUNCULUS, *Linné;* Tarragon, *E.;* Estragon, *Fr., Sp.;* Dragunbeifuss, Kaisersalat, *G.* Siberia, Tartary, Southern Europe; cultivated. Plant green and glabrous; radical leaves trifid, stem-leaves narrow lanceolate, entire; odor anise-like; taste aromatic, bitterish. The volatile oil consists largely of anethol, $C_{10}H_{12}O$.

A. LUDOVICIANA, *Nuttall;* Western Mugwort. It grows from Michigan to Oregon and southward, is 1–1.5 M. (3 to 5 feet) high, white woolly, with lanceolate, deeply cut, serrate, or entire leaves and numerous small flower-heads. It has a bitter taste, and a slight odor like that of wormwood. The fruit of this species, and of A dracunculoides, *Pursh*, is used as food by the Indians. The last-named plant extends from Western Illinois to Oregon and southward to Arizona; it has also appeared in Arkansas. It has linear entire smooth leaves, of which the lower ones are occasionally three-cleft, and very numerous small mostly pedicelled heads in compound leafy panicles. It resembles the preceding in odor and taste.

A. FILIFOLIA, *Torrey*, growing from Nebraska to New Mexico, and known there as *southernwood*, has filiform, revolute, sometimes three-cleft, whitish tomentose leaves, and small about four-flowered heads in leafy panicles, and is more aromatic than the preceding.

A. FRIGIDA, *Willdenow*, known in Colorado as *sierra salvia* and *mountain sage*, is covered with silky white hairs, and has small leaves with linear lobes. It was analyzed by F. A. Weiss (1890), and probably contains absinthin.

A. TRIDENTATA, *Nuttall*, is the *sagebrush* of Western North America, growing from Sonora to Nevada and Oregon and eastward to the Rocky Mountains. It is a shrub 1.5 to 2 M. (5–6 feet) high, with crowded canescent, cuneate, and truncate, mostly bluntly three-toothed leaves and obovoid or oblong flower-heads, which are about 4 Mm. ($\frac{1}{6}$ inch) long, are about five-flowered, and spicately clustered in narrow compound panicles. The plant contains a pungent volatile oil, and is used by the Indians in the form of infusion for headaches, colds, and for worms.

A. ARBUSCULA, *Nutt.*, and A. TRIFIDA, *Nutt.*, are the dwarf sagebrushes of the same localities, and have similar properties.

A. ABYSSINICA, *Olivier*, is known in Abyssinia as *tshuking* and *zerechtit*. The inflorescence, which is employed, forms corymbose racemes with small globular heads, having a woolly involucre, whitish florets, an aromatic odor, somewhat resembling chamomile and tansy, and an aromatic bitterish taste. Dragendorff (1878) found in it 1.7 per cent. volatile oil, 2.8 tannin, and a trace of bitter principle.

Pharmaceutical Preparations.—EXTRACTUM ABSINTHII is prepared with diluted alcohol (*P. G.*) or with boiling distilled water (*F. Cod.*).

TINCTURA ABSINTHII, *P. G.* Macerate wormwood 1 part with alcohol (sp. gr. .892) 5 parts, express and filter.

Action and Uses.—In small doses a stimulant tonic, but in large doses, and especially in its alcoholic preparation "absinthe," by its habitual use produces marked derangement of the nervous system, with loss of virile power and a peculiar tendency to hallucinations and convulsions (Laborde, *Archives gén.*, Nov. 1889, p. 609). Wormwood may be advantageously employed in *atonic* and especially *flatulent dyspepsia*, and in various conditions of the system in which local disorders are maintained by general debility of the functions, and particularly by that of the digestive apparatus. In this manner partly, and partly also as a direct anthelmintic, it sometimes is used successfully to remove *lumbricoid worms*. Externally, a decoction of wormwood may be applied as a dressing to unhealthy and indolent *ulcers*. The *dose* of wormwood in substance is from Gm. 1.30–2.60 (20 to 40 grains). An *infusion* made with Gm. 32 (an ounce) of wormwood in Gm. 500 (a pint) of water may be given in doses of Gm. 32–64 (1 or 2 fluid-ounces).

A. vulgaris was at one time held in high repute as a remedy for *epilepsy*, and especially for those cases of it which occur in persons of feeble constitution and of a highly nervous temperament—more especially in young females with disordered menstruation. It was prescribed in hot infusion, so as to provoke diaphoresis, and not only for epilepsy, but also for the cure of *amenorrhœa*.

Prof. Maisch has included the following statements in a "Note on Some American Species of Artemisia" (*Amer. Jour. of Phar.*, lii. 69): The infusion of A. ludoviciana was recommended as a hair tonic and febrifuge. The same plant was used by the Pah-Utes to assist childbirth and to stop hemorrhage from the nose. A. dracunculoides is said to produce irritation when bruised, and the tea of it to be diaphoretic. A. filifolia, according to Dr. Palmer, is used in decoction by the Indians against swellings and bruises, and a very penetrating volatile oil obtained from it by distillation is usefnl in liniments. According to the same authority, a strong tea made from the sage-plant of the Rocky Mountains, which includes several species of Artemisia, is given for headache, colds, and worms, and a pungent volatile oil may be procured from it. It is alleged to be diuretic and diaphoretic, the former in cold, the latter in hot infusion (*Therap. Gaz.*, xi. 659).

ACACIA, *U. S.*; ACACIÆ GUMMI, *Br.*, *P. A.*—GUM ACACIA.

Gummi arabicum, *Gummi mimosæ*, P. G.—*Gum arabic*, E.: *Gomme arabique*, Fr. Cod.; *Arabisches Gummi*, G.; *Gomma arabica*, F. It.; *Goma arabiga*, Sp.

A gummy exudation from Acacia Senegal, *Willdenow* (A. Verek, *Guillemin et Perottet*), and other species of Acacia. Bentley and Trimen, *Med. Plants*, 94.

Nat. Ord.—Leguminosæ, Mimoseæ, Acacieæ.

Origin.—The gum-yielding species of Acacia are shrubs or trees with mostly abruptly bipinnate leaves, and with the stipules often transformed into thorns. The flowers are generally yellow, have numerous stamens, and are aggregated in dense elongated spikes or in globular heads.

A. Senegal, *Willdenow*, occurs from Kordofan, where it is called *Hashab*, west to the river Senegal; it is a small tree attaining the height of about 6 M. (20 feet), and yields the Kordofan and Senegal gums.

Acacia (Mimosa, *Lamarck*) arabica, *Willdenow*, which species includes also A. vera, *Willd.*, A. (Mimosa, *Linné*) nilotica, *Delile*, and A. Adansonii, *Guillemin et Perottet*, is found from India westward to Senegambia, and yields some brown-colored gum. Near the Nile it is known as *Sont*, and the variety A. tomentosa, *Bentham*, near the Senegal as *Nebneb*. The *gum Mogador*, also known as *Morocco* and *Barbary gum*, is probably produced by this species.

A. tortilis, *Forskäl*, called *Seyal* or *Seyaleh*, and A. Ehrenbergii, *Hayne*, a shrub, called *Seyah*, now yield little gum in Arabia and Upper Egypt.

Collection and Commerce.—Gum arabic has been supposed to be formed by the metamorphosis of the cell-walls of the parenchyma, or, according to Carré, of the vascular bundles in the cambium layer; but according to Höhnel's investigation (1888) it is produced by the transformation of the cell-contents in the inner bark, and the gum-cleft occupies only a small space. The gum exudes spontaneously, but the discharge is often hastened by incisions. It is yielded most plentifully during the hot summer months, the trees producing it in largest quantity having a sickly appearance. The thick liquid hardens upon the bark, and finally falls to the ground, but is collected by detaching it from the tree with the aid of a wooden axe.

The best gum is collected westward of the White Nile in Kordofan, and enters commerce by being shipped down the Nile to Alexandria; it is the *Kordofan gum*, called *Hashabi* in Egypt, and for some years has been very scarce. A gum nearly or quite as handsome in appearance, though considered inferior in quality, is collected near the Blue Nile and shipped from Sennaar, either down the Nile or by way of the port of Suakin (Savakin) on the Red Sea; it is the *Sennaar* or *Sennari gum*, which, of late years, has become quite plentiful in our commerce. The kind known in commerce as *Suakin* or *Savakin gum* is collected farther east, not far from the west coast of the Red Sea, and shipped from the port named. The gum collected in Southern Abyssinia and adjoining countries is mostly exported from Berbera, either by way of the East Indies or through some neighboring ports of Arabia to the Mediterranean. Some gum is collected in India from several species of Acacia, Albizzia, Anogeissus, Bauhinia, Odina, Feronia elephantum, *Correa*, etc., but the great bulk of the commercial *East Indian gum* is of African origin. Arabia also exports some gum; but the *Gedda* or *Jidda gum* and the *gum Tor* or *Turic* come originally from the Somali coast of Eastern Africa.

Gum arabic, before it finally enters commerce, is usually assorted in the Mediteranean ports, the clearest and whitest quality being known as *Turkey gum*. It is imported in casks, boxes, bags, and also in skins.

Description.—Gum arabic occurs in roundish tears of various sizes, but usually more or less broken, and then constitutes angular fragments, of a glass-like, somewhat iridescent fracture, opaque in consequence of the numerous fissures contained in it, but transparent in thin pieces. The finest quality is colorless or white in mass, the pieces exhibiting more or less of a yellowish or brownish tint being the inferior varieties.

It has a very faint odor and a mucilaginous insipid taste. It is completely insoluble in strong alcohol, but dissolves in 2 parts of water, forming a thick transparent mucilage of an acid reaction; this solution is not precipitated by lead acetate, but basic lead acetate causes a white precipitate even in very dilute solutions (1 in 50,000) of this gum; soluble silicates yield white precipitates, and borax and ferric salts gelatinize the solution. Its specific gravity varies between 1.355 and 1.491, and after drying at 100° C. (212° F.) is increased to 1.525, with an absolute loss of 13.14 per cent. (Flückiger).

Savakin gum, which is quite brittle, is often not entirely soluble in water, but yields with it a pasty mass of rather strong acid reaction, depositing, when diluted with water, transparent globules, which Reimann (1881) found to consist of metagummic acid; this may be rendered soluble by the addition of a little potassa or by lime-water.

For pharmaceutical purposes only the whitest gum should be used, but in the arts the colored gums are frequently quite as serviceable, and their solutions are decolorized by filtering through aluminum hydrate, or by treatment with sulphurous acid, followed by barium carbonate.

Composition.—Gum arabic or arabin is the calcium compound of *arabic* or *gummic acid*, but contains also magnesium and potassium. This acid, which has been found by Scheibler (1873) in the sugar-beet, and is identical with Frémy's *metapectic acid*, may be obtained pure by precipitating with alcohol the mucilage, previously acidulated with hydrochloric acid, washing the precipitate well with alcohol, and repeating the operation several times. While still moist, gummic acid is soluble in water, and from this solution it is not precipitated by alcohol unless hydrochloric acid be added. After drying (metagummic acid of Frémy) it merely swells up, but does not dissolve either in cold or boiling water, in which it is rendered soluble again on the addition of alkalies. It is amorphous, and after drying at 100° C. (212° F.) its composition is $C_{12}H_{22}O_{11}$; treated with lime-water and alcohol, the compound $C_{12}H_{20}CaO_{11} + 5C_{12}H_{22}O_{11}$ is obtained (Neubauer, 1854). This contains 2.56 per cent. $CaO = 4.58$ $CaCO_3$. Löwenthal and Hausmann (1853) obtained 3.17 to 3.30 per cent. of ashes from gum arabic. Solution of gum rotates polar-

ized light usually to the left, but some kinds have a right rotation. By continued boiling with dilute sulphuric acid sugar is produced; nitric acid oxidizes it to mucic, saccharic, tartaric, and oxalic acids. Some gums yield little or no mucic acid, and these, on being treated with dilute sulphuric acid, produce *arabinose*, $C_{12}H_{22}O_{11}$, which crystallizes from hot alcohol in groups of minute radiating prisms, is not fermentable, but reduces Fehling's solution like grape-sugar. It was discovered by Scheibler in 1868, and obtained also from the gum of the juice of the sugar-beet. Kiliani (1880) regarded the sugar as identical with lactose. But Claësson (1881) proved it to be distinct from the latter; however, from gums which yield much mucic acid a sugar was obtained corresponding in the main with lactose. Reichardt's *pararabin* (1875) is a constituent of the sugar-beet, soluble in warm dilute acids, swelling with water, and by long-continued boiling with alkalies converted into arabic acid.

The inferior qualities of gum contain a little grape-sugar, which may be removed by alcohol; thus purified, gum does not reduce alkaline solutions of cupric oxide. 3 Gm. Kordofan (and Senegal) gum, precipitated from its aqueous solution by an excess (15 grams) of solution of subacetate of lead, yield a scarcely opalescent filtrate, which remains almost clear with ammonia. The filtrate yielded under similar circumstances from Sennaar gum is slowly obtained, is milky, and yields with ammonia a gelatinous precipitate (Schlosser, 1869).

Other Varieties of Gum.—Savakin or Suakin Gum, which is described above, is also known as *talca* or *talha gum*, and is the exudation of Acacia stenocarpa, *Hochstetter*, and A. fistula, *Schweinfurth*.

Gum Senegal derives its name from the river Senegal. It is chiefly the product of Acacia Senegal, and to a limited extent also of a few other species of Acacia growing in Senegambia and adjoining countries of Western Africa. It occurs often in elongated and larger tears than the Egyptian gum, mostly varies in color between yellow and brownish-red, has few fissures, but occasionally contains air-cavities in the centre, and otherwise has the appearance and chemical properties of gum arabic. A variety called *gum Galam*, *gomme du bas du fleuve* in France, is lighter in color, and has not the bitterish taste often found in the ordinary kind. Senegal gum enters commerce through France, where it is officinal; it is extensively used in the arts. The principal collection commences in March, and in some years has reached 5,000,000 Kgm.

Cape Gum, imported from the Cape of Good Hope, exudes from Acacia horrida, *Willdenow*, occurs in small tears and fragments, and is of a pale-yellow to amber color.

Australian Gum, Wattle Gum, the produce of Acacia decurrens, *Willdenow*, A. pycnantha, *Bentham*, and other species, is found in tears, which are frequently quite large, vary in color from yellowish- to reddish-brown, have a slightly astringent taste, and break with a glass-like fracture.

Mesquite Gum is obtained from Prosopis juliflora, *De Candolle*, s. Algarobia (Prosopis, *Gray*) glandulosa, *Torrey & Gray*, a tree 6–12 M. (20 to 40 feet) high, indigenous to Texas, New Mexico, and California, and southward through Mexico to Chili and Buenos Ayres; the yield by natural exudation is increased by making incisions; it is collected during the months of July, August, and September. It occurs in tears varying in size and in color from colorless to amber-brown, and resembles gum arabic in the fissures, specific gravity, solubility, its behavior to nitric acid, and the amount of ash yielded on incineration, 2.1 to 3 per cent.; but its aqueous solution is not precipitated by subacetate of lead, ferric salts, or borax; acetate of lead, with ammonia subsequently added, yields a gelatinous precipitate. The reactions, however, differ to some extent in different samples, and it is not unlikely that several Mimoseæ may furnish this gum.

Chagual Gum is collected in Chili from Puya (Pourretia, *Ruiz et Pavon*) lanuginosa, *Molina*, nat. ord. Bromeliaceæ, and yields a thick acidulous mucilage, which is precipitated by lead acetate, but not by borax or silicates. About 20 or 25 per cent. of the gum is insoluble in water.

Hog Gum, Doctor Gum, comes from South America in translucent or transparent reddish irregular tears, which are but partly soluble in water. It is usually referred to Rhus Metopium, *Linné*, by others to Moronobea coccinea, *Aublet*, both of which yield gummy exudations. It is not identical with Hogg Gum or Kathira of India, which is obtained from Cochlospermum Gossypium, *De Candolle*, nat. ord. Bixaceæ, and closely resembles the inferior kinds of tragacanth; its solution in water is neutral; the portion insoluble in water yields with alkalies a thick mucilage of a pinkish color, which according to Mitchell (1880) is not precipitated by acids.

Adulterations and Substitutions.—The inferior kinds of gums described above are frequently substituted for gum arabic in tears, and on one occasion an adulteration with rock-salt was noticed. In powder it is liable to the substitution named, and also to adulteration with flour and dextrin. The former is easily detected by adding to the cold mucilage, prepared with hot water, a solution of iodine, when a blue color will be produced; the latter by Trommer's test, which will separate cuprous oxide at ordinary temperatures in an hour or two, or immediately on heating. Owing to the high price of gum arabic

for some years past, various substitutes have been seen in the market prepared from the mucilage of flaxseed, Irish moss, agar-agar, or other drugs, and dextrin has been converted into granular or irregularly globular pieces resembling gum arabic.

Pharmaceutical Uses.—Powdered gum arabic is extensively used in the preparation of emulsions of oleoresins, fixed and volatile oils, also for forming troches and pills; for the latter purpose a solution of gum in glycerin is preferable, particularly if the pills are to be kept for some time. Gum arabic is preferably made into a moderately fine powder (*sanded gum*), which retains its ready solubility in water; by drying it so that it may be finely powdered it loses nearly 10 per cent. in weight, does not dissolve rapidly, and reduces alkaline copper solutions (Hager, 1873).

Pasta gummosa s. Pasta althææ, Marshmallow paste. *E.;* Pâte de gomme; P. de guimauve, *Fr.;* Gummipaste, *G.* Dissolve 1000 Gm. of white gum arabic in 1000 Gm. of water, strain, add 1000 Gm. of sugar, and with continuous stirring evaporate in a water-bath to the consistence of thick honey; then add gradually 100 Gm. of orange-flower water and the white of 12 eggs, previously well beaten; continue to beat the mixture until of proper consistence; let it cool upon a marble slab or in boxes, and keep it in a mixture of 3 parts of powdered starch and 1 of sugar.—*F. Cod.*

Other Products of Acacia (see also Catechu).—The *sabicu-wood* of Cuba, from A. formosa, *Kunth*, the *blackwood* of Australia, from A. melanoxylon, *R. Brown*, the fragrant *myall-wood* of Australia, from A. homalophylla, *Cunningham*, and others, are valuable for cabinet and other work.

Acacia Farnesiana, *Willdenow*, is indigenous to Western Texas and to the tropical and subtropical parts of America, and is cultivated in Southern Europe for the fragrant flowers, which yield a delicious perfume, known as *cassie*. The small tree is called in Texas *huisache*, and in Mexico *matitas*. In Germany the flowers of the *sloe*, Prunus spinosa, *Linné*, are known as *flores acaciæ*.

Action and Uses.—Various observations on the use of acacia as food, and experiments upon animals that were kept exclusively upon a diet of this substance, appear to render it probable that it cannot contribute much to real nutrition—that is, by providing materials for forming tissue. It is certain that an exclusive diet of gum cannot sustain life. Yet it may possibly retard waste, and thereby prolong life. Such appears to be in part its operation when used by the sick in the form of gum-water. But unquestionably its more demonstrable merit consists in its serving as a protective to inflamed surfaces, such as the mucous membrane during *pharyngitis*, *laryngitis*, etc., when it is usually given in the form of troches or lozenges. In *febrile* affections generally, in *inflammations* of the gastro-intestinal mucous membrane, in *gastritis*, *typhoid fever*, *dysentery*, etc., it is in ordinary use. In all such cases it is a local palliative. By coating the mucous membrane it moderates the irritation which the contents of the intestine tend to maintain, and thereby checks *diarrhœa* and tends to constipate. Its solution (*mucilago acaciæ*) may be rendered more agreeable and useful by the addition of sugar and various flavoring syrups; or the syrup, which is officinal, may be used alone. Powdered acacia may be applied to arrest bleeding from leech-bites and other sources of slight *hæmorrhage*. Its thick mucilage is sometimes used as a protective for superficial *burns*, *excoriations*, and *ulcers*.

Mesquite gum is applicable to all the purposes of gum arabic.

ACETANILIDUM, *U. S., Br., F. It., P. G.*—Acetanilid.

Antifebrinum, P. A.—*Phenylacetamide*, *Acetylamidobenzene*, *Antifebrin*.

Formula, C_8H_9NO, or $C_6H_5NHC_2H_3O$. Molecular weight, 134.73.

Preparation.—Acetanilid was first prepared by Gerhard in 1852 by acting upon aniline with acetyl chloride or with acetic anhydride. It is manufactured by moderately boiling in a retort, connected with a reflex condenser, equal parts of aniline and glacial acetic acid, until a small portion, removed from the retort, will congeal on cooling; the mass is then distilled, when water and acetic acid will pass over, and finally acetanilid, which is recrystallized from boiling water. The new compound is formed by the elimination of water, according to the equation $C_6H_5NH_2 + CH_3.COOH = C_6H_5NH.CH_3CO + H_2O$.

Properties.—Acetanilid forms colorless glistening scales or a white shining crystalline powder, not altered by exposure to air or light, free from odor, but having a somewhat pungent, slightly burning taste. It melts at 113° C. (235.4° F.) (about 112° C.,

P. A.; 235° F., *Br.*; 112–113° C., *F. It.*), boils at 295° C. (563° F.) without decomposition, and when ignited upon platinum-foil burns without leaving any residue. It is soluble in 194 parts of water at 15° C., *U. S.*, *P. G.*; in about 200 parts of cold water, *Br.*, *F. It.*, and in 18 parts of boiling water; also in 5 parts, *U. S.* (4 parts *F. It.*; 3.5 parts, *P. G.*) of alcohol, in 0.4 parts of boiling alcohol, in about 18 parts of ether, and is easily soluble in chloroform and benzene; but slightly soluble in carbon disulphide. The solutions have a neutral reaction to test paper.

The tests of identity and purity adopted by the different pharmacopœias are nearly identical. The solution of acetanilid in sulphuric acid without the production of a dark color indicates the absence of dust, saccharine matter, and many other organic compounds. On heating about 0.1 Gm. of acetanilid with a few Cc. of concentrated solution (1 in 4) of potassium or sodium hydroxide, the characteristic odor of aniline becomes noticeable; on now adding chloroform and again heating, the disagreeable odor of *isonitril* is evolved (*U. S.*). Analogous reactions are produced by all primary amines, as was shown by A. W. Hofmann (1875) who discovered (1867) this isonitril, known as *phenyl carbylamine* or *phenyl isocyanide*, $C_6H_5.NC$, which has a repulsive, penetrating odor and is very poisonous. On boiling 0.1 Gm. of acetanilid for several minutes with 2 Cc. of hydrochloric acid, a clear solution results, which, when mixed with 3 Cc. of a 5 per cent. aqueous solution of carbolic acid, and afterward with 5 Cc. of a filtered saturated solution of chlorinated lime, acquires a brownish-red color, becoming blue upon supersaturation with ammonia (*U. S.*). This is the so-called indophenol or indoaniline reaction, which is shown also by phenacetin and other allied compounds, from which acetanilid may be distinguished by the melting-point and solubility. A cold saturated aqueous solution of acetanilid, added to ferric chloride test-solution, should not affect the color of the latter (*U. S.*). This shows the absence of aniline salt, of antipyrine, hydracetin, and some other compounds; on the application of heat the mixture of acetanilid and ferric salt becomes deep red.

Allied Compounds.—A number of mixtures of from 50 to 90 per cent. of acetanilid with sodium bicarbonate, and in some cases with ammonium bromide, salicylic acid, and other compounds, have been introduced as proprietary articles and sold under copyrighted names.

Bromacetanilid, $C_6H_4BrNH.C_2H_3O$, or *Acetbromanilid*, was prepared pure by Gürke (1875), and the para-compound was recently introduced into medicine under the name of *antisepsin*. It is formed by the action of bromine upon acetanilid, and crystallizes in colorless needles, which, owing to their sparing solubility, are tasteless; they melt at 165.5° C. (330° F.). The ortho-compound is more freely soluble in alcohol, and melts at 99° C.

Benzanilid, $C_6H_5NH.C_7H_5O$, or *phenylbenzamid*, was discovered by Gerhardt (1845), and is produced by the action of benzoic anhydride, benzoic acid, or of benzoyl chloride upon aniline, and crystallization from alcohol. It forms small white scales of a pearly lustre, inodorous, tasteless, insoluble in water, and fusible at about 162° C.

Methylacetanilid, $C_6H_5NCH_3.C_2H_3O$, has been used under the name of *exalgin*. It was first prepared by A. W. Hofmann (1874), and may be obtained by warming monomethylaniline with half a molecule of acetylchloride, and crystallized from hot water to remove the methylaniline hydrochloride. By acting with methyl iodide upon sodium acetanilid, sodium iodide and methylacetanilid are formed. The latter crystallizes in colorless needles or prisms, which are inodorous and tasteless, and melt in the air at 102° C. (215.6° F.), but under water at 98° C. It is neutral to test-paper, and is freely soluble in alcohol, chloroform, carbon disulphide, and in boiling water. It requires about 60 parts of cold water or 10 parts of ether for solution. On heating it with potassium hydrate, and then with chloroform, as directed above for acetanilid, the disagreeable odor of isonitril is *not* produced, but a faint rather pleasant odor is observed. Methylacetanilid boils on being heated to 245° C. (473° F.), and finally evaporates without leaving any residue; its aqueous solution is not precipitated by silver nitrate.

Action and Uses.—Experimental and clinical observations agree in showing that acetanilid powerfully depresses the nervous system and the heart, causing coldness, cyanosis, collapse, and even death, while affecting febrile temperature but slightly. Cohn and Hepp estimated the antipyretic power of acetanilid as being four times greater than that of antipyrin. They found that from Gm. 0.25–1 (grs. 3–15) at a single dose, and repeated to the extent of Gm. 2 (30 gr.) in twenty-four hours, should be administered, according to the grade of the fever, the condition of the patient, etc. They believed that its action became manifest within an hour, reached its height in about four hours, and lasted from six to eight hours. A single dose sometimes sufficed to restore the normal temperature. This process was generally accompanied by redness of the skin and moderate sweating. As in the case of antipyrin, the reaction was sometimes attended by chilliness. As the temperature fell the pulse became less frequent and gained in tension. According to them, the medicine produced neither nausea, vomiting, nor diarrhœa.

During the apyrexia, in certain cases, urgent thirst and profuse diuresis occurred. In some, also, cyanosis of the face and hands appeared in the remission. These conclusions were, in the main, confirmed by Lépine, Mouisset, Kruger, Weill, Weinstein, Edemsky, Peirce, Hawkins, Crombie, and many others. Weill placed the preparation at the head of antipyretics (*Centralb. f. Med.*, v. 634), saying that it tends first to stimulate, and then to depress, the nervous system, causing the temperature to fall and a tendency to collapse, as well as general analgesia and anæsthesia. In general, a dose of Gm. 0.25 (4 grs.) sufficed to reduce the febrile temperature by three degrees. Hidowitz (*Med. News*, li. 543) exalted its virtues in the febrile affections of children. Cohn and Hepp (*Centralb. f. Ther.*, v. 59), like Weill, proclaimed it to be the best representative of the group of medicines to which it belongs, as reliable, relatively free from danger, and efficient in small doses. Way and several others found it a useful palliative in typhoid fever (*Med. News*, lii. 11). But this opinion is by no means held by all. Dujardin-Beaumetz rejected acetanilid altogether from the treatment of the diseases from which it obtained its name of antifebrin (*Bull. de Thérap.*, cxii. 211; cxiii. 103). He dwelt on its tendency in fever to occasion cyanosis and excessive depression of temperature, although in non-febrile affections these effects are not produced unless the doses are excessive. Other observers have remarked that it sometimes entirely fails to exhibit antipyretic virtues (*University Med. Mag.*, i. 228).

In articular *rheumatism* the value of this medicine is not more clearly defined than in fevers. There can be no doubt that it generally palliates, and sometimes entirely neutralizes, the pain of the acute disease, while it reduces the fever. Reise regarded it as less prompt and efficient than salicylic acid, but free from the unpleasant effects of the latter (*Centralbl. f. Med.*, v. 12); Eisenhart made a similar comparison bstween it and sodium salicylate (*ibid.*, v. 181); and Dujardin-Beaumetz agreed with them in saying that it is less apt to disturb the brain than salicylic acid. Weinstein, and also Demme, have expressed analogous opinions (*ibid.*, v. 634; vi. 299); and Sarda concluded that acetanilid is inferior to antipyrin in acute, but not in chronic, rheumatism (*Bull. de Thérap.*, cxiv. 433).

The pains of certain *neuralgic* affections appear to be more readily controlled by acetanilid than even those of rheumatism: they are the neuralgiæ due to an organic cause, and notably to alterations of the spinal marrow. According to Dujardin-Beaumetz, none of the objections to acetanilid in fevers apply to it in neuralgic affections (*Bull. de Thérap.*, cxiii. 103). Similar observations have been made by Dulàcska, Biro, Fischer, and others, Fischer noted that the remedy succeeded best when the pains were paroxysmal. He gave Gm. 0.25 (gr. 4.) at a dose. Demiéville confirmed these results, and added that the medicine was efficient in the pain of senile *gangrene* and *cancer* (*Therap. Gaz.*, xi. 698). Weinstein (*Cent. f. Therap.*, v. 634), Seifert (*ibid.*, v. 563), Leidy (*N. York Med. Jour.*, Oct. 29, 1887), Ott (*Centralbl. f. Therap.*, v. 13), Fischer (*ibid.*, vi. 611), and Fraser (*Practition.*, xliv. 291) gave similar testimony. In no case, however, did it prevent the recurrence of the paroxysms of pain, and the general conclusion agreed with Ferreira's (*Bull. et Mém. Soc. thér.*, 1888, p. 171), that in these conditions it is inferior to antipyrin. Hirsch's summary appears to state the truth of the matter: "It seems to be useful in diffused *headache*, but is useless in *rheumatic neuralgia* and in sympathetic paralytic hemicrania. It acts well in the neuralgia of *tabes dorsalis*" (*Centralb. f. Med.*, vi. 724). An exceptional case is that reported by Dr. Flint (*Med. Record*, xxxiv. 646), in which a very obstinate *sciatica* was cured with heroic doses of the medicine, 40 to 50 grains in the course of four hours. It does not appear to relieve *insomnia* as a direct effect, but only by suppressing the influences that prevent sleep. In this way it procures repose in fevers and in *mania à potu* and other forms of maniacal excitement. In like manner it relieves congestive *headache*. In exceptional cases it has palliated or suspended the paroxysms of *epilepsy*, and in the treatment of *whooping cough* and other forms of reflex cough is thought to be equal to antipyrin. It has been found useful in *phthisis* to control or palliate the hectic fever, and thereby lessen the exhausting effects of this incident of the disease (*Med. Record*, xxxi. 426; *Centralbl. f. Ther.*, v. 119; *Med. News*, lii. 99; *Therap. Gaz.*, xi. 162).

Administration.—The average dose of acetanilid as an antipyretic is Gm. 0.30 (gr. 5); as an anodyne, Gm. 0.6–0.13 (gr. 1–2). It should be dissolved in a small quantity of alcohol, and then diluted with water. It may be repeated at intervals of about four hours or less, according to its effects. To counteract its poisonous effects, it has been recommended to evacuate the bowels with castor oil, to stimulate the skin by heat and friction, and to administer coffee and injections of æther. Alcohol, except in very small doses, is not advised.

Benzanilid has been employed by Kahn in diseases of children. He found it a very efficient *antithermic*. Its general action resembled that of acetanilid, although the reaction following its use took place more slowly. No cyanotic effect was noted, but in one case there was a rubeoloid eruption. The pulse and respiration rates fell along with the temperature, and by use the activity of the medicine declined. The dose for children of from one to three years was Gm. 0.1–0.2 (gr. 1½–3); for children from 4–8 years, Gm. 0.2–0.4 (gr. 3–6). The largest quantity given in a day was Gm. 3.2 (gr. 48). It was administered in powder (*Centralbl. f. Ther.*, vii. 53).

Methylacetanilid (exalgin) is an efficient analgesic, especially for purely *neuralgic* pains, and has proved useful in *chorea*. Among the toxical effects of it have been noted ringing in the ears, confusion of sight, vomiting, headache, jaundice, cyanosis, and muscular spasm. Dose, Gm. 0.06–0.20 (gr. j–iij) three times a day.

Antikamnia, a proprietary medicine, is composed essentially of acetanilid. A case of death preceded by delirium, unconsciousness, has been attributed to a dose of 24 grs. of this compound (*Med. News*, lix. 547).

Antinervin is also essentially a compound, of 50 per cent. of acetanilid with 25 per cent. each of ammonium bromide and salicylic acid (Squibb). It has been used as a nervous sedative and analgesic.

Exodyne and Phenolid are also proprietary compounds, and have essentially the same composition as the preceding.

ACETONUM.—Acetone.

Spiritus (*s. Æther*) *pyroaceticus.*—*Pyroacetic spirit or ether*, E.; *Acétone, Éther* (*Esprit*) *pyroacétique*, Fr.; *Aceton, Essiggeist, Mesitalkohol*, G.; *Chetone, Metilacetone*, It.

Formula C_3H_6O. Molecular weight 57.87.

Formation and Preparation.—Acetone is formed on the dry distillation of wood, of acetates, citric acid, and, in the presence of lime, from sugar and other carbohydrates. It is obtained nearly pure by the dry distillation of barium acetate (Liebig), but is usually prepared from calcium acetate or from a mixture of 4 parts of crystallized acetate of lead and 1 of burnt lime; the distillate is neutralized with dry sodium carbonate, treated with calcium chloride, and purified by fractional distillation over lime.

Properties.—It is a thin, colorless liquid, which when ignited burns with a luminous, non-sooty flame. It has a peculiar ethereal somewhat mint-like odor, and a refreshing but very pungent and sweetish taste. Its density at 15° C. (59° F.) is .8008; it boils at 56.5° C. (133.7° F.). It is soluble in all proportions in water, alcohol, ether, volatile oils, and most compound ethers, dissolves gun-cotton, camphor, many resins, including copal, and fats, and forms crystalline compounds with the alkali disulphites. Most of the salts soluble in alcohol are insoluble in acetone, which separates even from a concentrated aqueous solution of calcium chloride.

Composition.—The empirical formula has been given above. Constitutionally it is *dimethyl-ketone*, $CO.CH_3.CH_3$.

Impurities.—The principal impurities met with in acetone are alcohol and water, which impart a higher specific gravity; the former may be recognized by the addition of iodine, followed by potassa solution, when iodoform will be separated. Water, if present, will liquefy a fragment of calcium chloride, but the same salt powdered, according to Hlasiwetz (1850), will form with acetone a solid compound which is decomposed by water. Empyreumatic products present in acetone will cause an opalescence on dilution with water.

Allied Compounds.—Acetal, $C_6H_{14}O_2$ or $CH_3CH(C_2H_5O)_2$; mol. weight 117.74. It is formed on the oxidation of alcohol by manganese dioxide and sulphuric acid, or by platinum black or by chlorine, and is purified by fractional distillation and by treatment with calcium chloride and potassa. It is a thin, colorless liquid, of an agreeable alcohol-like odor, a refreshing taste, and the specific gravity .831 at 20° C. (68° F.). It boils at 104° C. (219.2° F.), dissolves in alcohol and ether in all proportions, but is rather sparingly soluble in water. In contact with air and by oxidizing agents it is readily converted into aldehyde and finally into acetic acid.

Acetophenone, or *Phenylmethyl-ketone*, $C_6H_5.CO.CH_3$, introduced into medicine as *hypnone*, is formed by the action of zinc-methyl upon benzoyl chloride, and was first prepared by Friedell (1857) by the dry distillation of a mixture of molecular weights of calcium benzoate and acetate, and subjecting the product to fractional distillation for the separation of acetone, benzene, and other compounds. It crystallizes readily in white laminæ, which, if pure, melt at 20.5° C. (68.9° F.) (Staedel, 1880). Liquid hypnone is colorless, mobile, very refrangent, has a persistent odor of bitter almond and orange, and a pungent taste. It is not inflammable, but intensifies the combustion of substances impregnated with it. It boils at 200° C. (392° F.), has the specific

gravity 1.032, remains for some time suspended in water in the form of globules, is insoluble in water, sparingly soluble in glycerin, and freely soluble in alcohol, ether, chloroform, benzene, and fixed oils. It is not affected by cold sulphuric acid, hydrochloric acid, or ferric chloride, is colored yellow by nitric acid, dissolves iodine and bromine freely and with the development of heat, and by chromic acid is converted into benzoic acid and carbon dioxide. From 38 to 40 drops of hypnone weigh one gram.

Syrup of Hypnone.—Hypnone 1 drop, alcohol 1 Gm., syrup of orange-flowers 6 Gm. (Vigier).

Elixir of Hypnone.—Hypnone 1 drop, alcohol 3 Gm., syrup of peppermint 3 Gm.

Action and Uses.—This preparation was originally employed in chronic *pulmonary affections* to allay cough and diminish expectoration; but it has long been disused for these purposes. It is asserted to act, not as an anæsthetic, but as a soporific only; but the better opinion is that, while its anæsthetic action is comparatively feeble, its intoxicating operation is decided. It has been recommended as an *anthelmintic* and in *rheumatism* and *gout*. It may be prescribed in doses of Gm. 1.0–1.30 (15 or 20 drops), dissolved in spirit of nitrous ether. It may also be used by inhalation from a watery solution, either atomized or diffused by heat.

Acetal, according to Von Mering, acts first on the brain, causing a gradual loss of consciousness, and then upon the spinal marrow, arresting respiration before the heart. When fatal it kills by asphyxia. In doses of Gm. 4–12 (ʒj–ʒiij) he found its hypnotic effects certain and not followed by disagreeable feelings. Stoltenhoff made similar observations; but Berger and Leyden saw only unsatisfactory results (*Amer. Jour. Med. Sci.*, Oct. 1883, p. 556), and Leubuscher observed no good and various evil effects of its use (*Therapeut. Gaz.*, ix. 187). Hiller reports that its internal administration is not easy, since its taste is acrid and burning, and, moreover, that it is six times as weak as chloral hydrate, acting as a hypnotic only in doses of from Gm. 8–12 (2 to 3 drachms). On the day after taking it patients have complained of depression, heaviness of the limbs, and nausea (*Zeitschrift f. klin. Med.*, vi. 492).

Acetophenone, received from Dujardin-Beaumetz the name of *hypnone*. He regarded it as a pure hypnotic, and but slightly anodyne in the dose of 6 or 8 drops. It cannot be relied upon where pain exists, and hardly when wakefulness is due to nervous excitement. Further objections to its use are its offensive taste, the smell it imparts to the breath, and the disorder of the stomach it is apt to occasion. It may be given in capsules containing Gm. 0.06–0.03 (ɱlj–v).

ACETUM, *Br., P. A., P. G.*—Vinegar.

Acetum crudum.— *Vinaigre*, Fr.; *Essig*, G.; *Aceto*, It.; *Vinagre*, Sp.

Production.—Vinegar is a dilute acetic acid, obtained by the acetic fermentation of alcoholic liquids; the materials from which it is prepared influence its color, and to a considerable extent also its odor and taste.

Wine, cider, beer, and similar liquids not containing too large an amount of alcohol, when exposed to the atmosphere, turn sour in consequence of the oxidation of alcohol to acetic acid; $C_2H_6O + O_2$ yields $C_2H_4O_2 + H_2O$. This acetification is accomplished in partly-filled casks having a small opening at the top, and requires several weeks or months, or even about two years, to be complete, according to the temperature, which is most suitably kept between 20° and 35° C. (68° and 95° F.). The process of oxidation is effected by Mycoderma (Ulvina, *Kützing*) aceti, *Pasteur*, consisting of elliptic bacteria. The acid liquid thus obtained requires clarification, which is effected either by allowing it time to settle or by transferring it to other casks containing wood shavings. In this manner *wine*, *cider*, *malt*, and *beer vinegars* are made.

Vinegar is extensively made by the so-called *German* or *quick vinegar process*, for which the simple apparatus suggested by Wagenmann is employed. This consists of several straight-sided casks 6 to 9 feet high, having, a few inches above the bottom, a false bottom or perforated diaphragm, upon which is packed a layer, 2 to 3 feet in thickness, of fresh beech-wood shavings which have been previously steeped in vinegar, whereby the mycoderma is introduced. Several inches below the top another perforated diaphragm is inserted, or, in place of it, the cask is covered with a well-fitting tub having a perforated bottom. The liquid, containing from 6 to 10 per cent. alcohol, is placed upon the upper diaphragm; its flow is regulated by means of wooden pins inserted into the perforations, and it is thus compelled to trickle through the shavings, the atmosphere being admitted through a number of holes bored through the side of the cask immediately above the lower diaphragm, and by several tubes passing through the upper

diaphragm and above the surface of the alcoholic liquid. The partly acetified liquid is drawn off from below the lower false bottom, and transferred to another similarly prepared cask, until the whole of the alcohol has been converted into acetic acid. During all this time the change of air in the room and its temperature (about 20° C.) must be carefully attended to, as otherwise the oxidation may become too rapid and the heat within the casks too high. At and below 7.2° C. (45° F.) little or no acetic acid is produced. The process is finished in from three to fifteen days.

Properties.—Made by the German process, vinegar generally contains some aldehyde and alcohol, which are usually absent if the production has been effected by the slow oxidation in casks. The sensible properties of vinegar are affected to a much larger extent by the material from which it has been obtained. *Malt vinegar* is largely made in Great Britain from beerwort or from the fermented solution of malt; it is of a more or less deep-brown color. *Beer vinegar*, made from stale beer, has the bitter taste of the hops. Upon evaporation these varieties of vinegar yield about 2.5 per cent. of extract, while *wine vinegar* (*acetum vini*) yields only about 1.5 per cent. *Vinaigre blanc*, F. Cod., prepared from white wine, is used in France. *Cider vinegar*, which is much employed in the United States, is made from cider, and contains malic acid. *Common vinegar*, made from diluted whiskey, has the flavor of the latter to some extent, and contains the salts of the water used in its manufacture, the residue amounting to about 0.3 per cent.

The color of vinegar varies from yellowish to brown, and its specific gravity between 1.003 (*P. A.*) and 1.018 (*Br.*) It has an agreeable acidulous odor, differing from that of diluted acetic acid by the presence of some ethers, principally acetic ether. By exposure to the air it undergoes putrefaction and becomes muddy. It should contain between 5 and 6 per cent. of acetic acid. 445.4 grains by weight require at least 402 grain-measures of the volumetric solution of soda for neutralization, indicating 5.4 per cent. of real acetic acid (*Br.*). 5 Cc. of vinegar require for neutralization not less than 50 Cc. of decinormal alkali solution (*P. A.*); or 10 Cc. of vinegar require 10 Cc. of normal potassa solution (*P. G.*), indicating 6 per cent. of acetic acid.

Impurities and Adulterations.—Poisonous metallic salts, like tin, lead, and copper, which may be present as accidental impurities, are detected by the dark coloration or precipitate occurring with hydrogen sulphide; moreover, copper would be precipitated upon a bright iron spatula kept in the vinegar for a short time; lead, if present will yield a white precipitate with sulphuric acid, and a yellow one with potassium iodide. Acrid substances, such as capsicum, pepper, pellitory, ginger, etc., which may have been added to impart artificial strength, are recognized by the taste after the vinegar has been neutralized with an alkali, or after it has been evaporated; hence the extract left on evaporation must not have an acrid taste, and must yield an ash having an alkaline reaction (*P. G.*). The latter test indicates the absence of adulterations with free acids. In testing for mineral acids it must be remembered that crude (but not distilled) vinegar is likely to contain sulphates, chlorides, and occasionally even nitrates, derived from the water which has been used in its manufacture. The pharmacopœias indicate the allowable limits of such salts as follows: A fluidounce of vinegar, mixed with 10 minims of test solution of barium chloride, yields a filtrate giving no precipitate on the further addition of the test liquid (*Br.*). 20 Cc. of vinegar, mixed with 0.5 Cc. of barium-nitrate test solution, and 1 Cc. of decinormal silver solution, yield a filtrate free from sulphate and chloride; on carefully pouring upon a mixture of 2 Cc. each of vinegar and sulphuric acid 1 Cc. of ferrous sulphate solution, a brown zone should not be produced at the point of contact between the two layers (*P. G.*). This last test proves the absence of nitrates; obviously, it is applicable only to pale-colored vinegars. Tests for recognizing free sulphuric acid in vinegar were recommended by J. T. King (1872), W. C. Young (1877), J. C. Wharton (1882) and others. According to Chiappe (1882), a very simple test for free mineral acids is an aqueous solution of methyl-aniline-violet or Paris violet (1 : 1000), the color of which is not affected by organic acids, but is changed to ultramarine blue by inorganic acids. The presence of *aldehyde* in vinegar is indicated by the brown color produced in the first portion of the distillate with an excess of potassa solution. Vinegar which has been prepared or kept in oaken barrels contains a little tannin, and acquires a black color with ferric salts.

Allied Compounds and Derivatives.—*Acetum destillatum s. A. purum.*—Distilled vinegar, *E.*; Vinaigre distillé, *Fr.*; Destillirter Essig, *G.*—Distil vinegar from a glass retort until about three-fourths have passed over. It is colorless, leaves no residue on evaporation, is not colored by excess of potassa (absence of aldehyde), and is free from mineral acids. It is nearly identical with the diluted acetic acid.

Acetum aromaticum.—Aromatic vinegar, *E.*; Vinaigre (Acétolé) aromatique, *Fr.*; Aromatischer Essig, *G.*—Volatile oils of lavender, rosemary, juniper, peppermint, and cinnamon cassia, of each 1 part; oils of lemon and cloves, of each 2 parts; alcohol, 450 p.; acetic acid (sp. gr. 1.041), 650 p.; water, 1900 parts. Dissolve the oils in the alcohol, add the acid, then the water, set aside for eight days, frequently agitating, and finally filter.—*P. G.* Compared with the formula of the previous edition, which is also that of the National Formulary, the solvents have been increased from 1950 to 3000 parts, thus ensuring a more complete solution of the volatile oils. It is a clear and colorless liquid, of an aromatic acetous odor, miscible with water in all proportions without becoming turbid. (See also Acidum Aceticum.) The corresponding preparation of the *Fr. Cod.* is made from a tincture of fresh herbs and has a pale reddish color.

Acetum antisepticum.—Antiseptic vinegar, *E.*; Vinaigre (Acétolé) antiseptic, V. des quatre voleurs, *Fr.*; Vierräuberessig, *G.*—Absinth, Roman wormwood, peppermint, rosemary, rue, sage, and lavender, each 15 Gm.; calamus, cinnamon, cloves, nutmeg, and garlic, each 2 Gm.; vinegar, 1000 Gm.; macerate for ten days, express, add camphor 4 Gm. dissolved in glacial acetic acid 15 Gm., and filter.—*Fr. Cod.* A simpler formula directing peppermint, rosemary, and sage, each 25 parts; angelica, zedoary, and cloves, each 2 parts, and vinegar, 1000 p., is recognized by *P. A.* as acetum aromaticum. *Acetoaromatico* (*A. antisettico*), F. It., contains camphor and orange-leaves.

Action and Uses.—It promotes digestion by stimulating the salivary and gastric secretions, while it quickens the softening and digestion of crude food, and allays thirst and *fever*; but in excess it impairs digestion and causes diarrhœa, thereby interfering with nutrition. Its power of preserving animal and vegetable substances immersed in it (Davy, *Researches*, etc., ii. 376) probably led to the notion that it possesses special virtues in the falsely-called putrid fevers, and especially that it prevents contagion. But these opinions are groundless. In such affections, however, the use of vinegar as a lotion is useful by the evaporation of the liquid producing a refreshing sense of coolness. Possibly, also, its stimulant action upon the skin may promote a salutary diaphoresis. It is an error to suppose, as the ancients did, that vinegar is an antidote to the poisonous effects of *narcotics*; its stimulant action may be advantageous when the poison has been removed from the system and its direct operation has ceased. In this respect, however, it is greatly inferior to ammonia, coffee, and even alcohol. When given after the ingestion of caustic *alkalies* or earths, or of the carbonates of these substances, it unites with them, and, forming innocuous acetates, arrests their corrosive action. Vinegar and dilute acetic acid have been used beneficially in the treatment of *lead colic* after the bowels had been moved by purgatives. Vinegar is an old popular remedy for *diarrhœa* and *dysentery*, and it has even been used with alleged success in *cholera*. More than half a century ago large enemas of diluted vinegar were believed to be efficacious in dysentery (Richter, *Ausführlich*, Arzneim., iv. 134). Engelmann found its application in *diphtheria* more efficient than that of carbolic acid (*Archives gén.*, Dec. 1886, p. 741). The stimulant action of strong vinegar or dilute acetic acid is usefully employed by snuffing the fumes of these liquids, to which camphor and various aromatics have been added. This expedient is useful in relieving *nervous headache*, *faintness*, *drowsiness*, *commencing coryza*, etc., but is less efficient than a similar application of ammonia. Vinegar, distilled or not, is a very useful agent for arresting *hæmorrhage*, especially from the nose, stomach, rectum, and uterus. It should, if possible, be applied directly to the source of the bleeding, as in post-partum hæmorrhage by expressing vinegar from a sponge introduced into the cavity of the uterus. At the same time, compresses saturated with vinegar and water should be laid upon the abdomen. It is, however, alleged to be efficient when taken by the mouth in wine-glassful doses. Vinegar is popularly employed to prevent *discoloration* of the skin after injuries of the integument, and to retard the redness and swelling and allay the pain of local *inflammations*. This method is particularly useful in superficial *burns* and in preventing *suppuration* of the mamma. A weak solution of vinegar may be used to limit the action of particles of *lime* in the eye. Lotions of vinegar check colliquative *perspiration*, and procure a refreshing coolness when the skin is hot in *fevers*, and allay *headache* and *delirium* when applied to the forehead. Enemas of vinegar are sometimes used to destroy *ascarides* of the rectum; and lotions of the same are said to be efficient in destroying *pediculi*.

The *dose* of vinegar is Gm. 4–16 (f℥j–f℥xvj) in from 2 to 4 parts of water. An acidulated drink may be made with Gm. 64 (f℥ij) of vinegar in Gm. 1000 (a quart) of water. By enema vinegar may be given to the extent of Gm. 30–130 (f℥j–f℥iv). A lotion may be made with 1 part of vinegar and 3 or 4 of water. The doses of distilled vinegar do not differ materially from the above.

ACETUM CANTHARIDIS, *Br.*—Vinegar of Cantharides.

Vinaigre cantharidé, Fr.; *Canthariden-Essig*, G.

Preparation.—Take of Cantharides in powder, 2 ounces; Glacial Acetic Acid, 2 fluidounces; Acetic Acid, sufficient for 20 fluidounces. Mix 13 fluidounces of the acetic acid with the glacial acetic acid, and digest the cantharides in this mixture for two hours at a temperature of 93.4° C. (200° F.); then transfer the ingredients after they have cooled to a percolator, and when the liquid ceases to pass pour 5 fluidounces of acetic acid over the residuum in the apparatus. As soon as the percolation is complete, subject the contents of the percolator to pressure, filter the product, mix the liquids, and add sufficient acetic acid to make 1 pint (Imp. meas.).—*Br.*

At the elevated temperature directed in this process the cantharidin, with various extractive matters, is readily dissolved by the acetic acid, and after cooling remains in solution. The specific gravity is about 1.060.

Action and Uses.—Vinegar of cantharides is irritating to the skin by means of both its constituents. Like other strong liquid vesicants, it is especially appropriate when the surface to be blistered is uneven and of very limited extent, and when it is an object to produce vesication rapidly. It is perhaps more painful than other vesicating preparations of cantharides. It should be applied with a brush in several successive coats, according to the delicacy of the skin and the effect desired, and then dressed with some simple ointment upon soft lint or cotton wadding. Vesication usually occurs within two or three hours. It is very suitable for blistering the skin over the superficial portions of nerves in *neuralgia*, as was first recommended by Cotugno, and more recently systematized by Valleix; and also for blistering in *rheumatism* after the manner of Herbert Davies.

ACETUM IPECACUANHÆ, *Br.*—Vinegar of Ipecacuanha.

Vinaigre d'ipecacuanha, Fr.; *Brechwurz-Essig*, G.

Preparation.—Take of Ipecacuanha, in No. 20 powder, 1 oz. (or 1 part) Diluted Acetic Acid sufficient for 20 fluidounces (or 20 fluid parts). Moisten the powder with a suitable quantity of the menstruum, and macerate for twenty-four hours; pack in a percolator, and gradually add the acid until the required volume of the vinegar of ipecacuanha is obtained.—*Br.*

The preparation is of a yellowish-brown color, and is intended to keep the emetic in permanent solution.

Action and Uses.—Locally it is a slight irritant to the skin, due to its containing acetic acid. It is used as an expectorant, especially in earlier stages of bronchitis in doses of 5–40 minims.

ACETUM OPII, *U. S.*—Vinegar of Opium.

Black drop, E.; *Vinaigre d'Opium*, Fr.; *Opium-Essig*, G.

Preparation.—Powered Opium, 100 Gm.; Nutmeg in No. 30 powder, 30 Gm.; Sugar, 200 Gm.; Diluted Acetic Acid, sufficient to make 1000 Cc. Macerate the opium and nutmeg in 500 Cc. of diluted acetic acid during seven days, frequently stirring; then strain through muslin of close texture and express the liquid. Mix the residue with 200 Cc. of diluted acetic acid to a uniform magma, and strain and express again. Mix and filter the strained liquids, dissolve the sugar in the filtrate, and pass enough diluted acetic acid through the filter to make the product measure 1000 Cc.—*U. S.*

Opium, 410 grains; nutmeg, 123 grains; sugar, 810 grains, with sufficient dilute acetic acid to make 8 fluidounces. This preparation represents 1 grain of powdered opium in 10½ minims (about 9 minims in 1880 and 6⅔ minims in 1870), and is now, by measure, of the same strength as the tincture of opium. It has a deep reddish-brown color. It is to be assayed by neutralizing the acid of 50 Cc. of this vinegar with calcium carbonate, and then proceeding as directed by the Pharmacopœia for tincture of opium.

Action and Uses.—Vinegar of opium is nearly free from the sickening smell and taste which belong to laudanum, and is much less apt to nauseate. This last quality is probably due in part to the nutmeg it contains, and in part to the almost complete absence from it of narcotine, the most irritating to the stomach and depressing to the nervous system among the constituents of opium. This advantage it shares with the deodorized tincture. The dose is Gm. 0.30–0.60 (gtt. v–x).

ACETUM SCILLÆ,—*U. S., Br., P. G.*—Vinegar of Squill.

Acetum scilliticum.—*Vinaigre* (*Acétolé*) *de scille*, Fr. Cod.; *Meerzwiebel-Essig*, G.; *Aceto scillitico*, F. It.

Preparation.—Squill in No. 30 powder, 100 Gm.; Diluted Acetic Acid sufficient for making 1000 Cc. Macerate the squill with 900 Cc. of diluted acetic acid during seven days, frequently stirring; then strain through muslin, and wash the mass on the strainer with enough diluted acetic acid, until the strained liquid measures 1000 Cc. Finally filter.—*U. S.*

Squill, 4 oz. av. yield $38\frac{3}{8}$ fluidounces by this formula.

Squill, $2\frac{1}{2}$ oz. av.; diluted acetic acid, 1 pint imperial; macerate for seven days, strain with expression and filter. Spec. grav. about 1.030.—*Br.*

Squill, 100 Gm.; glacial acetic acid, 20 Gm.; white vinegar, 980 Gm. Macerate for eight days, express, and filter.—*F. Cod.*

Squill, cut and dried, 5 parts; alcohol, 5 parts; acetic acid (spec. grav. 1.041), 9 parts; water, 36 parts; macerate for three days at 15 to 20 per cent.; strain without forcible expression, and after twenty-four hours filter.—*P. G.*

The formula of *P. A.* agrees with that of *P. G.*, except that percolation is directed. The other pharmacopœias direct maceration, this being better calculated to extract the squill; the drug absorbs much of the watery menstruum, swells considerably, and is apt to cake together and obstruct the uniform descent of the percolating liquid. It will be found of advantage to set the strained liquid aside for a day or two before filtering it.

Vinegar of squill is a clear liquid of a yellowish color, an acetous odor, and acid and bitter taste. That of *P. A.* is red brown, it being prepared from the red variety of squill, which is also directed by *F. It.* in the proportion of 1 : 10.

Action and Uses.—Vinegar of squill was anciently employed, and for very diverse purposes, among which it is only necessary to mention the cure of spongy gums, various forms of sore throat, hoarseness, etc., in all of which it is certain that the vinegar, and not the squill, in the compound was the efficacious ingredient. The diuretic action of squill is probably enhanced by its solution in vinegar, which is the best form for its administration in *dropsy*. Its efficiency is much increased by associating it with acetate of potassium and digitalis, as in the following formula: ℞. Tinct. scillæ f℥ss; tinct. digitalis f℥ij; spt. juniperi comp., vin. hispan., āā. f℥ij; aquæ f℥viij; potassii acetat. ℥j.—M. S. A tablespoonful, diluted, three times a day. Vinegar of squill should not be used in renal dropsy, but only in dropsy of cardiac origin. Its average dose is Gm. 1 (♏xv), and it is best administered in an aromatic draught.

ACHILLEA.—Yarrow, Milfoil.

Herba (*Summitates*) *millefolii*, P. A.—*Millefeuille*, *Herbe aux charpentiers*, Fr.; *Schafgarbe*, *Schafgrippe*, G.

Achillea Millefolium, *Linné*. Bentley and Trimen, *Med. Plants*, 153.

Nat. Ord.—Compositæ, Anthemideæ.

Description.—A perennial herb 60–90 Cm. (2 to 3 feet) high, growing in fields and pastures throughout the greater part of the northern temperate zone of America and Europe. The hairy furrowed stem is branching only near the top. The radical leaves are petiolate, 20–30 Cm. (8 to 12 inches) long; the stem-leaves nearly sessile, 5–10 Cm. (2 to 4 inches) long, all more or less soft-hairy, dark-green, lanceolate in outline, and twice or thrice deeply pinnatifid; the segments are linear-spatulate, three- to five-cleft, crowded, finely mucronate, and upon the lower side with small oil-glands. The flowers grow in level-topped corymbs; heads numerous, with the involucre oblong; scales imbricate, keeled; receptacle flat, chaffy; ray-florets pistillate, 4 or 5, short ligulate, white or rose-colored; disk-florets several, perfect, tubular, with the margin whitish and the tube yellowish; akenes flattened, oblong, without pappus. It has a feeble aromatic, somewhat chamomile-like odor, and a bitterish, rather saline, and somewhat astringent taste. It should be collected while flowering, the coarse stems being rejected. The loss in drying is about 85 per cent.

Constituents.—Yarrow yields by distillation with water about $\frac{1}{10}$ per cent. of a blue or dark-green volatile oil, that of the flowers having a spec. grav. of 0.92, that of the leaves being butyraceous. The bitter principle *achillein* obtained by Zanon (1846) was regarded by Von Planta (1870) as being identical with achilleïne of iva (see below).

Zanon's *achilleic acid* is aconitic acid (Hlasiwetz, 1857). Yarrow also contains a small quantity of resin, tannin, and gum, and malates, nitrates, phosphates, and chlorides of potassium and calcium; on incineration, from 13 to 17 per cent. of ash is obtained.

Pharmaceutical Preparation.—Extractum millefolii is prepared by macerating the drug with diluted alcohol and evaporating. The yield is from 20 to 25 per cent.

Allied Species.—The following, which are indigenous to Europe, are to some extent employed:

Ach. ptarmica, *Linné;* Sneezewort, *E.;* Herbe à éternuer, *Fr.;* Bertramgarbe, *G.* It has been naturalized in some of the New England States. It has lance-linear, finely, but sharply serrate leaves, and elongated white ray florets. The root is sternutatory.

Ach. ageratum, *Linné*, has tufted, oblong, serrate, and clammy leaves, and very short ray-florets; its odor is strong, but not agreeable; taste bitter.

Ach. nobilis, *Linné*, is softly pubescent, has oval or oblong bi- or tri-pinnatifid leaves, with linear-oblong toothed lobes; the 5 ray-florets are reflexed; odor and taste stronger than in the common yarrow.

Ach. moschata, *Linné;* Iva, *E., G.;* Génépi blanc, *Fr.;* is largely used in Switzerland; has white flowers and smooth pinnatifid leaves with linear entire lobes; it is strongly aromatic and bitter. Von Planta-Reichenau (1870) obtained from it a bluish-green volatile oil, *ivaol*, of a refreshing odor and bitterish mint-like taste; *ivain*, $C_{24}H_{42}O_3$, soft, yellow, insoluble in water, soluble in alcohol and bitter; *achilleïne*, $C_{20}H_{38}N_2O_{15}$, is red brown, readily soluble in water, with difficulty in absolute acohol, insoluble in ether, and when boiled with dilute acids yields sugar, ammonia, and odorous body, and *achilletine*, $C_{11}H_{17}NO_4$, which is dark-brown, insoluble in water, and not bitter; *moschatine*, $C_{21}H_{27}NO_7$, is insoluble in cold water, and has an aromatic bitter taste.

Ach. atrata, *Linné*, and Ach. nana, *Linné*, are used like the other species.

Action and Uses.—Milfoil appears to be a general stimulant and tonic, with peculiar relations to the pelvic organs. Like other stimulant tonics, it has been found capable of curing certain cases of intermittent fever, and is apt to promote the appetite and digestion in atonic gastric disorders. Its special local action is illustrated by the virtues ascribed to it in *piles* and *amenorrhœa*, for the cure of which it was celebrated even in ancient times. The form of the first of these diseases in which it appears to be most efficient is that in which, along with relaxation of the sphincter ani, there is a discharge of mucus, more or less bloody, during defecation. A similar condition of atony in the reproductive organs of the female is attended sometimes with *menorrhagia*, and sometimes with imperfect and painful menstruation. A tonic and stimulant regimen is essential to its successful treatment, and as a portion thereof milfoil may sometimes be employed with advantage. By this mode of action, doubtless, milfoil has proved beneficial in *leucorrhœa* and flatulent *colic;* and it may assist in curing relaxed and otherwise inert conditions of the *throat*, when its infusion is used as a gargle, or in cases of sore *nipples*, when it is applied as a lotion. An infusion may be made with Gm. 16 (℥ss) of milfoil in Gm. 250 (f℥iij) of water, reduced by heat to Gm. 192 (f℥vj). It may be given in tablespoonful doses every hour. The expressed juice has been prescribed in doses of Gm. 32–64 (℥j–ij) three times a day. The volatile oil may be given in doses of Gm. 1.30 (20 drops).

Achilleïn, in doses of from Gm. 0.50–1.30 (grs. 8–20), is reported to have occasioned a sense of epigastric oppression and some irregularity of pulse, but to have increased the appetite.

Sneezewort, as its name implies, is very irritating to the nostrils when applied in powder, and the root, when chewed, produces salivation and an acrid impression on the fauces. These qualities have led to its use in commencing *coryza*, *conjunctivitis*, *pharyngitis*, and *laryngitis*. *Musk milfoil* is stated to be stimulant and antispasmodic, and, like A. atrata, is used as a stimulant at the commencement of febrile attacks.

ACIDUM ACETICUM. *U. S., Br., P. G.*—Acetic Acid.

Acide acétique, Fr.; *Essigsäure*, G.; *Acido acetico*, It., Sp.

Formula $HC_2H_3O_2 = CH_3COOH$. Molecular weight 59.86.

Production.—To obtain acetic acid from vinegar, Stahl proposed, about the year 1700, to expose it to cold and separate the stronger acid from the ice, and to neutralize it with an alkali, evaporate, and distil with sulphuric acid. Crystallized acetic acid was observed by the Count de Lauraguais (1759) in the so-called *copper spirit*, the distillate of copper acetate; and Löwitz found that a diluted acetic acid, if repeatedly rectified

over powdered charcoal, would yield a product crystallizing at a low temperature, and named it glacial acetic acid. Acetic acid and glacial acetic acid are obtained by the decomposition of an acetate by a stronger acid, for this purpose sodium (or potassium) acetate and sulphuric acid are most generally employed now. The proportions (equal equivalents), adopted already by Stahl, were (1873) proven to be correct by Mohr, Buchner, and others also for the preparation of the glacial acid; in this case, however, the mechanical difficulties of the operation are such as to make it preferable to use a larger quantity, nearly 2 equivalents of sulphuric acid. The British Pharmacopœia, 1864, directed fully 2 equivalents; in the later editions (1867 and 1885) the process has been omitted. By far the largest quantity of the acetic acid of commerce is now obtained from wood vinegar. Glauber (1648) was already acquainted with vinegar as one of the products of the destructive distillation of wood and other vegetable substances; but the identity of the volatile acid contained therein with that of vinegar from alcoholic liquids was proven by Fourcroy and Vauquelin (1800), and Thénard showed (1802) the same to be contained among the products of the dry distillation of animal substances.

I. **Acidum aceticum pyrolignosum, Acidum pyrolignosum.**—*Pyroligneous acid*, E.; *Acide acétique du bois, acide pyroacétique, acide pyroligneux*, Fr.; *Holzessig-Säure*, G.

Preparation.—The destructive distillation of wood is effected in sheet-iron cylinders, either upright or horizontal, which may be charged with billets of wood from the top, and from which the charcoal may be removed through a lateral opening. The cylinder is rapidly heated, the resulting volatile products being passed through wide condensing-tubes, cooled by being surrounded with water, into a wooden or iron receiver, from which the condensed products may be drawn off by means of a tap, while the uncondensible gaseous products, consisting of *acetylene* C_2H_2, *ethylene* C_2H_4, *propene* C_3H_6, *marsh gas* CH_4, and other hydrocarbons, as well as carbonic oxide, are carried off through a pipe into the furnace, there to be burned up in place of other fuel. The condensed portion consists of an aqueous stratum and of an oily or tarry layer containing empyreumatic oils and resins, cresylic and phenylic compounds, various hydrocarbons, etc., and furnishing the material used for the preparation of creosote.

The watery liquid, amounting to about 30 per cent. of the weight of the wood, is the *crude wood vinegar* or *pyroligneous vinegar*, a solution of a large number of products of decomposition, such as small quantities of phenols, guaiacol, and empyreumatic oils and resins, also furfurol $C_5H_4O_2$, acetone, methylic and allylic alcohol, methylamine, pyrocatechin, and several acids, the principal one of which is acetic acid, accompanied by formic, propionic, butyric, capronic, crotonic, and other acids. The distillation being carefully conducted, wood yields from 6 to 8, or even 9, per cent. of acetic acid, and wood vinegar, on being evaporated in the water-bath, leaves about 8 per cent. of residue.

On subjecting the crude product to distillation, the first portion (about 10 per cent.) of the distillate contains mainly the alcohols and acetone, and subsequently a colorless or yellowish acid liquid is obtained, amounting to about 75 or 80 per cent. of the crude article. This distillate is *Acetum pyrolignosum rectificatum*, P. G.; *purified pyroligneous* or *wood vinegar*; *Vinaigre de bois*, Fr.; *Holzessig*, G.; and contains variable quantities of most of the constituents of crude wood vinegar, which on exposure to light and the atmosphere cause the distillate to assume a brown color, rendering filtration or redistillation necessary; to avoid this, it should be kept in full and well-corked bottles and in a dark place. The peculiar smoky odor of wood vinegar is due to the presence of empyreumatic products.

Wood vinegar, both crude and rectified, is recognized by the German Pharmacopœia, and required to contain at least 6 and 4.5 per cent. of acetic acid respectively, so that 10 Gm. of the former and 6 Gm. of the latter require for neutralization not less than 10 Cc. of volumetric solution of potassa. With diluted ferric chloride it usually acquires a dark-green color, due to pyrocatechin. Wood vinegar, particularly that obtained from beech-wood, contains *hydrocœrulignone* $C_{16}H_{18}O_6$, a colorless diatomic phenol, which under the influence of oxidizing agents yields *cœrulignone* $C_{16}H_{16}O_6$. Liebermann (1872) obtained it from the brown precipitate produced in crude wood vinegar by potassium bichromate, and regards it as identical with Reichenbach's *cedriret*; it forms purplish-blue minute needles, is insoluble in most solvents, but dissolves in strong sulphuric acid with a blue, and in phenol with a red, color, the latter solution yielding with alcohol or ether dark steel-blue needles of cœrulignone, and this, by reduction with tin and hydrochloric acid or other agents, is again converted into hydrocœrulignone.

A much cleaner pyroligneous acid than by the process described above is obtained by

subjecting strips of wood for about 4 hours to the heat of steam under a pressure of from 70 to 100 pounds (150° to 162° C. = 300° to 330° F.), whereby the texture of the wood is but little altered, and the subsequent purification of the acid is simplified. On rectifying the crude product a heavy oil is separated, in which Heill (1877) found furfurol, pyromucic acid, a yellow body yielding, with caustic soda, pyroxanthin and other products.

By fractional distillation the volatile impurities of pyroligneous acetic acid cannot be removed, nor can they be readily destroyed by chlorine or other oxidizing agents. To attain this end milk of lime is added in excess, partly for the purpose of forming calcium acetate, partly with the view of removing various tarry products, as insoluble calcium compounds. The solution of calcium acetate freed from the precipitate is evaporated to dryness; the crude salt thus obtained, which contains from 74 to 75 per cent. of hydrogen acetate, is carefully heated upon an iron plate in thin layers until it chars, then redissolved in water, the solution decomposed by sulphuric acid, or preferably by hydrochloric acid, and then distilled. Owing to the difficulty of regulating the heat so as to avoid the destruction of the calcium acetate, the solution of this salt is usually decomposed by sodium sulphate, the resulting gypsum removed by settling and filtration, and the filtrate evaporated to dryness. The sodium acetate is more manageable in regard to the regulation of the temperature (about 260° C. = 500° F.) necessary to destroy the empyreumatic compounds without affecting the acetate. The latter is purified by dissolving it in a little water, and decanting from the sediment; sulphuric acid is added, the liquid separated from the crystals of sodium sulphate and distilled, when an acetic acid will be obtained more or less pure in accordance with the care exercised in the process of purification.

II. **Acidum aceticum glaciale,** U. S., Br.; *Acidum aceticum s. Acidum aceticum concentratum s. Acetum glaciale*, P. A., P. G.; *Glacial acetic acid*, E.; *Acide acétique crystallizable*, Fr. Cod.; *Esprit de vinaigre*, *Vinaigre glacial*, Fr.; *Essigsäure*, *Eisessig*, G.; *Acido acetico-concentrato*, F. It.

Preparation.—Carefully heat 13½ parts of pure crystallized sodium acetate until the water of crystallization has been completely expelled and the salt has been fused: the residue, weighing nearly 8¼ parts, is coarsely powdered, introduced into a glass retort, intimately mixed with 9½ to 10 parts of concentrated sulphuric acid, and then distilled. It is advisable to warm the retort, by placing it in a sand-bath, before the acid is added. 136 parts of cryst. sodium acetate will yield 60 parts of acetic acid. The condensation of the acetic acid vapors may be effected either by a Liebig's condenser in a receiver connected directly with the retort or by means of an adapter.

The reaction is as follows: $NaC_2H_3O_2 + H_2SO_4 = NaHSO_4 + HC_2H_3O_2$. Acid sodium sulphate and acetic acid are formed, the latter distilling over, free from empyreuma if the heat has not been suddenly raised too high, and also free from sulphurous and other acids if the sodium acetate has not been contaminated with organic or other impurities. Although, theoretically, the hydrogen acetate or so-called monohydrated acid should be obtained, the product always contains some water, but crystallizes readily near the freezing-point of water. By partial crystallization, pouring off the liquid portion, and repeating this operation, an acid nearly free from water will be obtained. Hydrogen acetate is prepared, according to Hirsch (1873), by intimately mixing 12 parts of exsiccated sodium acetate with 20 parts of fused acid potassium sulphate, and with a carefully regulated heat distilling 7 parts.

Properties.—Glacial acetic acid forms colorless, flat, rhombic crystals, which melt on the application of heat to a colorless liquid, and this retains the fluid condition frequently on being cooled to 10° C. (74° F.), unless brought in contact with a crystal. At the mean temperature of the air it forms a colorless liquid with a pungent acetous odor. When heated to boiling, the vapor may be ignited and burns with a blue flame. Hydrogen acetate fuses at 22.5° C. (72.5° F., Mollerat); has at 16° C. (60.8° F.) a specific gravity of 1.0553, and boils at 119° C. (246.2° F., Sébille-Anger), or, according to Oudemans, between 117° and 118.2° C.

Rüdorff (1870) gives the congealing-point of hydrogen acetate at 16.7° C. (62° F.), and if 100 parts of this acid are mixed with water, the congealing-point will be as follows:

With water,	0.5	1.0	1.5	2.0	3	4	5	6	7	8	9	10 parts.
Congealing point,	15.65°	14.8°	14.0°	13.25°	11.95°	10.5°	9.4°	8.2°	7.1°	6.25°	5.3°	4.3° C.

The *U. S.* and *Br.* Pharmacopœias require glacial acetic acid to contain 99 per cent. of absolute $C_4H_2O_2$—84 per cent. of acetic anhydride $(C_2H_3O)_2O$; but the melting-

point is given at about 15° C. (59° F.) *U. S.* and above 60° F. *Br.*, and the specific gravity at 1.058 *U. S.*, *Br.*, 1.064 *P. G.*, *F. It.*, 1.063 *F. Cod.*, 1.06 *P. A.* An acid of the strength indicated is miscible in all proportions with alcohol, ether, and chloroform, and dissolves an equal weight of fresh oil of lemon, but less of the resinified oil. The oil is also far less soluble in weaker acetic acid, requiring about 10 parts of the latter if of 96 per cent. A more reliable test for the absence of water is carbon disulphide; equal parts of it and glacial acetic acid form, according to Flückiger, a clear solution at and above 20° C. (68° F.), but an opalescent or turbid liquid below that temperature. On neutralizing the acid 3. Gm. of it should require not less than 49.5 Cc. of the volumetric solution of potassa (*U. S.*), or 60 grains of the former 990 grain measures of the latter (*Br.*); 5 Cc. of a mixture of 1 part acid and 9 parts water, should require for neutralization not less than 8 Cc. potassa solution (96 per cent. acetic acid, *P. G.*). The absence of arsenic is determined by mixing 1 Cc. of the acid with 3 Cc. of stannous chloride solution; the mixture should not acquire a brown or black color within one hour (*P. G.*).

Glacial acetic acid absorbs moisture from the atmosphere, whereby its melting-point is lowered and its density increased to a certain degree (see below). For the detection of impurities this acid is to be diluted with distilled water previous to testing it, as stated below.

Pharmaceutical Uses.—ACIDUM ACETICUM AROMATICUM; Aromatic acetic acid, *E.*; Acide acétique aromatisé, Vinaigre anglaise, *Fr.*; Gewürshafte Essigsäure, *G.* Oil of cloves 9 parts, oil of lavender 6 parts, oil of lemon 6 parts, oil of bergamot 3 parts, oil of thyme 3 parts, oil of cinnamon 1 part, glacial acetic acid 25 parts; dissolve by agitation.—*P. G.*, 1872. The preparation of the French Codex contains 10 per cent. of camphor and ½ per cent. of volatile oils. Aromatic acetic acid is sometimes designated *aromatic vinegar* (see page 14).

Derivatives of Acetic Acid.—CHLOR-ACETIC ACIDS.—When chlorine is allowed to act upon acetic acid, either one, two, or three hydrogen atoms may be replaced by chlorine, according to the conditions prevailing, forming respectively mono, di-, and trichlor-acetic acids. All three compounds possess caustic properties; the latter only has been medicinally used.

ACIDUM TRICHLORACETICUM, *P. G.*; Trichloracetic acid, *E.*; Trichloressigsäure, *G.* This acid is usually prepared by treating 1 part of chloral hydrate with 3 parts of fuming nitric acid, exposing the mixture for several days to the sunlight, until red fumes cease to be evolved, when it is distilled. In the pure state the acid forms colorless rhombohedric crystals, which are deliquescent, of a slight pungent odor, have a strongly acid reaction, and dissolve readily in water, alcohol, and ether. The crystals melt near 55° C.; the boiling-point is near 195° C., and the acid evaporates without leaving any residue. It has the composition CCl_3COOH (mol. weight 162.97); when boiled with an excess of sodium carbonate it is decomposed, yielding chloroform, $CHCl_3$, and carbon dioxide, CO_2. Mono- and di-chloracetic acids yield under similar conditions no chloroform, but glycolic and glyoxylic acid, respectively. The limit of hydrochloric acid, admissible as impurity, is indicated by two drops of $\frac{n}{10}$, silver nitrate solution producing merely a faint opalescence in a solution of 1 Cc. of the acid in 9 Cc. of water.

III. Acidum aceticum. U. S., Br.; *Acidum aceticum dilutum s. Acetum concentratum*, P. G.; *Acetic acid*, E.; *Acide acétique*, Fr.; *Verdünnte Essigsäure*, G.

Preparation.—Like the glacial variety, this acid may be obtained by distilling sodium acetate with sulphuric acid, but in all probability manufacturers and dealers follow the more convenient plan of diluting a stronger acid with the requisite amount of water and finally standardizing the mixture with volumetric solution of alkali.

Properties.—Acetic acid has the specific gravity 1.048 *U. S.*, 1.044 *Br.*, 1.041 *P. G.* These figures indicate a percentage of hydrogen acetate, amounting to 36 *U. S.*, 33 *Br.*, and 30 *G.* *Acide acétique du commerce*, Fr. Cod., and *acido acetico-diluito*, F. It., differ considerably from the above, the former being of sp. gr. 1.060, the latter 1.027, corresponding to 49 and 19 per cent., respectively, of absolute acetic acid; *P. A.* requires 1.029 sp. grav. and 20.4 per cent. of acid. For acetic acid of somewhat greater strength, the determination of its specific gravity does not afford a reliable criterion, since the acid of maximum strength on being mixed with water increases in its relative weight until the percentage is reduced to about 79, when the maximum density will be reached, which at 0° C. (32° F.) is 1.0397 for acid of 80 to 82 per cent., at 15° C. (59° F.), 1.0748 for acid of 77 to 80 per cent., and at 40° C. (104° F.) 1.0501 for acid of 75 to 77 per cent. hydrogen acetate. An acid of 43 per cent. has, at 15° C., the same specific

gravity as one of maximum strength, and between 72 and 85 per cent. the density of acetic acid shows very little variation. The following table, by A. C. Oudemans (1866), gives the percentage of hydrogen acetate and the specific gravity of acetic acid of different strengths at 15° C. (59° F.). (The U. S. P. furthermore giving the specific gravities at 0° C. (32° F.) and at 40° C. (104° F.)

Per ct.	Spec. grav.	Per ct.	Spec. grav.	Per ct.	Spec. grav.	Per ct.	Spec. grav.	Per ct.	Spec. grav.
100	1.0553	80	1.0748	60	1.0685	40	1.0523	20	1.0284
99	1.0580	79	1.0748	59	1.0679	39	1.0513	19	1.0270
98	1.0604	78	1.0748	58	1.0673	38	1.0502	18	1.0256
97	1.0625	77	1.0748	57	1.0666	37	1.0492	17	1.0242
96	1.0644	76	1.0747	56	1.0660	36	1.0481	16	1.0228
95	1.0660	75	1.0746	55	1.0653	35	1.0470	15	1.0214
94	1.0674	74	1.0744	54	1.0646	34	1.0459	14	1.0201
93	1.0686	73	1.0742	53	1.0638	33	1.0447	13	1.0185
92	1.0696	72	1.0740	52	1.0631	32	1.0436	12	1.0171
91	1.0705	71	1.0737	51	1.0623	31	1.0424	11	1.0157
90	1.0713	70	1.0733	50	1.0615	30	1.0412	10	1.0142
89	1.0720	69	1.0729	49	1.0607	29	1.0400	9	1.0127
88	1.0726	68	1.0725	48	1.0598	28	1.0388	8	1.0113
87	1.0731	67	1.0721	47	1.0589	27	1.0375	7	1.0098
86	1.0736	66	1.0717	46	1.0580	26	1.0363	6	1.0083
85	1.0739	65	1.0712	45	1.0571	25	1.0350	5	1.0067
84	1.0742	64	1.0707	44	1.0562	24	1.0337	4	1.0052
83	1.0744	63	1.0702	43	1.0552	23	1.0324	3	1.0037
82	1.0746	62	1.0697	42	1.0543	22	1.0311	2	1.0022
81	1.0747	61	1.0691	41	1.0533	21	1.0298	1	1.0007

The strength of the U. S. P. acid may be ascertained by weighing out 5 Gm. of it, diluting with 10 Cc. of water, applying a moderate heat, and gradually adding 3 Gm. of potassium bicarbonate; after effervescence has ceased and the carbon dioxide has been entirely expelled, the liquid should have a neutral reaction to test-paper, or 6.0 Gm. of the acid are neutralized with volumetric solution of potassa, of which exactly 36 Cc. (*U. S.*), 33 Cc. (*Br.*), 26 Cc. (for 5 Cc. acid, *P. G.*), should be required. The test of the British Pharmacopœia, neutralization of 182 grains of acetic acid by 1000 grain-measures of volumetric solution of soda, indicates 33 per cent. of $C_2H_4O_2$, and that of the German Pharmacopœia, neutralization of 5 Cc. of the acid by 26 Cc. of the volumetric solution of potassa, proves a strength of 30 per cent. of the same acid. The use of potassium bicarbonate for neutralization has the advantage of ready calculation, since three-fifths of its weight in grains necessary for 100 grains of the acid indicates directly the strength; the resulting potassium acetate has a faint alkaline reaction, but the error occasioned thereby, being quite insignificant, does not detract from the practical value of the test, more particularly if alkanet-paper be used in place of litmus-paper for determining the neutrality.

Tests.—The tests for the purity of vinegar are, with some modifications, also applicable to acetic acid. The transparency of the acid is not disturbed on diluting it with distilled water or alcohol, and on evaporating it in a water-bath no residue should be left (saline impurities). Calcium salts will produce a white precipitate with ammonium oxalate. Iron is best detected by the blue color or precipitate occasioned with potassium ferrocyanide; zinc, by the white precipitate; and the other metals, like copper, lead, or tin, by the brown or black color or precipitate formed on the addition of hydrogen sulphide after previous dilution with water. Empyreumatic products, if present in considerable proportion, may be detected by the odor after the acid has been largely diluted with water or neutralized with an alkali; smaller quantities are indicated by adding a minute quantity of solution of potassium permanganate, the color of which will readily disappear; pure acetic acid, containing less than 50 per cent. of hydrogen acetate, is not affected by this test (Hager, Merck, 1873). If sulphurous acid be present, the hydrogen evolved by hydrochloric acid and zinc in the presence of the acetic acid will be contaminated with hydrogen sulphide, which will darken the color of white bibulous paper wetted with solution of subacetate of lead and suspended in the test-tube or flask; the same acid will also discharge the color of potassium permanganate, and, like the empyreumatic products, cause a dark color and precipitate with silver nitrate. In the presence of nitric acid the liquid will assume an orange-red color on dissolving a little brucine in it, and a dark-brown color on adding first strong sulphuric acid, and afterward a

crystal of ferrous sulphate. The U. S. P. directs proving the absence of copper by excess of ammonia (blue color); lead and other metals, by hydrogen sulphide (coloration or precipitate); sulphuric and hydrochloric acid, by barium chloride and silver nitrate (turbidity or precipitate); and formic or sulphurous acid, by neutralizing with ammonia and warming with silver nitrate (dark color and precipitate). The limit of empyreumatic substances is ascertained by diluting 2 Cc. of the acid with 10 Cc. of distilled water in a clear glass-stoppered vial, and adding 5 drops of decinormal potassium permanganate solution; the tint of the mixture should not change at once from pink to brown, and in half a minute should not be entirely free from pinkish-brown.

The salts of acetic acid are, with very few exceptions, readily soluble in water, and their solutions acquire a dark brown-red color with ferric salts, which disappears on the addition of hydrochloric acid. On adding sulphuric acid to an acetate the pungent odor of acetic acid is recognized.

IV. **Acidum Aceticum Dilutum,** U. S., Br.; *Acetum purum s. destillatum.*—*Diluted acetic acid*, E.; *Acide acétique dilué*, Fr.; *Reiner Essig*, G.

Preparation.—Mix Acetic Acid 100 Gm., and Distilled Water 500 Gm., *U. S.*; Acetic Acid 1 pint, and Distilled Water 7 pints, *Br.* If 4 av. ozs. of acetic acid be added to 20 av. ozs. of distilled water, the resulting mixture will measure nearly 23 fluidounces (22.85).

Properties.—Diluted acetic acid has a specific gravity of 1.008 (1.006 *Br.*), and 100 parts of it neutralize 10 parts (7.14 parts, *Br.*) of potassium bicarbonate, or 5.3 parts (3.8 parts, *Br.*) of exsiccated sodium carbonate, indicating a strength of acetic acid corresponding to 6 per cent. (4.27 per cent., *Br.*) of hydrogen acetate; therefore 10 Gm. of the acid require for neutralization 10 Cc. (7.12 Cc., *Br.*) of volumetric solution of potassa; or, as the British Pharmacopœia directs, 440 grains of its diluted acetic acid require for neutralization 313 grain-measures of the soda solution, corresponding to 3.63 per cent. anhydride. The purity of diluted acetic acid is ascertained by the same tests mentioned for the stronger acid.

Action and Uses.—In its pure state acetic acid is corrosive or irritant, softening the epidermis and the mucous membranes; when diluted and continuously used, it softens the gastro-intestinal mucous membrane and disorganizes the blood-corpuscles. It is more or less absorbed by the skin. Acetic acid is seldom if ever employed internally, except in the diluted form, which may be used for the same purposes as vinegar and in the same dose. Strong and glacial acetic acids are applied chiefly as caustics for the removal of *warts* and *corns*, and occasionally for *blistering* the skin. The former is a valuable application in the treatment of *favus*, and, if diluted, allays itching in *lichen*, *prurigo*, and *psoriasis*. It was alleged to possess peculiar advantages as a caustic in *cancer* when injected into the substance of the tumor. But the results of this method are satisfactory only in cases in which, from the situation of the tumor or the objections of the patient, an operation is unadvisable. A solution employed by Gies (1877) varied in strength from 1 part in 3 to 1 part in 9 of glacial acetic acid in water. *Nasal polypus* is reported to be readily curable by injections of pure acetic acid into its substance. The growth shrivels and decays, and its fetor may be corrected by a weak carbolic-acid solution (Caro, *Med. Record*, xvi. 526).

Chloracetic acid has been compared to nitric acid in its action. It penetrates deeply, but does not excite much inflammation of the adjacent parts, and leaves behind a moderate eschar, which soon separates and exposes healthy granulations. The scar is rather smooth, and does not contract a great deal. It is said to cause less pain than nitrate of silver, chloride of zinc, or caustic potassa. It has been used for removing *warts*, *condylomata*, *lupus*, and various neoplasms. It may be applied by means of a glass rod or an asbestos brush or a wad of cotton. It has been recommended to use trichloracetic acid as a cauterant in diseases of the *nose* and *throat*, as preferable to chromic acid (*Med. News*, lvi. 541; *Am. Jour. Med. Sci.*, Aug. 1892, p. 235).

ACIDUM ARSENOSUM, U. S.—Arsenous Acid.

Acidum arseniosum (Br.), *Acidum arsenicosum* (P. A., P. G.), *Arsenicum album.*—*Arsenic*, *White arsenic*, *Arsenic trioxide*, *Arsenious anhydride*, E.; *Acide arsénieux*, *Arsenic blanc*, Fr. Cod.; *Arsenige Säure*, *Weisser Arsenik*, G.; *Arsenico bianco*, It.; *Arsenico blanco*, Sp.

Formula, As_2O_3. Molecular weight 197.68.

Preparation.—Arsenous acid appears to have been known since about the begin-

ning of the Christian era, but was first distinguished from other arsenical compounds by Geber in the eighth century. It has been found in many mineral waters in minute proportion, and is obtained in large quantities as a by-product in roasting cobalt, nickel, tin, and even some silver ores, and particularly arsenical iron pyrites; the vapors are conducted through long tubes or chambers, where they are condensed in the form of a white powder, formerly called *flowers of arsenic*. This is not pure, but contains some metallic arsenic, arsenic sulphide, dirt, etc., from which it is purified by resublimation. For this purpose the crude powder is introduced into cast-iron kettles, surmounted by several communicating iron cylinders, from the top of which a large pipe leads into a series of chambers, where the vapors, which are not condensed in the cylinders, are recovered again as a white powder. The heat, which is applied directly to the kettle, is sufficient to keep the condensing product in the heads or in the first chamber in a soft condition, so that on cooling it congeals into masses. That consumed in this country is mostly imported from Europe.

Properties.—Arsenous acid occurs in heavy, inodorous masses, which are at first glass-like, transparent, and of a conchoidal fracture, but become superficially white, opaque, and of a waxy lustre, the change penetrating gradually to the interior, so that ultimately the entire mass is converted into a porcelain-like mass, the formation of which is dependent upon a molecular change, the amorphous glass-like arsenous acid becoming indistinctly crystalline. The specific gravity of the vitreous acid is 3.7385, and of the opaque variety 3.699 (Guibourt). Durand and Mitchell determined (1832) the density of the former to be about 3.3. When heated in a sealed tube arsenous acid may be melted to a thick liquid, and again be obtained as a glass-like mass, or, when very slowly cooled, in crystals of different form. Rapidly heated in an open test-tube, it begins to soften superficially at about 218° C. (424° F.), but is at the same time rapidly volatilized. Slowly heated in a glass tube to about 200° C. (392° F.), minute transparent crystals are obtained, which under a magnifying-glass are recognized as regular octahedra. It is dimorphous, crystallizing also in thin pearly prisms, which are sometimes obtained in the process of roasting arsenical ores. When thrown upon burning charcoal, it is reduced to the metallic state and vaporized, arsenous acid being again produced and an alliaceous odor emitted. It does not readily mix with water, and has a scarcely perceptible, faintly sweetish taste, due to its slow and sparing solubility in water; but this solution has a slight but distinct metallic taste and a feeble acid reaction, and unless acidulated with a mineral acid is not completely precipitated by hydrogen sulphide, but remains yellow and transparent, or in reflected light slightly turbid from dissolved As_2S_3. The crystalline acid is less soluble than the amorphous, but one is under various circumstances converted into the other. At 15° C. (59° F.) the vitreous variety is soluble in about 30 parts of cold water, while the porcelain-like requires about 80 parts; both are slowly but completely soluble in 15 parts of boiling water (U. S.). By prolonged contact with cold water about ½ per cent., and by boiling water about 7 per cent., of the acid is dissolved, but after boiling for several hours about 11 per cent. is taken up, the greatest portion crystallizing on cooling, leaving about 2½ per cent. in the solution; and on prolonged standing this amount is reduced to somewhat less than 2 per cent. The acid does not volatilize with the vapors of boiling water. Bussy found (1847) that 100 parts of water of 13° C. (55.4° F.) will dissolve 4 parts of amorphous and 1.2 parts of crystalline arsenous acid, the former solution gradually depositing crystals until reduced in strength to the latter. Treated with warm or cold ammonia-water, the amorphous acid is converted into the crystalline variety without combining with the ammonia (Guibourt). Solutions of both the amorphous and crystalline variety pass readily through the septum of the dialysator. By the aid of heat glycerin dissolves arsenous acid slowly but freely, and deposits again a portion of it on dilution with water. Oil of turpentine dissolves only the glassy variety. Arsenous acid is insoluble in ether, quite sparingly soluble in alcohol, but combines with fixed oils when heated, forming a plaster-like mass; several acids increase its solubility in water, particularly hydrochloric and tartaric acids.

Powdered arsenous acid is often adulterated; hence it should not be employed for medicinal purposes unless its purity has been previously established. When rubbing the hard masses of vitreous or porcelain-like acid to powder, sufficient alcohol should be sprinkled over it to prevent the dust from rising, and the mouth and nostrils should be protected by a moist sponge. When larger quantities are powdered, it is even advisable to protect the eyes and the bare hands.

Tests.—Arsenous acid is completely volatilized without fusion at a temperature of 218° C. (424.4° F.) *U. S.*, 204.5° C. (400° F.) *Br.*, and yields a white sublimate free

from gray or orange-colored portions (absence of metallic arsenic and sulphides). By prolonged boiling with diluted hydrochloric acid it dissolves completely without leaving any residue, and 100 grains of it, thus dissolved, yield with hydrogen sulphide a lemon-yellow deposit of arsenic trisulphide weighing, after washing and drying, 124 grains. Four grains of it, dissolved in boiling water with 20 grains of sodium bicarbonate, discharge the color of 808 grain-measures of the volumetric solution of iodine.—*Br.* Both the tests mentioned prove arsenous acid to be almost absolutely free from impurities; but the U. S. P. and P. G. now admit this compound if containing not less than 98.8 per cent. of the pure trioxide; in which case 0.1 Gm. of it, dissolved together with 1 Gm. of sodium bicarbonate, in 20 Cc. of water by aid of heat, should decolorize not less than 20 Cc. of decinormal solution of iodine; if absolutely pure, 20.23 Cc. of the latter would be required. The reaction occurring in this test is shown by the equation: $As_2O_3 + 5H_2O + 2I_2 = 2H_3AsO_4 + 4HI$; 1 molecular weight of arsenous acid is oxidized by 4 atomic weights of iodine, with the formation of 2 molecules of arsenic and 4 of hydriodic acid. The admixture of arsenic acid is detected by agitating an excess of the powder with cold alcohol, filtering, evaporating, and neutralizing with ammonia, when silver nitrate will produce a red-brown precipitate. Arsenous acid should be completely soluble in 10 parts of warm ammonia-water, forming a colorless solution, which should not be colored yellow or produce a yellow precipitate (absence of *arsenic sulphide* and other metallic impurities).

Pharmaceutical Uses.—Pulvis Arsenicalis Cosmi.—Côme's arsenical powder, *E.*; Poudre escharotique arsénicale (du frère Côme), *Fr.*; Cosmisches Pulver, *G.* An intimate mixture of vermilion 5 parts, arsenous acid 1 part, and burned sponge 2 parts.—*U. Cod.* A weaker escharotic, containing one-twenty-fifth its weight of arsenous acid, is known as *poudre escharotique d'Antoine Dubois.*

Detection of Arsenic and Arsenous Acid.—A neutral or, more promptly, an acidulated solution of arsenic yields with hydrogen sulphide a bright-yellow precipitate of *arsenic sulphide*, which is entirely insoluble in dilute acids, but dissolves readily in alkalies, their carbonates and sulphides; if such a solution in ammonium sulphide is acted upon by silver nitrate in excess, silver sulphide is precipitated, and the solution contains the arsenic in its original state of oxidation, either as arsenous or arsenic acid; and on the careful neutralization of the ammonia by means of nitric acid the former is precipitated as yellow silver arsenite, and the latter as red-brown silver arsenate, both precipitates being readily soluble in nitric acid and in ammonia. Neutral solutions of arsenous and arsenic acids yield with cupric sulphate precipitates, that of the former being yellowish-green (*Scheele's green*), and of the latter bluish-green, in color; both precipitates are freely soluble in nitric acid and in ammonia. It follows, from the behavior just described, that in testing by a soluble silver or copper salt for arsenous or arsenic acid the solutions of the latter must be very carefully neutralized, or, if acid, are best tested with ammoniacal solutions of copper and silver; but the complete precipitation of arsenic is most conveniently effected from an acidulated solution by means of hydrogen sulphide; if strongly acid, the liquid should be diluted with water, and it is in all cases advisable, after adding an excess of gas, to set the mixture aside for some time, if little arsenic is present, even for twenty-four hours. If not mixed with other metals, the precipitate thus obtained is pretty characteristic, since only two other metals yield under the same circumstances precipitates of sulphides having a similar color—namely, *cadmium* and tin in *stannic* compounds. *Cadmium sulphide* has a bright lemon-yellow color, but is readily distinguished from the corresponding arsenic compound by being completely insoluble in potassa, ammonia, and ammonium sulphide; on the other hand, cadmium sulphide dissolves completely in strong hydrochloric acid, forming cadmium chloride, and giving off hydrogen sulphide, while arsenic sulphide is insoluble in the acid mentioned. *Stannic sulphide* has a dusky-yellow color, and dissolves in potassa, ammonia, and ammonium sulphide, but differs from arsenic sulphide not only in the shade of color, but also in its complete solubility in strong hydrochloric acid. The three sulphides may likewise be distinguished from each other by their behavior with *cyanide flux*, which is an intimate mixture of 1 part of potassium cyanide with 3 parts of anhydrous sodium carbonate; when heated with this flux in the bulb of a Berzelius reduction-tube, arsenic sulphide yields, in the cooler part of the tube, a sublimate of metallic arsenic having an iron-gray color, and in the upper portion of the ring occasionally a brown color, produced by the intimate mixture of metallic arsenic with some arsenous acid; during the sublimation a garlic-like odor is observed; the sublimate volatilizes

on the application of heat, and condenses again in a cooler part of the tube, and, if atmospheric air has been admitted, is partly or entirely converted into minute brilliant octahedral crystals of arsenous acid. Cadmium sulphide under the same circumstances yields a red-brown sublimate, consisting of cadmium oxide, which is not volatilized by heat; and tin sulphide produces no sublimate, but in the fused mass will be found metallic grains of tin. The above tests characterize arsenic if in the form of solution and if present in more than a very minute quantity. Tests of still greater delicacy will be described below. Arsenous acid, which is usually met with in cases of accidental or criminal poisoning, yields, if heated in a narrow tube (see Fig. 2), the crystalline sublimate described above; and if mixed with charcoal or cyanide flux, the sublimate will, as in the above case, consist of metallic arsenic, and this, on being sublimed in the presence of air, will yield the same crystals.

Fig. 1.

Reduction-tube of Berzelius.

Fig. 2.

Reduction-tube with sublimate of arsenous acid.

Fig. 3.

Sublimate of arsenous acid, magnified.

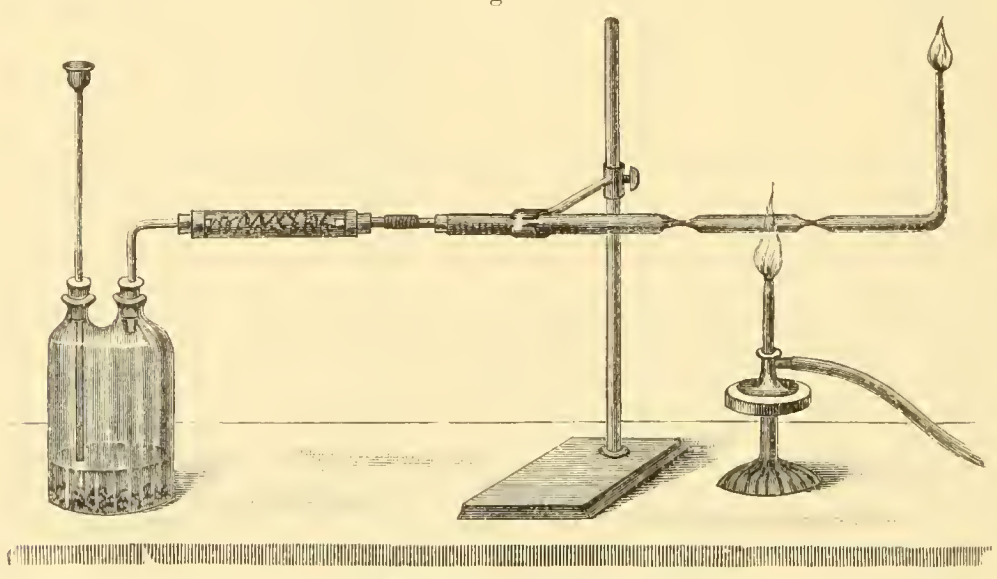
In the presence of much organic matter the detection of arsenic is a more complicated process, involving the separation of most of the organic matter, which Fresenius and Babo (1844) have accomplished by heating the mass in a water-bath with hydrochloric acid, and adding to it potassium chlorate in small quantities until a thin liquid is produced; if the heat be not raised beyond the temperature of boiling water, no arsenic chloride will be volatilized, but the mixture becomes more liquid in proportion as the solid organic substances are destroyed. The liquid is then filtered, the clear filtrate saturated with hydrogen sulphide, and the precipitate, which contains organic matter, treated with strong nitric acid, and subsequently fused with pure sodium nitrate, whereby the organic compounds are completely destroyed, and the antimony and arsenic are converted into soluble arsenate and insoluble antimonate of sodium. On mixing this residue intimately with about twelve times its weight of an exsiccated mixture prepared of sodium carbonate 3 parts and potassium cyanide 1 part, the powder may be heated to redness in a reducing-tube in a current of dry carbon dioxide, when a mirror of metallic arsenic will be obtained, while the presence of antimony, tin, and other metals will not interfere with the result. This method is less delicate than others mentioned below; however, the mass obtained after the destruction of the organic matter and fusion with sodium nitrate may be dissolved in water, and this solution, after acidulation with hydrochloric acid, may then be treated again with hydrogen sulphide, or in Marsh's apparatus—in the latter case, after evaporation with an excess of sulphuric acid to expel the nitric acid.

The destruction of the organic matter, as described above, may in some cases be

omitted, the material being simply boiled with water and the filtrate acidulated with hydrochloric acid, previous to passing hydrogen sulphide through it. A solution suitable for the purpose may likewise be obtained by the process of dialysis, whereby mucous, amylaceous, and albuminous substances are left behind, while the dialyzed liquid contains the arsenous acid, besides organic and inorganic salts. A method for converting arsenous acid and sulphides of arsenic into the volatile chloride, which may be readily separated from the organic matter by distillation, was proposed by F. C. Schneider (1851); it consists in mixing the material with large crystals of sodium chloride equal in weight to the dry matter, adding concentrated sulphuric acid, and heating slowly to boiling. To avoid the generation of sulphurous acid, an excess of sodium chloride must be present during the entire operation. A modification of this process, whereby the sulphides are more readily decomposed and arsenic acid is reduced to arsenous acid, and then readily converted into chloride, consists, according to Hager, in the addition of ferrous chloride to the contents of the retort. Dr. Penny (1852) suggested the thorough drying of the material, mixing it with strong hydrochloric acid, and then heating in a retort placed in a sand-bath. Dr. A. S. Taylor observed that portions of dried liver or stomach gave up every trace of arsenic by one distillation. The distillate may be tested for arsenic by the reagents mentioned above, or in Marsh's apparatus.

Marsh's test depends upon the formation of arsenetted hydrogen (arsine) by the action of nascent hydrogen upon the oxygen compounds of arsenic. A simple form of Marsh's

Fig. 4.



Marsh's test for arsenic.

apparatus is shown in Fig. 4. Hydrogen is generated in a suitable flask and dried by conducting it through a tube filled with fragments of calcium chloride. After the air has been completely expelled and the apparatus filled with hydrogen, some of the liquid to be tested is introduced through the funnel-tube, and the escaping gas ignited. Upon holding a piece of porcelain in the flame, a brown-black spot of metallic arsenic will be deposited, which will quickly dissolve on the addition of a little chlorinated lime or chlorinated soda (Bischoff, 1840). Antimony compounds will yield a similar spot, which, however, is not affected by the hypochlorites. When a dry beaker or test-tube is held over the jet, arsenous acid is deposited upon the inside, and may be recognized by its crystalline form; and after dissolving it in a little hot water a yellow precipitate will be obtained on the addition of some solution of silver ammonium-nitrate. Antimony similarly treated gives no precipitate. The delivery-tube, which must be of hard glass, may be heated to redness by the flame of a gas-lamp, when the hydrogen arsenide will be decomposed, metallic arsenic being deposited. Antimony gives a similar reaction, and the two metals may be distinguished by heating the deposit in contact with air, when the arsenic will be converted into crystallized arsenous acid; or hydrogen sulphide may be passed through the tube and the deposit gently heated, when the arsenic will be converted into yellow sulphide and the antimony into orange sulphide. On now passing dry hydrochloric acid through the tube the antimony sulphide will disappear and the arsenic sulphide remain unaffected.

On passing the hydrogen gas from the delivery-tube through lead acetate to remove

any H_2S into a solution of silver nitrate, a black precipitate will be produced both by antimony and arsenic. If the former, the deposit will consist of a compound of antimony and silver; if the latter, metallic silver only is precipitated, while the solution contains the arsenic as arsenous acid mixed with the excess of silver salt, and on cautiously neutralizing with ammonia a yellow precipitate of silver arsenite is obtained.

Gutzeit's test (*Phar. Zeitung*, 1879, p. 263).—Into a test-tube (about 6 by ½ in.) place a single piece of pure zinc (weighing about 1 Gm.), and add about 5 Cc. of pure 5 per cent. sulphuric acid; now add the liquid to be tested, which should not be alkaline nor materially increase the volume of the contents of the tube. At once fasten over the mouth of the test-tube a cap made of three thicknesses of pure filter-paper free from dust, and apply to the upper paper 1 drop of a saturated aqueous solution of silver nitrate, containing about 1 per cent of nitric acid. Place the tube at once in a box, rigidly excluding light, and examine the paper cap after a while. A bright-yellow stain will appear upon the paper—rapidly if the amount of arsenic be considerable, slowly if the amount be small; if the yellow stain be moistened with water, the color changes to brown or black. (Antimony colors the spot black or brown without a previous yellow color.) The action of hydrogen arsenide upon silver nitrate in the absence of water takes place, with the formation of a yellow compound, thus: $AsH_3 + 6AgNO_3 = Ag_3As3(AgNO_3) + 3.HNO_3$. When water is added, metallic silver is separated, showing a brown or black color: $Ag_3As.3(AgNO_3) + 3H_2O = 6Ag + 3HNO_3 + H_3AsO_3$. Since hydrogen phosphide and hydrogen sulphide produce yellow-colored compounds under the conditions stated above, the zinc used in testing must be absolutely free from sulphur and phosphorus.

Bettendorff's test (1869).—On adding some arsenical solution to a solution of stannous chloride in strong hydrochloric acid, a gradual, or, on heating, a somewhat rapid, reduction to metallic arsenic takes place, the deposit having a brown or black color according to quantity. Dilution with water and the presence of nitric acid or nitrates interfere with the reaction.

Reinsch's test (1843).—If an arsenical solution is strongly acidulated with hydrochloric acid, and heated to boiling in the presence of a thin slip of bright copper—or, according to A. S. Taylor, preferably of finest copper gauze—the copper will become tarnished by the deposition upon it of metallic arsenic, the film having a bluish or iron-gray color according to quantity; the presence of nitric acid interferes with the reaction. The copper is washed with water, dried, and heated in a narrow test- or reduction-tube, when arsenous acid will be sublimed in the form of octahedral crystals.

Fleitmann's test, like the process of Marsh with its numerous modifications, depends upon the generation of arsenetted hydrogen from zinc; instead of an acid, however, a strong solution of caustic potassa or soda is employed, which has the advantage of preventing the formation of antimonetted hydrogen. If the gas is generated in a test-tube the orifice of which is covered with a piece of filtering-paper moistened with a solution of silver nitrate, the appearance of a black spot will indicate the presence of arsenic. In applying this test care must be taken to prevent the paper from coming into contact with the alkaline liquid, which would produce a similar color. A plug of cotton loosely inserted in the upper part of the tube will prevent any spirting of the liquid. A strip of paper moistened with solution of lead acetate, if colored brown or black by the gas, would prove the presence of hydrogen sulphide.

The process has been modified in various ways. Himmelmann (1868) proposed to generate the gas with a mixture of granulated zinc and powdered iron, which is warmed in a concentrated solution of ammonium chloride rendered alkaline by ammonia. The gas is passed through a solution of zinc and ammonium chloride into the silver solution. Johnson proposed aluminum in connection with potassa solution for the generation of hydrogen. In this as in the preceding case the metals employed are to be previously tested for the presence of arsenic.

Much simpler is the modification by E. W. Davy (1876), who employs an amalgam prepared by warming 8 or 10 parts of mercury, and dropping upon it gradually in small pieces 1 part of metallic sodium. The amalgam should be used only in a neutral or alkaline liquid; the gas is generated by the action of the sodium upon water, and the presence of arsenic in it is recognized with silver nitrate, as stated above.

Precautions.—It is scarcely necessary to remark that when testing for arsenic all the reagents must be absolutely free from that metal. The purity of sulphuric acid and hydrochloric acids is most conveniently ascertained by Bettendorff's or Reinsch's process, and the purity of zinc by that of Gutzeit. The use of copper for the purpose referred

to is not, as a rule, interfered with by its containing arsenic, but the presence of the latter may be readily detected, according to Odling (1863), by heating it in a retort with six times its weight of ferric chloride and an excess of hydrochloric acid, when chloride of arsenic will distil over and give the usual reactions of arsenic compounds.

In forensic analysis it is usually required that the arsenic be separated in the metallic state, and that the quantity of the poison be estimated. The former is accomplished by the methods described above; the latter, by weighing the metal deposited in the heated delivery-tube of Marsh's apparatus, either upon the glass or upon platinum introduced for the purpose, or by estimating it in the form of magnesium pyro-arsenate.

Action and Uses.—Arsenic is poisonous to all animal and vegetable life. It acts locally as an irritant, and through the blood upon the tissues, impairing their nutrition. Its soluble preparations may be absorbed by all the tissues. If taken in large doses, it occasions violent reaction and disorganization, but in minute doses, long continued, it may be tolerated, and even seem to be salutary in its operation, especially in preventing anhelation in mountain-climbing. Its injurious chronic effects consist of impaired gastro-intestinal vigor, vomiting and purging, various disorders of the skin, including shedding of the nails and hair, irritability of the nervous system, and paralysis. Acute arsenical poisoning presents the following as leading symptoms: constriction and heat of the fauces, burning pain in the abdomen, violent retching and vomiting, thirst, bloody stools, strangury, spasms, dyspnœa, and collapse. The remedial operation of arsenic seems to be due to its radical action upon all the organs and tissues of the body.

The use of arsenic as a remedy for *intermittent fever* has prevailed in China from time immemorial. As a substitute for the cinchona alkaloids in its treatment it has been extensively resorted to, and the general result of experience is that it is not comparable to the latter medicines in efficacy. The greater number of cases in which it shows a decidedly curative operation are of the chronic form, cases in which quinine fails to effect a cure, and in which the *malarial cachexia* is distinctly marked. In these the cure by arsenic generally coincides with evidences of the constitutional operation of the remedy. In various *skin diseases* arsenic is an invaluable remedy, but is especially so in *lepra*, *psoriasis*, and *chronic eczema*. In a large proportion of cases of these affections it effects a perfect cure, but in none of them can it be regarded in the light of a specific. Some dermatologists advise that the medicine should be given in very small doses at first, and gradually in larger doses, until its constitutional effects are developed; others insist upon commencing at once with a full but moderate dose (5 minims of the solution), and persisting in its use until injection of the eyes or swelling of the eyelids appears, when the dose should be gradually reduced until these phenomena subside. In either case the medicine should be continued for some time after the eruption has disappeared. The last point is of essential importance. Chronic *eczema* is less amenable than the dry scaly eruptions to the use of this medicine, but nevertheless will often yield to it alone. By several dermatologists arsenic is pronounced a specific for *pemphigus*, and, although this estimate of its value is too absolute, there is no doubt of the superiority of the medicine to any other in that disease. It must, however, be given perseveringly and for some time after the disappearance of the eruption, and does not dispense with the necessity of using preparations of cinchona and iron and appropriate diet and regimen. Syphilitic eruptions of the skin are not curable by arsenic. Of that most intractable of skin diseases, *prurigo*, arsenic is credited with a cure by Geber. But the patient was young, and other treatment was employed (*Boston Jour.*, Oct. 1880, p. 396). *Lichen ruber*, also a disease which is rarely cured, is stated by Koebner to have been removed by hypodermic injections of from Gm. 0.20–0.40 (℥iij–vj) daily of Fowler's solution, diluted with twice as much water. The treatment lasted for 2 months (*Med. News*, etc., May, 1881, p. 292). *Bromide of arsenic* has also been used with alleged special advantages in the above-named diseases, and particularly in *psoriasis vulgaris*, but the testimony has not yet proved its superiority to the usual arsenical preparations. *Warts*, especially those which appear rapidly in large crops, may generally be cured by arsenic given internally. Enlarged lymphatic glands (*lymphoma*), whether superficial or occupying the great cavities, are singularly amenable to this medicine when the dose is carried to the extent of producing its full constitutional effects and then gradually reduced. When the tumors were accessible, their injection with the arsenical solution (Fowler's) has been successfully practised. The operation is apt to produce some febrile reaction, but leads to the absorption of the hyperplasia (*Lancet*, Apr. 2, 1887). It may be mentioned for information, but not as an example to be imitated, that Fowler's solution has been injected

into the *enlarged spleen* by means of the hypodermic syringe, and with alleged success, although in other cases the effects were injurious or even fatal (*Bull de Thér.*, c. 380).

It is reported that several cases of *obesity* have been restored to a normal condition by the continued use of Fowler's solution in the dose of 5 drops three times a day.

This medicine has enjoyed a certain reputation in the treatment of *nodosity of the joints*, both as an internal medicine and under the form of arsenite of sodium in baths. Several distinguished names vouch for its efficacy, but we have made use of it persistently in several cases of the disease without the slightest advantage. In *chorea* it has enjoyed a very high repute, so much so as to have been looked upon by certain physicians as a specific; but, on the other hand, some of the best authorities do not even refer to it among the remedies for the disease. The former judgment is undoubtedly the correct one; but to ensure the efficiency of the medicine it must usually be given so as to induce its constitutional effects without deranging the stomach. Our own impression of its value is very decided in those numerous cases in which chorea occurs, as it so often does in delicate children, from overstrain of the mind or from any other exhausting excitement. In most of these cases it should be associated with iron. Its hypodermic administration, which has been advocated, and is probably the most efficient, is painful and peculiarly objectionable for children, the usual subjects of chorea.

The advantages of arsenic in *neuralgia*, especially of the fifth pair and of the intercostal nerves, the forms which most usually depend upon constitutional or acquired debility, have been recognized ever since they were first pointed out by Fowler. It is true that the cases most readily cured by it are those of miasmatic origin; but whether the disease depends upon miasma as a direct effect, or upon its indirect influence and the consequent anæmia, is not clearly determined. Instances are indeed cited of its effecting the cure of traumatic neuralgia, but they are very rare and are open to criticism. Besides the miasmatic forms, there are but few cases of neuralgia which are not benefited, even if not cured, by arsenic. The mode of its action may be inferred also from the well-known fact that facial and intercostal neuralgias are precisely those in which iron is a very efficient remedy. It would appear that large doses of the medicine are sometimes essential to the cure, such as Gm. 1.30–2.30 (♏ xx–xxx) of Fowler's solution at first, and subsequently smaller quantities (Francis). In certain cases sulphate of quinine and the arsenical medicine, each in half of the full dose, have been associated with results that could not be secured by either alone. Another form of the disease, *gastralgia*, very frequently arises under similar states of the system, and is often curable by arsenic; this is the more remarkable, considering how frequently this neuralgia is associated with gastric ulcer, and renders it probable that both affections are cured by the action of arsenic in improving nutrition. This power is conspicuously manifested by it in many cases of pulmonary *phthisis*. Under its influence the bronchial irritation and secretion decline, the hectic abates, the breathing grows calmer, the appetite improves, flesh is gained, and life is prolonged, if not permanently secured. It is not in every case that these effects are witnessed, nor is it possible to determine in what cases they may be looked for. But it would seem that arsenic is most efficient when the bronchitic element is strongest and the degenerative process is least active. This judgment is rendered probable by the manifest benefits derived from the medicine in many cases of chronic *bronchitis* affecting the lower lobes of both lungs. In nearly all of the diseases mentioned in this article more or less impairment of the blood exists, and many of them are more or less curable by iron. Indeed, in all of them the association of iron and arsenic is more efficient than either medicine alone. In no disease is this operation more distinct than in *chlorotic anæmia*, an affection in which the nervous as well as the blood element requires a specific treatment. The same is true of *malarial*, *puerperal*, and *dyspeptic* anæmia. Even in that grave affection known as *pernicious anæmia*, as well as in *leukæmia* and *pseudo-leukæmia*, which all present this double constitution, arsenic is the most available remedy. In the first-named disease Warfinge obtained cures when iron remained inefficient. These results are confirmed by the high authority of Wilks (*Lancet*, Apr. 11, 1885), and more recently by the excellent reports of Dr. Osler (*Therap. Gaz.*, x. 741, and *Boston Med. and Surg. Jour.*, Nov. 1888, p. 454). Sulphuret of arsenic was anciently used for asthmatic affections. Many years ago Koepel employed Fowler's solution in *spasmodic asthma*, in which he was imitated by Trousseau, who also prescribed cigarettes made of tissue-paper impregnated with the same solution. Subsequently, Thorowgood (1874) stated that this solution is alike useful in dry and in humid asthma, and that if the affection is connected with old chronic skin disease it may be prescribed with every prospect of benefiting the patient. No doubt the medicine is occasionally efficient in pure nervous asthma, but it is

more successful when the disease is combined with chronic bronchitis and emphysema. To the tonic and reconstituent power of arsenic must be attributed its utility in many cases of *uterine disorder* due to an enfeebled constitution or to more local causes; for it is in *amenorrhœa*, *menorrhagia*, *dysmenorrhœa*, and *leucorrhœa* that it has been found efficient; and these affections, although very different symptomatically, may have their root in the same organic debility. The utility of the medicine in many cases of *diabetes* may fairly be ascribed to a like operation. They are cases in which iron and also strychnia have been found useful—cases in which general debility is accompanied by a comparatively small secretion of urine, how high soever its specific gravity may be. Yet there are others which have been materially improved by this medicine, although the diuresis was profuse. In three-drop doses it is represented by Von Pap as greatly diminishing the sugar in the urine in diabetes, sometimes removing it, and in certain cases causing it to disappear for some time after the arsenic had ceased to be given. (Compare Quinquaud, *Bull. de Thér.*, ciii. 241.) Bromide of arsenic is alleged to be very efficient in the treatment of *diabetes*, but there is no evidence of its superiority over the more usual arsenical preparations.

In a case of long-continued *albuminuria*, apparently depending upon debility and indigestion, and in which the presence of albumen in the urine was not constant, Dr. Brinton found that small doses of Fowler's solution were more efficient than any other medicine. In the *chronic diarrhœa* of children it is reported to have cured cases that resisted other remedies.

The treatment of *cancer* by arsenic has been both internal and external. At one time the administration of iodide of arsenic was held by competent authorities to be capable of diminishing the size of cancerous tumors, but the treatment has now lost the credit it once possessed. As a caustic, arsenic was used for the destruction of cancerous tumors even by the ancients, and throughout the course of medical history examples may be found of faith in its propriety and efficacy. But in recent times the practice has chiefly fallen into the hands of quacks (*Am. Jour. Pharm.*, lix. 546). Superficial *cancers*, and tumors under various names which tend to occasion ulceration, including *lupus*, continue to be occasionally treated by means of arsenical caustics. Most of them are, however, excessively painful, and if applied over a large surface involve the risk of producing poisonous effects. Esmarch, in the treatment of desperate cases too far advanced for the use of the knife, employed arsenic both internally and externally, the former because the medicine is supposed to promote the disintegration of albuminous compounds; and for the latter purpose he applied a powder composed of 1 part each of arsenious acid and sulphate of morphine, 8 parts of calomel, and 48 parts of powdered gum arabic. The powder was thickly strewn over the ulcer or wound every day; its action was powerfully escharotic, but painless, and it neutralized the fetor of the sore. Kaposi, after Hebra, employs a paste composed as follows: Arsenious acid gr. x, factitious cinnabar ʒss, rose-water ointment ℥ss. "The healthy skin is not in the least affected by it, not even excoriated, whilst each individual lupus nodule is invariably and thoroughly destroyed." Labouléne removed *epithelial* tumors without severe pain by means of 2 parts of arsenious acid, 6 parts of sulphide of mercury and 12 parts of burnt sponge, mixed and reduced by water to a paste. He claimed that this preparation attacks the abnormal growth, and not the natural tissues (*Bull. de Thérap.*, cv. 143). Koebner cured a case of multiple *sarcoma* of the skin by injecting each of the small tumors with Fowler's solution (*Archives gén.*, Avril, 1883, p. 496), and Blair employed the same method successfully to remove a large *nævus* of the scalp (*British Med. Jour.*, Apr. 1884). Unna recommends for the treatment both of venereal and common *warts* the continuous application of mercurial ointment containing 5 per cent. of arsenic. The growths disappear by reabsorption, as in cases of spontaneous cure (*Practitioner*, xxix. 468). The peculiar caustic and drying action of arsenic has long been used to destroy the exposed pulp of *carious teeth*. About Gm. 0.001 ($\frac{1}{60}$ of a grain), or from that to Gm. 0.002 ($\frac{1}{30}$ of a grain), is applied to the nerve-pulp previously benumbed by some anæsthetic or astringent, and securely covered to prevent its displacement. The pain produced is severe in proportion to the inflammation of the part.

The symptoms of *poisoning* produced by arsenic taken into the stomach should be met by thoroughly evacuating that organ by means of ipecacuanha, alum, or the sulphate of zinc or of copper, and the administration of tepid water containing white of egg, flour, or lime-water. If these are unsuccessful, the stomach-pump should be speedily resorted to, after which the hydrated sesquioxide of iron or the hydrated sulphuret of iron should be largely administered as a chemical antidote. The saccharated oxide of iron, solution

of perchloride of iron, dialyzed iron, and also magnesia, have been recommended with the same object. The tendency of the patient to collapse is to be counteracted by means of hot bottles, bricks, etc. applied to the limbs and back, and by the cautious administration of alcoholic liquors and opiates by enema.

Administration.—The dose of arsenious acid may be stated to be Gm. 0.002–0.004 (gr. $\frac{1}{30}$–$\frac{1}{15}$). Like other preparations of the medicine, it should never be given when the stomach is empty, and like them, also, its dose should be gradually increased until the eyes begin to show signs of its operation or the symptoms of the disease for which it is prescribed are ameliorated. In the form of "Asiatic pills," which also contain pepper, the gastric disorder due to arsenic is not so apt to be produced. The formula for them is ℞. Arsenious acid ʒj; Black pepper ʒix; Liquorice-root, powdered, and mucilage, of each, q. s. Mix and divide into 800 pills. S.—One or two daily. Each pill contains about $\frac{1}{13}$ gr. of arsenious acid.

ACIDUM BENZOICUM, *U. S., Br., P. G.*—Benzoic Acid.

Acidum benzoicum sublimatum, Flores benzoes.—Flowers of benzoin, E.; *Acide benzoique, Fleurs de benjoin*, Fr.; *Benzoesäure, Benzoeblumen*, G.; *Acido benzoico*, It., Sp.

Formula $HC_7H_5O_2 = C_6H_5COOH$. Molecular weight 121.71.

Origin.—Benzoic acid is contained in benzoin, Tolu balsam, Peru balsam, storax, Botany Bay resin, in several other resinous exudations, and in certain plants. It was described by Vigenère (1608) as one of the products of the dry distillation of benzoin, and recognized by Lemery (1675) and Scheele (1775) as an acid. Liebig (1830) found it among the products of the dry distillation of hippuric acid, and Dessaignes (1847) obtained it from the latter by the action of acids and alkalies. Its artificial preparation is described below.

Preparation.—Benzoic acid may be obtained by subjecting benzoin in coarse powder, after removal of adhering moisture by careful warming or exposure over burnt lime, to dry distillation in shallow iron pans. The pan is covered with a porous diaphragm, preferably of cloth, and then provided with a suitable condenser consisting either of a cap of thick, well-sized paper or a pasteboard hood or box suitably lined with glazed paper. The application of sand-bath heat must be carefully regulated, as the acid begins to sublime at 100° C., and at 140°–145° C. (293° F.) is volatilized very freely. As the temperature is allowed to rise to 200° C. (392° F.) and over, the acid will be contaminated with other products, partly the result of decomposition—these are methyl benzoate, $C_6H_5CO(OCH_3)$, boiling at 199° C.; guaiacol, $C_6H_4OCH_3OH$, boiling at 200° C.; pyrocatechin, $C_6H_4(OH)_2$, boiling at 245° C.; benzylbenzoate, $C_6H_5COO.CH_2C_6H_5$; vanillin, etc. The sublimed acid obtained from the cooled apparatus is ready for use, but is never chemically pure; if made from good benzoin, the yield may reach 8 or 10 per cent., leaving often a still larger proportion in the fused resin, from which it may be obtained by the wet process, to be described presently, or the resinous mass may be broken again into small pieces and subjected to another sublimation.

Various modifications have been proposed from time to time in the form of sublimatory apparatus by Hager and others, with a view of increasing the yield of acid and lessening the contamination with other volatile products.

The *Wet Process* for obtaining benzoic acid is usually carried on as follows: 4 or 5 parts of powdered benzoin and 1 part of lime are mixed with 10 parts of water, and the mixture allowed to stand in a warm place for some hours, replacing the water lost by evaporation; 50 parts of water are now added, the mixture boiled down to 30 parts, and filtered while hot. The residue is again boiled with water, and the mixed filtrates are supersaturated with hydrochloric acid. In this process, which is essentially that of Scheele (1775), the benzoic acid, together with a little resin, is rendered more freely soluble in water through the formation of calcium benzoate. This salt is decomposed in the filtrate by the hydrochloric acid, with the production of freely soluble calcium chloride and crystallizing benzoic acid, the latter being contaminated with some resin and coloring matter, from which it may be freed by dissolving it in twenty times its weight of boiling water, adding some animal charcoal, filtering while hot, and crystallizing.

In order to impart to the acid obtained by this method the peculiar aroma characteristic of the sublimed benzoic acid, it has been suggested to subject it to sublimation in the presence of benzoin, and this plan is possibly followed by some manufacturers.

Although sodium benzoate is about fifteen times more soluble in water than the calcium salt, and hence the acid might be prepared from it with smaller quantities of liquid,

yet the use of sodium carbonate in place of lime is not to be recommended, as the resulting acid will be found mixed with larger proportions of resin than that obtained by the lime process.

The *process of Wöhler*, aiming at a pure product, particularly one free from cinnamic acid—which latter is often found in benzoin—is tedious and probably never followed. It consists in digesting benzoin with an equal weight of alcohol, and then adding hydrochloric acid until the resin begins to separate; the mixture is distilled in a retort on a sand-bath at 213° C. as long as ethyl benzoate passes over. The ethereal liquid is treated with potassium hydroxide on a water-bath, the alcohol recovered, and the resulting potassium benzoate decomposed with hydrochloric acid, yielding pure benzoic acid and potassium chloride.

The process suggested by Wagner (1879) has only scientific interest: Benzoin is dissolved in 3 or 4 parts of warm strong acetic acid, and the solution poured into 4 parts of boiling water, when the resin will be precipitated and the acid will crystallize from the clear liquid on cooling. Thus prepared, it has a pleasant storax-like odor.

Hippuric acid, $C_9H_9NO_3$, obtained from the urine of cattle or horses, on being boiled with hydrochloric acid, is split into glycocoll, $C_2H_5NO_2$, and benzoic acid; the latter must be purified from a fetid odor by recrystallization and sublimation with benzoin.

Naphtalene, $C_{10}H_6$, when oxidized with nitric acid, yields phtalic acid, $C_8H_6O_4$, the calcium salt of which, on being mixed with calcium hydroxide and heated to 300° or 350° C., is decomposed into calcium carbonate and benzoate, from the latter of which benzoic acid is liberated in the usual manner.

Recently benzoic acid is extensively manufactured from toluene (toluol), $C_6H_5CH_3$, and the bulk of artificial acid is probably now made by this method. If chlorine gas be conducted into boiling toluene until an increase of weight is no longer perceptible, the latter body is converted into benzo-trichloride (trichlormethyl-benzene or phenyl chloroform), $C_6H_5CCl_3$. This liquid, when treated with water under pressure, yields benzoic and hydrochloric acids, thus: $C_6H_5CCl_3 + 2H_2O = C_6H_5COOH + 3HCl$. It is important that the chlorine gas be passed into the boiling toluene in the presence of daylight, since other products are formed when light is excluded.

The *U. S. P.* recognizes the natural as well as the artificial benzoic acid, whereas the *Br.* and other European pharmacopœias specify the acid obtained by sublimation from benzoin.

Properties.—Benzoic acid is in yellowish-white feathery flexible crystalline plates and needles, having an agreeable aromatic odor and a warm acidulous taste. The odor is due to the presence of a small quantity of volatile oil, produced from the benzoin during sublimation. Exposed to the light, benzoic acid sublimed from benzoin becomes darker in color and separates a few oily drops of a brown color. The pure acid is white and without odor. It fuses at 120.5° C. (249° F.), and boils at 239° C. (462° F.), but volatilizes freely with the vapor of boiling water, and more slowly at a somewhat lower temperature. Its vapors are suffocating and acrid, inciting to coughing. It is soluble when pure in about 500 parts (*U. S.*), 370 (*P. G.*), 380 (*F. It.*) of water, and in 2 parts of alcohol at 15° C. (59° F.), in 15 parts of boiling water, and in 1 part of boiling alcohol. It is also soluble in 3 parts of ether, 7 parts of chloroform, and readily soluble in carbon disulphide, benzene, fixed and volatile oils, but sparingly soluble in benzin. Its solubility in water is increased by several sodium salts. According to Bourgoin, 1000 parts of distilled water dissolve—

At 0°	5°	10°	15°	20°	30°	50°	60°	70°	80°	90°	100° C.
1.70	1.85	2.10	2.45	2.90	4.10	7.75	11.55	17.75	27.15	40.75	58.75 parts benzoic acid.

According to R. Otto (1862), the benzoic acids obtained from different sources (benzoin, oil of bitter almond, urine, benzalanin, etc.) differ from each other in the degree of their solubility in water. The experiments of Reichenbach and Beilstein (1865), however, indicate the existence of but one variety of benzoic acid.

Its solution in strong sulphuric acid is colorless, and when gently warmed brownish, and on adding it to water benzoic acid is again precipitated; but the solution in fuming sulphuric acid, on being heated, gradually forms sulphobenzoic acid, $C_7H_6SO_5$, which is deliquescent. Boiling nitric acid does not affect benzoic acid, but fuming nitric acid produces substitution compounds. Nascent hydrogen causes deoxidation, with the formation of benzaldehyde (oil of bitter almond) and benzalcohol, and the production of crystalline hydrobenzoic acid, $C_7H_{10}O_2$.

The chemical composition of benzoic acid is represented by the formula, C_6H_5COOH.

Its salts are more or less soluble in water, and many of them also in alcohol; those with the alkalies dissolve very freely in water. Solutions of the salts yield with neutral or basic ferric salts pale brownish-red, and with lead acetate and silver nitrate white precipitates, which are sparingly soluble in water.

Tests.—Benzoic acid should completely evaporate from platinum-foil. If much charcoal be left behind, the presence of other organic substances would be indicated, of which sugar manifests itself by the odor of caramel, and hippuric acid by the odor of hydrocyanic acid, during the application of heat, while mineral substances will be left behind as a fixed residue. Since some varieties of benzoin contain cinnamic acid, this should always be tested for before benzoic acid is prepared. The U. S. and German Pharmacopœias have adopted a test indicating the limit of chlorine compounds that may be present by igniting in a crucible a dried mixture of 0.5 Gm. of the acid, 0.8 Gm. of calcium carbonate, and a little water; the residue is dissolved in water and nitric acid to 20 Cc. of filtrate, in which the addition of decinormal silver nitrate solution should not produce more than a faint opalescence at the utmost. Cinnamic acid is readily detected by the odor of oil of bitter almonds developed, if 0.5 Gm. of benzoic acid, 0.5 Gm. potassium permanganate, and 5 Cc. of water be warmed in a loosely-stoppered test-tube to about 45° C. (113° F.) in a water-bath, and then tightly stoppering the tube and cooling with cold water.

Pure benzoic acid does not decolorize a solution of potassium permanganate, but the odorous compounds present in the sublimed acid rapidly deoxidize it, both in acid and alkaline solution. This test has recently (1881, 1882) been perfected by C. Schacht and others, and is applied by mixing .1 Gm. (1.5 grains) of the acid and 5 drops of permanganate solution (1 in 200) with 5 Cc. of distilled water or with 3 Cc. each of potassa solution, sp. gr. 1.18, and distilled water, and heating the mixture just to boiling, when complete decoloration will be at once effected without the previous production of a green color. Benzoic acid prepared artificially or by the wet process will either not reduce the permanganate, or affect it more slowly than the sublimed acid. For this reason C. Schneider has increased the test-liquid to 16 drops, which, when the mixture has been set aside for eight hours, will be decolorized only by the sublimed acid, but not by the other kinds, even if resublimed with benzoin. In the presence of cinnamic acid reduction will likewise take place, but at the same time the odor of oil of bitter almond will be observed.

Action and Uses.—Taken internally in doses of Gm. 1.30 (grs. xx), and repeated several times a day, benzoic acid irritates the throat, and is said to occasion a diffused sense of warmth over the whole body, and to increase expectoration and perspiration. In the urine it is converted into hippuric acid at the expense of the urea.

It is maintained by authorities of equal weight to be no less advantageous when the urine contains an excess of *uric acid* than when it is *phosphatic*. Certainly, when the urine is excessively acid, this medicine, in doses of Gm. 0.60 (gr. x), dissolved in a weak solution of carbonate or phosphate of sodium, will materially lessen its acidity. On the other hand, phosphatic urine may be rendered acid by means of Gm. 1.33 (grs. xx) of benzoic acid given twice a day, and at the same time the accompanying local irritation will subside whenever the phosphatic state of the urine is due to derangements of the bladder. When, however, this condition is owing to constitutional causes, the medicine is of no avail. Phosphatic deposits are apt to arise when the urine becomes ammoniacal in the bladder from the action of fermenting mucus, and to form masses in layers upon the lining membrane, or calculous concretions of the ammoniaco-magnesian phosphate. The due administration of benzoic acid maintains the acidity of the urine and prevents the formation of such deposits. It is credited with possessing a cholagogue action, which, however, is more demonstrable in its salts.

According to Senator, who employed benzoic acid in the treatment of *rheumatism*, it is useless in the subacute forms of the disease. In the acute articular form its action was found very favorable, but inferior to that of salicylic acid, although it did not produce any disagreeable effects. On the other hand, it did not reduce the pulse or temperature as much. It was given to the extent of Gm. 8–12, (ʒij–iij) during the day (*Zeitschrift f. klin. Med.*, i. 262).

Incontinence of urine, without any altered condition of this secretion, and depending probably upon irritability of the lining membrane of the bladder, has been frequently treated by this medicine with success. It has also been used with apparent benefit in *Bright's disease* and *albuminuria;* it seemed to cause the disappearance of albumen from

the urine. In *chyluria*, with spontaneously coagulable urine, it has restored the secretion to its normal condition (*Am. Jour. of Med. Sci.*, July, 1882, p. 263).

Benzoic acid has some repute as a remedy for *jaundice*, but the conditions for its successful use are undetermined. It may be assumed, however, that it can only be employed with a hope of advantage when jaundice is due to simple obstruction of the ducts by inspissated bile, whatever may be the remaining conditions of the liver.

In *chronic bronchitis* the fumes of benzoic acid have for a long time been inhaled advantageously, and recently atomized solutions of the compound tincture of benzoin, whose internal administration is of much older date in the treatment of the same affection.

As a dressing for *wounds*, Richardson has recommended a solution of 3 drachms of benzoic acid in 12 ounces of chloroform, as also to protect and deodorize fetid *ulcers* and to protect the hands in post-mortem examinations.

Administration.—The dose of benzoic acid is from Gm. 0.60–2.60 (10 to 40 grains). In albuminuria much smaller doses, as 1 or 2 grains, have been found sufficient. To promote its solution in water, 4 parts of phosphate of sodium, or 1½ parts of borate of sodium, may be added. It may also be administered in pills made either with balsam of fir or Castile soap (*Am. Jour. of Phar.*, Aug. 1880, p. 406).

ACIDUM BORICUM, *U. S., Br., P. G.*—Boric Acid.

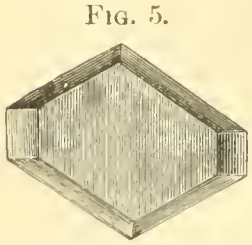
Acidum boracicum.—Boracic acid, E.; *Acide borique crystallisé*, Fr. Cod.; *Borsäure*, G.; *Acido borico*, F. It.

Formula H_3BO_3. Molecular weight 61.78.

Origin and Preparation.—This acid was obtained by Homberg (1702) by heating borax with copperas, and subsequently from sulphuric acid and borax. It was known as *Sal sedativum Hombergi* until Gay-Lussac and Thénard (1804) proved it to be an oxygen compound of boron. It is a constituent of several minerals, and is present, mostly in minute quantities, in various plants, mineral waters, and sea-water, and in somewhat larger proportion in several of the hot springs in Western North America. The crater of the Liparian island of Volcano, situated north of Sicily, contains a deposit of boric acid mixed with sulphur, and the same acid is found in the vapors which issue from fissures in the volcanic rocks of Tuscany in Italy. These fissures, called *soffioni*, are either natural or made artificially by drilling, sometimes to the depth of 150 or 200 feet. Surrounding one or more of the *soffioni* a series of basins or *lagoons* are constructed on the side of the mountain, either by excavation or masonry, and are then filled with water from a mountain-stream; the hot vapors in passing through the water yield to it boric acid and heat the water at the same time. The solution of boric acid thus obtained is passed from one basin to another lower one, and when sufficiently saturated into a reservoir; thence it is conducted into evaporating-pans, and finally into vats, where the acid is deposited. This crude product, of which about 200,000 pounds are annually imported into the United States, is used in the preparation of borax (see Sodii Boras), and from this salt boric acid is again prepared for medicinal use.

10 parts of borax are dissolved in 24 parts of boiling water; the solution is filtered while hot, mixed with 6 parts of hydrochloric acid, and the liquid set aside for a day in a cool place. The crystals are collected either in a funnel or upon a strainer, and are drained and washed with a little cold water, after which they are redissolved in five times their weight of boiling distilled water. After a day or two the crystals are collected as before, washed with cold water to remove the last traces of adhering hydrochloric acid, and dried in a moderately warm place. The yield is between 5½ and 6 parts. The reaction which takes place is explained by the equation $Na_2B_4O_7.10H_2O + 2HCl = 4H_3BO_3 + 2NaCl + 5H_2O$. Sulphuric acid may be employed in the place of hydrochloric acid, but will adhere more persistently to the boric acid, necessitating two or three recrystallizations.

Fig. 5.



Crystal of Boric Acid.

Properties.—Boric acid crystallizes in white, translucent six-sided scales, which have a slight pearly lustre, are somewhat unctuous to the touch, inodorous, and of an acidulous and slightly acrid taste. It is soluble at 15° C. (59° F.) in 25.6 parts of water, 15 parts of alcohol, or 10 parts of glycerin. Addition of hydrochloric acid increases its solubility in water (U. S.). The taste of the solutions is somewhat astringent and sweetish, and in the presence of salicylic acid quite bitter. When heated it melts, disengaging vapors of water, which contain some of the acid; between 80° and 100° C. it is converted into *metaboric acid*, HBO_2; between 140° and 160° C. it yields tetra-

boric or *pyroboric acid*, $H_2B_4O_7$; and at a red heat all the water is expelled, *boric anhydride*, B_2O_3, being left in the form of a transparent, very hard but brittle glass, and weighing about 56 per cent. or less of the boric acid used. Boric acid volatilizes appreciably with water at and above 60° C., and with the vapors of boiling alcohol; its solution in the latter burns with a green flame. It is nearly insoluble in ether, soluble in volatile oils, and at 17° C. dissolves in 6 parts of alcohol. According to Brandes and Firnhaber (1824), 1 part of boric acid dissolves—

At 18.8°	25°	37.5°	50°	62.5°	75°	87.5°	100° C.
in 25.66	14.88	12.66	10.16	6.12	4.73	3.55	2.97 parts of water.

The solutions impart a red color to blue litmus- and a red-brown color to turmeric-paper; the last-named reaction is also produced in the presence of diluted mineral acids.

Boric acid, mixed with the salts of mineral acids and ignited, decomposes all those containing volatile acids; in aqueous solution it decomposes the carbonates only, forming borates, of which those with an alkaline base are readily soluble in water, while most others are slightly soluble or nearly insoluble. On ignition they melt to a glass-like mass, and when mixed with sulphuric acid and alcohol, on igniting the latter the green flame of free boric acid is observed.

Tests.—In addition to its fusibility, and its complete solubility in water and alcohol, boric acid, dissolved in 50 parts of distilled water acidulated with nitric acid, should yield no precipitate with the nitrates of silver and of barium (absence of hydrochloric and sulphuric acid), and no dark color with hydrogen sulphide either before or after neutralization with ammonia (metals). The solution of 1 Gm. of the acid in a mixture of 1 Cc. of hydrochloric acid and 49 Cc. of distilled water should not at once assume a blue color on the addition of 0.5 Cc. of potassium ferrocyanide solution (limit of *iron*), nor should it, when heated on a clean platinum wire, impart to a non-luminous flame a persistent yellow color (absence of *sodium*). The absence of earths is determined by testing a 2-per cent. aqueous solution of boric acid with ammonium oxalate for calcium, and with sodium phosphate and ammonia-water for magnesium, which reagents should yield no precipitates (*U. S.*). If mixed with an excess of sulphuric acid, the addition of a crystal of ferrous sulphate should not cause the appearance of a dark-brown color (absence of nitrates).

GLACIALIN, which has been recommended as an antiseptic and for the preservation of articles of food, is a mixture of boric acid 6 parts, borax 3 parts, sugar 3 parts, and glycerin 2 parts.

Action and Uses.—Although its poisonous action upon quadrupeds is slight, boric acid is an insecticide, and in the higher animals it is rapidly absorbed from all mucous membranes and from all lesions. In this manner it has sometimes occasioned symptoms of irritant poisoning, with diarrhœa, bloody urine, and collapse. Boric acid has been used chiefly as an external application. According to Theobald (*Med. Record*, xvii. 140), a solution of 4 grains of the acid in an ounce of water does not irritate the conjunctiva. He used a solution of half that strength in various forms of *conjunctivitis*, accompanied or not with *corneal ulcer*. It is, however, to be noted that these beneficial results followed not only the application of the acid, but the simultaneous suspension of atropine, nitrate of silver, and other irritants that had been in use. Finely powdered boric acid has been a useful application to *granular eyelids* and to granular *ulcers* of various parts. Equal parts of boro-glycerite (50 per cent.) and vaseline form an ointment which is said to be superior to others in the treatment of chronic inflammations of the conjunctiva, and forms a convenient vehicle for atropine and other agents. Catarrhal obstruction of the *nasal duct* is benefited by solutions of from 3–6 grs. to the ounce. Greene (*Boston Med. and Surg. Jour.*, Aug. 1880, p. 197) reports that an ointment of boric acid is a very efficient dressing for *wounds* of large extent. Barwell, Bing, and others have stated that a glycerite of the acid is superior to carbolic acid for its antiseptic and cicatrizing virtues. The antiseptic properties of this boro-glycerite have been demonstrated by ample experiment, and its advantages over iodoform, carbolic and salicylic acids are claimed to be that it is unirritating and promotes the rapid healing of wounds and the drying up of suppurating surfaces; *e. g. vaginitis*, purulent *ophthalmia*, *otorrhœa*, etc. (*Med. News*, xl. 304, 602). Bing claimed that in all diseases of the *ear* for which boric acid is suitable it should be applied in a fine dry powder, and not dissolved or suspended (*Centralbl. f. Therap.*, iii. 337). It has been charged by Gruening with aggravating and rendering fatal several cases of inflammation of the middle ear by preventing the escape of confined pus; but the

general verdict of otologists appears to be that it is valuable through its mildness and antiseptic qualities, its lightness and solubility, and the facility of its removal from the auditory canal. Yet it calls for close supervision (*Meyer*). Theobald prefers a saturated solution or else one of Gm. 1 (15 grains) to the ounce to the more commonly used powder (*Therap. Gaz.*, xii. 768). Like sodium borate, which has long been applied to superficial lesions of the mucous membrane, boric acid is now used in lotions for the cure of the several forms of *stomatitis* and *pharyngitis*, including their parasitic form (*thrush*). Macgregor has recommended (*British Med. Jour.*, July 11, 1886) for a tooth-powder: Boric acid, finely powdered, 40 grs.; Chlorate of potassium, 30 grs.; Powdered guaiacum, 20 grs.; Prepared chalk, 60 grs.; Powdered carbonate of magnesia, to ʒj; Attar of roses, ½ drop. Greene ascribed to boric acid peculiar virtues in healing *ulcers* that follow severe *burns* and others of a foul and unhealthy aspect. He preferred for this purpose an ointment of vaseline containing the acid. On theoretical grounds Loewenberg proposed to substitute solutions of boric acid for the usual emollient or stimulant applications to *boils*. Neumann applied it in watery solution for *parasitic diseases of the skin*, in alcohol for *pruritis* and *urticaria*, and in an ointment for *eczema*. In *pityriasis* and *herpes tonsurans* solutions of from 10 to 20 parts of the acid to 300 of water have been recommended. A vaseline ointment containing about 5 parts of the acid to 10 or 15 of the excipient is a very serviceable application to *eczema*, *impetigo*, *prurigo*, and non-syphilitic *psoriasis*. An ointment made with 8 parts of lanolin to 2 parts of boric acid is also employed. Greene used a lotion and also an ointment of the acid in *erythema*, *erysipelas*, and *tinea*. In cases of chronic inflammation of mucous membranes attended with an unhealthy and especially a fetid discharge, such as *nasal catarrh*, *ozæna*, *cystitis*, etc., injections containing about 8 grains of the acid to an ounce of water have been found to correct the fetor and cure the discharge. It has also been prescribed internally (Rosenthal) in conjunction with its topical application. Others have employed it for this purpose, and found that it removed the turbidness of the urine and lessened the irritability of the bladder when given to the extent of from 10 to 30 grains a day. A similar solution is reported to have greatly palliated the coryza of *hay fever* (Atkinson). The insufflation of finely-powdered boric acid is preferable to its solutions after the diseased part has been thoroughly cleansed. A solution of equal parts of boric acid and of borax is preferable to either alone. A 1 or 2 per cent. solution, used as an injection, has cured *gonorrhœa* (Kurz; Hill). *Fetor of the feet* has been corrected by causing the patient to wear stockings that had been soaked in a saturated solution of boric acid and then dried (*Practitioner*, xxvii. 401). Greene, and also Harries, found it useful as a topical application in "*diphtheritic* and *aphthous* inflammation of the fauces."

Internally, boric acid is said to correct the fetid and other eructations that are apt to attend fermentative *dyspepsia*. The large proportion of boric acid eliminated with the urine suggested its employment to prevent the formation of ammonia in the urinary passages; and it has been found quite efficient in restoring *ammoniacal urine* to its normal condition. If it be true that bougies coated with this acid will cure *gonorrhœa*, then it probably would be more efficient as well as convenient if given by the mouth. The very improbable statement is made by a medical officer of the Madras service that every case of cholera recovered that was treated by him with 10-grain doses of this agent every two hours, associated with borax.

Forster has objected to the use of boric acid to preserve food. He states that it greatly increases the fecal solids and the excretion of albuminous compounds, even when given in a daily dose of seven or eight grains, and that these effects continue for some time after the suspension of the medicine (*Amer. Jour. Pharm.*, Nov. 1884, p. 597).

Administration.—The strength of the solutions for topical use has already been indicated. Internally, according to Atkinson (*Practitioner*, xxiv. 254), the dose is from Gm. 0.34–1 (5 to 15 grains); but Greene (*loc. cit.*) says, "I have repeatedly given at a dose 4 fluid-ounces of a saturated solution which contained about 80 grains of the acid, and in several instances patients have taken much more. I have never known any ill effects from it in any way. My ordinary dose for an adult is from 20 to 30 grains." Such doses are not safe. It may be given in wafers. The following are formulæ for ointments: R. Boric acid, White wax, of each 1 part; Paraffine, Almond oil, of each 2 parts. R. Almond oil, 210 parts; Paraffine, 60 parts; White wax, 30 parts; Boric acid, 60 parts. In poisoning by boric acid the proper remedies are diffusible stimulants and the hypodermic administration of morphine.

ACIDUM CARBOLICUM, *U. S.; Br.; P. A.; P. G.*—Carbolic Acid.

Acidum phenicum s. phenylicum, Phenol.—Phenic acid, Phenic alcohol, Phenol, E.; *Acide phénique, Acide carbolique, Phénol*, Fr. Cod.; *Carbolsäure, Phenylsäure, Phenylalkohol*, G.; *Fenolo cristallizzato*, F. It.; *Acido fenico (carbolico)*, It. Sp.

Formula $HC_6H_5O = C_6H_5.OH$. Molecular weight 93.78.

Origin.—Carbolic acid occurs in castoreum, in the urine of man and of herbivorous animals, and in the products of the dry distillation of various organic substances, such as resins, bones, wood, and more especially coal. It is from the latter source that it is obtained in the arts. It was first obtained by Runge (1834), and in a purer condition by Laurent (1840), who ascertained its composition and chemical behavior.

Preparation.—That portion of coal-tar which is known as *dead oil* is subjected to distillation. The portion distilling between 150° and 200° C. (302° and 392° F.) is collected separately, and is twice rectified between 170° and 190° C. (338° and 374° F.). The product thus obtained is sold as *crude carbolic acid, acidum carbolicum crudum*, U. S.; *acide phénique cru*, Fr.; *Rohe Carbolsäure*, G. For the purification of this product it is agitated with warm concentrated solution of potassa or soda, when a crystalline mass of sodium phenol or potassium phenol is obtained, from which the oily liquid is poured off. The solid mass on being heated to about 170° C. (338° F.) parts with a portion of the adhering empyreumatic products, and on being dissolved in water more of the oily impurities separate, and are removed from the aqueous solution, which, on being supersaturated with hydrochloric acid, yields the phenol in the form of an oily liquid. This is repeatedly agitated with solution of table-salt, then digested with calcium chloride for the purpose of removing the water, and distilled. The portion passing over between 180° and 190° C. (336° and 374° F.) is collected separately and exposed to a low temperature, when it solidifies into a crystalline mass, from which the mother-liquor is drained off and expressed.

This is essentially the process of Laurent (1844). Another, proposed by H. Müller (1865), differs from the preceding mainly in the following particulars: The potassium or sodium phenol is diluted with water as long as naphtalene and other empyreumatic products are separated. The liquid is exposed to the air for some days, by which it acquires a dark-brown color. It is filtered from the precipitated oxidation products, and then mixed with one-eighth or one-sixth of the total amount of sulphuric acid which is necessary for the complete decomposition of the phenate. Empyreumatic resins are thus separated, and on the addition of a second similar quantity of acid more resinous products and cresylic alcohol are removed, so that a third portion of the acid usually separates almost pure carbolic acid, requiring distillation to obtain it crystallized, or the crude carbolic acid is treated several times with soda solution sufficient to combine only with a fractional portion of the phenol, the solutions first obtained containing the acid in a purer condition than the last. It is obvious that if either process be interrupted at different points, carbolic acid varying greatly in degree of purity must be obtained. The purification of carbolic acid on a large scale is now generally effected by successive treatment with lead oxide, sulphuric acid, and potassium dichromate and sulphuric acid.

Absolutely pure carbolic acid was obtained by Church (1871) from the nearly pure commercial product by treating it with a quantity of water (about 20 parts) insufficient to dissolve it completely, removing the undissolved portion, and saturating the clear aqueous solution with pure table-salt, when the carbolic acid will separate as an oily layer, requiring distillation over some quicklime to obtain it crystallized. The portion passing over up to 185° C. (365° F.) has, at ordinary temperatures, merely a very faint aromatic odor.

Pure carbolic acid is chiefly imported from England; most of the impure acid, and a very fair quality of nearly pure acid used in this country, are manufactured here.

Synthetic Carbolic Acid.—Since 1888 considerable quantities of artificial carbolic acid have been placed upon the market. This is prepared indirectly from benzene (benzol) by first treating it with fuming sulphuric acid and moderately warming the mixture, whereby benzene-sulphonic acid is produced, $C_6H_6 + H_2SO_4 = C_6H_5SO_2OH + H_2O$. The acid thus formed is neutralized with potassium carbonate, yielding potassium benzene-sulphonate, and this compound then fused with a large excess of potassium hydroxide, whereby potassium sulphite and potassium phenol are formed [$2(C_6H_5SO_2OK) + 4KOH = 2H_2O + 2KSO_3 + 2C_6H_5OK$]. The potassium phenol is finally treated in solution with hydrochloric acid in order to liberate the phenol or carbolic acid, which is further purified by distillation, $C_6H_5OK + HCl = KCl + C_6H_5OH$. The advantages

of the synthetic method are chiefly the absence of homologous products (cresol, xylene, etc.), as the benzene can be procured of great purity by means of crystallization.

Properties.—Crude carbolic acid is rarely colorless. It usually has a more or less reddish or dark-brown color, and gradually turns darker on exposure to air and light. The better qualities crystallize almost completely below the ordinary temperature, the solidifying point being influenced by the amount of water and of oily impurities present in it. The latter are estimated by agitating the impure acid with two hundred times its bulk of warm water, and allowing the oily matters to separate, when they should measure not over 10 per cent. of the measure of acid employed. The aqueous solution should not have an alkaline reaction upon test-paper, thus indicating that it is not an alkaline solution of carbolic acid; and if it yields a clear solution with water, not less than 15 parts of this solvent should be necessary for this purpose. Its odor is more or less empyreumatic. In other respects its properties agree with those of pure carbolic acid.

Absolutely pure carbolic acid has a faint aromatic odor, is colorless, crystallizes in needles, and does not absorb moisture from the atmosphere (Moss, 1875). Usually, however, it retains a minute quantity of water, by which it becomes deliquescent; with a little more water it forms an oily liquid, which crystallizes at a lower temperature, and if traces of the tar-products are present it acquires a reddish color on exposure, and deliquesces to a brown-colored oil. This peculiar red color has been investigated by E. Fabini, and, according to that author, is due to the formation of an organic coloring matter, named by him *phenerythen*, caused by the presence of minute quantities of metal (probably copper) in the acid. Hydrogen peroxide, metal, and ammonia must be present to produce the color; ammonium phenol, being formed by absorption of ammonia from the air, reacts with the metal present in the acid, forming a metal phenate, and this in turn is acted on by hydrogen peroxide, yielding the characteristic red color. The odor is modified by the presence of a little cresol. Carbolic acid is insoluble in benzin, but freely soluble in alcohol, ether, glycerin, the essential and fatty oils, in glacial acetic acid, caustic alkalies, carbon disulphide, and chloroform, the solutions in the last two liquids separating all the water present, the amount of which may thus be determined. Morson (1872) observed that the oily liquid, either pure or containing creosote, will dissolve in an equal bulk of glycerin, and not be reprecipitated by water. (See CREOSOTUM.) Carbolic acid dissolves at 15° C. (59° F.) in about 15 parts of water. The solution is perfectly transparent, and has only a faint action upon blue litmus-paper. Carbolic acid is less soluble in many saline solutions than in water; it yields with a limited amount of concentrated solutions of the fixed alkalies a crystalline mass, which, after being pressed, consists merely of carbolic acid, and is almost free from potassa (Calvert, 1865). Baumann (1877) observed that carbolic acid slowly decomposes a boiling solution of potassium carbonate, forming potassium phenol, which may be obtained in crystals from alcoholic ether. The fusing-point of crystallized carbolic acid is influenced by the amount of water with which it is combined: the U. S. P. does not specify the melting-point, but demands that the congealing- or crystallizing-point shall not be below 35° C. (95° F.), while the melting-point is placed not lower than 33° C. (91.5° F.) (*Br.*). At about 40° C. (*F. It.*, *P. A.*), between 40° and 42° C. (104°–107° F.) (*P. G.*), an almost pure acid. The boiling-point of carbolic acid is given at not higher than 188° C. (370.4° F.) (*U. S.*), not higher than 188.3° C. (371° F.) (*Br.*), about 180° C. (*F. It.*, *P. A.*), between 178° and 182° C. (352.4° and 359° F.) (*P. G.*). It must be borne in mind that cresols which may be present have a higher boiling-point, that the acid contains variable proportions of water, and that a lower boiling-point or a higher melting-point indicates a purer and less hydrated acid. Carbolic acid volatilizes slowly at ordinary temperatures, rapidly at the temperature of boiling water, without leaving any residue. It has the specific gravity 1.065, separates nitrocellulose in a gelatinous form from collodion, coagulates albumen, and has a caustic acrid taste, but when largely diluted with water tastes sweetish and smoky. The vapor of carbolic acid is inflammable.

A piece of pine wood dipped into an alkaline solution of the acid, and afterward into hydrochloric acid, assumes in the course of half an hour a deep-blue color. According to Tiemann and Haarmann, this color is a characteristic reaction of coniferin. The solution of carbolic acid has no effect on polarized light. The concentrated alcoholic solution yields with ferric chloride a brown liquid, which on the addition of much water remains transparent and assumes a beautiful and permanent violet-blue color (Flückiger, 1872). When heated in sealed tubes with ammonia it yields but small quantities of phenylamine

(aniline, $C_6H_5H_2N$). Fused with excess of potassa, oxybenzoic and salicylic acids are found among the products of decomposition. It is oxidized by potassium permanganate, yielding carbon dioxide and oxalic acid. Concentrated sulphuric acid converts it into sulphocarbolic (phenolsulphonic) acid, $C_6H_5HSO_4$. Under the influence of nitric acid several substitution-products are formed, the most important of which is picric acid. Substitution-compounds are likewise formed with chlorine, iodine, and bromine. The last-named element, acting either in the form of vapor or as bromine-water upon an aqueous solution of carbolic acid, produces a flocculent white precipitate of tribromophenol, $C_6H_3Br_3O$, which crystallizes from alcohol in silky needles, melting at 98° C. (208.4° F.). This reaction was recommended by Degener (1880) for the quantitative determination of phenol, and is so delicate that a solution of the latter in 57,000 parts of water is still rendered turbid; it must, however, be remembered that alkaloids, cresols, and various other compounds are likewise precipitated by bromine-water.

Tests.—The purity of carbolic acid is recognized by the properties described above, by the absence of all reaction upon red litmus-paper, and by the non-production of a dark color or precipitate in the aqueous solution by hydrogen sulphide, proving the absence of metallic compounds.

The valuation of carbolic acid is prescribed by the U. S. P. to be made with decinormal bromine solution (Koppescharr's solution; see VOLUMETRIC SOLUTIONS), each Cc. of which corresponds to 0.001563 of absolute carbolic acid. The test depends upon the formation of tribromophenol, and is made by adding to an aqueous solution of carbolic acid a slight excess of the bromine solution, adding potassium iodide and hydrochloric acid, and finally titrating the iodine liberated by the excessive bromine by means of decinormal sodium thiosulphate solution. Having found the excess of bromine solution, the calculation for percentage of absolute acid in the sample is easily made; for instance, if 0.05 Gm. carbolic acid should require exactly 30Cc. $\frac{N}{10}$ bromine solution for precipitation, the sample would be said to contain 93.78 per cent. absolute phenol.

To estimate the quality of commercial carbolic acid, Schoedler (1872) recommended its conversion into sulphocarbolic acid by heating it with an equal weight of sulphuric acid to 50° or 60° C., treating with barium carbonate, precipitating the filtrate by sulphuric acid, and weighing the ignited barium sulphate, 100 parts of which correspond to 80.69 parts of anhydrous phenol.

The presence of carbolic acid in watery solution may be detected, according to E. Hoffmann (1879) by pouring into a test-tube 1 or 2 Cc. of pure sulphuric acid, adding but not mixing the same volume of aqueous liquid, and dropping in small particles of potassium nitrate, each of which will produce a deep-violet streak; on agitation the liquid becomes violet, and on the addition of water assumes a red-orange color; $\frac{1}{10}$ per cent. of carbolic acid is thus detected. Salkowski's (1872) process consists in adding to the suspected liquid one-fourth its volume of ammonia, and then a few drops of solution of chlorinated lime (1 part to 20 parts of water). On the application of a moderate heat, a blue or greenish color will be produced, either immediately or in the course of fifteen minutes, the color changing to red upon acidulating with sulphuric or hydrochloric acid; 1 part of carbolic acid in 4000 may thus be detected. Bromine may be used in place of the chlorinated solution; the blue compound is insoluble in ether and chloroform, dissolves in alcohol with a green color, and changes with acids to red, but becomes blue again by ammonia. Of still greater delicacy (1 in 200,000) is the test suggested by Plugge (1872): when a liquid containing carbolic acid is boiled with a little solution of mercurous nitrate containing a trace of nitrous acid, a reduction of the mercurous salt occurs, and the liquid assumes, sooner or later, an intense red color.

Pharmaceutical Uses.—ACIDUM CARBOLICUM LIQUEFACTUM, *P. A., P. G., Br.;* Fenolo liquido, *F. It.* Pure carbolic acid, liquefied with 10 per cent. of water. 10 Cc. of this solution of water in phenol may be mixed, at 15° C., with 2.3 Cc. of water without producing permanent turbidity$_1$, proving the absence of an excess of water. O. Facilides (1872) recommended liquefying the phenol with 10 per cent. of glycerin.

AQUA CARBOLISATA, *P. G.;* Carbolized water, Phenol water, *E.;* Eau pheniquée, *Fr.;* Carbolwasser, Phenolwasser, *G.*—Mix 33 parts of liquefied carbolic acid with 967 parts of distilled water.

It contains 3 per cent. of pure carbolic acid by weight, or practically 220 grains in a pint. The preparation of the Fr. Cod. contains only 0.1 per cent. of phenol for internal use, and 1 per cent. if for external use.

ACIDUM CARBOLICUM IODATUM, *N. F.:* Phenol iodatum, Iodized carbolic acid, Iodized phenol, *E.;* Iodhaltige Carbolsäure, *G.*—Iodine in powder, 20 parts; carbolic acid, 76 parts; glycerin, 4 parts. Put the iodine into a flask, add the acid, previously melted, and the glycerin, and

digest the mixture at a gentle heat, frequently agitating, until the iodine is dissolved. Keep in glass-stoppered vials in a dark place.

Carbasus Carbolata, *N. F.*; carbolated gauze.—Resin, in coarse powder, 40 parts; castor oil, 5 parts; carbolic acid, 10 parts; alcohol, 225 parts; gauze muslin, a sufficient quantity. Dissolve the resin, oil, and acid in the alcohol. Then immerse in the mixture loosely-folded pieces of gauze muslin; allow them to become thoroughly saturated; then take them out and press out the excess of liquid until the weight of the impregnated gauze amounts to 170 parts for every 100 parts of the original fabric. Spread out the pieces horizontally, and as soon as the alcohol has nearly all evaporated fold and wrap the pieces in paraffin paper, and preserve in air-tight receptacles. The impregnated gauze, when dry, contains about 2.5 per cent. of carbolic acid.

Lister's catgut, for ligatures, is prepared by immersing for two days 200 parts of catgut in a fresh mixture of 200 parts of phenol with 4000 parts of water containing 1 part of chromic acid in solution; the string is then dried without untwisting it, and preserved in a solution of 1 part of phenol in 5 parts of olive oil.

Phenol is extensively employed in the manufacture of salicylic acid and of various dyestuffs, like picric acid, phenyl-brown, corallin (scarlet), peonin (red), aurin (yellow), azulin (blue), and others.

Allied Compounds.—Cresols, $C_7H_8O = C_6H_4CH_3OH$.—The compounds of this composition are obtained from those portions of coal-tar which are collected by distillation between 200° and 210° C.; they may also be obtained by fusing toluene sulphonic acid with potash. *Metacresol* is a thick liquid which boils at 201° C., but does not solidify even at—80° C.; *ortho-* and *paracresol* form colorless prisms with phenol-like odor, and dissolve sparingly in water; both give a blue color with ferric chloride. Ortho-cresol melts at 31° C., boils at 185° C., and by prolonged heating with potassa is converted into salicylic acid; paracresol melts at 36° C., boils at 198° C., and by heating with potassa is converted into paraoxybenzoic acid. The presence of cresols in carbolic acid lowers the melting-point and raises the boiling-point of the latter.

The cresols possess strong disinfectant and germicidal properties, while at the same time they are far less poisonous than carbolic acid; in form of various combinations they have of late years come more extensively into use. The more familiar compounds are creolin, lysol, solutol, solveol, saprol, sozal, etc.

Creolin is a dark-brown alkaline liquid which forms a turbid milky mixture with water, but is miscible in all proportions with ether, chloroform, and absolute alcohol. Two varieties of creolin are found in the market—Pearson's and Artmann's—the former being a mixture of cresol, resin soap, and certain hydrocarbons; the latter is a solution of hydrocarbons in cresol sulphuric acid.

Lysol is a brown clear, oily-looking liquid, with feebly aromatic odor. It is obtained by dissolving in fat that portion of coal-tar oil boiling between 190° and 200° C., and subsequently saponifying with addition of alcohol. It is said to contain 50 per cent. of cresol, and forms with water a clear frothing saponaceous liquid: it is likewise soluble in alcohol, chloroform, glycerin, and benzin. According to Cramer and Wehmer, lysol is five times stronger than carbolic acid and eight times less poisonous.

Solutol is the name given to a solution of cresol in sodium cresol, containing about 60.4 per cent. of cresol, of which three-fourths are combined with sodium. It is chiefly intended for crude disinfection, and occurs of two qualities.

Solveol differs from the preceding in being a concentrated solution of cresol in water by means of sodium cresotinate. It is comparatively innocuous, weakly inodorous, and mixes clear with lime-water; the presence of albumen does not reduce its activity.

Saprol is a mixture akin to lysol, solveol, etc., containing chiefly crude cresols, together with pyridine bases and hydrocarbons from petroleum-refineries. It is inflammable.

Sozal is the aluminum salt of paraphenol-sulphonic acid or so-called aluminum sulphocarbolate, $Al_2(C_6H_4OHSO_3)_6$. It occurs as a crystalline granular powder of slight phenol-like odor and strongly astringent taste. Sozal may be prepared by direct action of phenol-sulphonic acid on aluminum hydroxide or by mutual decomposition between the barium salt and aluminum sulphate. It forms stable solutions with water, glycerin, and alcohol, and is recommended as an astringent antiseptic.

Chlorphenol.—Under this name a liquid has been introduced from Italy, regarding which very little is as yet known. It is prepared by the action of chlorine gas upon phenol, with the temperature kept low, while the reaction is going on. In fact, the completed preparation must be kept cool, owing to its extreme volatility. It is especially recommended by Passerini for pulmonary tuberculosis. The inhalation liquid consists of 7 parts of monochlorphenol and 3 parts of a mixture of alcohol, eugenol, and menthol; 16–30 drops are inhaled daily, the heavy vapors penetrating into all recesses of the lungs. Chlorphenol has also been used as an application to indolent ulcers.

Pheno-salyl.—A very recent antiseptic introduced by Dr. De Christmas after some experimentation at Pasteur's Institute. It is probably nothing more than a mere mixture of carbolic acid 9 parts, salicylic acid 1 part, lactic acid 2 parts, and menthol $\frac{1}{10}$ part. The menthol is added to the mixed acids heated to the point of liquefaction; the mixture is soluble in twenty-five times its weight of water. Von Yersin finds that it possesses about double the antiseptic effect of carbolic or salicylic acid, and is only inferior to mercuric chloride.

Sulphophenol, Orthophenol-sulphonic Acid, Aseptol, Sulphocarbol, Sozolic Acid.—Formula

$C_6H_4.OH.SO_3H$. Mol. weight 173.64.—Two or three sulphophenols may be obtained by the action of sulphuric acid upon phenol (carbolic acid), the para-compound being produced at an elevated temperature, while the ortho-compound is formed in the cold by leaving together for a week 10 parts of carbolic acid and 12 parts of sulphhuric acid; after which time the excess of the latter is removed by calcium or barium carbonate. Sulphophenol is a reddish- or amber-colored viscous liquid, having the spec. grav. 1.45, a caustic taste, and a carbolic-acid-like odor. It is readily soluble in water, alcohol, and glycerin.

The commercial article, known as *aseptol*, is usually a straw-colored, slightly caustic liquid of the density 1.167, and containing from 30 to 35 per cent. of ortho-phenolsulphonic acid. Its aqueous solution should give no precipitate with barium chloride.

Action and Uses.—Carbolic acid acts as a caustic upon animal and vegetable tissues, and even very weak solutions of it destroy small animals. Its action upon man is analogous, and when taken internally it irritates the gastro-intestinal canal, produces a feeling of intoxication, and turns the urine to a dark and almost inky color. These phenomena are naturally most intense when a poisonous dose of the acid has been taken, and there may be added to them graver symptoms, such as delirium, dilated pupils, coma, and collapse. When undiluted the acid becomes caustic, and may produce a mummification of tissue. The best antidotes to its action are albuminous or oily liquids and solutions of sodium sulphate.

Carbolic acid has been used as an antipyretic, and especially in *typhoid fever*. It undoubtedly lowers the temperature through its poisonous operation, but no more than any other active medicine does it either reduce the mortality or abridge the duration of the disease.

Robin, who tested the question clinically, concluded that this acid should be banished from the treatment of typhoid fever. He held that the nervous and cachectic phenomena observed during its administration were chargeable to it (*Archives gén.*, Fev. 1885, p. 129). Villebrun also exposed the grave dangers attending the use of enemas containing carbolic acid in the typhoid fever of children (*Med. Record* xxviii. 601); and Dujardin-Beaumetz declared the acid to be a powerful and very dangerous medicine in this affection (*Les nouvelles Médications*, p. 120). In 1888, Dr. Gramshaw (*Lancet*, June 23, 1888) revived its use, but his description of its virtues appears to err by claiming for it what no other medicine has ever accomplished. Its use in *scarlatina* and in *intermittent fever* has also been advocated, but upon theoretical grounds chiefly. The chief use of carbolic acid is to prevent or delay *fermentation*, especially of the putrefactive sort. Its power, in this respect, is almost identical with that of the closely analogous product, creasote. It is supposed to act by preventing the production and multiplication of certain minute organisms upon which this process is assumed to depend. Whether these organisms are the causes, the concomitants, or the consequences of the process in question is not fully determined; but that carbolic acid restricts *suppuration* and neutralizes the foul *smells* which accompany fermentation and gangrene, as well as those extricated during all forms of *putrefaction*, including the effluvia of dissecting-rooms, privies, sewers, drains, etc., has become a matter of familiar experience. But there is no reason to believe that carbolic-acid vapor has any power to destroy the contagia of communicable diseases. It temporarily may suspend their action, but does not destroy their source. Its strong smell imposes upon the vulgar, who have most faith in what appeals most directly to the senses. Its influence in promoting the cicatrization of *wounds* is readily understood without the necessity of invoking its antiseptic qualities, for, like many allied substances (alcohol, creasote, terebinthinates), it operates as a stimulant of the parts to which it is applied, contracting and hardening them, while it protects them from the action of the atmosphere, and thereby limits those secretions which tend to prevent union in wounds, while it favors the natural processes through which alone healing can take place. On the theory that they act antiseptically, carbolic-acid dressings have been very extensively used in this country and in Europe, but most of all in Great Britain under the influence of Prof. Lister. The general result is that accidental or surgical wounds treated by carbolic-acid dressings, *with a complete exclusion of the air*, are healed with much less fever and suffering and in a shorter time than by any other method. These benefits are very conspicuous in the treatment of wounded or diseased joints and compound fractures, of chronic abscess, and incisions made for the ligation of arteries. The modes of employing the method it would be foreign to the purpose of this work to describe; suffice it to say that as little as possible of the acid should be applied to the affected tissues, but a liberal proportion to the dressings. In this manner the risks of poisoning are diminished. That result was met with five times in the course of four years by Küster,

and of these cases four were fatal. The same surgeon, examining the experience of others, found seven mild cases of carbolic-acid poisoning with one death, and thirteen severe cases with five deaths. Children are peculiarly liable to this danger. Ever since the first introduction of carbolic-acid dressings into surgery it has been assumed that they owed their advantages exclusively to the antiseptic virtues of the acid. But, as was intimated in the second edition of this work, and is repeated above, the exclusion of air is an essential part of all antiseptic dressings. It remained, then, to be determined whether or not the exclusion of air and of all mechanical hindrances to cicatrization formed an indispensable condition for the primary healing of wounds. In the antiseptic method, as originally practised by Mr. Lister, carbolic acid was not applied in spray, but only in lotions, injections, and the like, The observations and experiments of Trendelenburg, Von Bruns, and others led them to the disuse of the spray as unnecessary and disagreeable, but they still employed the acid to neutralize the poisons which, as they conceived, hinder the healing of wounds, occasion erysipelas, pyæmia, etc. Billroth, after sufficient trial, abandoned the acid as a surgical dressing. Experience seems to have shown that the absolute cleanliness of every person and thing concerned in an operation or dressing is, next to a perfect coaptation of the divided tissues, the essential condition of their healing; and that with this precaution carbolic acid, like the sympathetic powder, would cure a wound if applied upon the weapon that inflicted it almost as perfectly as if it were irrigated or sprayed upon the wound itself, This anticipation, made in 1884, was realized in 1886, when Lister abandoned carbolic-acid dressings. Later on, it was condemned by Edington, Terrier and others. Carbolized oil is not as apt as carbolic acid diluted with water to occasion symptoms of poisoning.

Carbolized spray, and also lotions, have been found useful to stimulate indolent and atonic *ulcers*. Their combined antiseptic and stimulant properties are serviceable in many cases of *gangrene*, both traumatic and spontaneous, as in *noma pudendi*, *gangrene of the lung*, and in those cases of fetid discharge from the lungs which are sometimes so distressing in *phthisis* and *chronic bronchitis*. In the last-named affections it also tends to lessen the secretion of mucus and pus, and is best employed in the form of an atomized spray. In tubercular phthisis it is often of service by preventing vomiting. It is unnecessary to say that it has no influence upon the tubercular element of the disease; but it does modify very greatly the ulcerative lesions of the lungs and bronchia, just as it does wounds and ulcers upon the skin, and just as the same effect is produced by various other stimulants, including benzoin, creasote, naphtha, oil of turpentine, etc. Years ago the emanations of illuminating gas manufactories were supposed to cure *whooping cough*, and carbolic acid has been applied, in imitation of that treatment, by inhalation. Some have used the atmosphere of a room impregnated with carbolic acid evaporated from extended cloths, others an atomized solution of from 1 to 2 per cent. strength (Pick; Goldschmidt; Suckling). The latter was applied three times a day, and seems to have promptly diminished the number of paroxysms and shortened the duration of the attack. Suckling used glycerin of carbolic acid internally, half a minim in peppermint-water, for a child a year old (*British Med. Jour.*, July 24, 1886); and extraordinary success was claimed by Ley for the subcutaneous injection of pure carbolic acid as the surest palliative of the pulmonary disorganization and the general symptoms (*Bull. de Thérap.*, cxii. 253). It is probable that the acid can palliate whooping cough only when applied directly to the larynx. In *diphtheria* the inhalation of a 1 or 2 per cent. solution of the acid has been alleged to dissolve the false membrane (Seiffert); and others have applied with a brush a mixture of equal parts of carbolic acid and glycerin, and limited its caustic action with iodoform (Garnett). Others, again, have employed injections of carbolate of sodium in the intervals of applying a caustic solution of carbolic acid, but the latter only in adults. Carbolized camphor has been used in the same manner with like results (Peraté). Stumpf used a 5 per cent. atomized solution of carbolic acid for the space of ten minutes every two hours, and claimed great success from this treatment (*Centralbl. f. Therapie*, iii. 324). These methods may be of service as local palliatives, but diphtheria is not a merely local disease. The treatment of surgical *erysipelas* with hypodermic injections of a 3 per cent. solution of carbolic acid was practised by Hueter in 1878. The punctures were made at intervals upon the edge of the inflammation. Rothe used a liniment containing, besides carbolic acid, oil of turpentine and tincture of iodine, so that the share of the acid in the result cannot be estimated. Tassi applied a "saturated solution" of the acid; and Radcliffe, 1 part of the acid to 16 of olive oil as a liniment in an aggravated case of erysipelas of a lower extremity, with immediate relief and rapid amendment (*Philad. Med. Times*, April, 1881, p. 455; *Med*

News, lv. 41; *Centralbl. f. Ther.*, vii. 295; *Therap. Monatsheft*, iii. 473). The results in some of the reports referred to seem to be out of harmony with general experience. Dr. Squibb found, from extensive experience in his laboratory, that a ½ to 1 per cent. solution applied by means of thin cloths, frequently renewed, will relieve the pain of *burns* within 10 minutes, prevent the suppuration of superficial burns, and moderate that of deeper ones (*Ephemeris*, i. 307). In a gargle it may be used to cure affections of the *throat* accompanied with a fetid secretion. Its antiseptic virtues are displayed in fermentative or flatulent *dyspepsia*, although they are inferior to those of sulphurous acid and of salicylic acid. This use of the acid is identical with that of creasote, which was many years ago in vogue to combat acidity, flatulence, and other effects of gastric fermentation. Claims have been made for the speedy and perfect cure of acute *dysentery* by means of enemas containing 1 part of carbolic acid to 500 of water. But they have not been substantiated. Doubtless this agent, like so many other stimulants and astringents, may aid in healing the rectal ulcers. It is said to be an efficient remedy for *ascarides* of the rectum when administered by enema and sufficiently diluted to prevent excessive irritation: 6 ounces of the one-fortieth or one-sixtieth solution have been used for adults, but it is apt to occasion unpleasant symptoms. The medicine has been given by the mouth with alleged success for the expulsion of *lumbricoid worms*, and is reported to have destroyed *tænia* when administered in the dose of 6 grains in half a pint of water four times a day (Bill), or of 2 grains in pill every three hours until four doses were taken (Brown), or of 2½ grains in half an ounce of water three times a day (Maxwell). The method does not seem to have proved acceptable. The corrugating and more or less caustic and yet anæsthetic operation of the acid has been employed in the treatment of *polypi*, *venereal vegetations*, *nævi*, *boils*, *carbuncles*, *whitlows*, *uterine ulcers*, etc. The injection of swollen and inflamed *hæmorrhoids* with a strong solution of carbolic acid was practised in England about 1860 by Mr. Turner. He stated that it coagulated their contents, and permitted them to be squeezed out after incision of the piles. The method, however, fell into disuse for a time, was revived by quacks, and adopted anew by surgeons. It has been denounced as very painful and liable to cause peritonitis, pyæmia, or hepatic embolism. Larger experience, restricting the operation to external piles, a due selection of cases, and especially variations in the strength of the solution used, are said to have overcome its greatest dangers, which are most apt to arise in injecting soft hæmorrhoidal tumors. (Compare Kinney, *Therap. Gaz.*, viii. 352; Kelsey, *Am. Jour., Med. Sci.*, Aug. 1885, p. 170; Shuford, *Med. Record*, xxxi. 711). It is said that more recently (1891) the operation has been practically abandoned.

Varicose veins, particularly of the lower extremities, have been treated by the careful injection of small quantities of the pure acid after arresting the superficial venous circulation by means of Esmarch's bandage, which is allowed to remain applied for fifteen minutes after the puncture of the veins, and then very gradually loosened. A number of punctures into the vein are made about an inch and a half apart, and the patient is kept at rest for a week (Stevenson, *Lancet*, Oct. 1886). The treatment of boils by the injection of this acid was practised by Cliborn, Surgeon U. S. A., in 1868, and by Bidder in 1875. He employed a 2 per cent. solution, and proposed the same method of treating *carbuncles* (*Annuaire de Thérap.*, 1889, p. 3) as had previously been done by Eade in 1869 (Sansom, *The Antiseptic System*, p. 272). Richardson used this method for the latter affection (*Med. Record*, xxxii. 188), and Chappell applied the pure acid by means of a dropping-glass to the apertures found on the surface of the swelling (*ibid.*, xxxiii. 634). But a still more superficial application has answered the same purpose. Verneuil found the prolonged and repeated use of a 2 per cent. spray arrested the development of *boils* and *carbuncles* of all sizes and in every stage, and rendered surgical interference unnecessary, while it subdued the pain and fever, disinfected the sore if any existed, and promoted its cicatrization (*Annuaire de Thérap.*, 1888, p. 61). Blanc reported a case confirming these statements (*Lancet*, June 9, 1888); but a simple lotion will sometimes be found sufficient (*Med. Record*, xxxiii. 520.) (Compare *Annuaire de Thérap*, 1889, p. 327; *Therap. Monatsheft*, Nov. 1889, p. 527). The strength of the lotion or injection should be from 5 per cent. to 10 per cent. Haven treated a large number of cases of *goitre*, all of which were materially benefited, by the injection of 20 or 30 minims of a 5 per cent. solution of the acid into the substance of the gland (*Therap. Gaz.*, x. 844). Collins gave to pure carbolic acid a preference over nitrate of silver and sulphate of copper in *granular ophthalmia* (*Med. News*, i. 373). In *hydrocele* concentrated carbolic acid has been injected into the cavity (Levis), and the cure is represented to have been painless as well as radical (Weber, *Med. Record*, xxviii. 649). On the other hand, severe

inflammation, sloughing, and non-success have been known to follow it. For *sore nipples* a 5 per cent. solution of the acid, applied by means of a fine brush to the fissures, has proved very efficient. According to Schwimmer, a paste composed of carbolic acid 4 to 10 parts, olive oil 40 parts, finely-powdered prepared chalk 60 parts, applied to the face on a linen mask, causes the pustules of small-pox to dry some days earlier than usual. A lotion of carbolic acid is convenient to lessen the discharge and correct the fetor of *otorrhœa*. The same may be used to relieve *earache*, or preferably a 4 to 10 per cent. solution of the acid in glycerin. The analgesic action of carbolic acid has been usefully applied in small *surgical operations* by McNeill, who found that a solution of 60 per cent. in olive oil, or of 80 per cent. in glycerin, was efficient. The oily solution caused a less sense of heat and corrosion than that in glycerin (*Edinb. Med. Jour.*, xxxi. 1115). *Ophthalmia neonatorum* and other forms of *conjunctivitis* have been favorably influenced by this preparation, which has been applied by some in a solution of 1 : 500, and by others of the strength of 1 : 20. In either case a very frequent application is required. *Freckles*, it is said, have been removed by a slight coating of the pure acid after the skin has been thoroughly washed and dried. There is reason for admitting the efficacy of a solution of 1 part of carbolic acid in 3 or 4 of alcohol in curing recent *acne rosacea*. That most obstinate of cutaneous affections, *prurigo*, is said to have been cured in some instances by carbolic acid (Geber), but as arsenic was given internally at the same time, the conclusion is not certain. The acid is, however, very efficient in allaying the itching of this affection when applied in a 2 per cent. solution, atomized or in lotion (Lailler). A mixture of 1 part of carbolic acid and 2 or 3 of glycerin has been advantageously applied several times a day by means of a mop to the crusts in *ringworm of the scalp* (A. Smith). Pure carbolic acid applied to *warts*, while the surrounding skin is adequately protected, gives no pain and causes the warts to shrivel and fall off, and is one of the best applications that can be made to *bunions*. The cure of alarming symptoms produced by the *sting of a bee* has been attributed to the hypodermic injection of 5 milligrams of this acid in solution (Klamann). A weak solution of the acid forms a suitable lotion for diphtherial and other forms of *sore throat* attended with fetid discharges. Like creasote, it is an efficient palliative for *toothache* due to an exposed nerve-pulp. Idiopathic *sciatica* and some other neuralgic and rheumatic pains are said by Schrumpf to have been cured by deep injections of from 1 to 3 per cent. solutions of this acid (*Med. News*, xlii. 386). It is known that similar injections of pure water, and also acupuncture, have been followed by a like result. Kurz used this method for muscular *rheumatism* (*Med. Record*, xxiii. 208), but, we must believe, without necessity, considering the many simpler ways in which the affection may be cured.

The power of the acid to check fermentation has led to its use in the treatment of *saccharine diabetes*, on the supposition that the disease is due to an increase of the ferment, which in the liver converts amyloid substance into sugar. The suggestion does not appear to have led to any confirmation of its value. Like creasote, which it so closely resembles, carbolic acid may be used to prevent *vomiting* in cholera, in pregnancy, and in all cases which do not involve inflammation of the stomach.

The *dose* of carbolic acid is Gm. 0.06–0.13 (1 or 2 grains or drops). An atomized inhalation may be used, consisting of Gm. 0.10–0.20 (2 or 3 drops) of the acid in Gm. 32 (an ounce) of water, to which a little glycerin has been added. For a gargle, Gm. 0.60–0.120 (about 20 drops), of the acid in from 2 to 4 fluidounces of water and glycerin may be employed. In the following solution the odor of the carbolic acid is masked: Carbolic acid, 1 part; oil of lemon, 3 parts; alcohol, 100 parts. Carbolized cotton is used as a surgical dressing.

Carbolic-acid water (*U. S. P.* 1870) was intended to furnish a perfect solution of carbolic acid of determinate strength. One pint of it contained about 2 fluidrachms of the acid, and it was given internally in the dose of Gm. 2–4 (from $\frac{1}{2}$ a fluidrachm to 1 fluidrachm). It is a convenient preparation for use in atomization, as a gargle, and as a wash in various cutaneous diseases.

Cresylic acid has been used successfully to mitigate the paroxysms of *whooping cough*, when its vapors were diffused through the chambers occupied by the patients (Merritt, *Med. Record*, xvi. 549). It is merely a palliative, and almost identical with carbolic acid in its action. Delplanque found it more antiseptic than carbolic acid (*Bull. de Thérap.*, cxv. 124).

Oxynaphtoic acid and its sodium salts are said to be more active than carbolic or salicylic preparations in preventing or arresting putrefaction and as an antizymotic. Solutions containing from $\frac{1}{2}$ to 1 per cent. of the acid do not derange the digestion. It passes

into the urine unchanged. The acid given internally to rabbits, dogs, and sheep in doses of Gm. 0.5–3, and the salt in doses of Gm. 1–4, caused death, with inflammation of the mouth and gastro-intestinal canal, and congestion of the solid organs. Externally applied it did not affect the skin. It has cured some cases of *scabies* (*Centralbl. f. d. g. Therap.*, vi. 250), and some other skin diseases, and is said to be strongly antiseptic. In solution of 1 to 100 with phosphate of sodium it has been used for vaginal injections.

Chlorphenol does not appear to possess any other virtues than belong to carbolic acid. It has been used for similar purposes.

Creolin's claims are similar to the above and no stronger.

Lysol as an antiseptic is held to be superior to creolin and to carbolic acid, and less irritating and poisonous. It has been used in the treatment of *gonorrhœa* and other mucous profluvia, including *dysentery*, *cholera morbus*, *leucorrhœa*, *rhinorrhœa*, etc., and for deodorizing and disinfecting surgical instruments, the articles in sick-rooms, etc. For internal use a solution of $\frac{1}{2}$ of 1 per cent. has been employed, and externally a 1 per cent. solution.

Phenosalyl is alleged to be more highly antiseptic than carbolic or salicylic acid.

Saprol is credited with a high degree of antiseptic power, even when applied in a 1 per cent. solution.

Solutol is a powerful disinfectant, but its caustic properties forbid its being applied to living persons. It is said to be "effective in the preservation of the cadaver."

Solveol is destitute of causticity and the greasiness exhibited by creolin and lysol. It is peculiarly fitted for surgical uses, and antiseptic virtues superior to those of carbolic acid are attributed to it, a $\frac{1}{2}$ per cent. solution being more active than a 2 per cent. solution of carbolic acid (Squibb).

ACIDUM CARBONICUM.—Carbonic Acid.

Carbonic anhydride, *Carbon dioxide*, E.; *Acide carbonique*, Fr.; *Kohlensäure*, G.

Formula $CO_2 = OCO$. Molecular weight 43.89.

Formation and Preparation.—Carbonic acid gas, as it exists in certain mineral waters, was regarded by Libavius (1597) as a very volatile spirit. In the following century Van Helmont distinguished it and other irrespirable gases from atmospheric air as "spiritus sylvestris" or "gas sylvestre." In the beginning of the eighteenth century F. Hoffmann recognized the acid character of carbonic acid in mineral waters, and called it "spiritus mineralis." Joseph Black (1755) observed that this "fixed air" combines with alkalies and earths and increases their weight. Lavoisier (1775) proved this gas to be composed of carbon and oxygen.

Carbon dioxide gas is a regular constituent of the atmosphere, in which it is present to the extent of .04 or .05 per cent. by volume or about .06 per cent. by weight. In certain localities it issues from fissures in considerable quantity; it is a product of respiration of animal life and of alcoholic fermentation, exists in combination in many minerals, and is formed on the complete combustion of carbon or organic compounds in the presence of an excess of oxygen; diamond and graphite require a high heat for their combustion. Many organic compounds are readily oxidized at the ordinary temperature by chromic or permanganic acid, with the production of carbon dioxide. But the best sources for preparing carbon dioxide in a pure state are whiting, marble-dust, or similar native carbonates, which are decomposed by dilute sulphuric acid in an apparatus provided with a stirrer to prevent the calcium sulphate formed from enveloping the undecomposed carbonate. On a small scale, and for obtaining a uniform current of carbon dioxide gas, fragments of marble and diluted hydrochloric acid are used, whereby calcium chloride is formed, together with some water, and remains in solution. $CaCO_3 + 2HCl$ yields $CaCl_2 + H_2O + CO_2$. Should the gas possess a disagreeable odor, it may be deprived of it according to Stenhouse, by passing it over granular charcoal, or, according to Hager (1868), by conducting it successively through solutions of ferric sulphate, sodium carbonate, potassium permanganate, and water, by which treatment it is freed from hydrogen sulphide and hydrocarbons.

A cheap source of carbon dioxide is sodium bicarbonate, which yields about half its weight of the gas, and when decomposed by sulphuric acid gradually added will, in addition, produce 15 parts of crystallized sodium sulphate for every 4 parts of the bicarbonate used.

Properties.—Carbonic acid—or, more properly, carbon dioxide—is a colorless, uninflammable gas, which has a slight pungent odor and pricking acidulous taste, colors moist

litmus-paper transiently red, and does not support combustion. It is heavier than atmospheric air, its specific gravity at 0° C. being 1.524 as compared with atmospheric air, and 1 litre of it weighing 1.967 Gm. By pressure it is converted into a very mobile colorless liquid, which is lighter than water, and on the removal of the pressure boils rapidly, and is partly converted into white flakes of solid carbonic anhydride. It dissolves at 15° C. (59° F.) in an equal volume of water, and is more soluble in alcohol, absolute alcohol of 15° C. dissolving 3 volumes of the gas, which is partly expelled on dilution with water. It unites with most of the basic hydroxides, forming salts which, with the exception of the alkali carbonates, are insoluble in water, but dissolve to a slight extent in carbonic-acid water and are decomposed by all mineral and most organic acids. Carbonic acid is bibasic; all the acid carbonates (bicarbonates) are decomposed by heat, carbon dioxide being evolved.

Pharmaceutical Uses.—In pharmacy carbon dioxide is almost exclusively employed in the preparation of carbonic-acid water.

Aqua acidi carbonici, U. S. 1870; *Aqua acidula simplicior*, F. Cod.; *Aqua carbonica*, *Carbonic-acid water*, E.; *Eau gazeuse simple*, Fr.; *Kohlensäure-Wasser*, *Brausewasser*, G.

This water is very extensively prepared in the United States and sold under the names of *soda-water* and *mineral water*. Several apparatus have been constructed and patented for the convenient preparation of carbon dioxide and for charging the water with this gas under pressure. They consist of a generator, a strong copper vessel into which the powdered marble, whiting, or sodium bicarbonate is introduced with some water, and which connects with another copper vessel containing the sulphuric acid, which is admitted in small quantities. The gas is first passed through a vessel containing water to deprive it of impurities, and then to the bottom of the fountain, as the receiving vessel is called, containing the requisite quantity of water. The fountains are made either of cast iron, well protected on the inside by enamel, or of copper lined with block-tin; or stoneware fountains, secured by iron bands, are employed. The water, which is usually charged with from eight to ten times its volume of carbon dioxide, is drawn off through block-tin pipes, which pass through a chamber containing ice.

Carbonic-acid water has an agreeable acidulous and refreshing taste, and effervesces strongly. It produces white precipitates with lime- and baryta-water, and acts upon iron, lead, and copper, which metals are gradually dissolved; tin and silver are less affected; hence the importance of preventing the water from coming in contact with other metals except the last two mentioned. It should not be discolored by hydrogen sulphide or ammonia, and yields no precipitate with sodium sulphate or with potassium ferrocyanide.

Action and Uses.—The respiration of pure carbonic acid is impossible, since an exchange of gases, which is the essence of the respiratory act, can no more take place in this gas than it can in water, and death by asphyxia is the direct result. Sufficiently diluted with atmospheric air, carbonic acid gas is more or less respirable. In the proportion of one-half or more its inhalation causes a prickling in the nostrils and larynx more agreeable than otherwise, together with a sense of constriction and oppression in the chest, headache, giddiness, and ringing in the ears, followed by unconsciousness, dilatation of the pupils, sometimes congestion of the face, and, if relief be not at hand, fatal congestion of the brain. Even when the proportion of the gas is smaller, it causes more or less giddiness, constriction of the præcordia, and feebleness of the legs; the pulse, which at first is fuller and stronger, becomes feebler, the respiration is slow and shallow, and the mind and senses are more or less confused. In moderate or medicinal portions the primary action of the gas is sensibly stimulant, but secondarily it inclines to repose and sleep. In experiments on man no evidence has been given of the anæsthetic influence of the gas, and it is probably not developed until a state of dangerous narcotism is induced. Some cases of death are recorded from the emanations of certain fissures, like the Grotto del Cane. When the body except the head is immersed in a vessel of this gas, a sense of heat and prickling is experienced over the entire surface, but especially where the integument is delicate, and is accompanied with perspiration and redness. The pulse, according to some, is quickened, according to others it is retarded. If the operation is sustained for half an hour, the head throbs and the senses are dulled; the respiration is labored, and borborygmi and colic occur. When a limb is exposed for some time to the action of the gas, the sensibility of the skin is obtunded, and if the exposed surface is a wound, it becomes the seat of smarting pain, followed by impaired sensibility, but the tissues grow redder. Brown-Séquard has shown that in animals the sensibility and reflex excitability of the larnyx can be completely obtunded by this gas. Water impregnated with it causes a prickling sensation in the mouth, fauces, and nostrils, a sense of warmth in the stomach, and a transient cerebral excitement. It also appears to quench thirst far better than water alone. The gas liberated in the stomach is mainly discharged by eructation, but it seems to stimulate the gastric

secretions and promote digestion. Habitually used, carbonated water becomes laxative. It also increases the urine, and is said to augument the oxalates and carbonates in that secretion.

The administration of carbonic acid gas by inhalation was at one time in vogue as a remedy for pulmonary *phthisis*, *chronic bronchitis*, and *laryngeal diseases*. Many leading English physicians vouched for its efficacy, and very possibly it may have palliated the the cough and lessened the secretions in these affections; but much more efficient remedies supplanted it. In 1886, Bergeon claimed that a current of carbonic acid gas passed through sulphurous mineral water and conveyed into the rectum twice in 24 hours suppressed all the active symptoms of *pulmonary* phthisis (*Archives gén.*, Sept. 1886, p. 375); but the treatment found a very limited acceptance, and the evidence in its favor is very slight (Oliven, *Ther. Monatsh.*, iii. 100). Inhalations of carbonic acid alone have been used with advantage as a palliative of the cough and oppression of advanced and laryngeal phthisis (Weill, *Annuaire de Thérap.*, 1888, p. 193). Its anæsthetic action has also been used advantageously for the relief of *whooping cough* (Campardon). One of the most useful internal applications of this gas is to allay *vomiting* caused by irritability of the stomach, and even the persistent vomiting of *pregnancy* (*Med. Record*, xxxiv. 175). It often subdues this symptom promptly when given in the effervescing draught, in plain carbonated water, in champagne wine, or in still and dry white wines mixed with such water. The liquid should always be cold, and, if possible, iced. Several cases of *intestinal obstruction*, the precise nature of which does not appear, have been relieved by allowing carbonic acid water to escape from a siphon bottle through a long tube into the bowel. In one case relief was obtained by injecting successively the two ingredients of a "soda powder" in solution, and in another by allowing the contents of a "siphon-bottle" of carbonated water to escape into the bowel (*Med. News*, xl. 597).

The most important uses of carbonic acid are those in which it is applied in water as a local stimulant. There can be no doubt that in its combined stimulant and anæsthetic properties reside the virtues which have long been recognized in the yeast poultice and other fermenting cataplasms applied to *ulcers*, simple, cancerous, etc. Injections of carbonated water were advised by Percival a century ago for the relief of *cancer* of the uterus, rectum, and other parts; and a similar result has been recently obtained by maintaining a current of the gas in contact with the uterus in ulcerated states of that organ, and also in certain cases of uterine *leucorrhœa*, *dysmenorrhœa*, *amenorrhœa*, etc. It is said to give instant relief to the pain of recent *burns* (*Amer. Jour. Phar.*, lix. 401), and to the pain of muscular *rheumatism*. The carbonic acid gas douche has also been successfully employed to induce *premature labor*. Whether it be owing to a stimulant action or to a slightly anæsthetic influence, carbonic acid water certainly aids in causing the stomach to retain what it might otherwise reject, as is shown in the familiar and popular habit of using it as a vehicle for magnesia and various saline medicines, and in febrile and other diseases attended with *nausea* or *vomiting*. It possibly promotes the diaphoretic action of the effervescing draught, and is perhaps more diuretic than simple water. Taken with the food, it forms one of the most efficient remedies for *flatulence*.

The treatment of poisoning by this gas consists in measures adapted to expel it from the lungs, to stimulate the nervous system, and to introduce atmospheric air or oxygen in its place. For the first purpose artificial respiration by mechanical and electrical means is indicated; for the second, active stimulation of the skin mechanically by warmth and by irritants, and the injection of a strong infusion of coffee into the rectum; if any oxygen gas can be procured, it may be forced through a larnygeal tube into the lungs.

ACIDUM CHROMICUM, *U. S., Br., P. G.*—Chromic Acid.

Chromium trioxide, *Chromic anhydride*, E.; *Acide chromique*, Fr.; *Chromsäure*, G.; *Anidride cromica*, F. It.; *Acido cromico*, It., Sp.

Formula CrO_3. Molecular weight 99.88.

Preparation.—This acid was discovered by Vauquelin in 1797, but its chemical composition was determined by Berzelius.

When a solution of potassium dichromate is acted upon by sulphuric acid, chromium trioxide is set free, as shown by the following equation: $K_2Cr_2O_7 + 2H_2SO_4 = 2CrO_3 + 2KHSO_4 + H_2O$; this is due to the fact that chromic acid proper (H_2CrO_4) cannot exist in a free state. When prepared by the ordinary methods, chromic acid is usually contaminated with sulphuric acid and potassium salts, the former rendering it very

hygroscopic. Inasmuch as the U. S. and Germ. Ph. demand chromic acid free from sulphuric acid, it is likely that the following plan, first suggested by Bunsen (1868), is now more generally used: To a solution of 2 parts of potassium dichromate in 20 parts of water are added 10 parts of sulphuric acid, and the mixture set aside for twenty-four hours; the crystals are then collected upon a filter of asbestos or pumice-stone in a cylindrical vessel, and are washed, under an air-pump, with strong nitric acid, which must be free from lower oxides, until free from sulphuric acid. Finally, the crystals, free from all impurities, are dried in a current of air heated to 80° C. The Br. Ph. directs that chromic acid shall be made by adding 42 fluidounces of sulphuric acid to a solution of 30 ounces of potassium dichromate in 50 fluidounces of water; after twelve hours the crystals of acid potassium sulphate are to be removed, and after heating the liquid to 85° C. (185° F.), 15 fluidounces more of sulphuric acid are to be added, together with sufficient water to redissolve any crystals of chromic acid that may have formed. The mixture is allowed to cool; the crystals now forming are collected, drained, and dried on porous tiles at a temperature not exceeding 37.8° C. (100° F.) in an air-bath. The acid obtained by this process is never free from sulphuric acid, and hence is very deliquescent.

The use of a large excess of sulphuric acid in all the processes is for the double purpose of decomposition and final dehydration of the crystals.

Properties.—Chromic acid occurs in needles or quadrangular prisms of a deep crimson-red or purplish-red color, inodorous, deliquescent in moist air only if pure, and very soluble in water; the concentrated solution is of a red-brown color, which changes to orange-yellow on being diluted; the dilute solution reddens blue litmus-paper and bleaches it on drying. Gradually heated, the crystals assume a blackish-brown color, and at a temperature of 192° C. (377.6° F.) fuse into a reddish-brown liquid, which on cooling becomes a dark-red, opaque, brittle mass. At about 250° C. (482° F.) the acid is decomposed into oxygen and dark-green chromic oxide. If strong alcohol is dropped upon the acid, a vigorous action takes place, accompanied with increase of temperature and ignition of the alcohol. A rapid ignition is likewise observed with benzene; but ether which is free from both alcohol and water dissolves this compound, and on spontaneous evaporation yields it again in minute crystals. Chromic acid dissolved in diluted alcohol is gradually deoxidized at the ordinary temperature, the alcohol being converted into aldehyde and acetic acid. Reduction takes place also in the presence of arsenous and sulphurous acids, hydrogen sulphide, and of organic compounds and deoxidizing agents generally. When heated with hydrochloric acid, chlorine and green chromic chloride are produced.

Chromic acid contains no water of crystallization; its salts have mostly a yellow or yellowish-red color; those of the alkalies and of magnesium are soluble in water; all others dissolve in nitric acid.

Tests.—Sulphuric acid and potassium salts are usually present in small quantity in the commercial article. The former is detected by adding to its hot aqueous solution some hydrochloric acid, deoxidizing with alcohol until the liquid becomes green, and then adding barium chloride, when a white precipitate will be produced; the latter, by concentrating the green solution as much as possible, and adding a concentrated solution of tartaric acid, when crystalline potassium bitartrate will be separated; or the chromic acid is by ignition converted into chromic oxide, and this is treated with water, which will dissolve potassium sulphate and chromate if present. The Pharmacopœia directs testing for sulphuric acid by barium chloride in a 1 per cent. solution of chromic acid acidulated with hydrochloric acid, when no turbidity should be produced.

Allied Acid.—ACIDUM OSMICUM S. PEROSMICUM; Osmic acid, osmicum tetroxide, OsO_4; molecular weight 254.14. It is obtained when very finely divided metallic osmium is heated to about 400° C. (752° F.) in a current of air or oxygen, the volatile tetroxide being caught in well-cooled receivers. The sublimed oxide occurs in lustrous, transparent yellow acicular crystals, very hygroscopic, and with an unbearable penetrating odor (the vapor is poisonous). Its boiling-point is about 100° C. (212° F.), and it forms with water a colorless solution which has an intensely acrid and burning taste, and upon addition of sulphurous acid is colored yellow, then red, green, and finally blue. Osmic acid liberates iodine from iodides, is reduced from its solution by silver and other metals, and oxidizes organic compounds. It has been employed internally in doses of 0.001 Gm. ($\frac{1}{65}$ grain), and subcutaneously in form of a 1 per cent. solution (which should be freshly prepared) in cases of neuralgia, goitre, cancroid and scrofulous ulcers, and also epilepsy.

See also POTASSIUM OSMATE.

Pharmaceutical Uses.—In prescription chromic acid should never be combined with organic or deoxidizing mineral compounds. It should never be weighed on paper, but always on watch-

crystals or in weighing-tubes. In liquid form it should be dissolved in distilled water. The *solution* of the French Codex is made of equal parts of chromic acid and distilled water, and has a specific gravity of 1.47.

Liquor acidi chromici, *Br.*—Chromic acid 1 part; distilled water 3 fluid parts. Spec. grav. 1.185.

Action and Uses.—Chromic acid is one of the most energetic of caustics. At a moderately high temperature it rapidly dissolves all animal tissues immersed in it, including even hair, bones, and teeth. When at ordinary temperatures it is applied to the skin, it renders that tissue moist, and then brown, and finally black, forming an eschar of 1 or 2 lines in thickness, which separates within forty-eight hours, leaving a granulating surface which tends to heal rapidly. According to the degree of its concentration it may be deeply or superficially caustic or merely astringent and drying. When pure it is said not to be severely painful, but it becomes so when it is contaminated with sulphuric acid or arsenic. Among caustics none is superior or even equal to chromic acid for the purpose of removing certain excrescences from the skin and the mucous membranes. *Condylomata*, *warty* growths, especially such as occupy a considerable surface, *vegetations* of the genital (and especially of the female genital) organs, and also *papillomata*, *lupi*, *carcinomata*, *malignant ulcers*, *telangiectases*, and *cysts*, are promptly destroyed by a solution of 1 part of it to 1 of water, or with the pure acid, and with far less pain than is inflicted by caustic potassa. Chromic acid is one of the best applications that can be made to the *gums* when they tend to ulceration and retraction in scrofulous patients and after mercurial salivation, as well as to scrofulous and syphilitic ulcers of the *pharynx* and the mouth. It is used to reduce obstructions in the upper and posterior portions of the *nasal passages*. The end of a probe is loosely wound with raw cotton containing small fragments of the acid, and is introduced into the nasal cavity, whose moisture dissolves the acid and renders it caustic. To prevent the detachment of the cotton and acid from the probe, it is, after adjustment, heated in the flame of a lamp, which chars the cotton and melts the acid. The previous application of a solution of cocaine in a great degree prevents pain. Any excess of acid in the nostrils is washed away with water; and if it seems to have reached the pharynx or stomach, it is neutralized with a weak solution of sodium bicarbonate. The caustic produces an eschar followed by a superficial ulcer. This method is adapted to chronic hypertrophic *rhinitis*, adenoid *vegetations* in the *naso-pharynx*, and chronic hypertrophic *pharyngitis*. It has been employed in the treatment even of the *coryza* of *influenza*, but the method seems superfluous and needlessly harsh. Similar affections of the interior of the *larynx*, œdema of this organ, and especially tumors of the vocal cords and adjacent parts, have been cured by skilful cauterization with chromic acid, aided by the laryngoscope. A mild solution may at first be used, but subsequently one containing 1 part of the acid to 8 of water, or even of twice that strength, may be applied by means of a small, fine, and compact piece of sponge. The solution of 10 grains of chromic acid in an ounce of water, recommended by Paget for ulceration of the *tongue*, has been similarly applied, and with striking success, to secondary syphilitic affections of the organ (ulcers, mucous tubercles, condylomata), but fails in the tertiary lesions. Various chronic affections of the skin, as *tineæ*, *sycosis*, and *lupus*, are appropriate for its use. A 5–10 per cent. solution of the acid has been used to check *hyperhidrosis*, or excessive *sweating*, of the feet, but it sometimes occasions prickling, numbness, and dryness of the part, and, if the skin is tender, blisters or even ulcers (*Therap. Monatshefte*, iii. 344), besides the risk of poisonous effects. Its prompt and powerful action renders it one of the best applications for arresting surface *hæmorrhage*, and in a diluted state it is a valuable stimulant for indolent *ulcers*. Syphilitic and even tuberculous ulcers of the *pharynx* have been treated in this manner; and so has granular inflammation of this part, and *conjunctivitis* of a similar character. Uterine *hæmorrhage*, depending upon laxity of the tissues of the organ, has been arrested by the insufflation of a few drops of the acid. In the treatment of *uterine leucorrhœa* no other caustic is more efficient than this; but it should be introduced very cautiously by means of a syringe having a lateral opening near the end of its tube, and the superfluous liquid should be removed when the syringe is withdrawn. Previous dilatation of the neck of the uterus facilitates the operation and the cure. If the acid is too strong, it may give rise to permanent stricture of the canal of the cervix. This tendency to contraction of the tissues to which it is applied has sometimes been taken advantage of to relieve *incontinence of urine* in the female due to relaxation of the urethra. When this infirmity is connected with *irritable tumor* of the urethra, the acid will sometimes prevent the necessity of employing cutting instruments. In applying

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this powerful caustic in a concentrated state—the deliquescent crystals, for instance—great care should be taken to protect the adjacent sound tissues by means of adhesive plaster or a simple ointment, and all superfluous acid should be immediately removed with a pledget of moist lint. The pure acid should be applied by means of a wooden, glass, or porcelain rod or spatula. Diluted solutions may be used with a camel's-hair brush, which immediately afterward should be well washed with water. Chromic acid ought not be dissolved in glycerin, for if the mixture be made rapidly ignition occurs with explosion. *Poisoning* by the internal use of the acid should be treated by a solution of bicarbonate or borate of sodium and stimulant enemas.

Perosmic Acid.—Fraenkel's experiments on animals showed that perosmic acid was a solvent of all the soft tissues (*Berlin. Klin. Wochensch.*, 1884, No. 15). This action was proposed and employed by means of injections for the removal of *goitres* by Delbastaille, Szuman, Eulenberg, and others (*Centralb. f. Ther.*, ii. 273; *Ther. Gaz.*, v. 211), and by Winiwarter in the treatment of *sarcomatous* and other *tumors* (*Med. News*, xlii. 495), but it failed in the hands of Bruns (*Med. Record*, xxiv. 159). A similar method was used in the treatment of *neuralgia* (Neuber; Lipburger, *Centralb. f. Ther.*, ii. 97; Wölfler, *Wiener med. Wochensch.*, Dec. 14, 1884; Schapiro, *Lancet*, Aug. 1, 1885). Partial confirmation of preceding reports was furnished by Mohr, Redtenbacher, Porteous, and especially by Mercer and S. Solis-Cohen (*Therap. Gaz.*, ix. 64; *Edinb. Med. Jour.*, xxxi. 924; *Lancet*, Jan. 10, 1885; and *Med. News*, liv. 384). In 1886, Grinivitski claimed for it a remarkable power over muscular rheumatism (*lumbago*) (*Practitioner*, xli. 198). Wildermuth reported in 1884 that he successfully treated cases of *epilepsy* that had proved refractory to other medicines by the internal use of potassium perosmite in the dose of Gm. 0.001 (gr. $\frac{1}{60}$) (*Centralb. f. Ther.*, ii. 353), but his reports have not been confirmed. Perosmic acid has generally been administered subcutaneously in the dose of 3 to 5 drops of a 1 per cent. solution.

ACIDUM CITRICUM, *U. S.*, *Br.*, *P. G.*—Citric Acid.

Acidum citri s. limonum s. limonorum—*Acide citrique*, *Acide du citron*, Fr.; *Citronensäure*, G.; *Acido citrico*, F. It., Sp.

Formula $H_3C_6H_5O_7.H_2O = C_3H_4(OH)(COOH)_3.H_2O$. Molecular weight 209.5.

Origin.—The acid properties of lemon-juice were observed at an early period, but the distinction of the acid from other vegetable acids was not recognized until Retzius (1776) proved it to differ both from tartaric and acetic acids. Scheele (1784) obtained citric acid in crystals. It was prepared artificially in 1880 by Grimaux and Adam from glycerin, and perhaps also by Andreoni and Kekulé from malic acid. Citric acid occurs in a large number of plants, either in the free state or combined with potassium or calcium, and frequently associated with malic acid. It has been found in the rhizomes of Asarum europæum and Sanguinaria canadensis, in the tubers of dahlia and Jerusalem artichoke, in the herb of lactuca and tobacco, and in many fruits, such as capsicums, tomatoes, tamarinds, cherries, gooseberries, raspberries, whortleberries, cranberries, blackberries, strawberries, etc. It occurs most abundantly, however, and as free acid, in the fruits of the Aurantiaceæ, and is prepared in large quantity from the juice of the lemon and the lime.

Preparation.—Citric acid is manufactured in this country and in England on a large scale from lemon- and lime-juice, which are obtained from Florida, the West Indies, and Italy. The juice is exported either in its natural condition or considerably concentrated by evaporation, or else in the form of a crystalline powder as calcium or magnesium citrate. The juice is clarified by ebullition, or, if obtained from unsound fruits, by allowing it to undergo the vinous fermentation. After decantation and straining an excess of chalk (calcium carbonate) is added, and finally some milk of lime. The calcium citrate thus formed being less soluble in hot than in cold water, the mixture is heated to boiling, and while hot the clear liquid is drawn off from the precipitated calcium citrate, which is washed with boiling water for the purpose of removing all the extractive matter. The calcium citrate is now decomposed by diluted sulphuric acid in such a proportion as to form calcium sulphate, and to leave a little sulphuric acid in excess: 10 parts of calcium citrate require about 9 parts of sulphuric acid diluted with from 50 to 60 parts of water. The solution of citric acid is drawn off from the precipitated calcium sulphate, and the latter washed with very cold or with boiling water, in which gypsum is less soluble than in water of a medium temperature. The liquid, with the washings, is evaporated by steam heat to a syrupy consistence, and then allowed to

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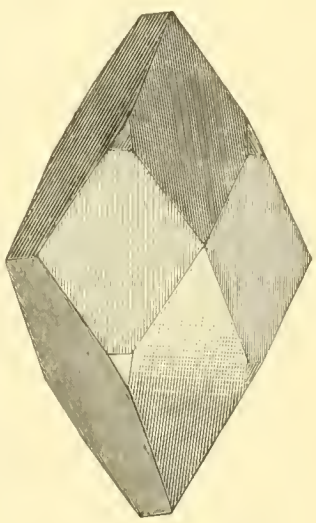
crystallize in suitable tanks lined with lead. The presence of a little sulphuric acid appears to favor crystallization, which is prevented or considerably retarded by acid calcium citrate. The crystals are redissolved in a small quantity of water, and the solution is treated with animal charcoal, and then evaporated to crystallize. These directions agree in the main with those given in the British Pharmacopœia. Citric acid may be prepared by this process from the juice of other acidulous fruits; Græger (1873) described the manipulations necessary to obtain it advantageously from whortleberries. The importations of citric acid amounted in 1867 to nearly 83,000 pounds, and at present average about 33,000 pounds annually.

Properties.—Citric acid crystallizes in colorless rhombic prisms which have an agreeable acid taste. The solubility is variously stated as follows: U. S. Ph., at 15° C. (59° F.), 1 part of acid in 0.63 parts of water, 1.61 parts of alcohol, and in 11 parts of ether; also soluble in 0.4 parts of boiling water and in 1.43 parts of boiling alcohol. Br. Ph., temp. not specified, but 15.5° C. (60° F.) generally understood, 1 part of acid soluble in 0.75 parts of water, less soluble in alcohol of 0.835 sp. grav., and insoluble in ether; also soluble in 0.50 parts of boiling water. Germ. Ph., at 15° C., 1 part of acid soluble in 0.54 parts of water, 1 part of alcohol, and in 50 parts of ether. It is also soluble in methylic and amylic alcohols and glycerin, and is freely soluble in hot creosote, but insoluble in chloroform and in hydrocarbons, except in the presence of alcohol. When a solution is made by dissolving 40 grains of the crystals in 1 ounce of water, it resembles lemon-juice in strength and in the nature of its acid properties, and, like lemon-juice, it undergoes decomposition, acetic acid being among the products, and becomes mouldy by keeping. The crystals are permanent in dry air, but at a somewhat elevated temperature slowly part with their water of crystallization, and in a damp atmosphere they become moist and gradually deliquesce. They melt at 100° C. (212° F.) in their water of crystallization; the anhydrous acid fuses between 135° and 152° C. (275° and 305.6° F.). When slowly ignited it is gradually decomposed without emitting the odor of burning sugar (difference from tartaric acid), and is finally consumed without leaving more than 0.05 per cent. of residue (U. S.).

Fig. 6.



Crystal of Citric Acid.

Citric acid is a tribasic acid, having the formula $H_3C_6H_5O_7$, or, as met with in the crystallized condition, $H_3C_6H_5O_7 + H_2O$. The water of crystallization, amounting to 8.6 per cent., is expelled at 135° C. (275° F.), and at 155° C. (311° F.) another molecule of water is given off, *aconitic acid*, $H_3C_6H_3O_6$, remaining behind, which is identical with the acids that have been isolated from aconite, yarrow, and other plants. Like citric acid, it forms three series of salts, either 1, 2, or 3 atoms of hydrogen being replaceable by a basylous radical.

The citrates of the alkalies are all soluble in water; the neutral citrates of the heavy metals are mostly insoluble in water, but dissolve in nitric, and many also in citric, acid. Ferric and aluminum citrates are not precipitated by alkalies. That the calcium citrate is soluble in cold and insoluble in hot water has been already mentioned. If lime-water is not completely neutralized by solution of citric acid, no precipitate will occur until the liquid is heated to boiling. 70 grains of citric acid dissolved in distilled water are neutralized by 1000 grain-measures of the volumetric solution of soda (*Br.*), or 3.5 Gm. of the acid by 50 Cc. of the soda solution (*U. S.*).

Impurities and Adulterations.—The impurities which may be present in citric acid in consequence of carelessness in its manufacture may be sulphuric acid, calcium, iron, lead, and copper. Minute fragments of metallic lead are occasionally observed adhering to some of the crystals. Sulphuric acid is readily detected in the aqueous solution of citric acid by the white precipitate occurring with barium chloride; iron, by the blue color occasioned by potassium ferrocyanide; and lead and copper, by the black coloration or precipitate resulting from hydrogen sulphide. For the detection of calcium it is advisable to neutralize the citric-acid solution with ammonia, then to acidulate with acetic acid, and add ammonium oxalate, when a white precipitate of calcium oxalate will appear. 5 Cc. of a 10 per cent. solution of the acid neutralized with ammonia should remain clear on the addition of 1 Cc. of ammonium oxalate test solution: and with 2 or 3 Cc. of hydrogen sulphide should not acquire more than a faintly brownish-yellow

solution, but should not deposit a colored precipitate (absence of *calcium*; limit of *metallic impurities* (*U. S.*). Mineral impurities may also be tested for in the ash after dissolving it in a little dilute nitric acid.

Tartaric acid is occasionally used as an adulteration, and oxalic acid and various crystallized salts are said to have been employed for the same purpose. Such frauds are usually accomplished by mixing the foreign compounds in a crystalline form with the acid, and it is therefore necessary to employ a larger quantity (say several ounces) of the large and small crystals, to be triturated in a mortar into powder. Many of the salts will be found to be insoluble in alcohol, and may thus be detected, or by the residue left on incinerating a portion of the powder upon platinum-foil. The aqueous solution of the powder is neutralized with ammonia, and then acidulated with acetic acid. Upon adding calcium chloride, oxalic acid, if present, will be precipitated as white calcium oxalate. The clear filtrate, neutralized with ammonia, will deposit in the cold white calcium tartrate if tartaric acid be present, and the filtrate from it will, on boiling, throw down calcium citrate. On dissolving some of the powder in diluted alcohol, and adding a concentrated solution of potassium acetate, tartaric acid will yield a white crystalline precipitate of potassium acid-tartrate. Oxalic acid, if present in sufficient quantity, will likewise cause a precipitate with this test. Or a number of crystals of different sizes are placed upon a glass plate in a little potassa solution, or preferably a strong solution of potassium acetate: the crystals of citric acid will remain transparent, while the crystals of tartaric acid will become opaque, in consequence of the formation of potassium acid-tartrate. Cailletet (1877) observed the slow action in the cold of potassium dichromate upon citric acid, and recommends testing for tartaric acid by adding 1 Gm. of the suspected acid in powder to 10 Cc. of a cold saturated solution of the dichromate, and stirring with a glass rod. Pure citric acid does not change the orange color of this solution in ten minutes; but in the presence of 1 per cent. of tartaric acid the mixture will have acquired, in the time mentioned, the color of infusion of coffee, and with 5 per cent. of tartaric acid it will have become blackish brown.

Preparations.—Pulvis ad limonadum. Triturate thoroughly white sugar 120 Gm., citric acid 10 Gm., oil of lemon 3 drops.—*A. D. A.*

Action and Uses.—In man citric acid does not diminish the coagulability of the blood; so far from this, indeed, in the form of lemon-juice it is of all agents the most efficient in correcting that incoagulability of the blood which is characteristic of scurvy. When largely administered it increases the acidity of the urine, causing a deposit of free uric acid. According to Langfeldt, 1 part of this acid in 2000 parts of water is sufficient to destroy all the animalculæ in the liquid that are not protected by a thick epithelial covering. Schaltz asserts that a solution of the acid, 1 : 1000, promptly kills vegetable organisms, and that meat immersed in a 5 per cent. solution underwent no change during five days (*Med. News* xlvi. 435). Citric acid used habitually is very apt to corrode the teeth. The most useful application of lemon-juice and citric acid is to prevent and cure *scurvy*, a purpose which long and extensive experience has proved them admirably fitted to fulfil. Of the two, lemon-juice is by far the most efficacious, and the opinion that its efficiency is not due to the acid alone is shown not only by this comparison, but also by the well-known fact that many fresh vegetables are endowed with a similar power. The use of lemon-juice in the treatment of acute articular *rheumatism* was at one time confidently relied on, but is no longer in vogue, and the article is employed only as means of assuaging the thirst and reducing the febrile heat in that disease, as well as in various other diseases of which *fever* is a prominent symptom. A physician has gone so far as to assert that if a fresh lemon is cut into pieces and boiled in 3 cups of water until reduced to one-third, the strained liquor will cure malarial affections as well as quinine, or still better (*Bull. de Thérap*, cv. 76). This statement has been confirmed by several reporters who appear to be unacquainted with the influence of the imagination upon periodical diseases. Citric acid may be used with some advantage during *hæmorrhage*, but its direct effect upon this symptom is slight, indeed, when compared with that of the mineral acids. The old practice of arresting post-partum hæmorrhage by squeezing out the juice of a cut lemon within the cavity of the uterus deserves attention, less from the coagulating action of the acid than from the stimulation exerted by it upon the interior of the womb, which is at the same time mechanically irritated. The injection of lemon-juice into the nostrils, after removing their contents, suffices sometimes to arrest *epistaxis*. Lemon-juice is of some advantage in *jaundice* depending upon congestion of the liver, and may be employed as an antidote to *alkaline and narcotic poisons*. It forms an agreeable application in *diphtheritic angina* and in *gangrenous sore mouth*, and has been used

with striking advantage to relieve *pruritus* of the genital organs. Hypodermic injections of a saturated solution of citric acid have been alleged to destroy *cancerous tumors.*

ACIDUM FORMICICUM, *P. G.*—Formic Acid.

Acidum formicarum s. formicum.—Acide formique, Fr.; *Ameisensäure*, G.

Formula $HCHO_2 = HCOOH$. Molecular weight 45.89.

Origin and Preparation.—In the beginning of the sixteenth century Otto Brunfels observed the acid reaction upon blue vegetable colors of the air in the nest of the wood-ant (Formica rufa, *Linné*). By distilling ants John Wray (1670) obtained an acid which Andrew Marggraf (1749) proved to differ from acetic acid. Scheele (1774) obtained the acid artificially from gum and sugar, but considered it to be acetic acid, a view disproved by Doebereiner (1822).

Formic acid is found in ants, in some caterpillars, old oil of turpentine, nettles and other plants, and is formed by the oxidation of methylic alcohol; by the action of black oxide of manganese and sulphuric acid or of chlorinated lime upon sugar, starch, and other carbohydrates and allied compounds; by the decomposition of chloral hydrate and of chloroform by means of potassa; and by other reactions. Lorin (1865) observed that in the presence of glycerin and a little water oxalic acid is readily decomposed into formic acid and carbonic acid gas; $C_2H_2O_4$ yields $CH_2O_2 + CO_2$. Berthelot prepares it by heating in a retort 10 parts each of oxalic acid and glycerin and 1 or 2 parts of water to a little over 100° C. (212° F.); the oxalic acid is preferably added in portions of 2 or 3 parts. After about 12 hours the decomposition is complete, and the contents of the retort are repeatedly diluted with 5 parts of water and distilled; the residue in the retort is preserved for a future operation, while the distillate is neutralized with sodium carbonate and evaporated to dryness by means of a water-bath; 100 parts of dry sodium formate require 75 to 76 parts of sulphuric acid for decomposition, which may be diluted with water according to the strength of formic acid desired; the latter is obtained by distillation.

Properties.—Anhydrous formic acid is a colorless liquid of 1.235 sp. gr., crystallizing below the freezing-point of water, boiling near 99° C. (210° F.), having a pungent acid odor, and producing a burning sensation when applied to the skin. Its vapor is inflammable and burns with a blue flame. The acid is soluble in all proportions of water, alcohol, and glycerin. According to Roscoe (1862), the boiling-point of aqueous formic acid gradually rises until the temperature 107.2° C. (225° F.) is reached, when the boiling-point remains constant and the distillate contains 77.5 per cent. of formic acid. Its salts impart to solutions of ferric salts a dark brownish-red color which disappears on the addition of hydrochloric acid. When heated with solutions of the salts of mercury, silver, gold, and allied metals, these are reduced to the metallic state.

The medicinal acid has the specific gravity 1.060 to 1.063, and yields with lead subacetate a white crystalline precipitate. 5 Cc. of it neutralize 28–29 Cc. of normal potassa solution, indicating 25 per cent. of absolute formic acid. Thus neutralized the acid has no pungent or empyreumatic odor (absence of acrolein). If diluted with 5 parts of water, it should not be precipitated by silver nitrate (hydrochloric acid), nor be colored by hydrogen sulphide (metals), nor, after neutralization with ammonia be precipitated by calcium chloride (oxalic acid). On heating for ten minutes 1 Cc. of the acid, 5 Cc. of water, and 1.5 Gm. of yellow mercuric oxide, the filtrate should have a neutral reaction (absence of other acids), *P. G.* The salts of formic acid can easily be prepared like the acetates by dissolving the respective carbonates in the acid, and also by mutual decomposition. The formates are all soluble in water, some quite readily, and a few also in alcohol; magnesium and lead formate, however, are insoluble in alcohol, differing in this respect from the respective acetates.

Preparations.—Spiritus formicarum, P. G. Mix alcohol 70 parts, water 26 parts, and formic acid 4 parts. It is a colorless liquid of an acid reaction, which, when mixed with one-twentieth of its weight of solution of subacetate of lead, becomes filled with feathery crystals.

Ammonii formas (formias), NH_4CHO_2, is obtained by neutralizing the acid with ammonia and evaporating to crystallization. It is in colorless prisms of a refreshing pungent taste, fuses at about 100° C. (212° F.), and when rapidly heated to 180° C. (356° F.) is decomposed into hydrocyanic acid and water; NH_4CHO_2 yields $HCN + 2H_2O$.

Action and Uses.—The experiments of Wolff show that formic acid is not an antiseptic, is only a feeble antifermentative, and is of no value as an antiputrid agent. Upon the skin it acts as an irritant and vesicant, and if its contact is prolonged it may produce a slough. In gouty patients it is reported to have caused a discharge of muddy and ill-

smelling urine. According to Arloing, small doses of *formiate of sodium* increase the number and depth of the respirations and render them irregular in the dog and horse. Large doses render the breathing rapid and shallow, and very large doses suspend it, the temperature meanwhile falling 2° or 3° C. Direct injection of a large dose of the salt into the right ventricle is followed by slower or suspended movements of the heart.

Formic acid was at one time used internally to stimulate, as ammonia is generally employed, and externally, like that irritant, for the relief of local *neuralgic* and *rheumatic* pains, etc. *Spiritus formicarum* (P. G.) is prescribed in doses of from Gm. 1.30–4.00 (20 to 60 drops). *Formiate of ammonia* has been used in chronic *paralysis* and in *epilepsy*, but uselessly. *Dose*, about Gm. 0.30 (gr. v).

Sodium formiate has been alleged, without substantial proof, to be curative of tuberculous affections.

ACIDUM GALLICUM, *U. S., Br.*—Gallic Acid.

Trioxybenzoic acid, Dioxysalicylic acid.—Acide gallique, Fr.; *Gallussäure*, G.; *Acido gallico*, It., Sp.

Formula $HC_7H_5O_5 + H_2O = C_6H_2(OH)_3.COOH + H_2O$. Molecular weight 187.55.

Origin.—Gallic acid is found in nutgalls, sumach, uva ursi, and in a number of other astringent plants. It was for a time confounded with tannin, but its distinction from this was recognized by Scheele (1785), who obtained it in a pure state. It is most advantageously prepared from galls by Scheele's process, as modified by Pelouze and Robiquet, for which the Pharmacopœia of 1870 gave the following directions:

Preparation.—Take of Nutgall in fine powder 36 troyounces; purified Animal Charcoal and Distilled Water, each a sufficient quantity. Mix the nutgall with sufficient distilled water to form a thin paste, and expose the mixture to the air, in a shallow glass or porcelain vessel, in a warm place for a month, occasionally stirring it with a glass rod, and adding from time to time sufficient distilled water to preserve the semifluid consistence. Then submit the paste to expression, and, rejecting the expressed liquid, boil the residue in 8 pints of distilled water for a few minutes, and filter, while hot, through purified animal charcoal. Set the liquid aside that crystals may form, and dry them on bibulous paper. If the crystals be not sufficiently free from color, they may be purified by dissolving them in boiling distilled water, filtering through a fresh portion of purified animal charcoal, and again crystallizing.

The Br. Ph. recommends the following process, which is based upon the observation of Liebig that tannin is converted into gallic acid by being boiled for some time with diluted sulphuric or hydrochloric acid, or for a few seconds with potassa solution: Boil 1 part of coarsely-powdered galls with 4 fluid parts of diluted sulphuric acid for half an hour; then strain through calico while hot; collect the crystals that are deposited on cooling, and purify these with animal charcoal and repeated crystallization.

The above directions are so clear that the preparation of gallic acid by them presents no difficulties, and the only additional precaution that deserves to be mentioned is the avoidance of its contact with iron and iron salts, which would impart to the acid a color difficult to remove. The conversion of the whole amount of tannin into gallic acid is readily proved by testing a small portion of the filtered liquid with solution of isinglass, which should cause no turbidity. The change takes place slowly at a low temperature; P. Weber (1880) found about 45° C. (113° F.) to be most suitable for the process given above. The yield must necessarily vary with the amount of tannin present in the galls.

Gallic acid has been obtained artificially by the action of alkalies upon diiodo-or dibromosalicylic acid (Lautemann, 1861), and upon bromdioxybenzoic or bromoprotocatechuic acid (Barth and Semhofer, 1872).

Formation.—The conversion of tannin into gallic acid has been the subject of much controversy, involving numerous researches. It was at first supposed that gallic acid existed ready formed in galls; the experiments of Pelouze (1833) proved that most of it is formed from the tannin contained therein, and this conversion he supposed to be due to the oxidizing influence of oxygen, by which carbon dioxide was eliminated. Robiquet (1837) found that the tannin of galls is converted into gallic acid without the admission of oxygen and without the evolution of gas. He ascribed this to the action of a ferment present in the galls, which was subsequently named *pectase*. Laroque's experiments (1841) supported this view. That the growth of mould upon the infusion of galls is without influence upon the production of gallic acid was proved by Winckler (1835). C. Wetherill (1847) advanced for the first time the opinion that gallic acid differs from

tannin merely by containing additional water, and he was supported in this theory by the investigations of Mulder (1848). Meanwhile, Liebig had suggested that in the transformation of tannin into gallic acid a carbohydrate was liberated; and Strecker's experiments (1854) appeared to furnish conclusive proof that tannin is a glucoside, which on being boiled with diluted mineral acids yields theoretically 82.5 per cent. of gallic acid. The quantity obtained was, however, in excess of this figure, and Stenhouse, Knop, Rochleder, and others proved that gallic acid almost equalling the weight of tannin used could be thus obtained. Robiquet (1854) considered this result due to molecular change accompanied by hydration, whereby tannin is transformed into gallic acid just as cane-sugar under similar influences is transformed into grape-sugar. This view, however, did not explain why, on the treatment of tannin with diluted acids, glucose was obtained in variable quantities. Hlasiwetz (1867) suggested that it probably was not a true glucoside, owing to the difficulty with which the glucose is obtained. The relation of the two compounds to each other appears to be finally settled by the researches of H. Schiff, Sac, and J. Löwe (1871 and 1872), according to which pure tannin is *digallic acid*, an anhydride of gallic acid, the conversion of the former into the latter occurring as follows: $C_{14}H_{10}O_9 + H_2O = 2C_7H_6O_5$; and the sugar observed in the preparation of gallic acid is referable to the glucose which naturally exists in galls, perhaps in combination with digallic acid, and from which tannin is with difficulty purified. Löwe prepared pure tannin from galls, and Schiff succeeded in converting gallic acid into tannin absolutely free from glucose.

Properties.—Gallic acid is in fine white or pale fawn-colored silky needles, which have a slightly acid and faint astringent taste, and are inodorous. It is soluble at 15° C. (59° F.) in 100 parts of water and in 5 parts of alcohol; in 3 parts of boiling water and 1 part of boiling alcohol. Also soluble in 40 parts of ether and in 12 parts of glycerin. Very slightly soluble in chloroform, benzene, and benzin. The solution has an acid reaction, and gives no precipitate with ferrous sulphate. With ferric salts a bluish-black precipitate is obtained, which is easily soluble in acetic acid, and disappears on boiling. It is not precipitated by solution of gelatin or albumen except in the presence of gum, and yields no insoluble compounds with vegetable alkaloids. Gallic acid dissolves permanently in a solution of potassium citrate to such an extent that, according to F. Long (1881), 15 grains of it, with 20 grains of the citrate, will yield a clear solution in 1 ounce of water. At 100° C. (212° F.) it loses 9.5 per cent. of water of crystallization. Heated to between 200° and 215° C. (392° and 419° F.), or, according to Schiff (1879), to about 240° C. (464° F.), it melts, and then yields carbon dioxide gas and a sublimate of pyrogallol = $C_6H_6O_3$, without leaving any residue.

Alkalies added to a solution of gallic acid rapidly color the liquid, which in the presence of very little potassa or soda gradually becomes green, but with an excess is at once yellow and turns red and brown; little ammonia causes a yellow, and an excess a reddish and red-brown, color. Alkaline carbonates produce similar colorations, but act less energetically; on the subsequent addition of hydrochloric acid the color is changed to red. Dudley (1879) observed that a dilute solution of ammonium picrate with excess of ammonia causes in solution of gallic acid a red color, rapidly changing to a beautiful green. Lime-water produces with gallic acid a flocculent precipitate, which turns rapidly blue and green, and is soluble in much lime-water with a pink color, and in excess of gallic acid with a brown color. Most of its salts, those with the alkalies excepted, are insoluble in water. When perfectly dry they keep unaltered, but in the presence of water, and particularly of alkaline liquids, they are speedily decomposed, becoming brown and black. Solutions of salts of silver, gold, platinum, and the allied metals are gradually reduced by gallic acid and its salts at the ordinary temperature.

Impurities and Adulterations.—Tannin is indicated in the aqueous solution of gallic acid by the white curdy precipitate produced on the addition of a solution of gelatin. Resinous substances would be insoluble in boiling water; sugar and dextrin would remain undissolved on treatment with spirit of ether; and mineral admixtures would remain behind upon heating the acid to redness.

Action and Uses.—Although gallic acid is not astringent in taste or in its application to raw or bleeding surfaces, it certainly exerts a powerful control over all forms of passive hæmorrhage when taken internally, as well as upon several of the secretions, and notably upon the urine and the sweat. Unlike tannic acid, it has no constipating effect upon the bowels. It is perhaps the first in value of the medicines used in *menorrhagia*. It should be given between the periods as well as during the flow, and in doses of from Gm. 0.60–1.30 (gr. x–xx) a day, in pilular form. Of similar affections in which it is useful may be mentioned *purpura*, *epistaxis*, *hæmoptysis*, *hæmatemesis*, *hæmaturia*, and

intestinal hæmorrhage. To the inordinate secretions which this acid tends to control belong *night-sweats* and other forms of profuse perspiration, and excessive flow of urine in *polyuria* and in *Bright's disease*. Its influence in the last-named affection is often very prompt and salutary, since it not only reduces the total discharge of urine, but in a still larger proportion the loss of albumen. It is very efficient in correcting *pyrosis*, an annoying symptom of various *dyspeptic* conditions. Locally, it has been used in an ointment for the treatment of *alopecia*. The *dose* of gallic acid is from Gm. 0.30–1.20 (5 to 20 grains), repeated several times a day, according to the urgency of the case. The glycerite is a convenient form for administering it.

ACIDUM HYDRIODICUM.—Hydriodic Acid.

Acidum iodhydricum.—Acide iodhydrique, Fr.; *Jodwasserstoffsäure*, G.

Formula HI. Molecular weight 127.53.

Origin.—Clement and Desormes (1813) recognized this acid, which was more fully investigated in the same year by Gay-Lussac. It is formed on the decomposition of metallic iodides by means of acids; on the ignition of a mixture of hydrogen and iodine vapors; and on the action of iodine upon various hydrogen compounds, or upon oxidizable bodies, like phosphorus and its lower oxides, arsenous acid, etc., in the presence of water.

Preparation.—As formerly official in the U. S. Pharmacopœia, it was prepared of such strength that 6 fluidounces contained the hydriodic acid from 480 grains of iodine. The process adopted was the one originally suggested by Gay-Lussac, modified by Le Royer and Dumas, according to which 30 grains of iodine are mixed with 5 fluidounces of water, and hydrogen sulphide is passed into the mixture until the color of iodine has disappeared. More iodine is now dissolved in the liquid; again hydrogen sulphide is passed into it until it is decolorized, and this process is repeated until all the iodine has been used. The liquid is then boiled until the odor of hydrogen sulphide is no longer perceived, filtered from the sulphur, and the filter washed with distilled water until the filtrate measures 6 fluidounces. It contains about 15 per cent. HI.

In the presence of water, iodine and hydrogen sulphide react with each other, the hydrogen uniting with the former, liberating sulphur; $2I_2 + 2H_2S$ yields $4HI + S_2$. The sulphur separates as a fine powder, which would cover the iodine and prevent the further reaction: to obviate this difficulty, a small quantity is first converted into hydriodic acid, which is a good solvent for iodine, and, with proper management, no iodine will be lost by remaining enveloped by the sulphur.

The process recommended by Buchanan (1837) consisted in dissolving 264 grains of tartaric acid and 330 grains of potassium iodide, each in 1½ fluidounces of water, mixing and cooling the solutions, agitating for some time, straining from the precipitated potassium bitartrate, and diluting with water to obtain 6¼ fluidounces. This acid speedily decomposes, for which reason J. Murdoch (1855) proposed to preserve it by sugar. It contains about 8 per cent. HI.

Properties.—Pure hydriodic acid is a colorless irrespirable and uninflammable gas, having the density 4.37 and an odor resembling that of hydrochloric acid. The aqueous solution is colorless, has a strong acid reaction, and a pungent afterward styptic sour taste. The concentrated aqueous solution of the acid, saturated at 0° C. (32° F.), has the spec. grav. 1.99. The acid formerly officinal had the spec. grav. 1.112. The most concentrated acid obtainable by distillation boils at 127° C. (260.6° F.), contains 57.75 per cent. HI, and has the spec. grav. 1.708. Topsöe (1870) found an acid having at 13.5° C. (56.3° F.) the densities 1.077, 1.102, or 1.126 to contain respectively 10.15, 13.09, and 15.73 per cent. of HI. Exposed to the air, this acid is decomposed, the hydrogen being oxidized to form water, and iodine liberated, coloring the liquid red-brown. The addition of a small quantity of sodium thiosulphate, as suggested by Dunn (1868), will for a time prevent the change. Pharmaceutically, hydriodic acid is a very unsatisfactory preparation.

Action and Uses.—According to Binz (*Arch. f. Pathol. u. Pharm.*, viii. 320), the poisonous phenomena produced by iodic acid prove that iodine is endowed with narcotic powers, and he quotes the assertion of Melsens, that hydriodic and iodic acids are equally operative. He and others also aver that the oxygen of the compound is its active element, and that the iodine is eliminated with the urine. The same authority maintains (*op. cit.*, xiii. 125), on the strength of his experiments, that iodic acid is an antipyretic, in that it reduces the pulse-rate; that its oxygen unites with and destroys "the decom-

posing products out of which the fever arises;" and that "the nascent iodine can only act upon the cells and ferment by reducing their activity." It is unnecessary to pursue these ingenious but unpractical suggestions, which, however, induced Luton (*Traité des injections sousentanées*. Paris, 1875) in 1873 to employ tissue injections of iodic acid in the treatment of certain degenerations. He held that the preparation was caustic in virtue of its iodine and resolutive through its oxygen. He asserted it to be useful in certain ill-conditioned and especially cancroidal *ulcers*, and that it might be injected into *ganglions*, *goitres*, and various other *tumors;* that its action was not more painful than that of iodine itself; and that, according to the strength of the solution, it acted as a caustic or simply resolved the morbid growths. For the former purpose a saturated solution was employed; for the latter, one containing a tenth of the acid or less. Binz (*loc. cit.*, p. 131) refers to experiments in which sick rabbits illustrated the antipyretic virtues of the preparation, and urges that its poisonous qualities do not constitute a sufficient objection to its use. Yet he prudently advises that the sodium salt, and not the acid, should be employed. In 1879, however, Wylie prepared hydriodic acid by mixing 1 drachm of potassium iodide with 90 grains of tartaric acid, and dissolving in f℥iv of water. He claimed that a teaspoonful of this solution had as much influence as 20 grains of potassium iodide, and did not disorder the stomach. To prevent partially its decomposition, it was mixed with a heavy syrup. He recommended it in "*bronchitis* and in chronic and subacute catarrhal diseases," and also in chronic *malarial* poisoning, in Graves' *disease*, and, like Luton, for *goitre*, and adipose *tumors* (*Med. Record*, xx. 454). The effects of the acid in bronchial *asthma* resemble those of potassium iodide, and do not so frequently include the annoying operation of the latter medicine (Wile, *Therap. Gaz.*, xii. 541; *Jour. Am. Med. Assoc.*, xii. 116). The dose is generally stated at Gm. 2 (f℥ss) of the freshly made acid. A syrup has been used containing Gm. 0.45 (gr. 6.67) of the acid in Gm. 32 (℥j).

ACIDUM HYDROBROMICUM DILUTUM, *U. S.*, *Br.*—Diluted Hydrobromic Acid.

Acidum bromohydricum.—Acide hydrobromique, Fr.; *Bromwasserstoffsäure*, *Hybrobromsäure*, G.

Formula HBr. Molecular weight 80.76. Strength 10 per cent. Sp. gr. 1.077.

Origin.—Hydrobromic acid was discovered by Balard (1826). It is formed by the direct union of its elements at a red heat, by the decomposition of hydrogen sulphide and other hydrogen compounds by bromine, by the action of bromine in the presence of water upon the lower oxides of sulphur, phosphorus, arsenic, and other elements, and by the action of water upon the sulphur, phosphorus, and other compounds of bromine. *Br.* recommends to pass H_2S into bromine kept under water.

Preparation.—Markoe (1875) recommended the following procedure: 1 pound of phosphorus is spread over the bottom of a one-gallon jar, covered with water, and the jar half filled with ice, after which a large funnel is inserted into the throat of the jar, a funnel-tube adjusted so as to reach a short distance above the phosphorus, and the jar surrounded with ice. 3 or 4 pounds of bromine may now be very slowly added through the funnel-tube, care being taken to prevent the accumulation in the jar of uncombined bromine, which would give rise to an explosion when reacting with the phosphorus. The two elements unite to form phosphorus pentabromide, PBr_5; and this, reacting with water, forms phosphoric and hydrobromic acids; $PBr_5 + 4H_2O$ yields $H_3PO_4 + 5HBr$. After the reaction is completed the excess of phosphorus is removed, and the aqueous liquid distilled until hydrobromic acid ceases to come over. The syrupy residue left in the retort, when properly diluted, is utilized as phosphoric acid.

Fothergill's formula is an adaptation of that of Dr. D. C. Wade (1875). An acid of the strength required by the Pharmacopœia, but containing small quantities of potassium bitartrate and bromide, may be prepared extemporaneously by dissolving 8 parts of potassium bromide and 10 parts of tartaric acid, each in 25 parts of distilled water, mixing the solutions, cooling the mixture, and stirring it well; after the potassium bitartrate has precipitated the whole is thrown upon a small filter, and the vessel and precipitate are washed with 10 parts of ice-cold water.

The difficulties of distilling hydrobromic acid by decomposing potassium bromide with sulphuric acid have been overcome by Dr. Squibb (1878) as follows: 7 parts by weight of sulphuric acid, sp. gr. 1.838 at 15.6° C. (60° F.), are added to 1 part of water, and the mixture allowed to cool, when it is slowly, and with constant stirring, added to a hot

solution of 6 parts of potassium bromide in 6 parts of water. A decomposition into hydrobromic acid and potassium sulphate will take place; $2KBr + H_2SO_4$ yields $2HBr + K_2SO_4$. On setting the mixture aside for twenty-four hours, the salt crystallizes, the liquid is poured off into a retort, and the crystalline mass broken up, transferred to a funnel, and washed with 2 parts of cold water to recover adhering hydrobromic acid. The washings are likewise poured into the retort, which is placed upon a sand-bath or set upon a wire gauze, and the whole is then distilled nearly to dryness. The distillate, which weighs about 10 parts, is assayed with normal solution of soda, and then diluted with distilled water so as to contain 34 per cent. of HBr. When of this strength, the acid represents one-half the bromine strength of an equal weight of potassium bromide, and should be dispensed only as *acidum hydrobromicum concentratum*. According to W. Grüning (1883) distillation of the acid is readily accomplished by using 100 parts of potassium bromide and 250 parts of phosphoric acid, sp. gr. 1.304.

Hager avoids distillation of the acid by operating as follows: 15.5 parts of potassium bromide are dissolved in 25 parts of hot water; the solution is mixed with 38 parts of sulphuric acid, spec. grav. 1.115, or 32 parts of water and 6.7 parts strong sulphuric acid, and the mixture cooled by immersing the flask in cold water; 40 parts of strong alcohol are added, and after two hours, when the potassium sulphate has separated, the liquid is filtered through glass-wool, and the vessel and filter washed with 15 or 20 parts of 60 per cent. alcohol; the clear filtrate is either evaporated or distilled at a temperature not exceeding 80° C. (176° F.) until the alcohol has been expelled. At the temperature named but very little hydrobromic acid is volatilized; the residue is diluted with water until it weighs 100 parts.

The process of Bruylants (1879) consists in carefully dropping bromine into oil of copaiva, and afterward applying heat; the reaction is very energetic.

Properties.—Pure hydrobromic acid is a colorless gas of a pungent and irritating odor, and produces dense white fumes in a moist atmosphere. Its aqueous solutions are colorless, odorless, limpid liquids of a strongly acid taste, which remain colorless on exposure to air. Dr. Squibb determined the acid of the strength suggested by him to have the specific gravity 1.274 at 15.6° C. (60° F.), and to contain 33.58 bromine, .42 hydrogen, and 66 water. When heated, water and a weak acid distil over, and when the temperature reaches 126° C. (258.8° F.) an acid remains which has the specific gravity 1.490 and contains 47.8 per cent. HBr. This strong acid may be distilled unchanged.

Hydrobromic acid liberates bromine on the cautious addition of chlorine-water or of nitric acid, the bromine being soluble, with a yellow or orange-red color, in chloroform, ether, and carbon bisulphide; and such a solution, agitated with starch paste, imparts to the latter a yellow color; excess of chlorine-water will destroy the color.

The density of aqueous hydrobromic acid at 15° C. (59° F.), according to Biel (1881), is as follows:

Per ct. HBr.	Spec. grav.	Per ct. HBr.	Spec. grav.	Per ct. HBr.	Spec. grav.	Per ct. HBr.	Spec. grav.	Per ct. HBr.	Spec. grav.
1	1.0082	11	1.085	21	1.172	31	1.270	41	1.388
2	1.0155	12	1.093	22	1.181	32	1.281	42	1.401
3	1.0230	13	1.102	23	1.190	33	1.292	43	1.415
4	1.0305	14	1.110	24	1.200	34	1.303	44	1.429
5	1.038	15	1.119	25	1.209	35	1.314	45	1.444
6	1.046	16	1.127	26	1.219	36	1.326	46	1.459
7	1.053	17	1.136	27	1.229	37	1.338	47	1.474
8	1.061	18	1.145	28	1.239	38	1.350	48	1.490
9	1.069	19	1.154	29	1.249	39	1.362	49	1.496
10	1.077	20	1.163	30	1.260	40	1.375	50	1.513

Tests.—Hydrobromic acid should evaporate without leaving any residue. It should not be precipitated by barium chloride, showing the absence of sulphuric acid, nor should a brown color appear within half an hour if 1 Cc. of the acid be mixed with 1 Cc. of stannous chloride solution and a small piece of pure tin-foil (absence of arsenic). It yields, like hydrochloric acid, white precipitates with solutions of lead, mercurous and silver salts. Silver bromide is nearly insoluble in *dilute* ammonia-water, which dissolves silver chloride readily; on the subsequent addition of nitric acid only a slight tur-

bidity should be produced. If contaminated with hydriodic acid, the latter on exposure to air will liberate iodine, which gives a blue color with starch. On cautiously adding chlorine-water to such an acid, iodine will first be liberated, and dissolve in carbon disulphide with a purple color; on the further addition of the reagent bromine will be liberated. The strength of hydrobromic acid may be determined by neutralization or by silver. 8.08 Gm. of the official acid should require for neutralization 10 Cc. of the volumetric solution of potassa; and 10 Gm. of it, when treated with silver nitrate in excess, will yield a precipitate which, after washing and drying, weighs 2.32 Gm., and when heated in chlorine gas is converted into silver chloride weighing 1.77 Gm.

Action and Uses.—In its liquid and diluted state, and particularly when prepared by decomposing bromide of potassium with tartaric acid, it has an agreeable acidulous taste; but the pure acid is as corrosive as concentrated hydrochloric acid. The experiments of Reichert (1881) appear to prove conclusively that the action of hydrobromic acid is essentially the same as that of potassium bromide. Its operation is, however, more transient. It is of interest to note that, like other agents classed as narcotic, it is stimulant in small doses and in large doses depressing. It is less apt than its potassium salt to provoke an acneiform eruption. It was first employed to prevent the headache occasioned by quinine, and also by iron, by combining it with those medicines, as well as to palliate the nervous irritability or disorders for which they are often prescribed. It soon appeared to be, in many cases, an appropriate substitute for bromide of potassium, and at least equal to that salt in the energy, if not in the duration, of its action upon the nervous system. In combination with quinine and iron its own comparatively transient influence forms an appropriate preparation for their more permanent action. It especially seems to prevent the tinnitus aurium and the disorder of vision which sometimes follow the use of large doses of quinine. But as these phenomena are often the only guides in regulating the dose of quinine, a medicine capable of suppressing them is of questionable advantage unless the appropriate dose of quinine has been experimentally determined. It appears to co-operate with digitalis as well as with quinine and iron in improving the tone of the heart when weak and irritable. Like the bromides, it has been successfully employed in a variety of nervous disorders induced by reflex irritation, such as *vomiting*, *muscular spasm*, *whooping cough*, *irritable heart*, and *neuralgia*, and in *coughs* excited by *bronchial* or *laryngeal* irritation. In cases also of *cerebral hyperæmia*, *headaches*, and *insomnia*, due to excessive mental activity in study, business, etc., it appears to have the same influence as the bromides (*Med. Record*, xx. 545). In *tinnitus aurium* and other subjective sensations in the ear, especially those of a throbbing or knocking character, depending upon vascular congestion, the medicine has proved very efficient. According to some competent observers, it is more injurious than useful in *epilepsy*, aggravating the attacks and rendering them more frequent. Dr. H. C. Wood has shown that they probably employed quite insufficient doses of the acid, and such as were not at all equivalent to efficient doses of the bromide salts. He found by a series of comparative trials that under bromide of sodium the largest number of fits occurred; that they were reduced to one-third by bromide of potassium; and were still further reduced under the daily dose of f℥iij of dilute hydrobromic acid (U. S. P.). The acid was given after meals with an equal amount of ginger syrup, and diluted with half a pint of water. No untoward effects appeared, but the patients were generally in robust health and had a powerful digestion (*Med. News*, xliv. 209). It has been suggested that the acid may be substituted wholly or partly for the salt to check the development of the bromide eruption and of the debilitating influence of its alkaline base. It has been found more efficient and less painful than muriatic acid for treating *mercurial ulcers*.

Dr. Squibb has called attention to the difficulty of administering the acid "in consequence of the large dilution necessary and its disagreeable effect of" setting the teeth on edge." "A dose of fifty grains requires not less than 8 fluidounces of dilution, which must contain not less than an ounce of sugar or 2 ounces of syrup to make it drinkable." Doses of about half this amount have been found necessary to produce a prompt sedative effect. Dr. Squibb has proposed the use of a syrup containing about 3 minims of his acid in each fluidrachm. Gm. 16 (half an ounce) of this syrup contains about Gm. 1 (15 grains) of the acid, and is reckoned to be equivalent to Gm. 0.80 (12.5 grains) of potassium bromide. It must be given diluted with from Gm. 64–120 (2 to 4 ounces) of water. Dr. Randolph suggested pure milk as the best excipient of the medicine, and advised that it be not administered much within an hour after meals, lest it impede the digestion of starchy food in the stomach. Hydrobromate of quinine, being very soluble in water, is more suitable than the neutral sulphate for hypodermic use. It

may be prepared thus: R. Potassii bromid. 162 gr.; Acid. tartaric. 198 gr.; Quininæ sulph. 60 gr.; Aquæ f℥iij.—M. Filter. Dose, Gm. 2–4 (f℥ss–i).

ACIDUM HYDROCHLORICUM, *U. S., Br., P. G.*—Hydrochloric Acid.

Acidum muriaticum s. hydrochloratum s. chlorhydricum.—Muriatic acid, E.; *Acide chlorhydrique s. muriatique*, Fr.; *Salzsäure, Chlorwasserstoffsäure*, G.; *Acido cloridico.* F. It., Sp.

Formula HCl. Molecular weight 36.37. Strength 31.9 per cent. Spec. grav. 1.160 (25 per cent.; spec. grav. 1.124 *P. G.*).

Diluted Hydrochloric Acid: Strength 10 per cent. *U. S.*, 10.58 per cent. *Br.*, 12.5 per cent. *P. G.* Spec. grav. 1.050 *U. S.*, 1.052 *Br.*, 1.061 *P. G.*

Origin.—Hydrochloric acid occurs in the uncombined state among the gases emitted by active volcanoes, and in combination its radical, chlorine, is found in numerous minerals, prominent among which is sodium chloride, or common salt, which is also one of the most important constituents of sea-water and the source of nearly all the hydrochloric acid of commerce. The acid was obtained in the fifteenth century by Basilius Valentinus, and was described as *spirit of salt*, a name which is occasionally used even at the present time. The correct composition of hydrochloric acid was first proved by Humphry Davy (1810).

Preparation.—Enormous quantities of hydrochloric acid are produced in the preparation of potash and of sodium carbonate, for which purpose it is necessary to convert the chlorides into sulphates. The escaping gas is made to pass through long vertical cylinders, which are filled with coke, over which water is made to trickle. The water, dissolving the acid in its descent, is collected below or allowed to run to waste. If the acid is intended for uses in the arts, a purer article is required, and the gas is then made to pass through a series of stone receivers having the shape of large Woulfe's bottles, the first of which is empty, while the other five or six contain a certain quantity of water. The stills consist of horizontal iron cylinders, into which equal weights of common salt and sulphuric acid are introduced, after which heat is applied. The first receiver retains any sodium sulphate and sulphuric acid which may be mechanically carried over, the gas being absorbed by the water in the other receivers.

By this process 117 parts of sodium chloride require 98 parts of concentrated (or a correspondingly larger quantity of a somewhat weaker) sulphuric acid. The first reaction results in liberation of one-half of the hydrochloric acid and production of acid sodium sulphate; $2NaCl + H_2SO_4$ yields $HCl + NaCl + NaHSO_4$. The decomposition of the remaining chloride by the acid sodium sulphate is effected at a temperature beyond 200° C. (392° F.), but on the large scale a much higher heat is found necessary; the reaction takes place as follows: $NaCl + NaHSO_4 = HCl + Na_2SO_4$. The salt cake remaining in the retort is worked up into Glauber's salt by dissolving it in water and crystallizing, or it is used for the preparation of soda. The acid thus obtained has a lighter or deeper yellow color, due to a small quantity of ferric chloride dissolved in it. If otherwise pure and of sufficient strength, it may be employed for preparing ferrous and ferric chlorides.

In a process recommended by Eschellmann (1882) the product obtained in preparing hydrochloric acid may be again utilized for the same purpose: calcium chloride and magnesium sulphate are mixed with water to form a soft mass, and then heated to dull redness. The reaction taking place is explained by the equation $CaCl_2 + MgSO_4 + H_2O = (MgO.CaSO_4) + 2HCl$. The basic calcium-magnesium sulphate may be used for generating ammonia from sal ammoniac, resulting in the formation of calcium sulphate and magnesium chloride, from which the above basic sulphate and hydrochloric acid gas may be again obtained. On treating in the same manner a mixture of magnesium chloride and sulphate, the result is, besides hydrochloric acid, basic magnesium sulphate, $MgO.MgSO_4$, from which, on boiling with water, magnesium hydroxide is precipitated, while magnesium sulphate remains in solution.

A pure acid, suitable for pharmaceutical purposes, is obtained by rectifying 12 parts of the crude acid in a glass retort in such a manner that the delivery-tube terminates at the surface of 3 parts of distilled water contained in the receiver, which is refrigerated with water; the heat is continued until about 7 parts have distilled over. The pure acid is usually prepared on a large scale by distilling sodium chloride and sulphuric acid in the proportions given above, using glass retorts having a capacity of 5 or 6 gallons, and collecting the acid in suitable glass receivers; a number of these retorts are usually

arranged in a properly constructed furnace having the requisite number of sand-baths, each of which is large enough to receive one retort, and may be sufficiently heated to recover all hydrochloric acid, with the production of sodium sulphate. In the pharmaceutical laboratory, however, it is usually preferable to employ the sulphuric acid in such a quantity that acid sodium sulphate is formed, since the hydrochloric acid is then obtained at a lower temperature; $NaCl + H_2SO_4 = HCl + NaHSO_4$. For 3 parts of dry sodium chloride but little more than 5 parts of concentrated sulphuric acid are required, and these are the proportions employed in the following process, which likewise contains the necessary details for successfully carrying on the operation:

Take of Sodium Chloride, dried, 48 ounces; Sulphuric Acid 44 fluidounces (80 ounces); Water, 36 fluidounces; Distilled Water 50 fluidounces. Pour the sulphuric acid slowly into 32 ounces of the water, and when the mixture is cooled add it to the sodium chloride previously introduced into a flask having the capacity of at least 1 gallon. Connect the flask by corks and a bent glass tube with a three-necked wash-bottle furnished with a safety-tube and containing the remaining 4 ounces of the water; then, applying heat to the flask, conduct the disengaged gas through the wash-bottle into a second bottle containing the distilled water by a bent tube, dipping about half an inch below the surface, and let the process be continued until the product measures 66 ounces or the liquid has acquired a specific gravity of 1.16. The bottle containing the distilled water must be kept cool during the whole operation.—*Br.*

Acidum hydrochloricum (s. muriaticum) dilutum, *U. S.*, *Br.*, *P. G.*—*Diluted hydrochloric acid*, E.; *Acide chlorhydrique dilué*, Fr.; *Verdünnte Salzsäure*, G.—Add Hydrochloric Acid 100 Gm. to Distilled Water 219 Gm., and mix.—*U. S.* The British Pharmacopœia adds to 3060 grains of hydrochloric acid sufficient distilled water, until the mixture, at 15.5° C. (60° F.), after it has been shaken, measures 1 imperial pint. The Germ. Ph. directs that equal parts by weight of hydrochloric acid and water be mixed. It must be borne in mind that the official hydrochloric acid of the Germ. Ph. contains only 25 per cent. of absolute HCl. The specific gravity of diluted hydrochloric acid is 1.050 *U. S.*, 1.052 *Br.*, 1.061 *P. G.*

Properties.—1. Hydrochloric Acid Gas.—It is colorless, has a pungent, acid, suffocating odor, and when inhaled is highly irritating, though less so than chlorine. Its specific gravity is 1.2844 (Thomson). It strongly reddens blue litmus-paper, does not support combustion, and in contact with the atmosphere produces grayish-white fumes by condensing the moisture of the air. It may be condensed into a colorless liquid by a pressure of 1 atmosphere and a refrigerating mixture of solid carbon dioxide and ether. This liquid does not congeal at —110° C. (—166° F.), and at 10° C. (50° F.) exerts a pressure equal to 40 atmospheres. Its composition is HCl, or equal volumes of hydrogen and chlorine united without condensation.

2. Official Hydrochloric Acid.—It is a colorless liquid, having the specific gravity 1.160, and emitting white vapors in contact with the air. It gives with silver nitrate a white curdy precipitate, which is soluble in ammonia and insoluble in nitric acid. The strength of the acid is determined, after suitably diluting it with distilled water, by neutralizing it with volumetric solution of soda or potassa. 3.64 Gm. of the acid require 31.9 Cc. of the latter (*U. S.*), or 114.8 grains of acid need 1000 grain-measures of the soda solution (*Br.*). Pure hydrochloric acid of the German Pharmacopœia is required to have the density 1.124, and to contain 25 per cent. HCl.; and 5 Cc. of the acid will therefore require 38.5 Cc. of normal alkali solution.

Water absorbs at 0° C. (32° F.), the barometer being 760 Mm., 501.5 volumes of hydrochloric acid gas. The concentrated acid, on being heated, loses gas, becoming weaker on boiling until, at the barometric pressure given before, it has reached the specific gravity 1.101 at 15° C. (59° F.), contains 20.01 per cent. HCl, and distils at 110° C. (230° F.) unchanged, leaving no residue if the acid was perfectly pure. On boiling a weaker acid it becomes stronger, the final density depending on the atmospheric pressure.

Hydrochloric acid of the specific gravity 1.01 at 25° C. (77° F.) contains, according to E. Davy, 2.02 per cent. of gas, and for every additional 2.02 per cent. increases in density at the ratio of 0.01, so that an acid of 1.10 specific gravity contains 20.20 per cent., and if of specific gravity 1.19 contains 38.38 per cent. of gas. These figures differ little from those ascertained by A. Ure.

The following table, which is essentially that prepared by Prof. G. Lunge and incorporated in the U. S. Ph., refers only to chemically pure acids. The percentage of real acid in the commercial acids, particularly when they are concentrated, is always less than that given in the table:

Specific Gravity 15° C. at 4° C. in vacuo.	Specific Gravity 15° C. at 15° C. in air.	100 Parts by weight contain — parts of HCl.	1 Liter contains — kilos of HCl.	Specific Gravity 15° C. at 4° C. in vacuo.	Specific Gravity 15° C. at 15° C. in air.	100 Parts by weight contain — parts of HCl.	1 Liter contains — kilos of HCl.
1.000	1.0008	0.16	0.0016	1.105	1.106	20.97	0.232
1.005	1.00059	1.15	0.012	1.110	1.111	21.92	0.243
1.010	1.00109	2.14	0.022	1.115	1.116	22.86	0.255
1.015	1.0159	3.12	0.032	1.120	1.121	23.82	0.267
1.020	1.021	4.13	0.042	1.125	1.126	24.78	0.278
. .	1.0253	5.		. .	1.1271	25.	
1.025	1.026	5.15	0.053	1.130	1.131	25.75	0.291
1.030	1.031	6.15	0.064	1.135	1.136	26.70	0.303
1.035	1.036	7.15	0.074	1.140	1.141	27.66	0.315
1.040	1.041	8.16	0.085	1.145	1.146	28.61	0.328
1.045	1.046	9.16	0.096	1.150	1.151	29.57	0.340
. .	1.0502	10.		. .	1.1532	30.	
1.050	1.051	10.17	0.107	1.155	1.156	30.55	0.353
1.055	1.056	11.18	0.118	. .	1.160	31.326	
1.060	1.061	12.19	0.129	1.160	1.161	31.52	0 366
1.065	1.066	13.19	0.141	. .	1.163	31.90	
1.070	1.071	14.17	0.152	1.165	1.166	32.49	0.379
. .	1.0752	15.		1.170	1.171	33.46	0.392
1.075	1.076	15.16	0.163	1.175	1.176	34.42	0.404
1.080	1.081	16.15	0.174	. .	1.179	35.	
1.085	1.086	17.13	0.186	1.180	1.181	35.39	0.418
1.090	1.091	18.11	0.197	1.185	1.186	36.31	0.430
1.095	1.096	19.06	0.209	1.190	1.191	37.23	0.443
. .	1.1005	20.		1.195	1.196	38.16	0.456
1.100	1.101	20.01	0.220	1.200	1.201	39.11	0.469

Diluted Hydrochloric Acid has the same properties as the strong acid, but contains only 10 per cent. (*U. S.*), 10.58 per cent. (*Br.*), 12.5 per cent. (*P. G.*) of HCl, and has the specific gravity of 1.050 (*U. S.*), 1.052 (*Br.*), 1.061 (*P. G.*). The amount of volumetric solution of soda required for neutralization is 10 Cc. for 3.64 Gm. of the acid (*U. S.*), or 1000 grain-measures for 345 grains of the latter (*Br.*).

Impurities and Tests.—Hydrochloric acid evaporates completely without leaving any residue (saline impurities). When diluted with at least five times its volume of distilled water, it yields no precipitate with hydrogen sulphide (lead, copper, arsenic, tin), ammonia in excess (lead, iron), or barium chloride (sulphuric acid); nor shows a turbidity on adding a few drops of decinormal iodine solution to this test (sulphurous acid); nor does it acquire a blue color with the ammonia test (copper), or a brown or black color on the subsequent addition of ammonium sulphide (metals); it is not colored red by potassium sulphocyanate (iron), or blue by a mixture of starch paste and potassium iodide (chlorine), and does not tarnish or alter the color of bright copper-foil when boiled with it (arsenic). To test it for sulphurous acid or arsenic, put a few pieces of pure zinc into a rather long test-tube and introduce the hydrochloric acid, diluted with 2 parts of water, which should fill about one-tenth part of the tube. In the upper part of the tube place a small bunch of cotton moistened with solution of lead acetate, and cover the mouth of the tube with a piece of white filtering-paper moistened with solution of silver nitrate. After the evolution of hydrogen gas has continued for an hour, neither the cotton nor the paper should be blackened, proving the absence of sulphurous acid in the former case and of arsenic in the latter. Under the conditions described sulphurous acid evolves hydrogen sulphide, which blackens the lead salt, and arsenic yields hydrogen arsenide, which does not affect lead acetate, but blackens silver nitrate. The quantitative tests of the U. S. P. as to the purity of the acid are—(1) absence of *iodine* or *bromine:* 1 Cc. of the acid diluted with twice its volume of water should not give to a few drops of chloroform any color when a small quantity of freshly-prepared chlorine-water or a granule of potassium chlorate is added; (2) absence of *chlorine* and *bromine:* 1 Cc. of the acid diluted with 5 Cc. of water should not give a blue color on adding 0.5 Cc. of zinc-iodide starch solution; (3) limit of *arsenic:* on mixing 1 Cc. of stannous chloride solution with an equal volume of the acid and a small piece of pure tin-foil, no brown color should appear within one hour; (4) absence of *thallium, arsenic, lead*, etc.: a few Cc. of freshly-prepared hydrogen-sulphide solution should cause no color at the

zone of contact when poured on an equal volume of hydrochloric acid; (5) absence of *iron*, *aluminum*, etc.: 1 Cc. of ammonium-sulphide solution should cause neither a color nor a turbidity when added to 1 Cc. of hydrochloric acid which has been slightly supersaturated with ammonia.

Pharmaceutical Uses.—Hydrochloric acid is employed in numerous processes, either on account of its properties as a solvent for decomposing certain compounds with the view of liberating certain constituents (sulphur, carbonic acid, hydrocyanic acid, etc.), or for the purpose of generating chlorine. It is used in the preparation of nitromuriatic acid and of the various official chlorides, and for promoting the precipitation of resin of podophyllum.

Action and Uses.—Given to man in small doses, hydrochloric acid occasions a sense of warmth in the stomach and arterial excitement, with a decided tendency to cerebral intoxication. Its protracted use causes salivation. In a concentrated form it attacks the tissues as a caustic, but less powerfully than nitric or sulphuric acid. An ounce of the officinal acid has been taken without causing death. The symptoms of poisoning by hydrochloric acid are sunken features, dilated pupils, a white stain upon the tongue and fauces, a small, irregular, and feeble pulse, epigastric pain, and cold extremities. Vomiting and purging sometimes occur. After large doses, as 3 or 4 ounces, death takes place in from three to six hours. Hydrochloric acid was at one time extensively employed in *low fevers*, probably only upon theoretical grounds, which have disappeared along with the practice. It was vaunted in *scrofula* and other affections involving debility; but, as it was associated with cinchona, its share in whatever benefit accrued is more than doubtful. Perhaps upon better grounds it may be recommended for constitutional *syphilis* when mercury and iodine are inappropriate. But, not improbably, its use in this disease may be attributed to its sometimes causing salivation. The frequent connection of *acid dyspepsia* with gastric fermentation, the development of bacteria, etc., and even with putrefaction of the food, has led, on the one hand, to the use of alkalies and their carbonates, which correct an effect of the disorder, and to that of mineral acids, which tend to remove its cause. Muriatic acid, which is naturally formed in the stomach, has been found successful in correcting this disorder. It must be given after meals, diluted with water in the proportion of not less than 1 : 750, or daily about 15 grains of the acid in 24 ounces of water. It has been employed in *calculous* complaints, and perhaps advantageously in so far as they were associated with dyspeptic disorders. In this way, possibly, it may be found useful in eczema and psoriasis and other *diseases of the skin*, which sometimes depend upon digestive derangements. Hydrochloric acid was at one time regarded as a most valuable agent in the treatment of *diphtheria*, but recent experience has shown that the local affection is of subordinate importance, and that the mere removal of the exudation does not modify the disease. Moreover, chlorate of potassium and other agents are more eligible than the acid as palliatives of the pharyngeal inflammation. The same may be said, even more emphatically, of gangrenous, mercurial, scorbutic, and other forms of ulcerative *stomatitis*. According to Voltolini, *fish-bones* lodged in the pharynx are rendered flexible, and may finally be broken up, by a mixture of 4 parts of hydrochloric acid and 240 parts of water, the teeth being first protected by oil or lard. The method is probably not to be relied on. A poisonous dose of this acid should be counteracted by magnesia, soap, bicarbonate of sodium, or, in the absence of these, by albumen. The dose of the stronger acid is from Gm. 0.30–2.00 (5 to 30 minims); of the weaker acid, from Gm. 1.30–4.00 (20 to 60 minims), largely diluted and taken through a glass tube. As a gargle, Gm. 4–8 of the stronger acid may be diluted in Gm. 350–400 (10 or 12 ounces) of barley-water sweetened with honey.

ACIDUM HYDROCYANICUM DILUTUM, *U. S.*, *Br.*—Diluted Hydrocyanic Acid.

Acidum hydrocyanatum s. borussicum.—Prussic acid, E.; *Acide cyanhydrique s. hydrocyanique*, Fr.; *Cyanwasserstoffsäure*, *Blausäure*, G.; *Acido cianhidrico*, Sp.

Formula HCN = HCy. Molecular weight 26.98. Strength 2 per cent. HCy.

Origin.—Hydrocyanic acid was discovered by Scheele (1782); Berthollet (1803) ascertained it to be a compound of hydrogen, carbon, and nitrogen; and Guy Lussac (1815) succeeded in analyzing it and in isolating the radical *cyanogen*, CN. The acid has been found in the root of Janipha Manihot, and in the bark, leaves, flowers, and seeds of many shrubs and trees belonging to the sub-orders Amygdaleæ and Pomeæ of the order Rosaceæ. It occurs in the free state only in some of the more juicy parts of these

plants, but a larger quantity is formed on macerating the parts indicated in cold water, when the amygdalin contained therein is split by the action of emulsin or a similar ferment into sugar, oil of bitter almonds, and hydrocyanic acid; $C_{20}H_{27}NO_{11}$ (amygdalin) + $2H_2O$ yields $2C_6H_{12}O_6$ (glucose) + C_7H_6O (oil of bitter almonds) + HCN (hydrocyanic acid). It is likewise found among the products of the reaction of nitric and nitrous acids upon many organic compounds, and of gaseous ammonia upon incandescent charcoal. For medicinal purposes it is mostly prepared by the decomposition of potassium ferrocyanide by means of sulphuric acid.

Preparation.—Place 20 Gm. of potassium ferrocyanide in a tubulated retort, and add to it 40 Cc. of water. Connect the neck of the retort (which is to be directed upward), by means of a bent tube, with a well-cooled condenser, the delivery-tube of which terminates in a receiver surrounded with ice-cold water and containing 65 Cc. of distilled water. All the joints of the apparatus, except the neck of the receiver, having been made air-tight, pour into the retort, through the tubulure, 8 Cc. of sulphuric acid previously diluted with 25 Cc. of water. Agitate the retort gently, and then heat it in a sand-bath so as to keep the liquid in brisk ebullition until about one-half of its volume has passed over into the receiver. Detach the receiver, and add to its contents so much distilled water as may be required to bring the product to the strength of 2 per cent. of absolute hydrocyanic acid.—*U. S.*

The process of the British Pharmacopœia is similar to the foregoing, differing chiefly in distilling from a weaker solution. The proportions employed are $2\frac{1}{4}$ ounces of potassium ferrocyanide dissolved in 10 ounces of water, and 1 fluidounce of sulphuric acid diluted with 4 ounces of water; the receiver contains 8 ounces of distilled water, and the distillation is continued until the liquid is increased to 17 fluidounces, when it is diluted with distilled water so as to contain 2 per cent. of hydrocyanic acid.

On mixing diluted sulphuric acid with the solution of potassium ferrocyanide in the cold, only one-half of the latter salt is decomposed, with the formation of potassium sulphate and hydroferrocyanic acid, thus: $K_4FeC_6N_6$ (potassium ferrocyanide) + $2H_2SO_4$ yields $2K_2SO_4$ + $H_4FeC_6N_6$ (hydroferrocyanic acid). This last compound may be obtained by adding ether to the mixture, when the acid will be separated as a whitish powder or pearly scales. On the application of heat to the mixture this acid reacts with the remaining potassium ferrocyanide and sulphuric acid, yielding hydrocyanic acid, which distils over, potassium sulphate, which remains in solution, and ferrocyanide of iron and potassium (Everitt's salt), which precipitates as a white powder, rapidly turning green, and finally blue, in the presence of oxygen. The reaction is explained in the following: $H_4FeC_6N_6 + K_4FeC_6N_6 + H_2SO_4 = 6HCN$ (hydrocyanic acid) + K_2SO_4 + $K_2Fe(FeC_6N_6)$ (Everitt's salt). 2 molecules of potassium ferrocyanide with 3 of sulphuric acid yield, therefore, finally, 6 molecules of hydrocyanic acid, 3 of potassium sulphate, and 1 of Everitt's salt, the latter having a white color, but turning rapidly blue on exposure.

The preparation of official hydrocyanic acid by the above process presents no difficulties. Distilling the acid over a naked fire would cause concussions endangering the safety of the retort. The Pharmacopœia very properly orders the retort to be placed in a sand-bath, or an ash-bath may be substituted for it. The complete decomposition of the potassium ferrocyanide and the distillation of the hydrocyanic acid are readily effected, the entire amount being obtainable at a temperature little exceeding that of boiling water. The contamination of the distillate with the contents of the retort, which may occur in consequence of spirting, is easily prevented by substituting a flask for the retort or by keeping the neck of the latter in a slightly elevated position.

The strength of the distillate may be determined by weighing 100 grains of it in a small beaker containing some distilled water, and precipitating completely with silver nitrate; the precipitate of silver cyanide is collected upon a tared filter, washed, dried at at 100° C. (212° F.), and weighed. From the excess of this weight over 10 grains the amount of distilled water is easily calculated, which must be added to the distillate, the precise weight of which has been ascertained, in order to obtain it of the official strength. The Pharmacopœia prescribes the following method for ascertaining the strength of the distillate: Into a 100 Cc. flask put 0.27 Gm. of the distillate, together with sufficient water and magnesia to make an opaque mixture of about 10 Cc. To this add 2 or 3 drops of potassium-chromate solution, and then decinormal silver-nitrate solution, until a permanent red tint is produced. Each cubic centimeter of silver solution used will indicate 1 per cent. of absolute HCN (*U. S.*); from this the amount of water to be added to the distillate can at once be calculated; for instance, if 3.5 Cc. of $\frac{N}{10}$ silver solution were necessary to produce the permanent color caused by formation of silver chromate,

then every 100 parts of distillate require the addition of 75 parts of distilled water, because 2 : 3.5 : : 100 : 175. The object of adding magnesia in the foregoing test is to neutralize the free acid; an excess of magnesia, not being hurtful, serves as a desirable background for the red color of silver chromate, which latter does not appear permanent until all the hydrocyanic acid present has been converted into silver cyanide. After proper dilution it should at once be put into clean small vials, well corked.

The amount of hydrocyanic acid contained in the finished product may also be determined volumetrically by the method above stated, using, however, 1.35 Gm. of the dilute acid in place of 0.27; in this case each Cc. of $\frac{N}{10}$ silver solution used will indicate 0.2, or one-fifth, of 1 per cent.

The Br. Ph. requires that 270 grains of dilute acid, made alkaline by the addition of soda, shall require 1000 grain-measures of volumetric silver-nitrate solution before a permanent precipitate appears. This is essentially Liebig's method, depending upon the formation of a double salt, $KAgCy_2$, which is not decomposed by an excess of alkali. The permanent turbidity occurs when all the hydrocyanic acid present is in combination as the double cyanide, and the further addition of silver solution then causes decomposition, insoluble silver cyanide separating.

Diluted hydrocyanic acid may be advantageously prepared from several cyanides. Potassium cyanide, however, is not well adapted for this purpose, owing to the difficulty of obtaining it absolutely pure; but even if the salt were decomposed by the requisite quantity of tartaric acid to form potassium bitartrate, the portion of the latter salt remaining in solution would tend to speedily decompose the acid, unless distillation were resorted to. A convenient method for obtaining an acid suitable for immediate use is the following:

Take of Silver Cyanide 6 Gm.; Hydrochloric acid 5 Cc.; Distilled Water 55 Cc. Mix the hydrochloric acid with the distilled water, add the silver cyanide, and shake the whole together in a glass-stoppered vial. When the precipitate formed has subsided pour off the clear liquid.—*U. S.*

The hydrochloric acid decomposes the silver cyanide, forming insoluble silver chloride and hydrocyanic acid; thus, $AgCy + HCl = AgCl + HCy$.

The French Codex employs a mixture of mercury cyanide and ammonium chloride, the latter being used to produce readily soluble and fusible double salts. The mixture is treated with hydrochloric acid, and the resulting gas passed first over marble to remove hydrochloric acid, and then over calcium chloride to remove water, into a narrow tube placed in a refrigerating mixture. The anhydrous acid is condensed, and is diluted with nine times its weight of distilled water. This process presents no advantages whatever. On the contrary, owing to the concentration of the acid as at first condensed, precautions are necessary to avoid dangerous results in handling this volatile liquid.

Properties.—Anhydrous hydrocyanic acid is a colorless, mobile liquid which congeals at −15° C. (5° F.) to feathery crystals, has the density .697 at 18° C. (64.4° F.), boils at 26.5° C. (79.7° F.), and when ignited burns with a slightly luminous flame to carbonic anhydride and nitrogen. It has a strong odor, resembling that of oil of bitter almond, and is extremely poisonous. It is the hydride of the radical cyanogen, and its composition is expressed by the formula $HCN = HCy$. It reddens litmus-paper slightly and transiently, and with alkalies yields crystallizable salts having a strong alkaline reaction, and producing with an acidulated mixture of ferrous and ferric salts a precipitate of Prussian blue. Most of its salts, on being treated with diluted mineral or many organic acids, yield hydrocyanic acid, and are decomposed by strong nitric acid, with the evolution of nitrogen and other gases; silver cyanide dissolves in boiling nitric acid, the solution containing silver nitrate. A solution of an alkali cyanide mixed with solution of picric acid and heated to about 60° C. (140° F.) acquires a deep-red color, from the production of a salt of *isopurpuric* or *picrocyanic acid*, $C_8H_5N_5O_6$ (Hlasiwetz, 1859).

Hydrocyanic acid is soluble in water, alcohol, and ether in all proportions. The medicinal acid contains 2 per cent. of anhydrous acid; the aqueous solution of this strength has the spec. grav. 0.997 (*Br.*). The methods for ascertaining the strength have been given above. Minute qantities of hydrocyanic acid may be detected by Schœnbein's (see GUAIACUM) or by Liebig's test (1847); the latter is applied by adding a little ammonium sulphide, evaporating at a moderate heat to dryness, and adding to the residue a drop of diluted ferric chloride, when the blood-red color of ferric sulphocyanate will appear.

Under various circumstances hydrocyanic acid is decomposed on keeping, evolving

ammonia and depositing a brown or blackish substance containing paracyanogen, C_3N_3 or C_6N_6. The causes of these changes have not been fully explained: it is, however, well known that the presence of alkalies and exposure to the light favor decomposition; and since, by heating hydrocyanic acid in the presence of free mineral acids, ammonium formate is apt to be produced, it will be seen that even recently prepared dilute hydrocyanic acid may be prone to change, and that, if altered, the decomposition cannot be arrested by distillation except after the previous addition of sufficient sulphuric acid. The addition of a minute quantity of hydrochloric acid, and of alcohol in place of a portion of the water, to the recently prepared acid, appears to retard that change, but does not altogether prevent it. The stronger the hydrocyanic acid is, the more liable it is to decomposition. The acid known as Scheele's acid, which contains 5 per cent. of HCy, is therefore not adapted for medicinal use.

Another difficulty in preserving the strength of hydrocyanic acid must be attributed to its volatility and the loss suffered by the medicinal acid on the frequent opening of the vial containing it. This has (1873 and 1874) been the subject of investigation by A. Towerzey and others. J. Williams states that an addition of 20 per cent. of glycerin will preserve acid up to the strength of about 5 per cent., and J. U. Lloyd (1878) observed that alcoholic hydrocyanic acid could be kept in partially-filled bottles unaltered and without material loss of acid for three years. Careful observations made by large manufacturers have thus far failed to suggest a desirable remedy for the well-known instability of hydrocyanic acid. The use of diluted alcohol as prescribed by the Pharmacopœia of 1880 gave no better results than the present method. Weaker solutions of hydrocyanic acid are known to keep better, but even these are not stable. The U. S. and Br. directions to keep the acid in a cool, dark place should always be observed.

Impurities.—On adding a few drops of solution of corrosive sublimate, and heating to boiling, a reduction of the mercuric salt to calomel or to mercury will indicate the presence of formic acid. Sulphuric acid is recognized by the white precipitate produced on the addition of barium chloride. Hydrochloric and phosphoric acids are detected by adding solution of borax, evaporating to dryness, and dissolving the residue in diluted nitric acid; a white precipitate with silver nitrate will indicate the former, and a yellow precipitate with ammonium molybdate the latter, impurity.

Derivative.—Hydrocyanic Ether, *ethylcyanide* or *propionitrile*, $C_3H_5N = C_2H_5CN$. Prepared according to Pelouze's process (1834), by distilling barium ethylsulphate with potassium cyanide, it has a garlicky odor, which is due to the isomeric *ethylcarbylamin*, and is difficult to remove. A purer product is obtained, according to Williamson (1853), by digesting ethyl iodide with 4 parts of alcohol containing an equivalent quantity of potassium cyanide until decomposed, and then distilling. When perfectly pure it is a colorless liquid of the density 0.787, has an agreeable ethereal odor, suggesting that of hydrocyanic acid, is almost insoluble in water, and boils at 97° C. (206.6° F.). It is poisonous, but less so than hydrocyanic acid.

Action and Uses.—In man, hydrocyanic acid, when taken in medicinal but still overactive doses, may produce the following symptoms: irritation of the throat, salivation, warmth at the epigastrium, lightness of the head, dizziness, buzzing in the ears, headache, numbness, a dusky countenance, staggering, constriction of the chest, palpitation of the heart, a frequent or abnormally slow pulse, weariness, and drowsiness. Poisonous but not fatal doses have produced the following effects: insensibility, usually a feeble pulse, dilated pupils, a turgid and dusky face, heat of head, convulsions or rigidity, or both in succession, but no paralysis. Consciousness and muscular power return rapidly, considering the gravity of the initial symptoms. The symptoms attributed by Martin to chronic poisoning by this acid are dyspnœa, headache, anorexia, irritation of the throat, cough, thirst, and debility, followed by feebleness of heart, anæmia, muscular ataxia, and debility (*Amer. Journ. Med. Sci.*, Sept. 1888, p. 328). This acid may be detected in the urine. It can be developed from several articles used as food, such as bitter almond, and a bean, pois d'Achery (*Phaseolus lunatus*), which grows in Mauritius, and some varieties of which are used as food (*Practitioner*, xxxii. 434). In fatal cases it is remarkable that there are no convulsions, but relaxation rather. The pupils are usually dilated and the eyes lustrous, and the pulse sometimes grows slower until extinction. After death the skin is purplish, and all the internal veins are gorged with blood, which is dark and uncoagulated. The eyes retain their peculiar glistening aspect. The mucous membrane of the stomach is usually congested.

The dangerous potency of this acid necessarily restricts its use in medicine. It has

been employed with a certain advantage in the treatment of *whooping cough*, but is at best a palliative merely. The same may be said of its influence in cases of purely *nervous cough*, spasmodic *dysphagia*, and *angina pectoris*. It is related that in a case of the *night cough of children*, which had resisted every other treatment, the attacks ceased almost abruptly on the administration of this acid in doses of from one-half to three-quarters of a minim every 3 hours (Macdonald). In *gastralgia* there is perhaps more reason to anticipate advantage from its use, and, as the disease is often rebellious, the possibility of relieving it by prussic acid should not be overlooked. Most of the cases supposed to illustrate its efficacy were clearly not examples of pure gastralgia, but of painful dyspepsia, and very possibly instances of gastric ulcer were included among them. Probably in all the element pain was most beneficially influenced; in some, *vomiting* was palliated or arrested. These effects appear to indicate an anæsthetic action in the acid, which is more distinctly manifested by the topical use of the medicine in various *diseases of the skin* in which tingling, itching, and other distressing sensations exist.

The average *dose* of diluted hydrocyanic acid is Gm. 0.10–0.15 (2 or 3 minims), given several times a day in some neutral vehicle with the addition of a few drops of alcohol. It should be dispensed in vials covered with black paper or varnish, to prevent the decomposing action of the light; and a minimum dose should be directed when a fresh prescription is made. From Gm. 2–4 (30 minims) to a fluidrachm, in Gm. 32 (a fluidounce) of distilled water or rose-water, forms an appropriate lotion, which, however, should not be applied to the skin unless it is perfectly unbroken.

Although the experiments of Preyer upon guinea-pigs demonstrate that hydrocyanic acid and atropine are mutually antidotal when given simultaneously or in quick succession, and in duly-proportioned doses, it is nevertheless practically true that as regards man there is no antidote to the poisonous action of hydrocyanic acid. The most efficient remedy consists in the stimulation produced by the shock of cold water dashed at intervals upon the chest and spine. Subordinate in efficiency, but not to be neglected, are the application of ammonia to the nostrils, the stimulus of induced electricity, artificial respiration, and the judicious agitation of the patient.

ACIDUM HYDROFLUORICUM.—Hydrofluoric Acid.

Acidum fluorhydricum.—Hydrogen fluoride, E.; *Acide fluorhydrique, Acide phtorique*, Fr.; *Fluorwasserstoffsäure*, G.

Formula HF. Molecular weight 20.

Origin.—Fluorine exists in nature in combination with calcium as *fluor-spar*, also in *cryolite* (kryolite) and other minerals; small quantities of fluorine have been found in some mineral and potable waters, in bones, and in the ashes of various plants. The use of fluor-spar for etching on glass was known in the seventeenth century, but hydrofluoric acid was discovered by Scheele (1771), and first prepared pure by Gay-Lussac and Thénard (1808).

Preparation.—Powdered fluor-spar (or cryolite) which is free from silica is heated with sulphuric acid in a retort of platinum or lead, and the gas is conducted into distilled water contained in a well-cooled receiver of the same metal. Great caution is necessary to prevent contact with the vapors and avoid inhaling them.

Properties.—Pure hydrofluoric acid forms a thin, colorless fuming liquid which is lighter than water, does not solidify at −35° C. (−31° F.), boils at 19.4° C. (67° F.), and is freely soluble in water. The aqueous solution, which is sometimes called *fluoric acid, acide fluorique*, is heavier than water; a solution having the density 1.15 contains 35.37 per cent. HF, and boils constantly at 120° C. (248° F.) (Bineau). Like the pure acid, it is extremely caustic, and causes severe ulceration when applied to the skin. It corrodes glass and attacks most organic and inorganic compounds, but does not act upon paraffin; it is best preserved in bottles made of lead or of gutta-percha.

The element *fluorine* was isolated by H. Moissan (1886) by electrolysis of anhydrous hydrogen fluoride. It is a gaseous body similar in its properties to chlorine; its color is more yellowish than that of the latter, and has a stronger affinity toward most bodies than this. Platinum is not markedly acted on by it even at 100° C. (212° F.).

Uses.—Hydrofluoric acid in the gaseous state and its aqueous solution are used for etching glass. *Ammonium fluoride* has a similar effect; it forms white or colorless scales or prisms, which are deliquescent and should be kept in a gutta-percha bottle. According to F. L. Slocum (1880), a mixture suitable for writing on glass, like that sold at one

time as *diamond ink*, is made by mixing barium sulphate 3 parts, ammonium fluoride 1 part, and sulphuric acid sufficient to form a semfluid mixture; if kept in glass this should be coated on the inside with paraffin, wax, or gutta-percha.

Action and Uses.—According to Chevy (*Bull. de Thérap.*, cix. 108), hydrofluoric acid powerfully restrains fermentation and putrefaction. In the proportion of $\frac{1}{3000}$ it prevents these changes in milk, soup, wine, etc., and it is said that a solution of $\frac{1}{1000}$ or $\frac{2}{1000}$ is not far inferior to corrosive sublimate in removing the fetor from wounds, etc. Similar results have been more recently reported by Gottbrecht (*Therap. Monatsh.*, iii. 411). In 1855 it was described as having a penetrating smell and powerfully irritating the air-passages. Even its vapors were said to get beneath the nails, causing great pain, and a single drop of it on the skin produced a white spot, followed by vesication and a purulent discharge (Strumpf). Simpson of Edinburgh experimented with it as a caustic, and Hastings prescribed it for *phthisis*. The latter use of it was tried in France, where the exemption of engravers upon glass, who used this acid in their work, from pulmonary disease (*Bull. de Thérap.*, cix. 108), was observed by Bastien, Charcot, Seiler, Bérgeron, Trousseau, Martin, and others. Bastien, indeed, employed it also in asthma, whooping cough, and diphtheria, but soon relinquished these uses of it. Dujardin-Beaumetz placed his consumptive patients in a special chamber of the capacity of about 22 cubic metres, where the vapor of 1 grain of the acid was diffused from a leaden crucible placed in a hot-water bath (*Nouvelles méd.*, p. 100). From 1885–87 it was employed in like manner by Sellier and Garcin. The revival of this use of the acid appears to have been due to the bacillar theory of tuberculous phthisis; but hardly any who have reported their results (except Gager, *Centralbl. f. Thérap.*, vi. 603) observed any benefit beyond an increase of appetite and lessened expectoration; and Polyák concluded that it was in every respect detrimental (*ibid.*, vii. 277). A full account of the methods of employing the acid was furnished by Jarjavay (*Bull. de Thérap.*, cxiv. 211, 277). Hydrofluoric acid was used by Woakes in twenty cases of *goitre*, of which seventeen were said to have been cured. The acid was given in doses of from 15 minims to 1 drachm, thrice daily, largely diluted with water. It is true that injections of iodine and the administration of iron and bitter tonics formed part of the treatment (*Lancet*, 1881, i. 497). Waddell employed it as an arterial sedative in *aneurism*. Dr. DaCosta concluded from clinical observation that the fluorides are prompt emetics without depressing, and relieve pain without producing sleep. But they readily derange the stomach, and even in small doses produce anorexia (*Med. Record*, xx. 168).

ACIDUM HYPOPHOSPHOROSUM DILUTUM, *U. S.*—Diluted Hypophosphorous Acid.

Acide hypophosphoreux, Fr.; *Verdünnte unterphosphorige Säure*, G.

Formula HH_2PO_2. Molecular weight 65.88.

Hypophosphorous acid was discovered by Dulong (1816), and more fully investigated by H. Rose (1826).

Preparations.—Whenever calcium or barium hydroxide mixed with water is boiled with phosphorus, the respective hypophosphites are formed and enter into solution, hydrogen phosphide being eliminated at the same time, as shown by the following equation: $3Ca(OH)_2 + P_8 + 6H_2O = 3Ca(H_2PO_2)_2 + 2PH_3$; some phosphate is no doubt also formed at the same time. In order to avoid the generation of offensive gases, and also to increase the yield of hypophosphite, E. Scheffer as early as 1858 suggested the use of phosphorus which had been partially oxidized under water by means of atmospheric air; at the same time it was found that the operation could be carried on at a much lower temperature, most advantageously at about 55° C. (130° F.). For the preparation of hypophosphorous acid any of the soluble hypophosphites may be chosen; the pure acid has been obtained in crystals by Markoe and others; it possesses strong reducing properties.

The Pharmacopœia recognizes only the 10 per cent. solution of hypophosphorous acid, but for manufacturing purposes a 50 per cent. solution is found in the market; its preparation presents no difficulty, as the solution can be evaporated without loss. The National Formulary recommends the following plan: Mix a solution of 208 parts of potassium hypophosphite in 588 parts of water with a solution of 300 parts of tartaric acid in 600 parts of diluted alcohol; the mixture is to be set aside in a cold place for twelve hours, and then carefully decanted and filtered. The filtrate having been weighed, the alcohol is evaporated on a water-bath, and the original weight restored by addition

of distilled water. This constitutes the 10 per cent. acid; any acid of greater strength may be obtained from it by carefully evaporating to the required percentage; for instance, if 50 per cent. acid be desired, evaporate the 10 per cent. acid to one-fifth of its weight, etc. Conversely, a 50 per cent. acid can readily be reduced to the 10 per cent. acid by adding to it four times its weight of distilled water. Moerk (1889) suggested the use of calcium hypophosphite and oxalic acid in boiling solution, as yielding a much better product. To 69 parts of calcium hypophosphite dissolved in 450 parts of boiling water are added 50.4 parts of oxalic acid dissolved in 200 parts of boiling water; the mixture is boiled for half an hour, and, after cooling, filtered through cotton and the precipitate washed with cold water. The filtrate is finally evaporated to 88 parts, yielding a 60 per cent. acid, which can be diluted as desired; at 15.5° C. (60° F.) this acid has a specific gravity of 1.2813.

Properties.—Diluted hypophosphorous acid is a colorless, odorless liquid, having a specific gravity of 1.046 at 15° C. (59° F.). It should not become colored upon addition of hydrogen sulphide (absence of *lead*, etc.), nor should different portions, neutralized with ammonia-water, yield a precipitate with ammonium-sulphide or ammonium-oxalate solutions (absence of *iron* and *calcium*). Phosphoric, sulphuric, oxalic, and tartaric acids would be indicated by barium chloride. The strength of the acid should be determined volumetrically, 6.6 Gm. of the liquid (if of 10 per cent. strength) requiring not less than 10 Cc. of normal potassa solution. The pharmacopœial test with potassium permanganate depends upon the reducing power of the acid: 0.5 Gm. of the 10 per cent. acid will require 30.35 Cc. of $\frac{N}{10}$ $KMnO_4$ solution for complete oxidation, and if 35 Cc. of the latter be used, 4.7 Cc. $\frac{N}{10}$ oxalic-acid solution will suffice to discharge the red color.

Action and Uses.—Dilute hypophosphorous acid is never used as a therapeutic agent by itself, but in combination with its salts in the form of syrups and solutions. *Dose*, 0.6 to 4.0 Cc. (♏x–℥j).

ACIDUM LACTICUM, *U. S., Br., P. G.*—Lactic Acid.

Isolactic, Ethylidene-lactic, or Oxypropionic acid, E.; *Acide lactique*, Fr.; *Milchsäure*, G.; *Acido lactico*, Sp.

Formula $HC_3H_5O_3$. Molecular weight 89.79. Strength 75 per cent. Sp. gr. 1.213 at 15° C. (59° F.).

Acidum lacticum dilutum, *Br.*, Lactic acid, 3 fluidounces; water sufficient for 20 fluidounces. Sp. gr. 1.040.

Origin.—Lactic acid was discovered by Scheele (1780) in sour milk, in which it results from the spontaneous fermentation of the sugar of milk under the influence of the casein; $C_{12}H_{24}O_{12}$ (milk-sugar) yields $4HC_3H_5O_3$ (lactic acid). This transformation of the former into the latter is called the *lactic fermentation*. A similar change is produced in dextrin, glucose, cane-sugar, etc. by the action of casein and other protein compounds; lactic acid is therefore met with in many vegetable products which have turned sour. T. and H. Smith's *thebolactic acid* of opium is identical with the lactic acid of milk; but the *sarcolactic acid* of meat-juice, discovered by Berzelius (1807), and recognized by Liebig as differing in several respects from the lactic acid of milk, consists of two acids, one of which, known as *paralactic acid*, has the composition given above, but is dextrogyre, and the solutions of its salts have a levogyre action. The second lactic acid of flesh is like that of milk, optically inactive, but is *ethylenelactic acid*, having the composition $CH_2OH.CH_2.COOH$, and its zinc salt is soluble in absolute alcohol. Strecker (1858) observed that by heating sarcolactic acid for some time to 130° or 140° C. (266° or 284° F.) the anhydride is produced, which, dissolved in boiling water, yields ordinary lactic acid. During lactic fermentation, alcohol, several acids, a peculiar gum, and mannit are formed in variable proportions, more particularly if the temperature be allowed to vary much from about 45° C. (113° F.).

Preparation.—100 parts of sugar are dissolved in sufficient water to yield a solution of 8° or 10° B.; 8 or 10 parts of fresh cheese and 50 parts of prepared chalk are added, and the mixture placed for several weeks in a sunny place, when calcium lactate will be found crystallized (Pelouse). Boutron and Frémy dissolve 300 Gm. of milk-sugar in 4 liters of skimmed milk, expose the mixture to a temperature of from 20° to 30° C. (68° to 84° F.), and neutralize every other day with sodium bicarbonate. When it ceases to acquire an acid reaction the liquid is boiled, filtered and carefully evaporated to a syrupy consistence; this is dissolved in strong alcohol, the sodium precipitated by sulphuric acid, and the lactic acid converted into calcium lactate by the addition of

chalk. Wackenroder operates in the same manner, except that an excess of chalk is added before fermentation begins, and the mixture is kept at 24° C. (75.2° F.), and the calcium lactate is recrystallized from boiling water. This salt, obtained by one of the foregoing processes, is then decomposed by an ascertained accurate amount of sulphuric or oxalic acid. If during fermentation the lactic acid is neutralized by commercial zinc-white, zinc lactate is obtained, which may be decomposed by hydrogen sulphide. Lautemann, who proposed this modification (1860) followed in the main Bensch's directions, dissolving 6 pounds of cane-sugar and ½ ounce of tartaric acid in 35 pounds of boiling water, adding after 2 days 4 ounces of old cheese diffused in 8 pounds of sour milk, and exposing the mixture to a temperature of 40° C. (104° F.). Below 20° C. (68° F.) the production of lactic acid is impeded; above 40° C. (104° F.) butyric acid begins to be formed.

A more expeditious method for the preparation of lactic acid has been described by H. Kiliani (1882): 500 Gm. of cane-sugar, dissolved in 250 Gm. of water, are converted into invert-sugar by boiling with 10 Ccm. of sulphuric acid; 450 Ccm. of solution, made of equal parts of caustic soda and water, are gradually added, and the mixture is heated to 60° or 70° C., until it ceases to react for sugar with Fehling's solution. The liquid is neutralized with sulphuric acid, the sodium sulphate allowed to crystallize, and the remainder precipitated by alcohol; one-half of the clear alcoholic liquid is heated, neutralized with zinc carbonate, mixed with the other half, and cooled, when zinc lactate will crystallize, from which the acid may be obtained in the usual manner.

Properties.—Lactic acid of the Pharmacopœia is a syrupy, colorless liquid, having no odor, a very sour taste, and the specific gravity 1.213; it absorbs moisture when exposed to damp air; the pure acid is colorless, inodorous, and has the specific gravity 1.215 at 20.5° C. (68.9° F.), or, according to Mendelejeff, 1.2485 at 15° C. (59° F.). In this market two commercial varieties of lactic acid are largely met with, designated respectively as concentrated and dilute lactic acid; since neither specific gravity nor percentage is indicated, the terms are meaningless and sure to lead to confusion. It unites in all proportions with water, alcohol, and ether, but is insoluble in chloroform, carbon disulphide, and benzin. It forms with cold concentrated sulphuric acid a clear liquid, which on heating becomes brown and black. On warming the acid with potassium permanganate the odor of aldehyde is given off. When kept at ordinary temperature over sulphuric acid, Wislicenus (1870) obtained *dilactic acid*, an amorphous bitter anhydride of the composition $C_6H_{10}O_5 = C_3H_4O_2.C_3H_6O_3$. The same compound is formed from lactic acid at from 110° to 130° C. (230° to 266° F.), and at about 150° C. (302° F.) the anhydride *lactid*, $C_3H_4O_2$, is obtained in volatile, fusible rhombic plates. Both anhydrides are insoluble in water, but on prolonged boiling with it, or more rapidly by dissolving in alkaline liquids, yield lactic acid. When distilled at a higher temperature or when heated in the open air, lactic acid decomposes, giving off a suffocating odor and forming a spongy charcoal, which is finally consumed, leaving not over 1 per cent. of residue (*U. S.*). It coagulates milk and albumen, and displaces carbonic and acetic acids from their compounds, yielding salts which are soluble in water, and mostly also in alcohol. Lactic acid on being oxidized by nitric acid yields oxalic acid, and by treatment with chromic acid formic and acetic acids are produced. On oxidizing ethene lactic acid large crystals of *malonic acid*, $C_3H_4O_4$, are obtained. 90 grains of the official acid are neutralized by 75 grains of potassium bicarbonate, or 4.5 Gm. of the acid by 37.5 Cc. of volumetric solution of soda, indicating 75 per cent. of $HC_3H_5O_3$, phenolphtalein being used as indicator (*U. S.*).

Impurities.—Treated with a hot solution of potassa, lactic acid is not materially colored; if it readily becomes brown, extractive matters are present. Dissolved in strong alcohol, gum and some mineral salts are left behind. Glycerin, glucose, mannit, tartaric acid, and most salts remain undissolved by ether. Acetic and butyric acids are recognized by their odor, which becomes more apparent on warming. For detecting other organic and mineral acids their special tests may be applied. In the diluted acid calcium salts are indicated by ammonium oxalate; lead, by hydrogen sulphide; zinc, after neutralization with ammonia, by ammonium sulphide; sulphuric acid, by barium chloride; sarcolactic acid, by copper sulphate; hydrochloric acid, by silver nitrate; and oxalic acid, by calcium chloride, after previously diluting the acid with twenty times its quantity of water and neutralizing with ammonia. On saturating the acid with zinc carbonate, drying at 100° C., and treating with absolute alcohol, zinc sarcolactate will be dissolved; also glycerin and mannit if present.

On adding 1 Cc. of lactic acid, drop by drop, to 2 Cc. of ether, no turbidity, either

transient or permanent, should be observed (*P. G.*); this is intended to prove the absence of glycerin, sugar, mannit, etc. The absence of sugars is also determined by the failure of the acid producing red cuprous oxide on being added to hot Fehling's solution. Solution of copper sulphate should have no effect upon a 10 per cent. solution of lactic acid (absence of sarcolactic acid). The limits of allowable impurities are determined as follows: 10 Cc. of a 1 per cent. aqueous solution of the acid should not be rendered opalescent by the addition of 1 Cc. of silver nitrate T. S. (limit of *chloride*). On mixing equal volumes of lactic and colorless sulphuric acids in a small, clean, glass-stoppered vial, the mixture should not acquire a tint deeper than a pale straw color (absence of more than traces of *organic impurities*, such as sugar, extractive, etc.).

Action and Uses.—Lactic acid is normally secreted by the stomach, and may be detected in the sweat and urine. Its excess in the system seems to be one of the most striking phenomena of rheumatism, and several cases have been published, in all of which its free administration during diabetes occasioned an attack of articular rheumatism. According to Mendel, it is hypnotic in large doses. Lactic acid has been employed in the treatment of various forms of *dyspepsia*, but chiefly in those presumed to depend upon debility of the stomach, and then as a solvent for pepsin. Hayem and Lesage considered lactic acid one of the best remedies for *infantile diarrhœa*. They used a 2 per cent. solution, of which from 15 to 20 dessertspoonfuls were given in the twenty-four hours (*Annuaire de Thérap.*, 1888, p. 80). Their results have been confirmed by Shaw (*New York Med. Jour.*, xlviii. 123). Huchard did not find that *tuberculous diarrhœa* was controlled by doses of 30 to 60 grains a day; but Sezary and Aune alleged that daily doses of 30 to 120 grains a day controlled the disorder (*Therap. Gaz.*, xiii. 41). The treatment can only be palliative when the diarrhœa depends upon tubercular ulcers. Lactic acid in a 20–40 per cent. solution has been used with advantage to correct the fetor and promote the cure of suppurative *otitis* (*Centralbl. f. Ther.*, vii. 118), and in ulcerative disease of the *nasal fossæ* (Astier, *Bull. de Thérap.*, cxvi. 327). Some years ago Cantani suggested that, in addition to the use of an exclusively animal diet in *diabetes*, an agent ought to be employed which would prevent the waste of the tissues by furnishing an appropriate substance in their stead. For this end he proposed lactic acid, which he believed would supply the very product which the deranged liver was no longer capable of furnishing. Whatever may be thought of the theory, it appears certain that, in the hands of the physician named, and in those of Dr. Balfour and Dr. Foster, several cases of diabetes treated by this medicine were improved by it more than by any other means whatever, the secretion of urine falling to the normal standard, while it became free from sugar and the patients regained their flesh and strength. From Gm. 8–16 (2–4 drachms), diluted in Gm. 250–320 (8–10 ounces) of water, were taken during the day. The remarkable solubility of false membranes in lactic acid led to its use in *diphtheria* and in *croup* (pseudo-membranous laryngitis); and the reports of several observers appear to prove that when the acid is applied with a mop in the former, and by atomization or the syringe in the latter disease, it may contribute to the cure. For the purpose last described a solution was used of 1 part of the acid in 20 parts of water.

In 1885, Mosetig-Moorhof (*Centralbl. f. Therap.*, iii. 216) used concentrated lactic acid as a caustic in cases of fungous *caries*, *lupus*, and *epithelioma*, and claimed that while it destroyed the morbid growth, it did not attack the healthy tissues. He applied it on linen cloth or on absorbent cotton, covered with impermeable tissue and a bandage, after protecting the surrounding skin with adhesive plaster. When the caustic was removed at the end of twelve hours, the part was cleansed, and water dressings were applied during from twelve to twenty-four hours. The acid was then applied anew, and the process repeated as often as necessary. The pain of the application was said to last only a few hours. Soon afterward Krause (*ibid.*, iii. 397) applied solutions of the acid, varying in strength from 10 to 80 per cent., to *ulcers* and *morbid growths* within the *larynx*, taking care to use no more of the solution than was necessary. The sensibility of the part was first blunted with cocaine. The benefit of this treatment depends, of course, upon the nature of the lesion. Usually it is only temporary, but it prolongs life and lessens suffering. These observations have been confirmed and carried further by Jelink (*ibid.*, iii. 529), Bum, and others; but the first named did not favor the treatment of *lupoid* growths with the acid, and denied that it respects the normal tissue of the part to which it is applied. He claimed that it is the best caustic application for *laryngeal* and *pharyngeal* affections, and especially for *tuberculous ulcers* of the larynx, securing a degree of comfort in breathing and swallowing which had before been unattainable. The

observations of Rafin agree with the above (*Practitioner*, xli. 214), as do those of Ihering (*Bull. de Thér.*, cxii. 283).

Mendel claims that laetic acid relieves *insomnia* produced by nervous excitement, and especially by fright. He recommends that Gm. 4–8 (fʒj–ij) be given in lemonade, or that much larger doses be administered by enema; *e. g.* Gm. 8–16 (fʒij–iv). In such cases the acid should be neutralized by bicarbonate of sodium. The results of Maragliano's use of the medicine in the insane hardly justify a belief in its hypnotic virtues.

ACIDUM NITRICUM, *U. S., Br., P. G.*—Nitric Acid.

Acidum nitri s. azoticum, *Spiritus nitri acidus.*—*Acide azotique s. nitrique*, Fr.; *Salpetersäure*, G.; *Acido nitrico*, It., Sp.

Formula $HNO_3 = NO_2.OH$. Molecular weight 62.89. Strength 68 per cent. *U. S.*, 70 per cent. *Br.*, 25 per cent. *P. G.* Spec. grav. 1.414 *U. S.*, 1.42 *Br.*, 1.153 *P. G.*

Diluted Nitric Acid. Strength, 10 per cent. *U. S.*, 17.44 per cent. *Br.* Spec. grav. 1.057 *U. S.*, 1.101 *Br.*

Origin.—Nitric acid occurs chiefly in combination with the alkalies and alkaline earths, and in localities where vegetable or animal matter has undergone putrefaction. It is found in the juice of many plants and in small quantities in rain- and snow-water. A process for preparing this acid was first made public by Geber in the eighth century, and its composition was determined by Cavendish (1785) and Davy (1816). For medicinal and technical purposes nitric acid is made by decomposing sodium or potassium nitrate by sulphuric acid.

Preparation.—1. Acidum Nitricum. It is prepared on the large scale in apparatus constructed similar to that used in the manufacture of hydrochloric acid. The sulphuric acid acts upon potassium nitrate, forming acid potassium sulphate, and liberating the nitric acid; thus $KNO_3 + H_2SO_4 = KHSO_4 + HNO_3$. The resulting acid salt does not decompose another molecule of potassium nitrate, except at so high a temperature that most of the nitric acid then given off will be decomposed into nitrous acid and oxygen. 1 molecule or 101 parts of potassium nitrate will therefore require 1 molecule or 98 parts of concentrated sulphuric acid. The same amount of nitric acid may be obtained from 1 molecule or 85 parts of sodium nitrate; but, according to Wittstein (1838), the sulphuric acid requires to be diluted with one-fourth its weight of water to prevent the mass in the retort from being carried over into the receiver, the foaming being prevented by supplying the acid sodium sulphate with the necessary water of crystallization. Graham showed that the reaction of acid sodium sulphate upon sodium nitrate occurs at a much lower temperature than between the corresponding potassium salts; hence, all the nitric acid may be obtained from 2 molecules or 170 parts of sodium nitrate with 98 parts of sulphuric acid, the decomposition furnishing sodium sulphate; $2NaNO_3 + H_2SO_4$ yields $2HNO_3 + Na_2SO_4$. The violent foaming of the residue toward the close of the operation is prevented by the addition of a little water or by the use of weaker sulphuric acid. Stieren recommends (1865) the employment of 21 pounds of sulphuric acid, specific gravity 1.717, for 24 pounds of sodium nitrate, as a charge for a retort of 5 or 6 gallons capacity; about one-fourth of the residue in the retort consists of acid sodium sulphate, the remainder being neutral sulphate.

In the manufacture of nitric acid from sodium nitrate, sulphuric acid may be replaced by manganous chloride, sulphate of iron, magnesium sulphate, and similar salts, the metals of which remain as oxides in the retort with the sodium salt; but in most cases the heat necessary to effect the reaction is sufficient to decompose a considerable portion of the nitric acid.

As obtained on the large scale it usually contains nitrogen tetroxide, N_2O_4, which imparts to it a red or yellow color. This is removed by applying to it a moderate heat, and after the red vapors have escaped the acid is diluted to the desired strength.

The sodium and potassium nitrates, as they occur in commerce, contain variable quantities of chlorides, from which, if used in the above process, hydrochloric acid is liberated, and this, reacting with some of the nitric acid, produces chlorine, which, for this reason, may contaminate the nitric acid. If the acid is desired in a pure state, the nitrates must be previously purified by repeated recrystallization, or the impure acid rectified either by itself or over some nitrate. The first portion of the distillate contains the chlorine, and the receiver is changed when the condensed liquid ceases to produce a curdy precipitate with silver nitrate. Iodine, if present from the sodium nitrate, will likewise be found in this part of the distillate. The distillation is continued into the new receiver until about

one-fifth or one-sixth is left in the retort, from which, if the heat is continued, nitrogen tetroxide is again produced. Formerly the chlorine and iodine were removed from the crude acid by silver nitrate; the acid was carefully decanted from the precipitate and rectified. The process of direct rectification, as already described, is more advantageous, from one-half to three-fourths being obtainable in the pure state, according to the purity of the crude acid used.

2. Acidum Nitricum Fumans, *P. G.*; Acidum nitroso-nitricum, Spiritus nitri fumans. —Fuming nitric acid, Nitroso-nitric acid, *E.*; Acide azotique fumante, *Fr.*; Rauchende Salpetersäure, *G.*

If one-half the amount of sulphuric acid is employed as stated above for the preparation of nitric acid from potassium nitrate, and the heat is finally increased until the reaction between the acid sulphate and the remaining potassium nitrate has been completed, the distillate will be nitric acid containing a considerable quantity of nitrogen tetroxide, N_2O_4, and nitrous anhydride or nitrogen trioxide, N_2O_3; in the presence of water these two compounds may decompose, with the formation of nitric acid and of nitrous acid, HNO_2, and nitrogen dioxide, N_2O_2. Fuming nitric acid therefore contains, besides HNO_3, variable quantities of lower nitrogen oxides.

3. Acidum Nitricum Crudum, *P. G.*—Crude nitric acid, *E.*; Rohe Salpetersäure, *G.* A clear colorless or faintly yellow liquid, when heated volatile without residue, and containing 61 per cent. of absolute HNO_3. Its specific gravity is 1.38–1.40.

4. Acidum Nitricum Dilutum, *U. S.*, *Br.*—Diluted nitric acid, *E.*; Acide azotique dilué, *Fr.*; Verdünnte Salpetersäure, *G.*

Mix 10 Gm. of nitric acid with 58 Gm. of distilled water.—*U. S.* Dilute 6 fluidounces of nitric acid with sufficient distilled water, so that at a temperature of 60° F. it shall measure 31 fluidounces, or dilute 2400 grains of nitric acid with distilled water, so as to obtain 1 imperial pint of the mixture.—*Br.*

Properties.—1. Nitric Anhydride, Nitrogen Pentoxide.—This was discovered by St. Clair Deville (1849) in decomposing pure crystallized silver nitrate by absolutely dry chlorine gas. It forms colorless shining prisms, which readily decompose into nitrogen tetroxide and oxygen, fuse at about 30° C. (86° F.) into a liquid boiling near 50° C. (122° F.), and deliquesce rapidly when in contact with moist air. Its composition is N_2O_5, molecular weight 107.82; combining with 1 molecule of water, H_2O, it forms 2 molecules of nitric acid, $2HNO_3$.

2. Crude Nitric Acid.—As met with in commerce, it is either colorless or of a pale yellowish color, and contains the impurities mentioned above, together with a little iron. It is often called *aqua fortis;* the weaker kind is of about 1.21 specific gravity, being known as single aqua fortis, and the stronger, of specific gravity 1.37, as double aqua fortis. Crude nitric acid is extensively used in many chemical processes.

3. Pure Nitric Acid.—It is a colorless liquid, wholly volatilized by heat. The concentrated acid or hydrogen nitrate, corresponding in composition to the formula HNO_3, has at 0° C. (32° F.) the specific gravity 1.559. When exposed to the light or heated to near its boiling-point, 86° C. (186.8° F.), it is decomposed partly into water and nitrogen tetroxide, so that its boiling-point is not constant. Nor is the boiling-point of weaker acids constant. Those below and those above the specific gravity 1.42 boil at a constantly rising temperature, until the acid in the retort has been raised or lowered in strength to correspond to the formula $2HNO_3 3H_2O$, when its boiling-point will be stationary at 121° C. (249.8° F.), and it will have at 15.5° C. (60° F.) the specific gravity 1.42 (Graham). This strength of nitric acid has been adopted as the official standard in the British and French Pharmacopœias. According to Roscoe, nitric acid containing between 70 and 65 per cent. of hydrogen nitrate yields, after continued boiling, a liquid the boiling-point of which is 120.5° C. (248.9° F.) at a barometer pressure of 735 Mm., and the specific gravity of which is 1.414 at 15.5° C. (60° F.). It contains 68 per cent. of hydrogen nitrate, while Graham's acid should contain 69.96 per cent. The existence of a definite hydrate having a constant boiling-point appears, therefore, somewhat doubtful. The strength is determined by diluting the acid with four or five times its weight of water, and neutralizing with volumetric solution of soda; 6.29 Gm. of the acid require 68 Cc. of the normal alkali solution (*U. S.*), or 90 grains of the former and 1000 grain-measures of the latter (*Br.*), indicating respectively 68 and 70 per cent. HNO_3, or 58.29 and 60 per cent. N_2O_5. The acid of the German Pharmacopœia is much weaker, its spec. grav. being 1.153.

Nitric acid is a powerful oxidizing agent, converting most metals into oxides or nitrates and decomposing most organic compounds. At the same time orange-red vapors are

given off, which are either the trioxide, N_2O_3, or the dioxide, NO_2, the latter being colorless, but acquiring a deep-red color in contact with oxygen. Exposed to the direct or diffused sunlight, even if of less than the official strength, it is partly decomposed, becomes red, and then contains lower nitrogen oxides. It is monobasic and combines with most of the basylous radicals, all its compounds being soluble in water, with the exception of a few so-called basic nitrates, such as bismuth subnitrate.

The following table, corrected by Prof. Lunge, shows the specific gravity of nitric acid as compared with water at 15° C. (59° F.) and also the percentage by weight of absolute HNO_3 and N_2O_5.

Specific Gravity $\frac{15°\ C.}{15°\ C.}$ at in air.	100 parts contain — parts of		Specific Gravity $\frac{15°\ C.}{15°\ C.}$ at in air.	100 parts contain — parts of		Specific Gravity $\frac{15°\ C.}{15°\ C.}$ at in air.	100 parts contain — parts of	
	N_2O_5.	HNO_3.		N_2O_5.	HNO_3.		N_2O_5.	HNO_3.
1.0001	0.08	0.10	1.206	28.36	33.09	1.402	55.97	65.30
1.0059	0.85	1.00	1.211	28.99	33.82	1.407	56.92	66.40
1.0109	1.62	1.90	1.216	29.6 1	34.55	1.412	57.86	67.50
1.0159	2.39	2.80	1.219	30.	35.	1.414	. .	68.
1.021	3.17	3.70	1.221	30.24	35.28	1.417	58.83	68.63
1.026	3.94	4.60	1.226	30.88	36.03	1.4228	59.83	69.80
1.028	. .	5.	1.231	31.53	36.78	1.422	60.	70.
1.031	4.71	5.50	1.236	32.17	37.53	1.427	60.84	70.98
1.033	5.		1.241	32.82	38.29	1.432	61.86	72.17
1.036	5.47	6.38	1.246	33.47	39.05	1.437	62.91	73.39
1.041	6.22	7.26	1.251	34.13	39.82	1.442	64.01	74.68
1.046	6.97	8.13	1.252	. .	40.	1.443	. .	75.
1.051	7.71	8.99	1.256	34.78	40.58	1.446	65.	
1.056	8.43	9.84	1.258	35.		1.447	65.13	75.98
1.057	. .	10.	1.261	35.44	41.34	1.452	66.24	77.28
1.061	9.15	10.68	1.266	36.09	42.10	1.457	67.38	78.60
1.066	9.87	11.51	1.271	36.75	42.87	1.462	68.56	79.98
1.067	10.		1.276	37.41	43.64	1.4655	. .	80.
1.071	10.57	12.33	1.281	38.07	44.41	1.467	69.79	81.42
1.076	11.27	13.15	1.285	. .	45.	1.472	71.06	82.90
1.081	11.96	13.95	1.286	38.73	45.18	1.477	72.39	84.45
1.086	12.64	14.74	1.291	39.39	45.95	1.479	. .	85.
1.088	. .	15.	1.2957	40.		1.482	73.76	86.05
1.091	13.31	15.53	1.296	40.05	46.72	1.487	75.18	87.70
1.096	13.99	16.32	1.301	40.71	47.49	1.492	76.80	89.60
1.101	14.67	17.11	1.306	41.37	48.26	1.493	. .	90.
1.103	15.		1.311	42.06	49.07	1.497	78.52	91.60
1.106	15.34	17.89	1.316	42.76	49.89	1.5005	80.	
1.111	16.00	18.69	1.317	. .	50.	1.502	80.65	94.09
1.116	16.67	19.45	1.3215	43.47	50.71	1.503	81.09	94.60
1.1195	. .	20.	1.327	44.67	51.53	1.5038	. .	95.
1.121	17.34	20.23	1.332	44.89	52.37	1.504	81.50	95.08
1.126	18.00	21.00	1.333	45.		1.505	81.91	95.55
1.131	18.66	21.77	1.337	45.62	53.22	1.506	82.29	96.00
1.136	19.32	22.54	1.342	46.35	54.07	1.507	82.63	96.39
1.141	19.98	23.31	1.347	47.08	54.93	1.508	82.94	96.76
1.1412	20.		1.3474	. .	55.	1.509	83.26	97.13
1.146	20.64	24.08	1.352	47.82	55.79	1.510	83.58	97.50
1.151	21.29	24.84	1.357	48.57	56.66	1.511	83.87	97.84
1.152	. .	25.	1.362	49.35	57.57	1.512	84.09	98.10
1.156	21.94	25.60	1.366	50.		1.513	84.21	98.32
1.161	22.60	26.36	1.367	50.13	58.48	1.514	84.46	98.53
1.166	23.25	27.12	1.372	50.91	59.39	1.515	84.63	98.73
1.171	23.90	27.88	1.375	. .	60.	1.516	84.78	98.90
1.176	25.54	28.63	1.377	51.69	60.30	1.517	84.92	99.07
1.180	25.		1.382	52.52	61.27	1.5177	85.	
1.181	25.18	29.38	1.387	53.35	62.24	1.518	85.04	99.21
1.185	. .	30.	1.392	54.20	63.23	1.519	85.15	99.34
1.186	25 83	30.13	1.3996	55.		1.520	85.26	99.46
1.191	26.47	30.88	1.397	55.07	64.25	1.521	85.35	99.57
1.196	27.10	31.62	1.401	. .	65.	1.522	85.44	99.67
1.201	27.74	32.36						

The density of pure nitric acid varies with its strength. In taking its specific gravity

the absence of notable quantities of nitrogen tetroxide should be ascertained, since they increase the density.

4. Fuming Nitric Acid has a brown-red color, and when in contact with the air emits vapors of the same color, which are of a suffocating odor. It requires to be kept in a cool place, and caution should be exercised in removing the stopper, lest a portion of the liquid should be violently ejected with the escaping vapors. The German Pharmacopœia requires for this preparation a specific gravity of from 1.45 to 1.50. The so-called *nitrous acid* of our commerce is a similar but weaker article, consisting of nitric acid, which is colored red by variable quantities of nitrogen tetroxide. If nitrogen trioxide, N_2O_3, is conducted into nitric acid, a corresponding quantity of nitrogen tetroxide, N_2O_4, is formed; thus: $N_2O_3 + 2HNO_3 = 2N_2O_4 + H_2O$. This compound is colorless at — 10° C. (14° F.), orange-red at 10° C. (50° F.), and darker red above this temperature.

5. Diluted Nitric Acid is colorless, has the specific gravity 1.057, and 12.6 Gm. of it are neutralized by 20 Cc. of the volumetric solution of soda, corresponding to 8.57 per cent. N_2O_5 or 10 per cent. HNO_3, *U. S.* That of the British Pharmacopœia has the specific gravity 1.101, and 361.3 grains of it (6 fluidrachms) require for neutralization 1000 grain-measures of the volumetric solution of soda, corresponding to 14.95 per cent. N_2O_5 or 17.44 per cent. HNO_3.

Impurities.—Such as are likely to be present have been mentioned above. Mineral impurities are left behind as a fixed residue on evaporation, and may then be recognized by appropriate tests. Iodine is detected by agitating the acid with chloroform, which will acquire a reddish color and impart to starch a blue color. If the color appears only after the careful addition of hydrogen sulphide, iodic acid has been present; with an excess of hydrogen sulphide the iodic acid would be converted into colorless hydriodic acid, $2HIO_3 + 6H_2S = 6H_2O + 2HI + 3S_2$. Diluted with 5 volumes of distilled water, nitric acid should not produce any precipitate with silver nitrate (chlorine or hydrochloric acid), barium nitrate (sulphuric acid), or hydrogen sulphide, either before or after neutralization with ammonia (metals). The diluted acid should not be colored blood-red by potassium sulphocyanate (iron) or blue by starch-paste (iodine.) Traces of arsenic are best detected by Fleitmann's test (see page 27), and the lower nitrogen oxides by the decoloration of solution of potassium permanganate or the liberation of iodine from solution of potassium iodide. As stated above, such lower oxides are formed on exposure to sunlight.

Pharmaceutical Uses.—Nitric acid is largely used for dissolving metals (bismuth, iron, mercury, and silver), for the oxidation of ferrous to ferric compounds and of phosphorous to phosphoric acid, and in the preparation of nitrous ether and amyl nitrite.

Action and Uses.—Several cases have been reported of death from inhaling the fumes of nitric acid. In 1854 (*Lancet*, Apr. 1854, p. 429) a chemist lost his life from inspiring the fumes of this acid mixed with those of sulphuric acid. The chief symptom was dyspnœa, and the lesions were congestion and hæmorrhage of the bronchia. In 1884 the poisoning of four persons by the fumes of nitric acid was reported (*Boston Med. Jour.*, May, 1884, p. 496). The symptoms were shallow breathing and dyspnœa, pallor, cough, rapid pulse, absence of râles, except in the one fatal case and near its close. The lungs were engorged and the bronchi congested; the blood in the heart dark and firmly clotted. In a third case three men died who had been exposed to the acid fumes in the hold of a ship (*Med. Record*, xxx. 185; for later cases see *Zeitsch. f. klin. Med.*, xiv. 502). If medicinal doses are long continued, unless precautions are taken the acid impairs and may destroy the enamel of the teeth. It increases the appetite and augments the secretion of urine. A white coating generally covers the tongue; the mouth at first grows dry, but later the salivary secretion may become profuse, while the gums grow spongy and bleed, and the teeth ache and are loosened. If continued, it occasions dyspepsia, colic, foul breath, headache, feverishness, debility, and derangement of the bowels. These symptoms are said to be occasioned by nitric-acid baths as well as by the internal use of the acid. They rapidly subside when the medicine is suspended.

Formerly used as a *disinfectant*, it was abandoned on account of the irritating quality of its fumes and of the introduction of chlorine and various other more efficient and less annoying agents. It was given internally in *typhus* and other low types of *fever* with presumed, but by no means demonstrated, advantage. In periodical, and especially *intermittent*, fevers, it has been proved to be one of the most efficient substitutes for cinchona, and indeed to cure many cases in which quinine was inoperative. From 6 to 8 drops of the acid, properly diluted, should be given every six hours without regard to remissions or exacerbations. It was formerly used in the treatment of *dysentery* and

other bowel affections on the recommendation of Hope, who employed nitrous acid ♏xxx and laudanum ♏xx, in camphor-water f℥iv, of which mixture a tablespoonful was given every two hours. At one time it enjoyed a certain reputation in *whooping cough*, for which very large doses were administered. As far as it did good, the effect was probably due to the stimulant and substitutive action of the acid upon the fauces. By the same agency it doubtless palliates the cough of *bronchitis* and *hoarseness* due to over-exertion of the voice; it also promotes the cure of syphilitic and other *ulcers* of the throat. When used long enough to excite ptyalism it is reputed to have cured constitutional *syphilis*. In the last-named disease it has been seldom prescribed since the introduction of iodide of potassium. It would seem to allay the thirst of *diabetes*, and the daily administration of Gm. 4–16 (from 1 to 3 or 4 drachms) of the acid in a quart of water has certainly cured several cases of *diabetes insipidus* (Kennedy). This treatment should be persevered in until the affection of the mouth produced by the medicine, and above described, is distinctly developed. In chronic enlargement of the *liver* in scorbutic, strumous, and syphilitic subjects, as well as in *jaundice* depending upon hepatic congestion, and in *scrofula* of the lymphatic glands, it appears to have been often efficacious. In chronic *impetigo* it has sometimes proved successful when other medicines were ineffectual. Externally, nitric acid has been much employed as a caustic for the *bites of rabid animals*, *poisonous serpents* and *insects*, etc. As already intimated, it forms an excellent ingredient of gargles for the treatment of syphilitic and other obstinate *ulcers* of the throat, as well as for sloughing sores in the mouth. It is an efficient application to ulcerated gums produced by mercury. In both of the last-mentioned cases it has been superseded by chlorate of potassium. Commercial nitric acid has been applied (T. G. Thomas) to ulcers of the rectum in *chronic dysentery*. The patient should first be etherized, the bowel exposed by means of a duck-bill speculum, and commercial nitric acid lightly applied by means of a small piece of wet cotton wrapped around the end of a whalebone rod. This method was used in imitation of a similar application of nitrate of silver. Lotions or foot-baths containing nitric acid are useful in the treatment of *chilblains*, and a mixture of equal parts of dilute nitric acid and peppermint-water has been similarly employed. General baths feebly acidulated with nitric acid have been recommended for *infantile jaundice*. It is a very useful application to *periostoses* when used so as to maintain a slight irritation of the skin; and as a caustic it is often resorted to for the destruction of *warts*, venereal and non-specific, and of *condylomata* and *hæmorrhoids*. For these purposes its action should be limited to the diseased structure by means of cerate; or lint saturated with concentrated nitric acid, and adapted to the part in shape and size, may be allowed to remain in contact with it for a sufficient time. The tissue may have its sensibility blunted by carbolic acid, by rhigolene, cocaïne, or other anæsthetic, or by cold; or the patient may be etherized during the operation. In *caries* of the bones and *sloughing* of the soft parts it may be used to hasten the separation of the diseased tissue. Nitric acid is the most usual test for *albumen* in the *urine*. If it is added drop by drop to the urine in a test-tube, the coagulated albumen will cloud the liquid. Or if the acid be first placed in the tube, and the albuminous urine dropped or gently poured upon its surface, a zone of coagulated albumen will appear at the line of junction. The *dose* of the stronger acid is Gm. 0.30–1.30 (♏x–xx), and of the diluted acid Gm. 1.60–3.30 (♏xxv–l) three or four times a day, largely diluted. It should always be taken through a glass tube, and immediately afterward the mouth should be washed with a solution of bicarbonate of sodium.

ACIDUM NITROHYDROCHLORICUM, *U. S.*—Nitrohydrochloric Acid.

Acidum chloro-nitrosum, *Acidum nitromuriaticum*, *Aqua regia*, *Aqua regis*.—*Nitromuriatic acid*, E.; *Acide chloro-azotique s. chloro-nitreux*, *Eau régale*, Fr.; *Salpetersalzsäure*, *Königswasser*, G.

Preparation.—Take of Nitric Acid 180 Cc.; Hydrochloric Acid 820 Cc. Mix the acids in an open glass vessel, and when effervescence has ceased pour the product into glass-stoppered bottles, which should not be more than half filled, and keep them in a cool, dark place—*U. S.* (If 4½ fluidrachms of nitric acid and 20½ fluidrachms of hydrochloric acid be mixed, the official proportions will remain undisturbed.)

The French Codex directs 1 part of nitric acid, spec. grav. 1.32, and 3 parts of hydrochloric acid spec. grav. 1.17.

This preparation should never be made extemporaneously, as time must be allowed for

complete reaction, which is ascertained by cessation of effervescence; moreover, the vessel containing the acids should be kept in a cool place in the open air, as the fumes arising from the mixture are extremely annoying. As soon as reaction has ceased, the liquid should be poured into bottles as directed, and kept in a cool, dark place, so that the chlorine and nitrosyl chloride may remain as such.

The acid must always be dispensed in dark glass-stoppered vials, and the patient should be cautioned against exposing the vial to light and heat, so as to avoid accidents.

ACIDUM NITROHYDROCHLORICUM DILUTUM, *U. S., Br.*— Diluted Nitrohydrochloric Acid.

Acidum nitromuriaticum dilutum.—Diluted nitromuriatic acid, E.; *Acide chlorazotique dilué*, Fr.; *Verdünnte Salpetersalzsäure*, G.

Preparation.—Take of Nitric Acid 40 Cc.; Hydrochloric Acid 180 Cc.; Distilled Water 780 Ccm. Mix the acids in a capacious open glass vessel, and when effervescence has ceased add the distilled water. Keep the product in glass-stoppered bottles in a cool place.—*U. S.*

By mixing 2 fluidrachms of nitric acid with 9 fluidrachms of hydrochloric acid, and finally adding 39 fluidrachms of distilled water, the official strength will be preserved.

It is imperative that the reaction between the strong acids be completed before the water is added, even though the theory has been advanced by some that the new compounds formed are restored to the original condition of the acids by water.

The Br. Pharm. merely directs that 3 fluidounces of nitric acid and 4 fluidounces of hydrochloric acid be added to 25 fluidounces of distilled water, the mixture to be kept in a glass-stoppered bottle for fourteen days before it is used. The dilute acid must have a specific gravity of 1.07, and 352 grains of it (6 fluidrachms) require for neutralization about 833 grain-measures of volumetric solution of soda.

On mixing nitric with hydrochloric acid a decomposition takes place, resulting in the liberation of chlorine and the formation of water and chlorinated nitrogen oxides. This preparation has received the name of *aqua regia* from its property of dissolving gold, the king of metals, which is due to the presence of free chlorine; for the same reason are dissolved platinum, calomel, and all other metals and compounds which yield soluble chlorides. Its activity therefore depends upon the amount of free chlorine contained in it. The British Pharmacopœia employs the two acids very nearly in equal proportions by weight, while the proportion directed by the U. S. Pharmacopœia is 1 of nitric to 3.68 of hydrochloric acid. The chlorinated compounds formed in the two processes must therefore differ to some extent; in the latter case the reaction may take place as follows: $HNO_3 + 3HCl = Cl_2 + NOCl$ (nitrosyl chloride) $+ 2H_2O$, or according to this equation: $2HNO_3 + 6HCl = Cl_2 + 2NOCl_2$ (chloro-hyponitric acid) $+ 4H_2O$. A third compound, *chloronitric acid* or *nitrylic chloride*, NO_2Cl, is likewise formed, particularly if a larger proportion of hydrochloric acid be used; it is a yellow liquid, boiling at 5° C. (41° F.), and decomposed by water into nitric and hydrochloric acids. *Chloronitrous acid* or *nitrosyl chloride* is a yellowish-red liquid which boils at—5° C. (23° F.), and with water yields hydrochloric and nitrous acids. Gay-Lussac, its discoverer, described the *chloro-hyponitric acid* as boiling at —7° C. (19.4° F.), forming a lemon-yellow gas, and with water decomposing into hyponitric and hydrochloric acids. According to the older views, nitromuriatic acid is essentially a mixture of chlorine and nitrogen tetroxide, N_2O_4, the reaction being explained as follows: $2HCl + 2HNO_3 = Cl_2 + N_2O_4 + 2H_2O$.

As the stability of these compounds is influenced by temperature and by water, it is obvious that the composition of nitromuriatic acid must vary with the proportion and the strength of the acids employed, and with the temperature at which they have been mixed; at a low temperature this mixture may be kept without evolution of gas, but at ordinary or a somewhat elevated temperature a variable mixture of gas is given off; hence the necessity of not dispensing this preparation until after effervescence has ceased, and of keeping it in vials not quite filled.

Properties.—Nitrohydrochloric acid is a liquid having a deep golden-yellow color and the odor of chlorine. It readily dissolves gold-leaf, liberates iodine and bromine from their salts, and is wholly volatilized by heat. It should be kept in a cool and dark place, and dispensed in dark- or yellow-colored bottles. It should not be kept on hand for a long time.

In the diluted nitrohydrochloric acid the nitrosyl chloride has probably been decomposed by the water into hydrochloric acid and nitrogen trioxide, thus: $2NOCl + H_2O =$

$2HCl + N_2O_3$. On account of the free chlorine contained in it, it should likewise be kept in a cool place and protected from the light.

Action and Uses.—Like its constituent acids, nitrohydrochloric acid acts as a powerful corrosive poison when taken pure and in large quantities. In smaller doses it is very apt to disagree with the stomach, and it readily attacks the enamel of the teeth. When mixed with the water of a warm bath, so as slightly to acidulate it, it is absorbed by the skin, greatly increasing the acidity of the urine, and after several repetitions of the bath exciting a burning sensation in the mouth and throat, a considerable flow of saliva, superficial ulcers of the mouth, and redness and swelling of the gums. The bowels are more frequently moved, and there is sometimes an increased tendency to urination. The secretion of bile is said also to be augmented. From an experiment upon a dog performed by Rutherford he concluded that dilute nitromuriatic acid is "a hepatic stimulant of considerable power."

Diluted nitrohydrochloric acid has been employed for many of the same purposes as nitric acid, such as diseases of the *liver*, *scrofula*, *syphilis*, *cutaneous affections*, and chronic *rheumatism*, but there does not appear to be any sufficient ground for preferring it to the simpler nitric or muriatic acid, at least as an internal medicine. As orginally used, it was applied in the form of a general warm bath which contained no less than 32 fluid-ounces of the acid. A foot- and a sponging-bath of like strength were also employed, and several folds of flannel immersed in the liquid of the bath were wrapped around the body. The use of this regimen for at least two months was recommended. At the present time the literal application of nitrohydrochloric baths is seldom resorted to, but there is good reason to believe that in a much less energetic form they are sometimes of marked utility. Foot-baths and lotions, as well as cloths wet with the acidulated water applied over the hepatic region, we have several times employed with decided advantage in cases of slight *jaundice* accompanied with *dyspepsia*, hepatic tenderness and fulness, and *hypochondriasis* in persons who used alcohol to excess. The utility of this acid and of its individual components in these disorders, and in many cases of well-defined insane *melancholia*, probably depends upon its power to render the blood thinner and purer and the secretions more abundant.

The risk of its injuring the teeth should render physicians very circumspect in the internal use of this acid; and fortunately there are no conditions in which it is appropriate that cannot as well be treated by safer medicines. The *dose* of the stronger acid is Gm. 0.20–0.25 (gtt. iij–iv), and of the diluted acid from Gm. 0.60–1.30 (gtt. x–xx), largely diluted and imbibed through a glass tube. The antidotes are the same as those employed for its component acids.

ACIDUM OLEICUM, *U. S.*, *Br.*—Oleic Acid.

Acidum oleinicum s. elainicum.—*Elaic acid*, E.; *Acide oléique*, Fr.; *Oelsäure*, G.

Formula $HC_{18}H_{33}O_2 = C_{17}H_{33}.COOH$. Molecular weight 281.38.

Origin and Preparation.—Oleic acid exists as triolein in most of the solid and non-drying liquid fats. It was isolated by Chevreul (1811), and by Gottlieb (1846) obtained in the chemically pure state.

Large quantities of oleic acid are obtained in the manufacture of stearic acid for candles. (See Olea Pinguia.) This acid is usually of a brownish-yellow or red-brown color, and not entirely transparent at a temperature of 12° or 15° C. (53° or 59° F.), in consequence of the presence of solid fatty acids, which, according to Ch. Rice (1873), may be mostly removed by cooling to 4.5° C. (40° F.) and subjecting the soft mass to pressure; or the acid may be mixed with an equal bulk of strong alcohol, and the solution kept at a temperature of 7° or 8° C. (45° F.), when most of the solid fatty acids will be deposited, and the oleic acid may be further purified by combining with lead and treating as stated below.

Bromeis (1842) obtained oleic acid by saponifying almond or olive oil with potassa, decomposing the soap with hydrochloric acid, combining the fatty acids with lead by digesting with lead oxide, dissolving the lead oleate in ether, and agitating the ethereal solution with hydrochloric acid. This process has been improved by Dr. L. Wolff (1877, 1879), by saponifying almond oil directly with lead oxide, and substituting petroleum benzin for ether, which dissolves the lead oleate equally well. After decomposing this solution with dilute hydrochloric acid the benzin is evaporated and the remaining oleic acid washed with water.

C. T. George (1881) recommends dry white Castile soap, of which 30 parts are dis-

solved in 100 parts of hot water; the solution is decomposed by slowly adding, with constant stirring, 6 parts of sulphuric acid; the oily layer is washed with warm water, combined with 2 parts of powdered litharge, the warm lead oleate dissolved in 10 parts of petroleum benzin, and this solution decomposed by 1 part of hydrochloric acid diluted with 12 parts of water; after evaporating the benzin, about 15 parts of oleic acid are left.

To free oleic acid thus obtained from the products of oxidation, Bromeis recommends cooling it slowly to about 6.6° C. (20° F.) and expressing it in thin layers between absorbent paper: after repeating this several times it is remelted, a little alcohol added, cooled as before, and again expressed.

Adulterations.—Commercial oleic acid is said to be frequently adulterated with linoleic acid, and it is possible to detect even 1 per cent. of the latter by treating with potassium permanganate, whereby oleic acid is converted into azaleinic acid, which is soluble in ether; whereas linoleic acid yields sativic acid, insoluble in ether (*Proc. A. P. A.*, 1890, pp. 634 and 637).

Properties.—Pure oleic acid is a colorless, inodorous, and tasteless oily liquid of neutral reaction, having at 19° C. the density .898 (Chevreul), congealing to a white crystalline mass at 4° C. (39.2 F.), and crystallizing from alcohol in dazzling white needles melting at 14° C. (57.2° F.) (Gottlieb). The solid acid is but little affected by exposure to air, but in the liquid state it rapidly absorbs oxygen on exposure, becoming yellow and brown and acquiring a rancid odor, lower congealing-point, and an acid reaction. Commercial oleic acid is somewhat oxidized, and has a yellow or brownish color, a fatty odor, and a distinct acid reaction. It may be distilled *in vacuo* without decomposition, but if distilled in contact with air yields carbon dioxide, hydrocarbons, and an oily distillate containing *sebacic acid*, $C_{10}H_{18}O_4$. With melted potassa it is decomposed into palmitic and acetic acids. It is a solvent for fats and fatty acids, is insoluble in water, and dissolves in all proportions of alcohol, ether, chloroform, benzin, and other hydrocarbons, volatile and fixed oils. It unites with bases, and when heated slowly decomposes the alkali and earthy carbonates, forming soaps. Many of the oleates are soluble in alcohol, several also in ether; the normal lead oleate is white, melts at 80° C. (176° F.), and dissolves in ether and benzin. Oleic acid left in contact with nitrous acid is converted into the isomeric *elaidic acid*, which crystallizes in pearly plates and melts at 44° C. (111.2° F.). When oxidized by nitric acid, succinic and several other acids are obtained.

The official acid has a spec. grav. of 0.900 at 15° C. (59° F.), and its solution in alcohol has a feebly acid reaction upon litmus-paper; it is prepared from a good quality of commercial acid (usually known as "Red Oil") by cooling the latter to 5° C. (41° F.), and separating the liquid portion from palmitic and other acids. When cooled to 4° C. (39.2° F.), oleic acid becomes semi-solid, and on further cooling congeals to a whitish solid mass (*U. S.*).

Impurities.—The solution of oleic acid in an equal weight of alcohol should at 25° C. (77° F.) be perfectly transparent and not separate a layer of fixed oil, and at 7.2° C. (45° F.) should not yield a crystalline deposit of stearic or palmitic acid.

To show the absence of notable quantities of stearic and palmitic acids the *U. S. P.* requires oleic acid to stand the following test: 1 Gm. of the acid is to be heated with 20 Cc. of alcohol, and then, after the addition of 2 drops of phenolphthalein solution, sodium hydroxide solution (1 in 4) is dropped into the liquid until it has acquired a permanent red tint; acetic acid is then added to the liquid until the red color is just discharged, and filtered. 10 Cc. of the filtrate, mixed with 10 Cc. of ether, should be rendered only slightly turbid by 1 Cc. of lead-acetate solution.

Sulpho-oleic acid. When olive or castor oil is treated with sulphuric acid at a temperature not above 50° C. (122° F.), sulpho-oleic acid of the composition $C_{17}H_{22}CO_2$-HSO_3H is formed; any unchanged oil may be removed by ether, and the crude acid is neutralized with alkali hydroxides or carbonates, to be subsequently decomposed with sulphuric acid, and the pure acid extracted with benzin, which yields the acid in an anhydrous condition upon evaporation. When prepared from castor oil, it is known as sulphoricinoleic acid. The acid forms neutral salts with the alkalies, which are found in the market under such names as *oleite*, *solvine*, *polysolve*, etc.; they are soluble in water, and possess the property of taking up large quantities of substances otherwise immiscible with water. (For detailed descriptions see *The American Druggist*, 1884; *Pharm. Rundschau*, 1885; and *Proc. A. P. A.*, 1889.)

Action and Uses.—Oleic acid is used in medicine only in combination. Two of its compounds are officinal, but many others have been employed, especially since atten-

tion was called to them by Marshall in 1872. It is claimed that they will not decompose like ointments, and that they do not irritate the skin. They are also more cleanly in their application, and are credited with penetrating the skin more deeply than ointments. Marshall claims for the oleates of morphine and atropine a powerful action in allaying *pain* and *nervous irritation*, and for the oleate of mercury special advantages in the treatment of diseases of the skin, including *sycosis*, *chloasma*, *pediculi*, *syphilitic* affections, etc. Dr. Shoemaker (*Trans. Med. Soc. of Penna.*, xii. pt. ii. p. 709) confirms these statements, and claims that oleate of atropine has a marked influence in *seborrhœa* and *erysipelas*, and that oleate of mercury is an invaluable application to the scalp in general thinning and *loss of hair*. Of oleate of lead he states that he has obtained remarkably good results from its use in *eczema*, in *acne rosacea* after depletion of the parts, in *burns*, and in *erythema*. Oleate of copper he found capable of rapidly curing *ringworm* of the scalp and body; and he used it for *indolent ulcerating surfaces*, as well as on hard and horny *warts*, *corns*, and *bunions*. Oleate of aluminium he used in checking muco-purulent discharges in *eczema*, and as a dressing in foul *ulcers*, *abscesses*, *sinuses*, *burns*, and *scalds*. Oleate of bismuth he found efficacious in superficial *erysipelas* and *sunburn*, and, applied by means of a bougie, in *gleet*, and oleate of arsenic in *lupus*, *epithelioma*, *warts*, and various similar growths. Oleate of silver, in the form of a fine powder or in an ointment, was valuable in the treatment of chronic *ulcers*, *bed-sores*, *exuberant granulations*, etc. In most of these cases the oleate was associated with lard in varying proportions (*Philad. Med. Times*, xii. 758). Oleate of mercury and oleate of veratrine are officinal.

ACIDUM OXALICUM, *F., It.*—Oxalic Acid.

Acide oxalique s. carboneux. Fr.; *Oxalsäure*, *Kleesäure*, G.; *Acido ossalico*, It., Sp.
Formula $H_2C_2O_4.2H_2O = (COOH)_2 2H_2O$. Molecular weight 125.7.

Origin and Formation.—Oxalic acid occurs in combination with ammonium in guano, and with calcium in a large number of plants, among which may be mentioned the following official drugs: rhubarb, curcuma, ginger, squill, orris, valerian, quassia, etc. It is found as acid potassium oxalate in the leaves and stalks of phytolacca, belladonna, and several species of rumex (sorrel), rheum, and oxalis (wood-sorrel), taking its name from the last-named genus. Some urinary calculi consist of calcium oxalate, which is also found in the gall-bladder, in uterine mucus, and in some urinary sediments, in most lichens, and in many vegetable tissues. It is formed by the action of nitric acid upon many organic compounds, and sugar, gum, sawdust, and other organic bodies yield oxalates when gradually heated to redness with excess of potassium or sodium hydroxide (Gay-Lussac, 1829). The chemical behavior of salt of sorrel was investigated by Savary (1773), and its acids recognized by Wiegleb (1779) as being distinct from others then known. Scheele (1776) prepared the acid from sugar, and proved (1778) it to be identical with that in sorrel, rhubarb, and other plants.

Fig. 7.

Crystal of Oxalic Acid.

Preparation.—1 part of sugar, molasses, or starch is mixed in a retort with 8 parts of nitric acid, spec. grav. 1.38; a gradually increased heat is applied until the liquid finally boils, and red nitrogen tetroxide vapors cease to be given off; it is then concentrated by evaporation to one-sixth of its volume and set aside to crystallize. The crystals are drained from the mother-liquor and recrystallized from hot water. This is the process of Scheele and Bergman (1776), modified in the strength of nitric acid by Schlesinger (1841). L. Thompson (1848) recommended the use of a weaker nitric acid, of 1.245 density, in order to avoid the generation of formic acid by the decomposition of oxalic acid. Schlesinger obtained from 100 parts of sugar 58 to 60 parts of handsomely crystallized oxalic acid; Thompson, from the same quantity of sugar, 63 parts of acid, and, by utilizing the mother-liquor in each subsequent charge of the retort, from 107 to 115 parts of oxalic acid. If the nitric acid employed is insufficient in quantity, a corresponding amount of the sugar will be converted into *saccharic acid*, $C_6H_{10}O_8$.

E. Stieren (1865) used the dark mother-liquors obtained in the preparation of tartaric acid as a source for oxalic acid. They are advantageously worked up for this purpose by adding to 20 parts thereof, previously warmed, 2 parts of nitric acid, spec. grav. 1.33. After the extrication of the nitrogen tetroxide vapors more nitric acid is gradually added

until red vapors are no longer given off. The liquor is suitably concentrated and crystallized, and the crystals are purified by recrystallization.

Most of the oxalic acid is made by a process based upon Gay-Lussac's observations, mentioned above. Dale observed that caustic soda would not produce it from sawdust until it was mixed with potassa. 2 molecules of the former and 1 of the latter are dissolved in water to form a solution of 1.35 spec. grav., which is mixed with sufficient sawdust to obtain a pasty mass, and then heated, with constant stirring, upon iron plates. After it has been kept at a temperature of 204.5° C. (400° F.) for one or two hours, the heat is extended until the mass is quite dry, care being taken that no charring takes place. The gray powder contains 28 to 30 per cent. of oxalic acid combined with the alkalies; it is washed with solution of sodium carbonate, by which the potassium is removed as carbonate; the sodium oxalate is boiled with milk of lime, whereby caustic soda and calcium oxalate are formed, and the latter is decomposed by sulphuric acid; the oxalic acid is purified by recrystallization. By this process sawdust yields about half its weight of oxalic acid (*Am. Journ. Pharm.*, 1863, p. 359). Merz and Weith (1882) suggested the manufacture of oxalic acid from sodium formate, having observed that this salt, when heated energetically to over 400° C. (752° F.), (air being excluded as much as possible), would yield 70 and more per cent. of oxalate; this yield corresponds to about 50 per cent. of oxalic acid. Sodium formate is readily produced by heating sodium hydroxide with carbonic oxide to 100° C. (212° F.) ($NaOH + CO = NaHCO_2$). 323,366 pounds of oxalic acid were imported into the United States in 1867, and over 1,000,000 pounds in 1880.

For analytical purposes oxalic acid requires purification by several recrystallizations from distilled water; this acid is dissolved in hot alcohol, the solution filtered and allowed to crystallize; the crystals, containing ethyloxalate, are boiled with water, the solution on cooling yielding the pure acid.

Properties.—Oxalic acid crystallizes from its aqueous solution in flat, oblique, rhombic prisms, which are colorless, transparent, not deliquescent, inodorous, of a strongly acid taste and reaction, and soluble in about 10 parts of water at ordinary temperature, and in nearly all proportions of boiling water. Nitric acid increases their solubility in cold water. They dissolve in 2½ parts of cold and 1.8 parts of boiling strong alcohol, and are but little soluble in ether. Oxalic acid fuses at 98° C. (208.4° F.), and at about 160° C. (320° F.) sublimes partly unaltered, and is partly decomposed into carbonic anhydride and carbon monoxide without leaving any residue. The same decomposition takes place when oxalic acid is heated with strong sulphuric acid, but when dissolved in the latter at a moderate heat large oblique octahedra of anhydrous oxalic acid are gradually deposited (Villiers, 1880). The commercial acid usually leaves upon platinum-foil a little charcoal, which is finally consumed, a small residue of alkali carbonate often remaining. Heated with glycerin to a little above the temperature of boiling water, it is decomposed into carbonic and formic acids. In chemical affinity it is one of the strongest acids, yielding normal and acid salts which, with the exception of the normal alkali oxalates, are mostly insoluble or slightly soluble in water, but which dissolve in diluted nitric acid. Oxalic acid yields with lime-water, and the soluble oxalates with all soluble calcium salts, a white precipitate which is insoluble in oxalic and acetic acids. The acid potassium oxalates are popularly called *salt of sorrel*, also *salt of lemon*, and are employed for removing iron stains from paper, linen, leather, etc.; but at present oxalic acid is usually substituted for this purpose.

The composition of oxalic acid, dried at 100° C. (212° F.) or obtained by sublimation, is expressed by the formula $C_2H_2O_4$; crystallized from water, it is $C_2H_2O_4.2H_2O$.

Impurities.—Mineral impurities are left behind on incinerating the oxalic acid upon platinum-foil; organic impurities will blacken concentrated sulphuric acid on boiling. Sulphuric acid, if present, will produce with barium nitrate a white precipitate which is insoluble in diluted nitric acid.

Pharmaceutical Uses.—As a test for calcium salts and for preparing ferrous oxalate.

Action and Uses.—From its resemblance to Epsom salt many cases of poisoning by oxalic acid have occurred. Its taste is intensely sour; when swallowed, it, in general, soon occasions vomiting, with burning pain and constriction of the throat and stomach; the ejected matters are dark-colored, and may contain blood. When the pain is very severe, collapse may speedily ensue, with drowsiness or stupor. Sometimes these symptoms are unaccountably delayed. For several days the urine abounds in oxalates. In some cases death is rapid, occurring in from three to twenty minutes; in others it has been

postponed until the twenty-third day; in others still an excessive dose has been promptly vomited, and, after comparatively slight symptoms, the patients have recovered. In some who recovered a partial loss of power in the legs has been observed. The quantity of the acid fatal to life is equally indeterminate. The usual *post-mortem* lesions are: dark discoloration of the œsophagus and stomach, gelatiniform softening of the mucous membrane, and even perforation of the coats of the stomach. The blood is said to present an unusually bright color. The uriniferous tubes are filled with oxalates (Fraenkel). The appropriate antidote to this poison is lime in the form of powdered chalk mixed with water. If this is not at hand, slaked lime, as dried whitewash, may be resorted to until the better preparation can be procured. Binoxalate of potassium causes similar symptoms, which require the same treatment as those of oxalic acid. Oxalic acid and the oxalates appear to be poisonous through a special action upon the nervous system and the blood, as well as by producing gastro-intestinal inflammation; but Koch ranks it with the postassium salts as a heart poison (*Archiv f. Exp. Pathol.*, etc., xiv. 153).

According to Cornilleau (*Practitioner*, xxv. 486), a secret remedy for diphtheria which had proved very successful was found to contain oxalic acid in combination with potash and traces of tannin. He accordingly used the following: Oxalic acid Gm. 1.50; infusion of green tea Gm. 120; syrup of bitter orange-peel Gm. 30; of which mixture a dessertspoonful was given every three hours. Each dose would therefore contain about three-quarters of a grain of oxalic acid. The alternative method suggested by him—viz. a decoction of fresh sorrel-leaves—is certainly safer, and either is probably as useful as infusion of sumac-berries and other acidulous and astringent preparations used as palliatives of the throat affection in diphtheria. This acid has been recommended as a remedy for *asthma* and *chronic bronchitis*, but there is no sufficient proof of its virtues, while its dangers are evident.

ACIDUM PHOSPHORICUM, *U. S., Br., P. G.*—Phosphoric Acid.

Acide phosphorique, Fr.; *Phosphorsäure*, G.; *Acido phosphorico*, It., Sp.

Official Phosphoric Acid: Formula $H_3PO_4 = PO.(OH)_3$. Molecular weight 97.8. Strength 85 per cent. Spec. grav. 1.710 *U. S.*; 66.3 per cent., spec. grav. 1.50 *Br.*; 25 per cent., spec. grav. 1.154 *P. G.*

Diluted Phosphoric Acid: Strength 10 per cent., *U. S.*; 13.8 per cent., *Br.* Spec. grav. 1.057 *U. S.*, 1.080 *Br.*

Varieties and Origin.—Phosphoric (metaphosphoric) anhydride is obtained in snow-white flakes on burning dry phosphorus in dry oxygen or atmospheric air. That this new body has a greater weight than the phosphorus from which it was prepared was noticed by Marggraf (1743); but Gay Lussac (1772) showed this increase in weight to be due to the combination with air (oxygen). The anhydride has the composition P_2O_5, and attracts moisture with avidity, whereby it is converted into monobasic *metaphosphoric acid*, HPO_3, which is the formula of glacial phosphoric acid. This acid is, however, not prepared in the manner indicated, but is obtained from bones, which are the calcium compound of the tribasic *orthophosphoric acid*, H_3PO_4, discovered by Gahn (1769) and isolated by Scheele (1771). A third modification is the bibasic *diphosphoric* or *pyrophosphoric acid*, having the formula $H_4P_2O_7$. Rother (1876) regards the following as the correct formulas: metaphosphoric acid, $H_2P_2O_6$; pyrophosphoric acid, $H_4P_2O_7$; and orthophosphoric acid, $H_6P_2O_8$. The three acids differ from each other in the following reactions of their aqueous solutions: *Metaphosphoric acid* coagulates albumen, and produces white precipitates with barium chloride and calcium chloride, and a transparent gelatinous precipitate with silver nitrate. *Pyrophosphoric acid* does not affect albumen, calcium chloride, or barium chloride, but produces a white precipitate with silver nitrate on the addition of a little ammonia. *Orthophosphoric acid* does not affect albumen, calcium chloride, or barium chloride, and produces with silver nitrate a yellow precipitate on the addition of a little ammonia. The reaction of silver salts with orthophosphates was first described by Marggraf (1746), and with pyrophosphates by Clark (1828); and the difference in the behavior to albumen was noticed by Berzelius and Engelhart (1826). But the exact chemical relations of these different compounds was first explained by Thomas Graham (1833).

Phosphoric acid, met with in the combined state in the mineral, vegetable, and animal kingdoms, is orthophosphoric acid. Pyrophosphates are obtained by heating to redness orthophosphates containing 1 atom of basylous hydrogen or ammonium. (See Sodii

Pyrophosphas.) Metaphosphoric acid is produced on heating ortho- or pyrophosphoric acid or their ammonium compounds to redness.

Preparation.—1. Acidum Phosphoricum Glaciale.—Glacial Phosphoric Acid, *E.;* Acide phosphorique glacial, *Fr.;* Glasige Phosphorsäure, *G.*

Formula HPO_3. Molecular weight 78.84. About equal parts of bones burned to whiteness, and sulphuric acid diluted with 15 parts of water, are digested for some time until the insoluble part has been converted into white smooth calcium sulphate; the liquid, containing sulphuric and phosphoric acids, and holding calcium and magnesium phosphates in solution, is removed by filtration and washing with water, neutralized with ammonia or ammonium carbonate, separated from the precipitated phosphates, and evaporated to dryness. The ammonium phosphate is then heated in a platinum crucible to redness until the ammonia has been completely driven off. Porcelain capsules are corroded in this last operation. The fused acid is poured upon polished iron plates, and, when cool, put into bottles.

Thus prepared, phosphoric acid contains a little sodium, to free it from which Neustadtl (1861) proposes to neutralize the acid with ammonia, precipitate with barium chloride, and decompose the resulting barium phosphate after it has been thoroughly washed, with sulphuric acid; the acid filtrate is then evaporated and heated to redness.

2. Acidum Phosphoricum, U. S.—*Phosphoric Acid*, E.—When phosphorus is brought in contact with nitric acid, it is rapidly oxidized and converted into phosphoric acid, each part of phosphorus requiring about 3½ parts of absolute nitric acid for complete oxidation. The reaction may be seen from the following equation: $5HNO_3 + P_3 + 2H_2O = 3H_3PO_4 + 5NO$. In order to control the violent action, a portion of the nitric acid is properly diluted with water, about an equal weight, and having been introduced into a flask, the phosphorus is added and heat applied by means of a boiling water-bath; when the reaction begins to slacken, nitric acid is added, undiluted, small portions at a time. After all the acid has been added the heat is continued until the phosphorus is completely dissolved. The liquid is transferred to a porcelain capsule, and heated on a sand-bath at a temperature not exceeding 190° C. (374° F.), until the excess of nitric acid has been driven off. As phosphorus is nearly always contaminated with arsenic, the latter is best removed at this stage of the process; for this purpose the liquid is diluted with water, and a stream of hydrogen sulphide allowed to pass through it for several hours. The liquid is set aside for twenty-four hours, then filtered and heated to drive off all the gas; after again filtering the liquid is evaporated to the desired density. As each part of dry phosphorus will yield about 3.16 parts of absolute orthophosphoric acid, the approximate weight of finished product from any desired quantity of phosphorus can be found by calculation; thus, if 10 av. ozs. of phosphorus are used, they would produce about 31.6 av. ozs. of absolute H_3PO_4; and as the official acid must contain 85 per cent., the liquid should be evaporated to 37 av. ozs., and the proper specific gravity then adjusted. If an insufficient quantity of nitric acid has been used, the finished product will contain phosphorous acid (see *Impurities*), and this must be further oxidized by the addition of nitric acid, and the excess of the latter again expelled by heat. The foregoing process is practically identical with that of the Pharmacopœia of 1880, modified by Dr. Squibb.

Prof. Markoe (1875) proposed a process in which the oxidation of the phosphorus is effected through the intervention of iodine and bromine and at a low temperature. 2 troyounces of phosphorus and 12 troyounces of water are put into a flask or stone jar; 10 grains of iodine are added, and then 60 grains of bromine by drops; when the reaction has ceased, add 12 troyounces of nitric acid; set the vessel in cold water, and when in about twenty-four hours the solution has been effected, evaporate the liquid until all the iodine, bromine, and nitric acid have been expelled. In this process some phosphorus bromide and iodide are formed and decomposed by the water, with the formation of phosphoric, hydrobromic, and hydriodic acids, from the last two of which, reacting with the nitric acid present, bromine and iodine are again produced, which again act upon the phosphorus, etc. It is very important to follow the above directions strictly, since the incautious addition of bromine to phosphorus and nitric acid may cause a dangerous explosion. The solution is tested and finished in the manner described above.

Prof. W. T. Wenzell (1882) has again suggested a process which was originally proposed by Bucholz, and was formerly much employed. When phosphorus is partly immersed in water in such a manner that the sticks are not in contact with one another, and the apparatus is arranged so that the air has access to the phosphorus, the latter will be gradually oxidized in the moist atmosphere to phosphorous acid, and this is subsequently

oxidized by nitric acid. It is obvious that a considerable amount of the latter may be saved by utilizing atmospheric oxygen, but it is necessary to adopt precautions indicated above and thus prevent the exposed phosphorus from igniting. The mixture of phosphorous and phosphoric acids obtained by spontaneous oxidation was formerly known as *phosphatic acid.*

3. ACIDUM PHOSPHORICUM DILUTUM, *U. S., Br.*—Diluted Phosphoric Acid, *E.;* Acide phosphorique médicinal, *Fr.;* Verdünnte Phosphorsäure, *G.*

Mix Phosphoric Acid 10 Gm. with Distilled Water 75 Gm.—*U. S.*

Mix concentrated Phosphoric Acid 3 fluidounces with distilled water sufficient for 20 fluidounces, *Br.*

4. ACIDUM METAPHOSPHORICUM DILUTUM, *N. F.*—Diluted Glacial or Metaphosphoric Acid.

Glacial Phosphoric Acid, 780 grains, Distilled Water enough to make 16 fluidounces; dissolve without the aid of heat.

When prepared from pure glacial acid this preparation contains about 10 per cent. of metaphosphoric acid.

Properties.—1. GLACIAL PHOSPHORIC ACID. The commercial acid is in colorless, transparent, glass-like masses, which are slowly deliquescent in the air, and soluble in water and in alcohol; the solution has a strongly acid taste. It is metaphosphoric acid mixed with variable porportions of pyrophosphoric acid, according to the degree and duration of the heat used in preparing it; its aqueous solution yields gradually a bulky precipitate with tincture of ferric chloride. Chemically pure metaphosphoric acid is a soft gum-like mass, which melts at an elevated temperature, is volatilized at a red heat, and becomes solid and glass-like in the cold only through the presence of some sodium or other phosphates (Brescius, 1867). We found (1860) commercial glacial phosphoric acid to contain from 76.46 to 83.48 per cent. of phosphoric anhydride against the calculated quantity of 88.75, the impurities consisting of excess of water and of calcium and magnesium phosphates. Prescott obtained (1872) from the commercial acid an amount of soda corresponding to from .023 to .038 per cent. of sodium phosphate. Brescius found in a sample 15.3 per cent of soda. The commercial variety occurring in glassy lumps is, as a rule, far purer than that in form of sticks, and is to be preferred. These impurities render it unfit for the preparation of the medicinal phosphoric acid which was permitted by the Pharmacopœia of 1870. When dissolved in water it is gradually converted into orthophosphoric acid, the change being hastened by boiling; the solution best adapted for this purpose, according to Littleton Thompson (1874), is made of 1 part of the glacial acid and 2 parts of water, when boiling for about fifteen minutes was found to be sufficient. The presence of a small quantity of nitric acid favors the change.

Several series of salts are known of both metaphosphoric acid and pyrophosphoric acid, all of which are converted into orthophosphates by boiling with diluted acids, by heating with water to 280° C. (536° F.), and by fusing them with an excess of alkali. The soluble metaphosphates have a neutral or slightly acid reaction; the normal pyrophosphates are faintly alkaline, and the acid pyrophosphates of a weak acid reaction.

The insoluble salts of both acids are mostly soluble in dilute acids. Ferrous, ferric, and mercurous pyrophosphates, and those of copper, zinc, lead, and silver, dissolve also in solution of sodium pyrophosphate.

2. PHOSPHORIC ACID.—The acid now recognized under this name is a colorless, inodorous acid liquid having the specific gravity 1.710, but the German Pharmacopœia recognizes as acidum phosphoricum an acid of the density 1.154. If evaporated at a temperature not exceeding 160° C. (320° F.), a syrupy liquid is obtained, which gradually on standing, more rapidly on the addition of a crystal of phosphoric acid, yields colorless, flattish, hexagonal prisms, melting at about 40° C. (104° F.), deliquescing in a damp atmosphere and completely soluble in alcohol and in water. The table on page 85, after A. B. Lyons, indicates the strength of aqueous solutions in phosphoric acid and phosphoric anhydride.

The salts of orthophosphoric acid, with the exception of those of the alkalies, are mostly insoluble in water; the insoluble ones dissolve in nitric acid, likewise in acetic acid, with the exception of the phosphates of lead, iron (ferric), uranium, and aluminum. The solution of an orthophosphate rendered alkaline by ammonia yields a white precipitate with a mixture of magnesium and ammonium salts. This precipitate is insoluble in ammonia, sparingly soluble in water, freely soluble in acids, and at a red heat is converted into magnesium pyrophosphate; this reaction is often used for the gravimetric estimation of phosphoric acid. (See MAGNESII SULPHAS.) For its volumetric estima-

Specific Gravity 15° C. at 15° C. in air.	Percentage of		Specific Gravity 15° C. at 15° C. in air.	Percentage of		Specific Gravity 15° C. at 15° C. in air.	Percentage of	
	P_2O_5.	H_3PO_4.		P_2O_5.	H_3PO_4.		P_2O_5.	H_3PO_4.
1.0000	0.	0	1.1816	21.011	29	1.4215	42.021	58
1.0056	0.725	1	1.1889	21.735	30	1.4312	42.745	59
1.0113	1.449	2	1.1962	22.460	31	1.4409	43.470	60
1.0170	2.174	3	1.2035	23.184	32	1.4508	44.194	61
1.0226	2.808	4	1.2110	23.909	33	1.4607	44.919	62
1.0283	3.623	5	1.2184	24.633	34	1.4706	45.643	63
1.0340	4.347	6	1.2260	25.358	35	1.4807	46.368	64
1.0398	5.072	7	1.2336	26.082	36	1.4908	47.092	65
1.0457	5.796	8	1.2412	26.807	37	1.5010	47.817	66
1.0517	6.521	9	1.2489	27.531	38	1.5113	48.541	67
1.0577	7.245	10	1.2567	28.256	39	1.5216	49.266	68
1.0637	7.970	11	1.2645	28.980	40	1.5321	49.990	69
1.0698	8.094	12	1.2724	29.704	41	1.5426	50.714	70
1.0759	9.419	13	1.2804	30.429	42	1.5532	51.439	71
1.0821	10.143	14	1.2885	31.153	43	1.5638	52.163	72
1.0882	10.868	15	1.2967	31.878	44	1.5746	52.888	73
1.0945	11.592	16	1.3050	32.602	45	1.5854	53.612	74
1.1008	12.317	17	1.3134	33.327	46	1.5963	54.337	75
1.1072	13.041	18	1.3219	34 051	47	1.6073	55.061	76
1.1136	13.766	19	1.3304	34.776	48	1.6193	55.786	77
1.1201	14.490	20	1.3391	35.500	49	1.6304	56.510	78
1.1266	15.215	21	1.3479	36.225	50	1.6416	57.235	79
1.1332	15.939	22	1.3568	36.949	51	1.6529	57.959	80
1.1399	16.664	23	1.3657	37.674	52	1.6642	57.684	81
1.1467	17.388	24	1.3748	38.398	53	1.6756	59.408	82
1.1535	18.113	25	1.3840	39.123	54	1.6871	60.133	83
1.1604	18.837	26	1.3932	39.847	55	1.6986	60.857	84
1.1674	19.562	27	1.4026	40.562	56	1.7102	61.582	85
1.1745	20.286	28	1.4120	41.286	57			

tion the Pharmacopœia prescribes titration with normal alkali solution, using phenolphtalein as an indicator, as follows: 0.978 Gm. of phosphoric acid, diluted with water, should require for neutralization not less than 17 Cc. of decinormal potassium-hydroxide solution. Phosphoric acid, being tribasic, is capable of forming three classes of salts with the alkalies—namely, primary, secondary, and tertiary—the first having a distinctly acid reaction; the second neutral or only slightly alkaline; and the last, a strongly alkaline reaction. Complete neutralization, therefore, cannot be aimed at, as the normal phosphate itself would affect the indicator; and since different indicators show different behavior with the primary and secondary phosphates, it is of importance to know at which point the end reaction occurs. With phenolphtalein the point of neutrality is observed as soon as two-thirds of the acid present have combined to form dipotassiumhydrogen phosphate, K_2HPO_4, while with methyl-orange and Congo-red the change occurs when one-third of the acid has combined, forming monopotassiumhydrogen phosphate, KH_2PO_4. This peculiar behavior necessitates different calculations as the respective color indicators are used; with phenolphtalein each Cc. of normal KOH solution represents 0.0489 Gm. H_3PO_4, whereas with methyl-orange the value of each Cc. is increased to 0.0978. The number of cubic centimeters $\frac{N}{1}$ KOH solution, added in either case to produce the first permanent alkaline reaction, when multiplied by the respective factors will indicate the total amount of orthophosphoric acid present in the weighed sample, and from this the percentage is readily calculated. A solution of ferric chloride, lead acetate, or uranic acetate may also be employed for volumetric estimation, the precipitates by the three salts being soluble in nitric acid, but insoluble in acetic acid. The strength of medicinal phosphoric acid, which has been proved to be free from other acids and from salts, may be conveniently ascertained by combining with lead, using an excess of the pure oxide, evaporating to dryness, and igniting, when the increase of weight indicates the amount of phosphoric anhydride.

3. Diluted Phosphoric Acid corresponds in all respects to the preceding, except that it contains only 10 per cent. of H_3PO_4 and has the density of 1.057. When 4.89 Gm. of this acid are titrated with normal alkali solution, 10 Cc. of the latter should be required before the alkaline end reaction occurs, using phenolphtalein as an indicator. The British Pharmacopœia requires 355 grains of this acid to yield with 180 grains of

oxide of lead a residue weighing 215.5 grains; 6 fluidrachms (*Br.*) of this acid correspond to 35.5 grains P_2O_5 or 49 grains H_3PO_4.

Impurities.—Pure glacial phosphoric acid dissolves completely in distilled water, and this solution is not precipitated on standing for two days, after having been saturated with hydrogen sulphide (arsenic, lead). When boiled for some time, and then supersaturated with ammonia, no precipitate is produced, with the exception of a slight turbidness (calcium, magnesium), and the further addition of ammonium sulphide causes no change (iron and similar metals). With caustic potassa in excess ammonia is not evolved. If completely precipitated by lead acetate, the filtrate, after the excess of lead has been removed by hydrogen sulphide, leaves, on evaporation, only a very minute residue (potassium, sodium). Medicinal phosphoric and diluted phosphoric acid are tested in the same manner as the preceding, except that for the detection of calcium and magnesium boiling is not required before supersaturating with ammonia. The presence of nitric acid is determined by the black or dark-brown color appearing on the addition of a crystal of ferrous sulphate, followed by the careful addition, without agitation, of concentrated sulphuric acid. In applying the following tests the stronger phosphoric acid should be diluted with 5 volumes of distilled water: Hydrochloric acid is detected by the curdy-white precipitate insoluble in nitric acid occurring with silver nitrate; sulphuric acid, by a white precipitate with barium chloride; pyrophosphoric and metaphosphoric acids, by a precipitate with an equal volume of tincture of ferric chloride; and phosphorous acid, by the speedy decoloration of a drop of solution of potassium permanganate, by the precipitate of calomel when warmed with a solution of corrosive sublimate, or by the black color with silver nitrate solution. Hydrogen sulphide should not produce either a white turbidity of sulphur (phosphorous acid), or, after standing, a colored turbidness or precipitate (arsenic, lead). Arsenic is most conveniently detected by Fleitmann's test (see page 28) after supersaturating the acid with potassa or soda, or, according to U. S. P., by Bettendorff's test.

Action and Uses.—The views expressed by different writers in regard to the degree and mode of action of phosphoric acid are not easily harmonized, and seem to be rather theoretical deductions than the results of clinical observation.

According to Andrews, the sensations produced by a dose of from 40 drops to 3 drachms of the acid were those of moderate alcoholic stimulation. When a larger dose was taken there was a feeling of drowsiness and inertness that continued for some hours. It was employed by this physician in many cases of insane *melancholy*, and of persons whose minds had been overtaxed, and who had become nervous and timid, with a sense of weariness and inability to continue any occupation. But as its use was supplemented by "relaxation from business and labor" and "some suitable tonic," and especially by some popular medicines containing iron, potassa, magnesia, and lime, the share of phosphoric acid in the patients' improvement is more than problematical. It has been used, on theoretical grounds, in the treatment of *dyspepsia* with an excessive proportion of earthy phosphates in the urine; in *scrofulous caries* and in *exostoses* of the bones; to correct *night-sweats* in phthisis and other hectical diseases; in *hæmoptysis* and in *catarrhal affections* of the lungs and of the *genito-urinary* organs; in *jaundice* and in *diabetes*. In the last-named disease it has a remarkable power of diminishing thirst, and consequently of lessening the harassing secretion of urine. At the same time it affords a pleasant acidulous beverage. The *dose* of medicinal phosphoric acid is from Gm. 1.30–4.00 (♏xx–lx), sufficiently diluted to be agreeable to the taste. Grossich used a 10 per cent. solution of phosphoric acid as a dressing for *ulcers* and for injecting *sinuses* and even *scrofulous joints*, and claimed great superiority for this treatment over others (*Therap. Gaz.*, xii. 262).

ACIDUM PICRICUM, *F. Cod.*—Picric Acid.

Acidum carbazoticum.—*Carbazotic or Nitrophenisic acid*, *Trinitrophenol*, E.; *Acide picrique, carbazotique, nitroxanthique*, etc.; *Jaune-amer*, Fr.; *Pikrinsäure*, *Trinitrocarbolsäure*, *Welter'sches Bitter*, G.; *Acido picrico*, Sp.

Formula $C_6H_2(NO_2)_3OH$. Molecular weight 228.57.

Origin and Preparation.—A solution of this compound, as obtained from indigo, was recognized as a dyeing material by Woulfe (1771). Hausmann (1788) prepared picric acid from the same material as a bitter mass; Welter (1799) obtained it in crystals from silk, and subsequently its composition was investigated by Liebig, Dumas, and others. It may be obtained by the action of nitric acid upon salicin and its derivatives, phloridzin, indigo, aloes, benzoin, silk, and other substances, and is best prepared by dropping 1 part

of carbolic acid into 3 parts of warm nitric acid, adding, after the violent reaction has ceased, 3 parts of fuming nitric acid, heating the mixture, and finally evaporating it, when, on cooling, the new compound will crystallize, and may be purified by washing with cold water and recrystallizing from boiling water or diluted alcohol; $C_6H_6O + 3HNO_3$ yields $C_6H_3(NO_2)_3O + 3H_2O$.

Properties.—Picric acid crystallizes in bright-yellow, inodorous needles or scales, which melt at 122.5° C. (252.5° F.), and when cautiously heated sublime without decomposition, forming yellow suffocating vapors which condense again to crystals; but on being rapidly and strongly heated in a test-tube picric acid is decomposed with detonation, while upon platinum-foil it burns with a sooty flame, without leaving any residue. It has an acid and extremely bitter taste, dissolves at 5° C. (41° F.) in 160 parts, at 15° C. (59° F.) in 86 parts, and the boiling temperature in 25 parts of water, forming a bright-yellow solution, and is readily soluble in alcohol, ether, chloroform, benzene, and petroleum benzin. Its solutions stain the skin and other organic matter permanently yellow; hence its use in dyeing. The aqueous solution precipitates gelatin. It unites with bases, forming salts which are mostly yellow, crystallizable, have a bitter taste, and are explosive by percussion or when heated. The potassium picrate requires 260 parts of water of 15° C. (59° F.), but only 14 parts of boiling water, for solution.

Tests.—The above-described properties are sufficient for recognizing the acid. Its purity is shown by the complete solubility in the solvents mentioned before. On heating an aqueous solution of picric acid with chlorinated lime, very pungent and irritating vapors of the so-called *chloropicrin* are given off—a compound more properly known as *nitrochloroform* and *nitrotrichlormethane*, $C(NO_2)Cl_3$.

Pharmaceutical Uses.—A solution of 1 part of picric acid in 100 parts of water forms a convenient test for alkaloids, nearly all of which are precipitated from their diluted acidulated solutions, except aconitine, caffeine, cocaine, coniine, hyoscyamine, morphine, and theobromine.

Picric acid is much employed for dyeing wool and silk yellow, also for staining wood.

Action and Uses.—Given continuously to rabbits, picric acid causes emaciation, diarrhœa, ecchymosis in the intestine, yellowness of the conjunctiva and of the urine, and in large doses nausea, diarrhœa, flatulence, depression, and twitching of the cutaneous muscles. After death the red blood-disks are found dissolved in part, and in the white corpuscles the nuclei exhibit a lively molecular movement. The acid, and also its salts, given to man, induce a yellowness of the conjunctiva, skin, and urine (*Med. Record*, xxxii. 33). This fact is of interest as illustrating the mode of production of jaundice in certain cases, as in yellow fever and acute yellow atrophy of the liver. It has been prescribed in doses of Gm. 0.03–0.20 (grs. ½–iij) in alcoholic solution. Picrate of ammonium has been used in the treatment of *intermittent fever* and of *intestinal worms* in doses of about a quarter of a grain, and upon theoretical grounds, but fruitlessly. Chéron has used picric acid in fungous *endometritis* after employment of the curette. He used a solution of 1 drachm of the acid to 1½ pints of water, injecting it through a double canula, and claimed it to be antiseptic and analgesic (*Med. News*, l. 659). Calvelli has proposed a solution of the acid in water (6 : 1000) as a lotion for *erysipelas*, *eczema*, and *lymphangitis* (*Lancet*, Apr. 1889, p. 702). It has been applied with alleged advantage to *fissured nipples* in solutions containing 13 parts, and also 1 part in 1000 of distilled water, and has been recommended by Bufalini for *eczema impetiginoides* after the crusts were softened and removed by cod oil and soft soap. He employed a saturated watery solution of the acid, rubbing it in daily. At present it does not appear to possess much therapeutical value. It has been used as a test for albumen (*Med. News*, xliii. 458; xlv. 682).

Ammonium picrate was found by Dujardin-Beaumetz, in experiments on animals, to reduce the force and number of the arterial pulsations. Gm. 0.01 (gr. ⅙) arrested the heart of a frog, and Gm. 0.20 (gr. iij) lessened by one-half the pulse-rate of a rabbit. If a man took more than Gm. 0.07–0.08 (gr. 1¼) a day, it occasioned giddiness, headache, and general debility—a condition which seemed analogous to that produced by quinine. As long ago as 1830 ammonium picrate was used by Braconnot as an *antiperiodic;* and in 1873, Dujardin-Beaumetz spoke of it as a substitute, though an inferior one, for quinine (*Bull. et Mém. Soc. Thér.*, 1873, p. 1). In 1887, Dr. Marten Clark, an East Indian physician, reported that during four and a half years he had treated with it "over 10,000 cases of *malarial disease* with the happiest results," and therefore had abandoned the use of quinine entirely. He prescribed from Gm. 0.008–0.10 (gr. ⅛–jss) four or five times a day in pill. He also found it efficient in malarial *neuralgia* and *colic*,

but not in *remittent fever* (*Med. Record*, xxxi. 521). In several cases Fuller obtained analogous effects (*ibid.*, xxxii. 33). It has been used as a vermicide, and especially in trichiniasis, but without advantage.

ACIDUM SALICYLICUM, *U. S., Br., P. G., F. Cod.*—Salicylic Acid.

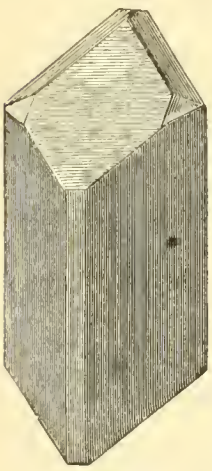
Ortho-oxybenzoic acid, E.; *Acide salicylique*, Fr.; *Salicylsäure*, G.; *Acido salicilico*, It., Sp.

Formula $HC_7H_5O_3 = C_6H_4.OH.COOH$. Molecular weight 137.67.

Origin and Formation.—It occurs in the free state in the flowers of Spiræa Ulmaria, and as methyl-salicylic ether in the leaves of Gaultheria procumbens and Andromeda Leschenaultii, and is formed from salicin, indigo, and some other organic matters by adding them to potassium hydroxide heated to fusion. It was discovered by Piria (1838) as a derivative of salicin; its presence in oil of wintergreen was proven by Procter (1848), and in several species of viola by Mandelin (1881).

Preparation.—It may be prepared from oil of wintergreen by heating it with strong solution of potassa as long as methylic alcohol is given off, and decomposing the resulting potassium salicylate by hydrochloric acid. But it is at present extensively prepared, according to Kolbe (1874), from carbolic acid. As the first step, dry sodium carbolate is prepared, which is introduced into a retort; dry carbondioxide is passed through it while heat is applied, gradually increased from 100° C. (212° F.) to 220° C. (428° F.), and not over 250° C. (464° F.). By this operation carbon dioxide is made to enter into the molecule of phenol, producing disodium salicylate, while one-half of the carbolic acid distils over; $2NaC_6H_5O + CO_2$, yields $Na_2C_7H_4O_3 + C_6H_5OH$. The residue in the retort is now dissolved in boiling water, filtered if necessary, and decomposed by hydrochloric acid, when, on cooling, impure salicylic acid, having a brown or reddish-brown color, is precipitated in the form of a crystalline powder; this reaction occurs as follows: $Na_2C_7H_4O_3 + 2HCl = 2NaCl + C_7H_6O_3$ (salicylic acid), sodium chloride remaining in solution. The impure acid thus obtained is further purified by dissolving it in boiling water or weak alcohol, treating the solution with animal charcoal, and crystallizing the filtrate after the addition of a little hydrochloric acid. R. Schmitt has proven that sodium phenate treated in the cold with carbon dioxide yields sodium phenylcarbonate ($NaC_6H_5O + CO_2 = NaC_6H_5OCO_2$), and that the latter compound, when heated under pressure to 120°–140° C. (248°–284° F.), is changed to monosodium salicylate ($NaC_6H_5OCO_2 = NaC_7H_5O_3$); from this salt salicylic acid can then be obtained by the usual method of decomposition with hydrochloric acid. The process has been patented. A. Rautert recommends (1875) the purification of it by distillation with steam previously heated to 170° C. (338° F.), by which some black resin is left as a residue: by recrystallization from boiling water a little carbolic acid is removed. Contact with iron or with materials containing iron is to be avoided, since a reddish color is thereby imparted. According to Squibb (1877), it is best purified by subliming it with the aid of steam heat.

Fig. 8.



Crystal of Salicylic Acid.

Properties.—Thus obtained, salicylic acid is in small acicular crystals, white, inodorous, of a sweetish, acidulous, somewhat acrid taste, and of the spec. grav. 1.45. The commercial article frequently has a yellowish or brownish tinge and a slight odor. It fuses at 156° C. (312.8° F.), and if carefully heated sublimes unaltered, and without boiling, at about 200° C. (392° F.). When rapidly heated to between 220° and 230° C. (428° and 446° F.), it is decomposed into carbon dioxide and phenol; $C_7H_6O_3$ yields $CO_2 + C_6H_5OH$. According to Bourgoin (1879), 1000 parts of distilled water dissolve

At	0°	5°	10°	15°	20°	30°	50°	60°	70°	80°	90°	100° C.
	1.50	1.65	1.90	2.25	2.70	3.90	8.00	12.25	19.90	32.55	51.80	79.15 parts salicylic acid.

The hot solution, when slowly cooled, yields long, slender needles. The solubility in water is considerably increased by the addition of phosphates, citrates, and acetates of the alkalies, and of borax, the solution made with the latter gradually acquiring a bitter taste. It dissolves freely at ordinary temperatures in wood spirit, in 2 parts of absolute and 2.4 parts of 90 per. cent. alcohol, in 3.5 parts of amylic alcohol, in 2 parts of ether, in 80 parts of chloroform, in 80 parts of benzene, and in 60 parts of fixed oils. Its solu-

tion in 5 parts of boiling oil of turpentine congeals on cooling. C. Becker (1875) observed that 1 part of salicylic acid and 2 parts of olive oil, heated together, form a homogeneous mixture. On adding to a small portion of salicylic acid, in a test-tube, about 1 Cc. of concentrated sulphuric acid, and then cautiously, about 1 Cc. of methylic alcohol, in drops, on heating the mixture to boiling, the odor of oil of gaultheria will be evolved. With borax a crystallizable union is obtained, $NaC_7H_5O_3 + C_7H_5(BO)O_3$ of acid reaction (Prescott). With half its weight of borax and two and a half times its weight of glycerin, a 25 per cent. solution of salicylic acid may be obtained. The alcoholic solution, evaporated spontaneously, yields the acid in large oblique quadrangular prisms. The aqueous or alcoholic solutions acquire a deep violet color with ferric chloride, provided alkalies, alkaline salts, and most acids are absent. The aqueous solution yields with bromine-water a crystalline precipitate sparingly soluble in water, and when boiled with Millon's reagent of mercuric nitrate gives a red color. A blood-red color, changing to brown and black, is produced by adding an excess of sulphuric acid to a mixture of salicylic acid and sugar, and applying a gentle heat. Sulphate of copper produces an emerald-green color in very dilute solutions of normal salicylates or salicylic acid. Potassium chlorate and hydrochloric acid convert it, like phenol, quinone, and allied compounds, into *chloranil* or tetrachloroquinone, $C_6Cl_4O_2$, which forms yellow crystals soluble in ammonia with a deep-red color. Salicylic acid effervesces with carbonates, behaving as a monobasic acid; but under certain circumstances a second hydrogen atom may be replaced by metals, yielding Piria's neutral salicylates (1855), which are decomposed by carbonic acid. Combined with alkalies, the solution of salicylic acid turns brown in contact with the air. On dry distillation the salicylates are decomposed, yielding carbon dioxide and phenol.

Impurities.—According to J. Williams (1878), salicylic acid prepared by Kolbe's process is contaminated with another acid, which he provisionally named *cresol-salicylic acid*, and which remains in the mother-liquor on neutralizing a solution in hot water with calcium carbonate; if the precipitated calcium salicylate be purified by recrystallization from boiling water and afterward decomposed by hydrochloric acid, pure salicylic acid is obtained. It should be absolutely free from the odor of phenol, the presence of which lowers its melting-point, and its aqueous solution, to which a little nitric acid has been added, should not be precipitated by barium chloride (sulphuric acid) or by silver nitrate (hydrochloric acid). Heated upon platinum foil, salicylic acid should evaporate without leaving any residue (mineral impurities). It should dissolve in cold concentrated sulphuric acid without imparting any or only a faint yellow-color (organic impurities). Kolbe (1876) has given the following practical test: It should be completely soluble in absolute alcohol, and the solution, if allowed to evaporate spontaneously and without contact with iron, should yield a white residue of aggregated crystals, the points of which are colorless and transparent. In the presence of iron the ends will be reddish or purplish, and with organic coloring matter will appear yellowish or brown.

Two other oxybenzoic acids are known, which melt at 200° and 210° C. (392° and 410° F.) and do not give a violet-red color with ferric chloride. The para-acid is more freely soluble than the others, and is obtained in Kolbe's process for salicylic acid by using potassium instead of sodium phenate and increasing the heat to above 150° C. (302° F.).

Pharmaceutical Uses.—Acidum borosalicylicum, Borosalicylic acid. Dissolve 1 part of boric acid in 5 parts of boiling water, and 2 parts of salicylic acid in 10 parts of alcohol; mix the solutions, and evaporate slowly by means of a water-bath (Hager). It is a white crystalline powder or small needles, soluble in 200 parts of cold water, 40 parts of hot water, and 10 parts of alcohol, and has a persistently bitter taste. It possesses antiseptic properties.

Salicylic Collodion. Dissolve salicylic acid 6 parts and extract of cannabis 1 part in collodion 48 parts (Gezon). It has been recommended for the removal of corns, and is applied for 4 or 5 consecutive nights and mornings, followed on the next day by a warm bath.

Salicylic acid is used for the preparation of salicylated cotton, of sodium salicylate, *U. S.*, and other salts.

Ammonium Salicylate is prepared by neutralizing salicylic acid with ammonia or ammonium carbonate, and evaporating, when the monobasic salt crystallizes in scales and needles; but on rendering the concentrated liquid alkaline with ammonia the bibasic salt is obtained. Both have a sweet taste and are readily soluble in water.

Mercuric Salicylate occurs as a white amorphous powder, and is obtained by

boiling yellow mercuric oxide, salicylic acid, and water together. It is soluble in solutions of sodium chloride and sodium hydroxide.

Calcium Salicylate is best prepared by decomposing a solution of sodium salicylate with calcium acetate, or salicylic acid may be neutralized with calcium carbonate. It is a white crystalline powder without odor and taste, and soluble in 2000 parts of cold water. Dilute acetic and mineral acids dissolve the salt readily. Its chief use is for children in diarrhœa in doses of 0.5–1.5 Gm. (7½–24 grains).

Allied Acids.—Sulphosalicylic acid, salicyl-sulphonic acid, $C_6H_3SO_3H.OH.COOH$, occurs as colorless acicular crystals, freely soluble in water and in alcohol. It is obtained by the action of sulphuric anhydride on salicylic acid, or by treating salicylic acid with strong sulphuric acid. Its chief use is as a delicate test for proteids of all kinds, albumen, peptones, globulins, and fibrin. 1 part of egg-albumen in 12,500 parts of water can be detected by this reagent. A dense bulky white precipitate, which is not redissolved on boiling, is formed in all cases except albumoses and peptones, and in these the precipitate, which dissolves on boiling reappears on cooling.

Cresotic acid, homosalicylic acid, oxytoluic acid, $C_6H_3CH_3OHCOOH$. Three varieties of this acid occur—ortho–, meta–, and paracresotic acid, homologous with the three oxybenzoic acids. They may be prepared from the three isomeric cresols by a process similar to that for synthetic salicylic acid. The acids occur in long prismatic crystals, dissolve readily in alcohol, ether, and chloroform, but less so in hot water and only with difficulty in cold water. The paracresotic acid is the only one that has met with much favor among physicians; its melting-point is at 151° C. (303.8° F.); it has been used as a sodium salt in form of a finely crystalline powder, soluble in 24 parts of warm water, and possessing a bitter but not repulsive taste. In many cases it has been found superior to salicylic acid. Young adults can safely be given as much as 60 or 90 grains daily, in divided doses.

Action and Uses.—Among the most usual effects of salicylic acid and salicylate of sodium in full medicinal doses are subjective auditory phenomena consisting of buzzing, humming, whistling, rushing, and knocking noises, accompanied with more or less deafness. They are seldom absent when the quantity of either medicine taken in twenty-four hours exceeds 150 grains. The symptom appears to be identical with one of the effects of quinine. Occasionally vision is disturbed, and objects appear to oscillate or to revolve. Gatti reports the case of a patient who while using the soda salt remained blind for about ten hours. Headache is not unusual, and may be attended with slight excitement or with dulness and an uncertain gait. It is apt to be accompanied with phantasms and violence, as in delirium tremens. Difficulty of breathing and palpitation of the heart are ordinary effects of the medicine, and the former symptom has been repeatedly observed in phthisical patients. Pulmonary hæmorrhage has been caused by it even in healthy persons (Wattelet). The large elimination of salicylic acid and its compounds by the kidneys explains their various effects upon these organs. If they are sound, and if the dose is not excessive or too long continued, the urine either remains normal in quantity or is more or less increased; but if the kidneys are diseased or the dose of the medicine is excessive, the secretion diminishes, vesical irritation occurs, and albumen, and even blood, may be found in the urine (*Centralblatt f. Therapie*, i. 527; *Med. Record*, xxv. 12). The temperature may rise to 103° or 104° F., and typhoid symptoms supervene. Sodium salicylate, but still more the uncombined acid, acts as an irritant upon mucous membranes. It occasions a sense of rawness in the fauces, and even vesicles and ulcers there, nausea, vomiting, and gastric distress, and sometimes diarrhœa. Salicylic acid and its compounds occasionally produce an eruption on the skin, usually in the form of erythema or urticaria. It is also stated to have occasioned numerous and large petechiæ and vibices, and even bullæ. Besides these superficial lesions, gangrene has been produced by the medicine, as in cases seen by Wattelet, Potain, and Gubler in France; while in England it is recorded that in a case of acute articular rheumatism it produced ecchymosis, gangrene, disorganization of the eyes, and the death of the patient (*Times and Gaz.*, Sept. 1879, p. 339). During the use of salicylic acid and its compounds the urine gives a violent color on the addition of solution of perchloride of iron. Its passage through the system is very rapid, for in a case of extrophy of the bladder its presence in the urine was demonstrated in about eight minutes after 75 grains of salicylate of sodium had been taken. Its excretion does not cease for several days after the medicine has been suspended. Huber has shown that it increases the elimination of solids as well as water, but only as long as the medicine continues to be given (*Therap. Gaz.*, xi. 697). Chopin has confirmed this statement (*Bull. de Thérap.*, cxvi. 119), and estimated that about 80 per cent. of the quantity taken passes through the kidneys, at least in health, but in obstructive diseases of those organs the proportion is greatly reduced. Hence there is a risk in employing it in such diseases. In numerous cases the urine has appar-

ently responded to the copper test for grape-sugar, but the precipitate was found not to be cupreous. Besides its elimination with the urine, it is also excreted in a small proportion with the sweat and with the serum of blisters; it is generally thought not to be discoverable in the saliva, but one observer (Musy) found it there. The experiments of Drs. Randolph and Dixon prove that salicylic acid incorporated with oil or fat and applied to the skin is absorbed and eliminated partly with the urine (*Med. News*, xlvi. 174).

The occasional toxical effects produced by salicylic acid and its compounds are partly local and partly general, The former consist mainly of the irritations already referred to, but they are by no means usual, and often excessive doses are employed without injury. Thus a patient affected with rheumatism took 6 drachms of salicylate of sodium in the course of twenty-two hours; he suffered no pain in the stomach, but, on the contrary, his appetite was improved (Ewald). Feltz reports the case of a man who took more than 6 ounces of the salt in one month. In the last seventeen days the dose was 120 grains three times a day. The symptoms were chiefly vomiting and headache, preceded by congestion of the neck, face, and head. The pupils were contracted. The symptoms continued for seventeen days after the last dose had been taken, and the acid could be detected in the urine for sixteen days. Chisholm states that a rheumatic patient, after taking by mistake 192 grains of the salt at a dose, experienced the usual head symptoms, vomited, had diarrhœa, and was greatly prostrated. But he was relieved of his rheumatism (*Therap. Gaz.*, x. 125). But in other cases the effects were fitted to inspire anxiety. Ewald reports that a woman became affected with alarming symptoms after using the acid or its sodium salt. After a drachm of the latter there was repeatedly observed delirium like that from alcohol, but frequently there is extreme jactitation, and even maniacal fury; also roaring in the ears, disorders of vision, and loss of muscular power in the limbs. The last symptom sometimes reaches the degree of complete resolution, and the gastric disturbance may resemble that produced by a corrosive poison. In children it occurs most frequently, as well as the prostration of the nervous system. Lürmann saw a girl, aged 20, after taking 60 grains of salicylate of potassium, seized with a chill, followed by high fever, hurried breathing, roaring in the ears, and œdema of the arms and legs; and Baruch observed a similar case. To these Erb adds one drawn from his own experience. A young man had moderate articular rheumatism and a slight heart-murmur. In the course of a week he had taken about 8 drachms of the salt, and the medicine was continued. A day or two afterward he was seized with a chill, followed by high fever, and a bright-red eruption spread over his face, neck, and trunk; on the limbs it was in patches. The eyes and nostrils were brightly injected, and the tongue was very red (*Centralbl. f. Ther.*, ii. 546). There is little doubt that this acid, like sodium salicylate, may occasion uterine hæmorrhage and even abortion (*Therap. Gaz.*, xiv. 72). Epistaxis has also been attributed to it (*ibid.*, xiii. 427). In a case of acute articular rheumatism a rapid cure appeared about to take place, when, besides buzzing in the ears and profuse sweats, extreme prostration came on, and the patient died suddenly on sitting up to eat (Empis). Jaccoud soon afterward reported three cases of sudden death in young rheumatic patients treated by this medicine in doses not exceeding 150 grains a day; and Goodhart one in which death followed the use of four doses of 15 grains each, given at intervals of three hours (*Times and Gaz.*, Jan. 1880, p. 105). Lahalle (*Thesis* cited) ventured to say that although the avowed number of fatal cases in France is considerable, yet probably others have occurred that have not been published. In the cases now referred to the phenomena seem to have been due to a derangement of the nervous system, but there have been others in which the heart was affected or the lungs; in the latter the symptoms were those of asphyxia. In another case, a girl of 15 took by mistake 7 drachms of salicylate of sodium within a few hours; besides the symptoms already mentioned she had dilated pupils, impaired vision, and strabismus, and became melancholic. Red spots appeared transiently on the skin; there was vomiting, but no diarrhœa; the urine contained albumen (Peterson). It sometimes contains blood or casts. Abelin states that acute nephritis may occur during the use of the medicine. It follows from the above that salicylic acid, and in a less degree its salts, should not be given in large doses to persons having a weak heart or who are otherwise greatly debilitated, or, at least, not without counteracting their toxical tendencies with nutrients and diffusible stimulants. Some of these toxical effects have been attributed to an impurity in the manufactured acid (*Therap. Gaz.*, xiv. 343).

If salicylic acid and its compounds are curative of any disease, it is of *acute articular rheumatism*. That it reduces the pulse-rate, and in a much greater degree the temperature (from 103° F. to 98° F.), the latter in nearly all cases, there is no doubt.

Whether it removes the disease as well as, or better than, some other remedies is not quite so certain. For acute articular rheumatism is a general disease, in which not only the joint but several internal organs, and especially the heart, are apt to be involved. Now, it is on all hands admitted that salicylic acid and its compounds neither exert any preventive influence on the complications nor prevent relapses; and some even go so far as to maintain that their development or occurrence is favored by those medicines. This opinion is probably due in part to the rapid relief obtained in many cases from pain and fever and the imprudent exposure which is apt to follow. It is very certain that when complications occur the medicines in question exert no control over them. Not only so, but heart affections may arise while the patient is under their fullest influence. It is therefore altogether probable that they have no antirheumatic virtues, and that they relieve inflammatory rheumatism merely by repressing two of its symptoms, very much as quinine and aconite and veratrum and opium may do. In a series of over one hundred cases of rheumatism the average time during which the acid was administered was a little over 6 days, the extremes being 1 to 31 days. The average quantity of salicylic acid taken by each patient was about 400 grains. This result does not bear out the claim of the medicine to be a specific remedy for the disease in question. Moreover, the antifebrile influence of the medicine is not specific, for in certain cases of hyperpyrexia occurring in rheumatism it not only failed to reduce the temperature, but during its use the temperature rose from 101° to 107°. It would be unfair, in presenting a summary of this subject, to withhold the positive declarations of some of the most competent advocates of the medicine. Dr. Broadbent said: "I have yet to see the case of genuine acute rheumatism without complication in which the pain is not entirely gone and the temperature normal after six consecutive doses of 20 grains at intervals of an hour on two successive days." Mr. Sharkey remarked: "One must, I think, allow that its discovery as a cure for acute rheumatism is a triumph of empirical therapeutics which has probably had but few parallels in the history of medicine." Dr. Fraser, comparing 316 cases treated with alkalies, lime-juice, etc. with 305 cases treated with salicylate of sodium, found that in the former series the average duration of pain was 17.2 days, and of illness in the hospital 22.6 days; while in the latter series the pain lasted, on an average, 2.92 days, and the hospital residence was 9.58 days (*Edinb. Med. Jour.*, xxxi. 2). He expressly excepts from the computation all cases of so-called gonorrhœal rheumatism, which is not amenable to the medicine; nor are any cases "associated with a discharge from the genito-urinary mucous surface" included. Dr. Bristowe holds a similar opinion. Dr. Jacob gave, as a result of its use in 150 cases, the recovery of 103 within three days. More or less analogous results have been obtained in Germany by Traube, Stricker, Bälz, Lebert, and others, and, according to Dr. Ackland, out of nearly 425 cases only 21 deaths occurred. In France, Sée declared that "we may promise with almost certainty the cure of febrile or apyretic acute rheumatism in from two to four days." Like other physicians, Blachez (1878) met with cases in which, under this medicine, the pains ceased "in from thirty-six to forty-eight hours." But he cautioned against suspending its administration when the pains subside, and insisted that relapses are common, although not severe. On the other hand, Guéneau de Mussy expressed a general dissent from these conclusions; and that eminent clinician, Jaccoud, while admitting that in febrile articular rheumatism, unaccompanied by any complication, it produces a cure more rapidly than any other medicine, denied that a uniform duration can be assigned to the treatment, or that it tends at all to prevent or modify complications; and he held that when these exist the medicine ceases to influence the rheumatic element of the attack. So, too, Dr. V. Y. Bowditch (1879) concluded from a series of records that the medicine is not a specific, yet that in acute cases, if used at the outset of the disease, pushed vigorously, and not abruptly suspended, "the most satisfactory results may be obtained." In 1879 and 1880, Drs. Andrew Clark and R. Southey fully corroborated the judgment of Jaccoud, the latter by analysis of 51 cases (*St. Bart's Hosp. Rep.*, xv. 6). Findlay and Lucas, by a like study of 158 typical cases, in 60 of which the salicylous treatment was used, in 60 the alkaline, and in 38 a combination of alkalies and quinine, found that although the duration of the primary attack was rendered shorter by the first-named than by the other methods, yet it was attended with far more cardiac complications, relapses three times as frequently, and a more usual return of pain without pyrexia (*Lancet*, Sept. 20, 1879). Dr. Greenhow concluded, from a careful analysis of 50 recorded cases, that although the pain and distress of the patient are undoubtedly assuaged, for a time, by the salicylate of sodium, the duration of his illness is not shortened, neither is his recovery as rapid as under other modes of treatment. He moreover called attention to the marked weakening of the first sound of the heart observed in so many cases, and suggested its immediate

danger, as well as its remoter significance, as showing a degenerative influence on the structure of that organ (*Clin. Soc. Trans.*, xiii. 346). With clinical results so ample and positive on record (consult, further, "Summary" in *Boston Med. and Surg. Jour.*, April, 1882, p. 315; *Ephemeris*, i. 56; *Brit. Med. Jour.*, Feb. 25, 1888) one is obliged to regret the errors of statements like those first quoted, and of such as these, that "by the brevity of the febrile condition the chances of the occurrence of cardiac complications are immensely diminished" (Moore), or that the medicine "immensely lessens the chances of heart disease or other complication" (Paul). As we have seen, the heart-complications form a special danger of the salicylous method of treatment. On the whole, it may be concluded that this method is antipyretic and analgesic, rather than antirheumatic. That in certain cases it should have appeared to be "prompt and decisive," or to have "acted like a charm," or to be "the only radical remedy for acute rheumatism," leaves out of view entirely the natural history of the disease, which in thousands of cases runs its course to cure within a week without any specific treatment. It also overlooks the well-known clinical fact that in one form the disease advances steadily toward cure, and in another is broken up into a succession of remissions and relapses. The observation of Marrot, that under the administration of sodium salicylate the excretion of urea and uric acid, which is so excessive in articular rheumatism, immediately declined, and the proportion of water was greatly augmented, suggests that the sodium base of the medicine had a share in this result. The treatment by salicylic acid may be compared to that by opium, which was once in vogue, and which was vaunted to control the pain and fever of rheumatism, but, as was soon discovered, at the expense of the heart's integrity. It is useless in *chronic rheumatism*.

A case of rheumatic *tetanus* is alleged to have been cured by salicylic acid. According to Abadie, salicylate of sodium greatly excels all other medicines in the rapidity of the cure of rheumatic *irido-choroiditis* and *sclerotitis*. He recommended the dose of 15 grains four times a day (*Bull. de Thérap.*, xcvii. 385). In *gout* Barclay (1878) claimed that it was second in value to colchicum alone, and the salicylates were said by Sée to display even more wonderful powers than in rheumatism, and to promptly arrest even the most painful paroxysms, as well as to prevent relapse and promote the removal of tophaceous deposits. Apparently, other physicians—Murchison, for example—have been less fortunate, for their results prove nothing in its favor.

If we cannot say that authors are unanimous in asserting the uselessness of salicylic acid in *intermittent fever*, we can at least declare that there is no proof of its utility, either by authority or by demonstration. In this case is presented an apt illustration of the error of deducing the therapeutical uses of a medicine from its apparent physiological action; for this acid and its compounds, whose physiological operation seems so closely to resemble that of quinine, is powerless to cure the disease for which quinine is a specific remedy. Salicylate of quinine has been recommended as an antiperiodic medicine, and doubtless it is so far as it contains quinine. In *scarlatina* salicylic acid neither mitigates the disease nor tends to prevent its complications or sequelæ, although it is alleged to have done both. As to *typhoid fever*, in which a full trial of the medicine has been made, the general result appears to be that it does not improve the typhoid state, nor reduce the splenic swelling, nor diminish the stools nor alter their qualities, nor lessen the customary debility and emaciation, nor improve the patient's feelings, nor shorten the attack, nor lessen the mortality of the disease. On the other hand, it is charged with causing hæmorrhage from the bowels. Reporters are not agreed even as to its influence upon the pulse and temperature, and some among them charge that it excites or exaggerates delirium, and produces nausea, prostration, albuminuria, and even suppression of urine (Sée; Murchison). These conclusions have been substantially confirmed by Filatow and by Weiss (1880), and no doubt remains of the inefficacy of this medicine, as of all others, in controlling typhoid fever. In *intermittent fever*, like many other agents, it may, as already stated, prevent or mitigate a paroxysm, but it has no influence on the disease. The medicine has been used in *relapsing fever*, with the alleged effect of lessening the duration and severity of the relapse (Reiss, 1880); but as in one case the patient died with cerebral symptoms, a very rare occurrence in the disease, the share of the medicine in the catastrophe is open to suspicion. A claim, without sufficient support, has been made for the efficacy of the medicine in *epidemic meningitis*. Dr. Bowyer claims that about 3 grains of salicylic acid every six hours aborts the eruption of *small-pox!* (*Practitioner*, xxvi. 456); another reporter states that it is peculiarly efficacious, topically and internally, in *erysipelas* (*Amer. Jour. of Med. Sci.*, Jan. 1882, p. 255); and a third, that it is a prophylactic against *yellow fever!*

In *acute inflammations* the evidence respecting the medicine in question is very contradictory; for while, on the one hand, they are affirmed to be "wholly uninfluenced by it," that it does "not in the least degree prevent the supervention of fresh inflammation," and that, "while it reduces the temperature, it does not in the least modify the local processes," it is alleged, on the other hand, to be the "surest antiphlogistic." It is true that the latter judgment is qualified by the statement that it even "excels quinine;" which is quite conceivable, since it is now well settled that there is no constant relation between the reduction of the pulse in febrile affections and the cure of the disease which renders the pulse frequent. In regard to *diphtheria*, while one reports that in thirty-one cases it was "uniformly curative," and another that it "modifies favorably the exudation," and a third that it also "arrests the fever," a fourth (Abelin) "derived none of the advantages from its use which various physicians ascribe to it, and found that, except in reducing the temperature and the pulse-rate, its results were entirely negative, or else that it irritated the throat and occasioned diarrhœa, albuminuria, or congestion of the lungs; and Sée could discern no appreciable influence exerted by it on the disease, the more so because, while one experimenter declares that only salicylic acid in substance is competent to arrest the development of certain disease-germs (Samter, *Centralbl. f. Med.*, vi. 376; *D'Espine*, *Med. News*, liv. 520), and a practitioner so treats nasal diphtheria (*Med. Record*, xxx. 435), another declares that a solution of 1:350 is very serviceable (*Practitioner*, xli. 138). On the whole, there is no ground whatever for believing in its efficacy. Even in the case of *aphthæ*, which some declare that it causes to heal rapidly, and of *thrush*, for which it has been vaunted as a specific, others allege that it is neither better nor worse than chlorate of potassium or than alkaline solutions in general. Enemas containing 1 part of the acid to 300 parts of water, with a little alcohol to perfect solution, are said to lessen the frequency, correct the fetor, and improve the quality of the stools in *dysentery*. Salicylic acid and its compounds may be added to the number of agents that tend to prevent *putrefactive fermentation* and *flatulence* in the digestive canal, and hence to counteract the crapulous diarrhœa which attends this state. It has been proposed as a prophylactic against *cholera*. Ridder (1879) and Tlyin (1880) have reported the expulsion of *tæniæ* by salicylic acid. A purgative dose of castor oil was given, the patient kept on low diet for twenty-four hours, and a second dose of oil administered, followed by one of 12 grains of the acid, which was repeated hourly until 60 grains had been taken. Finally, half an hour later another half ounce of castor oil was given. The method is not recommended by its simplicity or its pleasantness. Experience has not determined its value. The medicine has been used in the hectic fever of *phthisis*, because it is capable of reducing the temperature, without regard to the serious injury it causes by deranging the digestion and its absolute nullity as a palliative of any symptom peculiar to pulmonary consumption. Very probably it may be profitable in correcting the fetor of the breath in certain cases of this disease; for it does so in *fetid bronchitis*, and even in *gangrene of the lung*, when administered by the stomach, and still better when inhaled from an atomized solution. Sachse recommends a solution of 2 parts of borax, 2½ parts of salicylic acid, and 100 or 150 parts of hot water for an inhalation in ulcerating phthisis. It is scarcely necessary to say that as a stimulant and deodorizing agent this mixture, if useful at all, is not so through the salicylic acid only which it contains. V. Toeplitz has vaunted the application of this acid to the larynx in *whooping cough*. Various stimulants and irritants have been used for the same purpose, including nitric acid, nitrate of silver, ammonia, etc., but have obtained little permanent credit. It has been found efficient in preventing the development of acute *coryza* when given in doses of from 20 to 40 grains, and also in mitigating the symptoms of *hay fever* and of *influenza*. It has been thought to moderate the pain of *lumbago*. In *neuralgia* of a periodical type, and not amenable to quinine, it is said to have been very efficient in doses of from 20 to 40 grains, given every hour for three or four hours. Abbott (1879) has reported several cases of *sciatica* and of trifacial *neuralgia* in which its effects were prompt and permanent, and Labbé still others (1881), but he was of opinion that the medicine is only useful in cases of rheumatic neuralgia. Others regard its effects as very uncertain, and large doses of sodium salicylate as unsafe (Dujardin-Beaumetz). Neuralgic *headache* may frequently be controlled by this medicine given in doses of 5 to 10 grains at intervals of an hour or less, and in like manner the neuralgic pains of *herpes zoster*. One or two cases of *chorea* of rheumatic origin appear to have been cured by this medicine. Schaetzke in 1879 published three cases of the rapid cure of *diabetes* by salicylic acid, given in doses of from 15 to 30 grains three times a day, and Sawyer (1881) three others with nearly as favorable an issue in which sodium salicylate was associated

with laudanum. In 1885, Dr. Yarrow reported four cases in which the diabetes seemed to be entirely controlled by this medicine (*Therap. Gaz.*, ix. 446): and in the following year Dr. Holden opined that it was beneficial only in cases of rheumatic origin (*Edinb. Med. Jour.*, xxxii. 79). Dr. Holden prescribed the following mixture: R. Salicylic acid, ʒij; Sodium bicarbonate, ʒij; Ammonium carbonate, ʒj; Water fʒj. When the effervescence has subsided add water to fʒxij. Sig. From one to two tablespoonfuls three times a day.

As a topical remedy salicylic acid has been employed in a powder mixed with silicate of magnesia (1 : 10), with which the skin is dusted to prevent *night-sweats;* and a powder made with 1 part of the acid to 6 or 8 of burnt alum, or with 5 parts of starch, has been found efficient in correcting fetid *sweating of the feet* when freely applied several times a day to the part, previously washed with soapsuds and wiped very dry. It is said that in the Russian and Italian armies a powder is used to prevent sweating and *chafing of the feet*, which is composed of salicylic acid 3 parts, starch 10 parts, and powered talc 87 parts. A 1 per cent. mixture of the acid with tallow has been employed for the same purpose. An alcoholic solution of this acid (1 : 16) is recommended for removing the scales of *psoriasis*, for the treatment of *chloasma* and *freckles*, and as an antipruritic remedy. A solution of 1 part of the acid in 6 of glycerin has been found an efficient application to ulcerating *lupus*. Plasters containing salicylic acid have been used with great advantage to soften and remove various forms of *epidermal* thickening, including *corns*, *warts*, etc. A plaster especially recommended is composed of the acid incorporated with gutta-percha. Collodion has also been used as an excipient for the acid. Under the name of "plaster-mull" Unna has introduced into the treatment of *lupus* mixtures of salicylic acid and creasote of various strengths, mixed with some adhesive substance, and spread upon thin sheets of gutta-percha. The combination cauterizes the morbid nodules, and finally causes them to be discharged. Pain is mitigated or prevented by cocaïne. (Compare *Med. News*, xlix. 437; *Therap. Gaz.*, x. 760.) An ointment recommended by Hager as an innocent cure for scalled head (*favus tinea tonsurans*) and an exterminator and preventive of lice is made by reducing salicylic acid 10.0 Gm. and borax 3.3 to a fine powder, adding yellow wax 50.0 and lard 250 Gm., previously melted together and colored with alkanet, balsam of Peru 10 Gm., oil of bergamot 50 drops, oil of star-anise 20 drops, and rose-water Gm. 30, and stirring until the ointment solidifies. *Eczema* and *intertrigo* may be cured by a 4 per cent. ointment of this acid. A lotion made with 1 grain of the acid to an ounce of water has removed the eruption and ulcers that sometimes are produced by *bromide of potassium*. Three cases of *urticaria* are recorded which were cured by about 20 grains of salicylate of sodium three times a day. The following mixture has been recommended in *ozæna:* Borax ʒiij; salicylic acid ʒij; glycerin ʒiiss; water to ʒiij: 1 or 2 drachms of this mixture to half a pint of water may be used as a nasal douche and as a gargle. As an external application the acid has also been a good deal used in dressing *wounds* and *ulcers*, and especially such as tend to *gangrene*. Sometimes it is applied as a fine powder, sometimes in a 1 per cent. solution. Indeed, a claim has been made that it is a perfect substitute for carbolic acid, over which it has the advantage of being inodorous, unirritating, and, when absorbed, not poisonous. It is, however, very irritating unless in a weak solution. Its somewhat styptic qualities have caused it to be used topically in *uterine catarrh*, *leucorrhœa*, and *chronic dysentery*, and even to arrest slight *hæmorrhages*. A salicylate of iron has been employed for like purposes. A saturated solution of the acid applied on a tampon of carbolized cotton-wool has been used with alleged efficiency in *menorrhagia* and in bleeding *cancer of the uterus* (*Med. News*, liii. 300). *Pediculi* are said to be destroyed by a solution composed of salicylic acid 2 or 3 parts, vinegar 25 parts, and alcohol 75 parts, and applied on a flannel cloth with friction (*Med. News*, li. 425). The acid has been applied with alleged advantage to soft *chancres*. Salicylate of lime has been particularly recommended for chancres and syphilitic sores (*Am. Jour. Med. Sci.*, July, 1880, p. 286). An ointment made with vaseline, and containing from 2 to 4 per cent. of salicylic acid, is recommended by Lassar as the best of all applications in *eczema*. If this ointment is found to be too soft, it can be stiffened with oxide of zinc (*Centralbl f. Ther.*, i. 389). Given by the mouth or rectum, the acid tends to diminish fetor of the *stools* in diarrhœa and dysentery. It has been used to deodorize various decomposing substances, and amongst them the *bodies of the dead*. For this purpose a powder composed of salicylic acid and some moist substance, such as talc, has been employed. The addition of salicylic acid to vegetable infusions, solutions of bromide of potassium, quinine, atropine, morphine, etc. prevents the formation in them of fungous growths. Dr. J. G. Richardson recommends

for hypodermic injection the following solution of morphine: R. Morphinæ acet. vel sulph. gr. xvj; Acid. acetic. (No. 8) gtt. ij; Acid. salicylic. gr. iss; Aquæ destillat. f℥j. If, on standing in a conical glass, any sediment is observed, the clear liquid should be decanted.

It is probable that salicin, salicylic acid, and salicylate of sodium are equally active physiologically, but the sodium salt is more suitable for certain diseases, and especially for inflammatory rheumatism. Salicin, although not very soluble, may be given in water in the dose of Gm. 0.60–2.60 (gr. x–xl), and salicylic acid in wafers and in similar doses. It is better, except in acute articular rheumatism, to give the smaller dose and repeat it frequently than to administer a full dose at once. These substances may also be administered in powdered liquorice extracts.

Various formulæ for administering salicylic acid are really solutions of its salts: *e. g.* R. Salicylic acid 120 grs.; Solution of acetate of ammonium f℥ij; Water f℥vj.—M. Each fluidounce contains 15 grs. of the salt. Or, R. Salicylic acid 100 grs.; Borax 80 grs.; Water f℥xvj.—M. Or, R. Salicylic acid 120 grs.; Borax 60 grs.; Glycerin q. s. Mix the acid and borax with f℥iv of glycerin, heat until solution is complete, and add glycerin to make the whole measure f℥j. It contains 25 per cent. of the acid. Or, again: R. Peppermint-water, f℥iv; Acetate of potassium, ℥iss; Salicylic ac., ℥ss; Lemon syrup, f℥ij. Dissolve the acetate of potassium in the peppermint-water, introduce the acid gradually with agitation until dissolved, and then add the syrup. Of this solution each dessertspoonful contains 10 grains of salicylic acid, free or combined. For external use a solution of 1 part of the acid in 300 parts of water is recommended. Cotton saturated with a hot solution of the acid, from 3 to 10 per cent. strong, and properly dried, has been used as a surgical dressing.

Salicylate of Calcium has been stated on very insufficient evidence to be useful in the intestinal disorders of children.

ACIDUM STEARICUM, *U. S.*—Stearic Acid.

Acide stéarique, Fr.; *Stearinsäure*, G.

Formula $HC_{18}H_{35}O_2$. Molecular weight 283.38.

Origin.—Stearic acid occurs widely diffused throughout the animal kingdom, combined with glycerin in the form of stearin (glyceryl tristearate), and constitutes the bulk of the more solid fats, such as suet and tallow. It is also found in many vegetable fats, notably in palm oil.

Preparation.—When tallow and similar fats are saponified by boiling with soda-lye, the stearin is decomposed, sodium stearate being formed with liberation of glycerin; thus $C_3H_5(C_{18}H_{35}O_2)_3 + 3NaOH = C_3H_5(OH)_3 + 3NaC_{18}H_{35}O_2$. The soap formed is decomposed by heating with water and sulphuric or hydrochloric acid; by this means the fatty acids are set free, and will float on the aqueous liquid, whence they are removed and purified by solution in hot alcohol. Upon cooling, stearic acid will separate, while oleic acid remains in solution. Stearic acid is obtained on a large scale in the manufacture of candles, either by the foregoing process or by treating the fats with sulphuric acid and superheated steam, the latter decomposing the fatty compounds readily; the glycerin enters into solution in the condensed water, the acids floating on top.

Properties.—Pure stearic acid occurs in white glistening needles or leaflets, is odorless and tasteless, and does not appear greasy to the touch. It dissolves in all proportions in boiling alcohol and ether, from which it separates on cooling. It melts at 69.4° C. (157° F.) to a colorless oil, which on cooling solidifies to a white crystalline mass. The commercial acid should have a melting-point not lower than 56° C. (132.8° F.), and on cooling should congeal at 54° C. (129.2° F.) It is soluble in 45 parts of alcohol at 15° C. (59° F.). The presence of undecomposed fat is ascertained by boiling 1 Gm. of the acid with an equal weight of sodium carbonate in 30 Cc. of water; the resulting solution while hot should not be more than faintly opalescent.

Pharmaceutical Uses.—Stearic acid is used in the manufacture of glycerin suppositories, where it is combined with sodium carbonate to give body to the mass.

ACIDUM SUCCINICUM.—Succinic Acid.

Sal succini volatile.—Acide succinique, Fr.; *Bernsteinsäure*, G.; *Acido succinico*, F. It., Sp.

Formula $H_2C_4H_4O_4 = (CH_2)_2.(COOH)_2$. Molecular weight 117.72.

Origin.—Succinic acid exists in amber, in unripe grapes, in different species of Lac-

tuca, Artemisia, and other plants, and in many animal liquids. It is formed in the oxidation of wax, spermaceti, butyric, stearic, and some other fatty acids; of valerianic acid, benzoic acid, and other organic compounds; in the vinous fermentation of sugar; by the deoxidation or under the influence of casein as a ferment from asparagin, tartrates, malates, aconitates, fumarates, etc. It was observed by Agricola (1550), and recognized as an acid by Lemery (1675).

Preparation.—For medicinal use, succinic acid is prepared by the dry distillation of coarsely-powdered amber from a glass retort, which is entirely imbedded in sand and the short neck of which is connected with a large receiver. The heat is gradually increased to about 280° C. (536° F.), and kept at this temperature as long as white vapors are evolved. The distillate consists of succinic acid crystallized in the neck of the retort, while the receiver contains oil of amber and an aqueous liquid which, according to Marsson (1850), contains, besides succinic acid, also acetic, propionic, butyric, valerianic, and caprionic acids. On concentrating this solution more succinic acid is obtained. (See OLEUM SUCCINI.)

Properties.—The impure acid is in yellowish or brownish prismatic crystals, which have the odor of oil of amber and an acid, empyreumatic taste. It begins to volatilize at 100° C. (212° F.), fuses between 160° and 180° C. (320° and 356° F.), and boils at 235° C. (455° F.), giving off acrid vapors, dissolves in 2 parts of boiling and 28 parts of cold water, and is freely soluble in warm alcohol, slightly in ether, and insoluble in oil of turpentine. The pure acid is inodorous, is scarcely affected by oxidizing agents, and by fusing potassa is converted into oxalic acid. With the alkalies and magnesia it forms salts which are readily soluble in water; the salts with most other metals are less freely or not at all soluble in water, but dissolve in solution of potassium acetate. The neutral solutions produce, with ferric chloride, red-brown precipitates.

Tests.—A concentrated aqueous solution of the acid should not produce a precipitate with potassium-acetate (absence of tartaric acid), nor with barium chloride (sulphuric acid), calcium chloride (oxalic acid), hydrogen sulphide, nor, after neutralization, with ammonium sulphide (metals). When treated with soda in excess an ammoniacal odor should not be generated, and when heated upon platinum-foil the odor of caramel should not be observed (sugar), nor should finally any fixed residue be left (salts).

Pharmaceutical Uses.—It is employed for preparing

LIQUOR AMMONII SUCCINATIS (SUCCINICI, *P. G.* 1872), *s. Liq. cornu cervi succinici.*—1 part of succinic acid is dissolved in 8 parts of warm water, and neutralized by 1 part or a sufficient quantity of pyro-oleous ammonium carbonate; the solution is set aside for twenty-four hours and then filtered. It has a brownish or brown color, remains clear when mixed with three times its weight of alcohol, and when evaporated and ignited leaves no residue. Pure ammonium succinate is sometimes used for estimating the iron in ferric salts.

Action and Uses.—There is no reason to believe that this acid possesses any active properties or medicinal virtues. It has been taken in doses of from 60 to 120 grains without any definite effects. It is excreted partly by the skin, but chiefly with the urine, either unchanged, or, as has been asserted, in the form of hippuric acid. It has been alleged to raise the pulse, promote diaphoresis and the bronchial secretion, and augment the activity of the nervous centres; and has been prescribed in *rheumatism*, *bronchitis*, and *hysteria* and various other spasmodic affections. Even if its apparent utility had been demonstrated, the objection may fairly be made that the acid was not used alone, but as a succinate of ammonium and with empyreumatic oils, etc. The *dose* of the acid may be stated to be between Gm. 0.30–1.00 (5 and 15 grains).

Solution of succinate of ammonium has long been used in Germany as a stimulant of the nervous system in *spasmodic* disorders, *low fevers*, *hysterical affections*, etc. Dose, from 10 to 30 drops in an aromatic vehicle.

ACIDUM SULPHURICUM, *U. S.*, *Br.*—SULPHURIC ACID.

Acidum sulfuricum, P. A., P. G.—*Oil of vitriol*, E.; *Acide sulfurique, Huile de vitriol*, Fr.; *Schwefelsäure, Vitriolöl*, G.; *Acido solforico*, It.; *Acido sulfurico*, Sp.

Formula H_2SO_4. Molecular weight 97.82. Strength not less than 92.5 per cent., spec. grav. 1.835 at 15° C. (59° F.), *U. S.*; 98 per cent., spec. grav. 1.843, *Br.*; 94–98 per cent., spec. grav. 1.836–1.84, *P. G.*

Diluted Sulphuric Acid. Strength 10 per cent. *U. S.*, 13.65 per cent. *Br.*, about 16

per cent. *P. G.* Spec. grav. 1.070 *U. S.*, 1.094 *Br.*, 1.110–1.114 *P. G.*, 1.12 *P. A.*, 1.134 *F. It.*

Origin.—Sulphuric acid is found in the free state in certain springs emanating from volcanoes and in the salivary glands of some mollusks, but it mostly occurs combined with various bases both in the mineral and organic kingdoms. At an early date the acid was known to the alchemists, but its preparation from "calcined vitriol" (ferrous sulphate) was first described by Basilius Valentinus in the fifteenth century. Lavoisier (1777) determined it to be composed of sulphur and oxygen, and Richter (1795) ascertained the percentage of the two elements nearly correct. In the manufacture of sulphuric acid Roebuck and Garbett (1746) replaced the glass vessels by a lead chamber, and Lafolie (1774) introduced the use of steam. Polony (1888) suggested its manufacture from calcium (or similar) sulphate and steam at a temperature exceeding 600° C. (1112° F.).

Preparation.—1. Sulphuric Acid. Sulphur or iron pyrites is burned in a furnace arranged in such a manner that the sulphur dioxide is mixed with atmospheric air; in the same furnace, by the heat of the burning sulphur, nitric acid is generated from a mixture of sodium nitrate and sulphuric acid, the vapors of nitric acid being carried with the mixed sulphur dioxide and air into large leaden chambers where the current of these gases comes in contact with a jet of steam. The nitric acid reacts with the sulphur dioxide and steam as follows: $2HNO_3 + 2SO_2 + H_2O = 2H_2SO_4 + N_2O_3$; the newly-generated nitrogen trioxide causes the formation of nitrosyl-sulphuric acid, as shown by the equation $2SO_2 + N_2O_3 + O_2 + H_2O = 2SO_2OHNO_2$, which latter is decomposed by water, yielding sulphuric acid, and again liberating nitrogen trioxide, thus: $2SO_2OHNO_2 + H_2O = 2H_2SO_4 + N_2O_3$. The nitrogen trioxide now again combines with sulphur dioxide, oxygen, and water to form nitrosyl-sulphuric acid, which again undergoes decomposition by water. Some other reactions no doubt are also involved, but the foregoing are the principal ones. The sulphuric acid formed condenses and dissolves in the water, which covers the floor of the lead chambers to the depth of about 2 inches. The gases finally escaping from the third or last chamber, still containing nitrogen compounds, are denitrated in a so-called Gay-Lussac tower filled with coke, over which a finely-divided stream of sulphuric acid trickles, by which the nitrous fumes are dissolved. The acid thus charged is made to descend in a tall tower, known as the Glover tower, over coke and fire-brick, and at its exit meets the current of sulphur dioxide and air, whereby the nitrogen compounds are liberated and utilized for oxidation. It will be observed that, theoretically, a given quantity of nitric acid is capable of oxidizing an unlimited amount of sulphur dioxide; the limit in practice is occasioned by the loss of the nitrogen compounds which remain dissolved in the diluted sulphuric acid finally drawn from the chambers. If used once only, the nitric acid from 170 parts or 2 molecules of the sodium nitrate would be sufficient merely to oxidize the sulphur dioxide resulting from 96 parts or 3 atoms of sulphur, while practically about 5 or 6 parts of sodium nitrate are sufficient.

When the acid in the chamber, often designated as *chamber acid*, has attained the specific gravity 1.52 to 1.58, and contains about 64 per cent. of H_2SO_4, it is evaporated in shallow leaden pans until it has reached a density of 1.70 to 1.75. In this operation sulphurous, nitrous, and nitric acids are expelled, and iron lead, and calcium sulphates, deposited, the salts resulting from the corrosion of the vessels and the impurities of the water. The final concentration must be effected in platinum stills or glass retorts placed in a sand-bath, the distillation being continued as long as a weak acid passes over or until the residue has the desired density. For the preparation of a pure sulphuric acid, however, the commercial acid must be distilled from a glass retort, which is placed in a deep sand-bath surrounded by sand and covered with a metallic hood; the neck of the retort is connected without luting with a suitable receiver, which is changed when about one-eighth or one-sixth of the acid has come over; the subsequent portion will have the required specific gravity. It is important that an acid free from arsenic should be selected for distillation.

2. Nordhausen Oil of Vitriol, so named because it was first manufactured near Nordhausen in Saxony, is obtained from ferric sulphate, which is made by allowing ferrous sulphate to oxidize in the air. It is distilled from small earthen retorts, the dry salt yielding about 50 per cent. of acid, which consists of about 1 molecule each of sulphuric anhydride and hydrogen sulphate, $SO_3.H_2SO_4$. Ferric oxide remains behind, and is used under the name of *colcothar* or *rouge* for polishing glass and metals.

3. Acidum Sulphuricum Dilutum, *U. S.*, *Br.* Diluted Sulphuric Acid, *E.*; Acide sulfurique dilué, *Fr.*; Verdünnte Schwefelsäure, *G.* Take of Sulphuric Acid, 100

Gm., Distilled Water, 825 Gm. Pour the acid gradually, with constant stirring, into the distilled water, *U. S.* Mix 1350 grains of sulphuric acid with sufficient distilled water until the mixture at 15.5° C. (60° F.) measures an imperial pint, *Br.* Mix sulphuric acid 1 part and water 5 parts, *P. G.*

In place of using metric weights, 1 ounce (av. or troy) of sulphuric acid may be carefully mixed with 8¼ ounces (av. or troy) of distilled water, and when cool sufficient distilled water should be added to bring the weight of the diluted acid up to 9¼ ounces (av. or troy).

The direction of the Pharmacopœias to add *the acid to the water* must be observed in all cases, and more particularly if large quantities of acid are to be diluted. During the mixing of the two liquids, which is best performed in a porcelain dish or beaker-glass, a considerable elevation of temperature takes place, causing a portion of the water to evaporate; the weight of the cooled mixture should therefore be made up to 925 Gm. by the addition of distilled water. Filtration through paper or decantation is necessary only when pure sulphuric acid has not been used, to remove the lead sulphate, which is deposited from the commercial acid on diluting with water.

Purification.—To remove nitrogen compounds from strong sulphuric acid, Maxwell Lyte recommends (1864) the addition to it of ¼ or ½ per cent. of oxalic acid, and then exposure to heat until this compound is completely decomposed. To remove arsenic, Busy and Buignet (1863 and 1864) oxidize this metal, if present as arsenous acid, to arsenic acid, and then distil nine-tenths of the sulphuric acid after having previously added some ammonium sulphate. A. Buchner (1863) avoids distillation in such a case by reducing the arsenic, if present as arsenic acid, to arsenous acid by heating the sulphuric acid with a little charcoal. Hydrochloric acid gas is then passed through the liquid, and the arsenic is entirely eliminated from the hot acid as arsenic chloride.

Properties.—1. Sulphuric Anhydride or Anhydrous Sulphuric Acid. This distils first when Nordhausen oil of vitriol is heated. At a low temperature it forms long, colorless prisms having in quantity somewhat the aspect of asbestos. It fuses at about 20° C. (68° F.) to a colorless liquid, boils above 35° C. (95° F.), and dissolves in all proportions of oil of vitriol. When kept at a temperature below 25° C. (87° F.), it is gradually converted into a modification which is slightly soluble in oil of vitriol, and melts slowly above 50° C. (122° F.), at the same time passing into the former kind. Both kinds attract moisture with great avidity, and in contact with the air give off white fumes. Its composition is SO_3.

2. Nordhausen Oil of Vitriol. This was officinal in Germany under the name of *Acidum sulfuricum fumans.* It is an oily liquid, emitting white suffocating fumes, and having a specific gravity of from 1.860 to 1.896. It is usually of a brownish color, due to organic matter. Near 0° C. (32° F.) it forms colorless flat crystals, and at about 50° C. (122° F.) it commences to boil, sulphuric anhydride distilling over; on continuing the heat an acid is finally obtained which boils at 338° C. (see below).

Pyrosulphuric acid is a similar compound, which is solid below 15° C., and is either distilled from thoroughly exsiccated ferric sulphate or from sodium pyrosulphate, or it is prepared by passing sulphur dioxide and oxygen over red-hot asbestos. The acid is used in the manufacture of tar colors.

3. Commercial Sulphuric Acid, Acidum Sulfuricum Crudum, *P. G.* It forms a colorless or brownish, inodorous, oily liquid, intensely acid and corrosive, and having a specific gravity of not less than 1.830 (*P. G.*). It holds a small quantity of lead sulphate in solution, which, however, does not render it unfit for pharmaceutical purposes if it is otherwise pure, more particularly free from arsenic, since that salt is precipitated when the acid is diluted with water or alcohol. It is also liable to contain small quantities of nitric, hydrochloric, and sulphurous acid, iron and other metals, lime, ammonia, and other alkalies.

4. Pure Sulphuric Acid. It resembles the colorless crude acid in its physical properties, and, like it, is very hygroscopic. When cooled to about —35° C. (—31° F.) it congeals, and heated to 338° C. (640° F.) it boils, yielding a colorless gas producing dense white fumes when in contact with the atmosphere, and finally evaporates without leaving any residue. The boiling is usually accompanied with violent concussions. Weaker acids boil at a lower temperature, the strength and density being increased until the boiling-point mentioned above has been reached, when the acid contains 1.5 per cent. H_2O and 98.5 per cent. H_2SO_4 (Marignac, 1853). Pure hydrogen sulphate melts, according to Marignac, at 10.5° C. (51° F.), and has at 0° C. (32° F.) the density 1.854, and at 12° C. (53.6° F.) 1.842, in both cases compared with water of the same temperature. The affinity of concentrated sulphuric acid for water is so great that organic compounds left in contact with it are charred, while the acid at the same time acquires a brown color,

The specific gravities of sulphuric acid of different strengths, as ascertained by Vauquelin, Dareet, Bineau, Dalton, Ure, and Kolb, vary in some cases considerably. The following table is a condensation of the one by Lunge, which has been adopted by the U. S. P.

Specific Gravity 15° C. at 15° C. in air.	100 parts contain — parts of		Specific Gravity 15° C. at 15° C. in air.	100 parts contain — parts of		Specific Gravity 15° C. at 15° C. in air.	100 parts contain — parts of	
	SO_3.	H_2SO_4.		SO_3.	H_2SO_4.		SO_3.	H_2SO_4.
1.0008	0.07	0.09	1.261	28.22	34.57	1.522	50.28	61.59
1.0059	0.68	0.83	1.265	. .	35.00	1.527	50.66	62.06
1.0109	1.28	1.57	1.266	28.69	35.14	1.532	51.04	62.53
1.0159	1.88	2.30	1.271	29.15	35.70	1.537	51.43	63.00
1.021	2.47	3.03	1.276	29.62	36.29	1.542	51.78	63.43
1.026	3.07	3.76	1.280	30.00	. .	1.547	52.12	63.85
1.031	3.67	4.49	1.281	30.10	36.87	1.552	52.46	64.26
1.0345	. .	5.00	1.286	30.57	37.45	1.557	52.79	64.67
1.036	4.27	5.23	1.291	31.04	38.03	1.561	. .	65.00
1.041	4.87	5.96	1.296	31.52	38.61	1.562	53.12	65.01
1.042	5.00	. .	1.301	31.99	39.19	1.5670	53.46	65.49
1.046	5.45	6.67	1.306	32.46	39.77	1.572	53.80	65.90
1.051	6.02	7.37	1.308	. .	40.00	1.577	54.13	66.30
1.056	6.59	8.07	1.311	32.94	40.35	1.582	54.46	66.71
1.061	7.16	8.77	1.316	33.41	40.93	1.587	54.80	67.13
1.066	7.73	9.47	1.3215	33.88	41.50	1.5896	55.00	. .
1.0697	. .	10.00	1.327	34.35	42.08	1.592	55.18	67.59
1.071	8.32	10.19	1.332	34.80	42.66	1.597	55.55	68.05
1.076	8.90	10.90	1.334	35.00	. .	1.602	55.93	68.51
1.081	9.47	11.60	1.337	35.27	43.20	1.607	56.30	68.97
1.0856	10.00	. .	1.342	35.71	43.74	1.612	56.68	69.43
1.086	10.04	12.39	1.347	36.14	44.28	1.617	57.05	69.89
1.091	10.60	12.99	1.352	36.58	44.82	1.618	. .	70.00
1.096	11.16	13.67	1.354	. .	45.00	1.622	57.40	70.32
1.101	11.71	14.35	1.357	37.02	45.35	1.627	57.75	70.74
1.1058	. .	15.00	1.362	37.45	45.88	1.632	58.09	71.16
1.106	12.27	15.03	1.367	37.89	46.61	1.637	58.43	71.57
1.111	12.82	15.71	1.372	38.32	46.94	1.642	58.77	71.99
1.116	13.36	16.36	1.377	38.75	47.47	1.647	59.10	72.40
1.121	13.89	17.01	1.382	39.18	48.00	1.652	59.45	72.82
1.126	14.42	17.66	1.387	39.62	48.53	1.657	59.79	73.23
1.131	14.95	18.31	1.3914	40.00	. .	1.661	60.00	. .
1.1315	15.00	. .	1.392	40.05	49.06	1.662	60.11	73.64
1.136	15.48	18.96	1.397	40.48	49.59	1.667	60.46	74.07
1.141	16.01	19.61	1.401	. .	50.00	1.672	60.82	74.51
1.144	. .	20.00	1.402	40.91	50.11	1.677	61.20	74.97
1.146	16.54	20.26	1.407	41.33	50.63	1.6773	. .	75.00
1.151	17.07	20.91	1.412	41.76	51.15	1.682	61.57	75.42
1.156	17.59	21.55	1.417	42.17	51.66	1.687	61.93	75.86
1.161	18.11	22.19	1.422	42.57	52.15	1.692	62.29	76.30
1.166	18.64	22.83	1.427	42.96	52.63	1.697	62.64	76.73
1.171	19.16	23.47	1.432	43.36	53.11	1.702	63.00	77.17
1.176	19.69	24.12	1.437	43.75	53.59	1.707	63.35	77.60
1.179	20.00	. .	1.442	44.14	54.07	1.712	63.70	78.04
1.181	20.21	24.76	1.447	44.53	54.55	1.717	64.07	78.48
1.1829	. .	25.00	1.4517	. .	55.00	1.722	64.43	78.92
1.186	20.73	25.40	1.452	44.92	55.03	1.727	64.78	79.36
1.191	21.26	26.04	1.453	45.00	. .	1.730	65.00	. .
1.196	21.78	26.68	1.457	45.31	55.50	1.732	65.14	79.80
1.201	22.30	27.32	1.462	45.69	55.97	1.734	. .	80.00
1.206	22.82	27.95	1.467	46.07	56.43	1.737	65.50	80.24
1.211	23.33	28.58	1.472	46.45	56.90	1.742	65.86	80.68
1.216	23.84	29.21	1.477	46.83	57.37	1.747	66.22	81.12
1.221	24.36	29.84	1.482	47.21	57.83	1.752	66.58	81.56
1.222	. .	30.00	1.487	47.57	58.28	1.757	66.94	82.00
1.226	24.88	30.48	1.492	47.95	58.74	1.762	67.30	82.44
1.227	25.00	. .	1.497	48.34	59.22	1.767	67.65	82.88
1.231	25.39	31.11	1.502	48.73	59.70	1.772	68.02	83.32
1.236	25.88	31.70	1.505	. .	60.00	1.777	68.49	83.90
1.241	26.35	32.28	1.507	49.12	60.18	1.782	68.98	84.50
1.246	26.83	32.86	1.512	49.51	60.65	1.786	. .	85.00
1.251	27.29	33.43	1.517	49.89	61.12	1.787	69.47	85.10
1.256	27.76	34.00	1.5184	50.00	. .	1.792	69.96	85.70

Specific Gravity 15° C. at 15° C. in air.	100 parts contain — parts of		Specific Gravity 15° C. at 15° C. in air.	100 parts contain — parts of		Specific Gravity 15° C. at 15° C. in air.	100 parts contain — parts of	
	SO_3.	H_2SO_4.		SO_3.	H_2SO_4.		SO_3.	H_2SO_4.
1.7924	70.00	. .	1.830	74.69	91.50	1.841	77.23	94.60
1.797	70.45	86.30	1.831	74.86	91.70	1.842	77.55	95.00
1.802	70.94	86.90	1.8318	75.00	. .	1.843	78.04	95.60
1.8075	71.50	87.60	1.832	75.03	91.90	1.8431	78.33	95.95
1.813	72.08	88.30	1.833	75.19	92.10	1.8436	79.19	97.
1.818	72.69	89.05	1.834	75.35	92.30	1.8441	79.76	97.70
1.8227	. .	90.00	1.835	75.53	92.52	1.8438	80.00	. .
1.823	73.51	90.05	1.836	75.72	92.75	1.8436	80.16	98.20
1.824	73.63	90.20	1.837	75.96	93.05	1.8431	80.57	98.70
1.825	73.80	90.40	1.838	76.27	93.43	1.8426	80.98	99.20
1.826	73.96	90.60	1.839	76.57	93.80	1.8421	81.18	99.45
1.827	74.12	90.80	1.8396	76.90	94.20	1.8416	81.39	99.70
1.828	74.29	91.00	1.840	76.99	94.31	1.8411	81.59	99.95
1.829	74.49	91.25						

Pure sulphuric acid unites with water and alcohol in all proportions, forming transparent liquids; a white turbidity indicates lead sulphate, which becomes black with hydrogen sulphide. Arsenic would be indicated by a yellow precipitate occurring in the diluted acid with hydrogen sulphide, or more rapidly by silver nitrate in applying Marsh's test or by Fleitmann's method (see page 27). A cold concentrated solution of ferrous sulphate poured upon the surface of the concentrated acid does not develop a purplish-brown color where the two liquids unite, showing the absence of nitrogen oxides.

The acid should contain not less than 92.5 per cent. of H_2SO_4; 0.48 Gm. of it will be exactly neutralized by not less than 9.25 Cc. of the volumetric solution of potassa (*U. S.*). The British Pharmacopœia requires for 1000 grain-measures of the latter 50 grains of the acid, which corresponds to 98 per cent. of H_2SO_4, equal to 80 per cent. SO_3.

Sulphuric acid is one of the strongest of acids. It is bibasic, and forms normal and acid salts, which are generally crystallizable and soluble in water. The barium and lead sulphates are entirely insoluble in water and diluted acids; hence their soluble salts furnish the best reagents for sulphuric acid in its uncombined and combined state.

5. Diluted Sulphuric Acid. It has the general properties of the strong acid, but is not of an oily consistence, and is less caustic. 4.89 Gm. of it are neutralized by 10 Cc. of normal potassa solution. The British Pharmacopœia requires the diluted acid to contain 11.14 per cent. of SO_3, equal to 13.65 per cent. of H_2SO_4; of it 359 grains are neutralized by 1000 grain-measures of the volumetric solution of soda. Other authorities direct 10 (*Fr. Cod.*), 16.66 (*P. A.*), and 18.8 (*F. It.*) per cent. H_2SO_4.

Impurities.—The most important impurities, arsenic, lead, and nitrogen oxides, have been mentioned before. Saline additions made to increase the specific gravity of weaker acids are recognized by the fixed residue left on evaporating a small quantity from a platinum dish or crucible. Sulphurous and nitrous acid rapidly decolorize potassium permanganate. Arsenic is found principally in sulphuric acid manufactured from pyrites, more rarely if made from sulphur; for this reason the sulphuric acid manufactured in the United States is often free from this contamination. The purity of sulphuric acid is determined as follows: 1 vol. of acid diluted with 5 vol. of alcohol must remain clear and free from precipitate after one hour (absence of *lead sulphate*, or other salts). The mixture of 1 Cc. of sulphuric acid and 5 Cc. of water should not at once discharge the color of 0.1 Cc. $\frac{N}{10}$ potassium permanganate (absence of *sulphurous* or *nitrous acid*). 2 Cc. of the acid, upon which a layer of ferrous sulphate solution has been carefully poured, should not cause a brown or reddish color at the zone of contact (absence of *nitric* or *nitrous acid*). In sulphuric acid diluted with 20 volumes of water no precipitate should be formed by the addition of silver nitrate T. S. (absence of *hydrochloric acid*), or of hydrogen sulphide T. S. (absence of *lead*, *arsenic*, *copper*); nor by supersaturation with ammonia-water (*iron*); nor should the acid thus supersaturated leave any fixed residue on evaporation and ignition (absence of *non-volatile impurities*), or yield any precipitate on addition of ammonium sulphide T. S (*iron*, *thallium*, etc.). When 1 Cc. of a mixture of 1 volume of sulphuric acid with 2 volumes of water is mixed with 1 Cc. of stannous chloride T. S., and a small piece of pure tin-foil added, no coloration should appear within one hour (limit of *arsenic*, U. S.). These tests are nearly identical with those adopted by the German Pharmacopœia, which requires also

that on carefully pouring a solution of a small fragment of sodium sulphide in 2 Cc. of hydrochloric acid upon 2 Cc. of sulphuric acid, the zone of contact should not acquire a reddish color, nor should, on warming, a red compound be separated, showing the absence of *selenium*.

Pharmaceutical Uses.—Sulphuric acid is largely used in numerous pharmaceutical processes for the liberation of acids (hydrocyanic, hydrochloric, nitric, citric, tartaric); in the preparation of alkaloids, pyroxylon, ether, and oil of wine; for generating hydrogen with zinc and water; for decomposing certain organic compounds, as in the purification of chloroform; and for the preparation of sulphurous acid, the medicinal sulphates, and of *Acidum sulphuricum aromaticum*.

Mixtura sulfurica acida, *P. G.*, *s. Elixir acidum Halleri*.—It is prepared by dropping 1 part of pure sulphuric acid into 3 parts (1 pt. *F. It.*) of alcohol, and stirring continually; it is a colorless liquid, having the spec. grav. 0.993 to 0.997. It is an alcoholic solution of ethylsulphuric acid, into which the sulphuric acid is gradually converted. Acid and alcohol in the proportion of 1 : 3 is *acqua de Rabel* (*F. It.*). The same, but colored by red poppy-petals, is *Eau de Rubel*, (*F. Cod.*).

Mixtura vulneraria acida, *s. Aqua vulneraria Thedenii*.—Theden's vulnerary water, *E.*; Eau d'arquebusade, *Fr.*; Theden's Wundwasser, *G.* It is a mixture of diluted sulphuric acid 1 part; vinegar 6 parts; alcohol (sp. grav. .892) 3 parts; and clarified honey 2 parts.—*A. D. A.*

Michel's paste is a mixture of powdered asbestos 1 part and concentrated sulphuric acid 3 parts. It should be freshly prepared when needed. Similar are the caustic pastes of Rust, Velpeau, and Ricord, in which the asbestos is replaced by saffron, liquorice-root, and powdered charcoal respectively.

Action and Uses.—In a concentrated state sulphuric acid abstracts water from organized matter, turning it black and exposing its carbonaceous elements in the form of charcoal. Injected into the veins, it coagulates the blood and carbonizes it. When swallowed in a concentrated form it destroys all the tissues it touches, and in this condition, as well as when somewhat less strong, it produces whitish scalds of the lips and mouth, followed by ulcers, severe burning pain in the throat, œsophagus, and stomach, with violent efforts at vomiting, and collapse. The urine is sometimes albuminous or bloody. The mind remains clear. Even when death does not directly occur, it often does so at a later period, owing to stricture of the œsophagus or intestine resulting from ulceration of the mucous membrane. (For cases, see *Times and Gaz.*, Mar. 1877, p. 320; *Virchow's Archiv*, lxxxiii. 198; *Zeitch. f. klin. Med.*, xiv. 490.) In medicinal doses it diminishes thirst, restrains sweats depending on debility, improves the appetite, probably by stimulating the stomach, acidifies the secretions, and reduces the frequency of the pulse. Its action upon the teeth, even when it is greatly diluted, is exceedingly injurious, and by continued use it exhausts the digestive functions and causes diarrhœa, with debility and emaciation.

The corrosive action of sulphuric acid has been made use of to correct inversion and also eversion of the eyelid (*ectropion* and *entropion*) by forming an eschar upon the convex or projecting surface of the part, which in cicatrizing contracts the tissues and corrects the deformity. It has sometimes been employed as an escharotic application to various infecting or ill-conditioned *ulcers*, particularly in *gangrene* of the mouth and in *caries* of the bones, and also for the extirpation of *cancers*. In the last case a paste is applied to the tumors formed of asbestos and powdered sulphate of zinc, or saffron saturated with sulphuric acid. The operation is tedious, very painful, and as uncertain as any other for the same purpose. An ointment composed of 1 part of the acid to 8 parts of lard has been recommended for *tinea capitis*; and in the treatment of *scabies* it is often successful either in ointment or lotion, and has the advantage over sulphur ointment of being free from any unpleasant smell. Internally, sulphuric acid in the diluted or aromatic form is much used in chronic diseases with a tendency to a dissolution of the blood, such as *scurvy* and *purpura*, as well as in other and especially uterine passive *hæmorrhages*. It is thought to be particularly useful in mucous hæmorrhages and fluxes, because the acid is eliminated by the mucous membranes; but this explanation would not apply to blood diseases, whether chronic or acute, and especially to *fevers* of a low type, in which it is reputed to be efficient. Still less would it apply to *colliquative sweating*, for which this medicine is one of the very best remedies. It has been assumed to explain the efficacy of the acid in *diarrhœa*, *cholera morbus*, and even *epidemic cholera*. In the last-mentioned cases the most probable view is that its operation is local and in its nature astringent. So far as it acts by being taken into the blood, it probably does so in

the same manner, but from within instead of from without. Its apparent power of preventing as well as of curing epidemic cholera appears distinctly to be owing to the astringent influence by which it prevents the absorption of the cholera poison from the alimentary canal, the ordinary channel of its introduction, and at the same time limits the transudation of the contents of the blood-vessels into the bowels. Its value as a prophylactic against cholera is not so well authenticated. Its efficacy in *painter's colic* is generally admitted. It is administered with water in the proportion of about Gm. 8 (f℥ij) in 3 pints of water in the course of twenty-four hours. If it is useful, as alleged, in curing *gravel* and *stone*, its utility is probably due to a tonic action upon the stomach. It has sometimes appeared to remove *tape-worms*, perhaps by its physical action upon these parasites.

As *antidotes* to poisoning by sulphuric acid, chalk, magnesia, carbonate of magnesia, and the alkaline carbonates may be administered.

The *dose* of the strong acid is Gm. 0.06–0.13 (1 or 2 drops), dissolved in not less than Cc. 128 (f℥iv) of water; of the diluted acid, from Gm. 0.60–2.00 (10 to 30 drops) may be given in the same way.

ACIDUM SULPHURICUM AROMATICUM, *U. S., Br.*—Aromatic Sulphuric Acid.

Tinctura aromatica acida, Elixir vitrioli Mynsichti.—Elixir of vitriol, E.; *Elixir vitriolique, Teinture (Alcoolée) aromatique sulfurique*, Fr.; *Saure aromatische Tinctur, Mynsicht's Elixir*, G.

Strength of H_2SO_4: 20 per cent. *U. S.*, 12.5 per cent. *Br.*: Spec. grav. 0.939 *U. S.*, 0.911 *Br.*

Preparation.—Add gradually Sulphuric acid 100 Cc. to Alcohol 700 Cc., and allow the mixture to cool. Then add to it Tincture of Ginger 50 Cc., Oil of Cinnamon 1 Cc., and enough of alcohol to make the product measure 1000 Cc. *U. S.* (In the absence of metric measures the following proportions will correspond to the official formula: Sulphuric Acid 1 fluidounce, Tincture of Ginger ½ fluidounce, Oil of Cinnamon 5 minims, Alcohol sufficient to make 10 fluidounces.)

Take of Strong Tincture of Ginger 2 fluidounces; Spirit of Cinnamon 2 fluidounces; Rectified Spirit 36 fluidounces; Sulphuric Acid 3 fluidounces (or 2419 grains). Mix the sulphuric acid gradually with the spirit, and add the spirit of cinnamon and tincture of ginger.—*Br.* Spec. grav. 0.911; contains about 12.5 per cent. of H_2SO_4.

This preparation has been dismissed from both the French and German Pharmacopœias.

Properties.—The formula is essentially that suggested by T. N. Jamieson in 1867 as a substitute for one directing, the maceration of the aromatics in the mixture of alcohol and sulphuric acid, whereby a preparation of a deep brown-red color is obtained, which in the course of time deposits an unsightly precipitate, due perhaps to modified tannin. The preparation obtained by the new pharmacopœial process is of a light-straw color, and, while it yields only a slight precipitate, has about the same aromatic properties as the former.

On mixing sulphuric acid with alcohol the temperature rises, and some ethylsulphuric (sulphovinic) acid is produced, the quantity of which slowly increases with the age of the preparation. For the same amount of sulphur this acid has only one-half the saturating power of sulphuric acid; the acidimetric test must therefore vary with the age of this preparation, and when fresh and made at a low temperature 9.8 Gm. of the acid, properly diluted with water, will require for complete neutralization 37 (*U. S.*) Cc. of the volumetric solution of soda. The British Pharmacopœia requires 500 grain-measures of the soda solution for the neutralization of 195 grains by weight of its aromatic sulphuric acid.

Action and Uses.—This preparation is preferable to any other form of sulphuric acid for internal administration. It is peculiarly adapted to the treatment of *gastro-intestinal disorders*, for which the simple acid is also appropriate, and of the *colliquative sweats* of phthisis and other hectical affections. The cure of a case of *exophthalmic goitre* (Magruder, *Med. News*, liii. 499) has been attributed to it. Dose, Gm. 0.60–1.30 (gtt. x–xx).

ACIDUM SULPHUROSUM, *U. S., Br.*—Sulphurous Acid.

Sulphurous anhydride, Sulphur dioxide, E.; *Acide sulfureux*, F.; *Schweflige Säure*, G.

Formula, SO_2. Molecular weight 63.9. Strength 6.4 per cent. *U. S.*, 5 per cent. *Br.* Specific gravity, 1.035 *U. S.*, 1.025 *Br.*

Origin and Production.—Sulphurous acid was first distinguished from sulphuric acid by Stahel (1697); its properties in the gaseous state were studied by Priestly (1775), and Lavoisier (1777) showed that it contains less oxygen than sulphuric acid. It is met with in the exhalations of active volcanoes, and is produced on the burning of sulphur and when concentrated sulphuric acid is heated with charcoal or with organic matters, with copper, mercury, or other metals. The official process is as follows:

Preparation.—Take of Sulphuric Acid 80 Cc.; Charcoal in coarse powder 20 Gm.; Distilled Water 1000 Cc. Pour the acid upon the charcoal previously introduced into a glass flask, and mix the two well together. By means of a glass tube and well-fitting corks connect the flask with a 200 Cc. wash-bottle, which is one-third filled with water and fitted with a cork having three perforations. Into one of these perforations insert a safety-tube, which should reach nearly to the bottom of the bottle; into the remaining perforation fit a glass tube and connect it with a bottle which is about three-fourths filled by the distilled water. This tube should dip about an inch below the surface of the water. By means of a second tube connect this bottle with another bottle containing a dilute solution of sodium carbonate, to absorb any gas which may not be retained by the distilled water. Having ascertained that all the connections are air-tight, apply a moderate heat to the flask until the evolution of gas has nearly ceased, and during the passage of the gas keep the bottle containing the distilled water at or below 10° C. (50° F.) by surrounding it with cold water or ice. Finally, pour the sulphurous acid into glass-stoppered, dark amber-colored bottles, and keep them in a cool and dark place.—*U. S.*

If a safety-tube be inserted in the apparatus, the delivery-tube may be allowed to reach to near the bottom of the distilled water. The gas which is not absorbed must, to avoid inconvenience, be conveyed either into the open air, into a flue, or, as directed above, into an alkaline solution, where it will be absorbed.

The process of the British Pharmacopœia is essentially the same: the gas evolved from 4 fluidounces of sulphuric acid and 1 ounce of wood charcoal is washed by passing it through 2 ounces of water and conducted into 20 fluidounces of distilled water.

The charcoal acts as a reducing agent upon the sulphuric acid, generating carbon dioxide and sulphurous anhydride and water; thus: $C_2 + 4H_2SO_4 = 2CO_2 + 4SO_2 + 4H_2O$. The gas is therefore contaminated with carbon dioxide, which will likewise be retained by the distilled water to a slight extent. A purer acid is obtained by heating copper clippings with concentrated sulphuric acid, when copper sulphate and sulphurdioxide will be produced; $Cu_2 + 4H_2SO_4 = 2CuSO_4 + 2SO_2 + 4H_2O$. Double the quantity of sulphuric acid will be necessary to produce the same amount of sulphurous acid as is produced by the official process.

Properties and Tests.—Sulphur dioxide consists of 1 measure of gaseous sulphur and 2 of oxygen, condensed to 2 measures; it is a colorless, irrespirable gas, has a pungent and suffocating odor, and condenses to a liquid at −17.8° C. (0° F.) or under a pressure of 4 or 5 atmospheres; this liquid boils briskly on coming into contact with ice. Water dissolves at 10° C. (50° F.) 51 volumes, and at 20° C. (68° F.) 36 volumes, of sulphur dioxide; the solution contains sulphurous acid, $H_2SO_3 = (OH)_2SO$, and when saturated at ordinary temperature has, according to Anthon (1860), the density 1.046 and contains 9.54 per cent. SO_2. The density of sulphurous acid of different strength has been ascertained as follows:

Per ct. SO_2.	Specific gravity.			Per ct. SO_2.	Specific gravity.			Per ct. SO_2.	Specific gravity.		
	Anthon, med. temp.	Scott, 15° C.	Hager, 17.5° C.		Anthon, med. temp.	Scott, 15° C.	Hager, 17.5° C.		Anthon, med. temp.	Scott, 15° C.	Hager, 17.5° C.
10.00	.....	1.052	1.044	6.68	1.027			3.82	1.016		
9.54	1.046			6.50	.....	1.035	1.027	3.50	.....	1.019	1.014
9.50	.....	1.049	1.041	6.00	.....	1.033	1.025	3.00	.....	1.017	1.012
9.00	.....	1.047	1.039	5.72	1.023			2.86	1.013		
8.59	1.036			5.50	.....	1.030	1.023	2.50	.....	1.014	1.010
8.50	.....	1.045	1.037	5.00	.....	1.027	1.021	2.00	.....	1.011	1.008
8.00	.....	1.042	1.035	4.77	1.020			1.90	1.009		
7.63	1.031			4.50	.....	1.025	1.019	1.50	.....	1.008	1.006
7.50	.....	1.040	1.033	4.00	.....	1.022	1.017	0.95	1.005		
7.00	.....	1.037	1.030								

Strength and density, as given by the U. S. Pharmacopœia, correspond with the above table; those given by the Br. Pharm. also very nearly. Both authorities determine the strength by iodine, 1 atom of which will be converted into hydriodic acid by ½ molecule of sulphur dioxide; hence 2 Gm. of the pharmacopœial sulphurous acid, properly diluted, will not acquire a permanent blue color with starch-paste, until at least 40 Cc. of the volumetric solution of iodine have been added (*U. S.*), or 1000 grain-measures of the latter should oxidize 64 grains of sulphurous acid (*Br.*); $I_2 + H_2SO_3 + H_2O$ yield $H_2SO_4 + 2HI$.

The aqueous solution of sulphurous acid evaporates by heat without leaving any residue; in contact with air it is oxidized to sulphuric acid, and when exposed to light it acquires the property of precipitating silver sulphide from silver nitrate. Barium chloride, slightly acidulated with hydrochloric acid, yields no precipitate with it, or only a slight turbidity. The gas remains with the water when the solution freezes, and at the boiling temperature some time must elapse before it is entirely expelled.

Sulphurous acid is a powerful deoxidizing agent, abstracting oxygen from permanganic, chromic, iodic, arsenic, nitric, and other acids, from ferric, mercuric, argentic, and other salts, and from most vegetable colors, thereby bleaching the latter. It yields hydrogen sulphide and water when in contact with nascent hydrogen. It displaces carbon dioxide from carbonates, and yields salts which generally are sparingly soluble in water, except the alkali sulphites; they are inodorous, have a somewhat acrid taste, and on ignition are converted into sulphate and sulphide, or sulphur dioxide is given off, the metallic oxide remaining.

Pharmaceutical Uses.—Sulphurous acid is employed in the preparation of sodium, calcium, and other sulphites, and of calomel by the wet process, and serves as a powerful reducing agent. In pharmacy and the arts it is used for bleaching sponges, bones, straw, and other organic matters, for removing fruit-stains, and for arresting or preventing fermentation and putrefaction.

Action and Uses.—As stated elsewhere (v. *Sulphur*), the fumes of burning sulphur were, from a remote antiquity, employed to disinfect temples and houses (as Homer, Ovid, and Pliny relate), and for this purpose and for bleaching woollen cloths they continued to be used until they were superseded by chlorine. It seems probable that the irritating quality of the vapors caused greater virtues to be ascribed to them than they possess. In the last and early part of the present century sulphurous acid was used in the treatment of scabies and other contagious affections, as well as of rheumatism, neuralgia, and paralysis. From about 1875 experiments made by Pettenkoffer and others led to the use of sulphur fumes for disinfecting ships and hospitals. It seemed to be admitted that, except in the presence of water, they were of little use; yet under official pressure they were generally employed in Europe (Dujardin-Beaumetz, *Bull. de Thérap.*, cxv. 390, etc.). It was admitted that in watery solution the acid could destroy insects, including fleas, lice, and bedbugs, and also the contagious power of vaccine, glanders, Oriental plague, and cattle plague (*Practitioner*, xxxiii. 189), but that in this form its corrosive action upon woven fabrics and various articles of furniture was more injurious than when perfectly dry. The study of the subject by Sternberg (*Med. News*, xlvi. 343) led him to conclude that the acid does really deprive vaccine matter of its activity when the latter is retained in an atmosphere containing 1 per cent. of the acid, and also that in comparatively weak aqueous solutions it destroys the vitality of various micrococci; but that the conditions of its success on a large scale in practice render much of the "disinfection" ascribed to it illusory. Even admitting that "in the absence of spores, micro-organisms suspended in the atmosphere or attached to the surface of objects may be destroyed by sulphur dioxide when generated in a sufficient quantity in a well-closed apartment and in the presence of moisture, the question remains whether the same object may not be as well accomplished by thorough ventilation and by washing all surfaces with a 1 : 1000 solution of mercuric chloride." Experiments made by Dr. Biggs led him to conclude that sulphurous acid gas in 100 volume per cent. *under pressure* will destroy most forms of micro-organisms except the spores of bacilli; it will not destroy, but retard the growth of, permanent spores (*Med. News*, li. 706; compare Edson, *Med. Record*, xxxvi. 533; Aubert, *Bull. de Thérap.*, cxviii. 54).

Favus of the scalp and other hairy parts has been successfully treated by means of lotions containing 1 part of the acid to 3 of water, after removal of the crusts by means of emollient poultices. As already stated, it has been used to cure *scabies*. *Whooping cough* is said to have been cured by keeping the patients in rooms where sulphur had been burned (*Practitioner*, xxxviii. 372; xli. 120). The acid has been used in a gargle for

ulcerated and gangrenous *pharyngitis*, and for *diphtheria* when diffused through the air of the patient's room and in conjunction with warm-water vapor (*Edinb. Jour.*, xxxiv. 724). *Pulmonary phthisis* has also been treated by confining patients affected with it for a certain space of time every day to a room filled with sulphurous acid vapor. Dujardin-Beaumetz, Sollaud, and Balbaud (*Bull. de Thérap.*, cxiii. 165, 276; *Bull. et Mém. Soc. Thérap.*, 1887, p. 200) have testified that in non-febrile cases, under its influence, the cough and expectoration diminish, while the appetite, strength, flesh, and sleep improve. These statements have not been confirmed. Hypodermic injections made in the trochanterian notch of a saturated solution of sulphurous acid in vaseline have been employed for the same purpose, but with no demonstrable benefit (*Bull. de Thérap.*, cxiii. 132; cxiv. 160). As a lotion for recent *wounds* the acid has been said to allay pain, diminish suppuration, and promote cicatrization, and it has been recommended in a gargle for ulcerated and gangrenous *pharyngitis*. In many other local affections requiring an antiseptic and stimulant medication it is stated to be useful, as well as internally in the treatment of *urticaria* and *dyspeptic flatulence*; but for the latter the sulphites are preferable. It may also be employed to disinfect the *dejections* of the sick, and in lotions to diminish the *contagiousness* of eruptive fevers.

The dose of sulphurous acid is Gm. 4–12 (f℥j–iij), largely diluted. For inhalation the following method is suggested by Dujardin-Beaumetz: Select a small room of known capacity; close perfectly all openings into it; burn within it flowers of sulphur ignited by means of alcohol poured upon their surface; begin by small quantities, such as Gm 5 (gr. lxxv), and daily increase the amount by Gm. 5 (gr. lxxv) until it reaches Gm. 20 (℥v). Let this be done two hours before the patient enters the room, and let him remain therein for four hours. "The fumes do not change the color of paper-hangings or woven fabrics."

ACIDUM TANNICUM, *U. S., Br., P. G.*—Tannic Acid.

Acidum gallo-tannicum, *Tanninum*.—*Digallic Acid*, *Tannin*, E.; *Acide tannique*, *Tannin*, Fr.; *Gerbsäure*, *Tannin*, G.; *Acido tannico*, It., Sp.

Formula $C_{14}H_{10}O_9 = (C_6H_2)_2.(OH)_5.OCO.COOH$. Molecular weight 321.22.

Origin and Varieties.—Compounds having acid properties and an astringent taste, producing dark-colored solutions or precipitates with salts of iron, and precipitating gelatin and albumen from their solutions, are called by the generic name of tannins. The reaction of tannins with metallic salts, and one of their principal products, leather, were known in ancient times; but Deyeux (1793) and Seguin (1795) first proved tannin to be a distinct compound. The tannins are conveniently arranged into two groups, according to the color produced with ferric salts, which is either dark-green or dark-blue. A large number of plants contain tannin of the latter group, differing, however, from the official tannic acid in not furnishing gallic acid or pyrogallol. The tannin obtained from nutgalls is, for this reason, distinguished from the others by the prefix *gallo*. Gallotannic acid has been found in the official galls, in Chinese and Japanese galls, in the cups of the fruit of some oaks, and in the leaves of Italian sumach, Rhus Coriaria, *Linné*.

Preparation.—Take of Nutgall in fine powder, Ether, each a sufficient quantity. Expose the nutgall to a damp atmosphere for 2 or 3 days, and afterward add sufficient ether to form a soft paste. Let this stand in a well-closed vessel for 24 hours; then, having quickly enveloped it in a linen cloth, submit it to strong pressure in a suitable press, so as to express the liquid portion. Reduce the pressed cake to powder, mix it with sufficient ether, to which one-sixteenth of its bulk of water has been added to form again a soft paste, and express as before. Mix the expressed liquids, and expose the mixture to spontaneous evaporation until, by the aid subsequently of a little heat, it has acquired the consistence of a soft extract; then place it on earthen plates or dishes and dry it in a hot-air chamber at a temperature not exceeding 212° F.—*Br.*

The process is that proposed by Dominé in 1844, and based upon that of Leconnet, first published in 1836, the important modification being the exposure of the powdered galls to a damp atmosphere, and the addition of water to the ether in order to supply the water requisite for rendering the tannin soluble in the ether. That water is absolutely necessary was noticed by Pelouze (1834), who percolated powdered nutgalls with commercial ether containing water—a process suitable for preparing tannin on a small scale; the percolate separates into two slightly-colored layers, the lower of which is a very concentrated solution of tannin. Dominé's plan brings about the same result in

less time and with much less ether. Mohr, Guibourt, and others used a mixture of ether, alcohol, and water.

Gallotannic acid is insoluble in absolute ether, but in the presence of a little water a definite compound appears to be formed of tannin and ether, or with water in addition thereto, which is insoluble in ether, but may be dissolved in water; the ether retained in this syrupy liquid is larger in quantity than would be dissolved by the same amount of water. The complete drying of the tannin is effected at a somewhat elevated temperature, by which the volatile ingredients of the syrupy liquid cause the latter to froth up, leaving the tannin behind in loose, porous masses somewhat sponge-like in appearance. It is scarcely necessary to state that during the entire process contact with most metals, notably with iron, must be avoided; the operations are best performed in glass, porcelain, or earthen vessels.

For the manufacture of tannin on a large scale other and better methods are now followed; for instance, moderately finely powdered galls are treated with water heated to 40° or 60° C. (104°–140° F.) until the powder is exhausted and a concentrated solution obtained; this is allowed to settle, and then filtered into a churn-like vessel provided with numerous paddles. To the liquor is now added about one-fourth of its volume of ether (sp. gr. 0.750), and the mixture thoroughly agitated; when the resulting emulsion is allowed to stand for ten or twelve days it separates into two distinct layers, the upper ethereal layer being a solution of resin, fat, gallic acid, and coloring matter, while the lower aqueous layer contains the tannin with some few impurities. After separation the tannin solution is concentrated in a still to a syrupy consistence, and then spread on plates of sheet tin, which are warmed, so that the tannin may be obtained as dry, spongy masses; the syrupy liquid may also be spread on glass plates, which are then heated in drying ovens to 110° C. (230° F.). This ether-tannin will be nearly white and contain but very slight impurities. Two other varieties, less pure, are met with, known as alcohol-tannin and water-tannin; the former is made by extracting nutgall with 50 per cent. alcohol, carefully filtering, and concentrating the solution, which is finally evaporated in a vacuum. Water-tannin is extracted similarly to ether-tannin, but instead of adding ether the solution, after filtration, is concentrated to dryness in a vacuum apparatus (Trimble, *The Tannins*, 1892). Pure tannic acid has been obtained by Gartenmeister by exhausting powdered galls with acetic ether, and a patent has been granted for the process in Germany. The acetic-ether solution is concentrated, and thoroughly agitated with water, which forms an emulsion from which the impurities are removed by centrifugal action and admixture of charcoal or pumice-stone. Finally, the aqueous solution, almost free from color, is evaporated to dryness by appropriate means. The so-called crystallized tannic acid offered by E. Schering is simply finely-spun tannin obtained in thin threads by forcing a concentrated solution through finely-perforated sieves, and allowing the mass to fall from a height of fifteen feet or more on to rapidly-revolving wood cylinders.

Properties.—Tannic acid, thus prepared, has a yellowish-white color, frequently of a slight greenish tint. It has a strongly astringent taste, and is freely soluble in water, alcohol (0.6 part), acetone, oil of bitter almond, and in 1 part of glycerin, when moderately heated; but remains pulverulent when in contact with anhydrous ether which is free from alcohol, and is likewise insoluble, or nearly so, in absolute alcohol, chloroform, petroleum benzin, benzene, carbon disulphide, and in most fixed and volatile oils. The solutions have an acid reaction. Tannin being less soluble in acidulated water and in solutions of certain salts than in pure water, its aqueous solution is precipitated by mineral and certain organic acids, by the chlorides and several other salts of the alkalies, these precipitates being again soluble in water. Tannin renders iodine soluble in water, and prevents the reaction of the latter upon starch; this behavior has been recommended by F. Jean for the estimation of tannin. It yields precipitates with the alkaloids and many so-called neutral principles, with lime-water, most metallic salts, with starch, albumen, and gelatin. The latter precipitate is soluble in solutions of gelatin and of tannin, but insoluble in water and aqueous solutions of certain salts (see GELATINA); this tannate of gelatin is formed in the tanning of hides, and is an important constituent of leather. With solutions of pure ferrous salts no change takes place in the absence of oxygen, but ferric salts give at once in diluted solutions a deep-blue color, and in more concentrated solutions a bluish-black precipitate, with a reduction to ferrous compounds. In the presence of alkalies and in contact with air solutions of tannin rapidly assume a brown color. On the application of heat tannic acid is decomposed, and pyrogallol sublimes at 212° C. (419° F.), leaving metagallic acid behind, which is a black,

tasteless substance, insoluble in water, soluble in alkalies, and by heat finally consumed without leaving any residue. The odor adhering to tannic acid may, according to Procter (1864), be removed by benzin, together with some coloring matter.

Composition.—The impossibility of obtaining tannic acid in the crystallized state has rendered the determination of its composition very difficult. A brief review of the widely-differing views held by various chemists will be found under ACIDUM GALLICUM. The latest investigations on the subject appear to furnish conclusive proof that chemically pure tannin must be viewed as an anhydride of gallic acid, and that 1 molecule of it represents 2 molecules of the latter, minus 1 of water. This relation is seen from the following equation: $2(C_6H_2(OH)_3.COOH)$, gallic acid, $-H_2O=(C_6H_2)_2.(OH)_5.OCO.COOH$, tannin $=C_{14}H_{10}O_9$, which is the formula of Mulder (1848). The official tannin is contaminated with an odorous principle, some coloring matter, and variable quantities of glucose combined with tannin.

Tannin dissolved in water or in diluted alcohol is gradually converted into gallic acid; occasionally *ellagic acid*, $C_{14}H_8O_9$, is also formed. The latter is insoluble in ether, only sparingly soluble in hot water and alcohol, and in contact with excess of potassa becomes dark-red, and finally black.

Impurities.—Tannic acid should burn from platinum-foil without leaving more than 0.2 per cent. of ash, and be completely soluble in 5 parts of alcohol (dextrin insoluble) and the same proportion of warm water (resin insoluble), both solutions being nearly transparent. The latter solution should not be precipitated on mixing it with twice its volume of alcohol.

Pharmaceutical Uses.—Tannin is employed in the preparation of various proximate principles.

Estimation.—The estimation of tannin and the valuation of the various tanning materials is connected with considerable difficulty, and often requires to be modified according to the nature of other organic compounds present.

Von Schröder's modification of Löwenthal's method, although by no means free from defects, is looked upon as the most reliable for technical analysis: it was adopted by a committee of German chemists in 1885. The method combines Hammer's suggestion for the use of hide-powder with Löwenthal's for potassium permanganate in presence of indigo; the value of the permanganate solution for a known quantity of pure tannin before and after treatment with hide-powder must first be established, solution of sodium sulphindigotate being used as indicator; it is assumed that when the color of the indigo solution changes to a pure golden-yellow (evidence of complete oxidation) all the tannin present will also have been oxidized by the permanganate. The necessary reagents are (1) a solution of pure potassium permanganate of the strength of 10 Gm. to 6000 Cc. of distilled water; (2) a solution of 30 Gm. of pure sodium sulphindigotate in 3000 Cc. of dilute sulphuric acid (1 vol. acid, 5 vols. water)—after filtration 3000 Cc. more of water are added; (3) white woolly hide-powder, which yields to distilled water nothing capable of reducing the permanganate solution; (4) strictly pure tannin. The indigo solution should be tested separately, and 20 Cc. of the same, when diluted with 750 Cc. of water, should require about 10.7 Cc. of the permanganate solution for oxidation.

To standardize the tannin value of the permanganate solution, 10 Cc. of a solution of pure tannin (2 Gm. to 1000 Cc.) are added to 20 Cc. of indigo solution and 750 Cc. of water; the $KMnO_4$ solution is cautiously added until the color changes to pure yellow. 50 Cc. of tannin solution are now macerated with 3 Gm of hide-powder, previously well moistened and expressed, for eighteen or twenty hours with frequent agitation, filtered, and 10 Cc. of the filtrate added to 20 Cc. indigo solution and 750 Cc. of water; the mixture is titrated with $KMnO_4$ solution as before, the difference between the first and second titrations representing the tannin or oxidizable matter removed by the hide. From these data the tannin value per cubic centimeter of permanganate solution is readily calculated. For subsequent estimation of tannin in infusions or otherwise the same reagents must be employed, and the liquid to be tested should contain a quantity of tannic acid corresponding to not less than 4 nor more than 10 Cc. of permanganate solution.

Action and Uses.—When administered in moderate doses tannic acid causes constipation, at least at first, but the state is not made permanent by a continuance or even an increase of the dose, nor does it seem to derange the digestive function, as a general rule. Occasionally, however, it excites pain in the stomach and bowels, thirst, and eructation, and causes a coated tongue, with tenesmus in defecation. The stools are generally without fæcal odor. Tannic acid appears not to be absorbed, and not to circulate as

such, but to be converted into gallic acid. In this form alone is it found in the blood and urine. Indeed, it could not remain in the blood without coagulating it, as experiments on animals demonstrate. But as gallic acid is not an astringent, and as one of the best uses of tannic acid is to control internal hæmorrhages, it is difficult, while admitting the conversion of the one acid into the other, to explain the therapeutic operation of the latter in the affections named. It would appear that the hæmostatic and analogous qualities of tannic acid are due, not to an action upon the blood, but upon the blood-vessels, by which they become constringed and the flow of the blood through them is checked. Tannic acid has been known to occasion extreme dyspnœa, cyanosis, and an erythematous eruption (*Practitioner*, xxxvii. 37). Its application to the fauces and nostrils has produced swelling, oppression, and a diffused itching and eruption on the skin (*Therap. Monatsh.*, iv. 141, 313).

The astringent property of this substance renders it useful in relaxed states of the gastro-intestinal mucous membrane, such as exist in certain forms of *dyspepsia* (with excessive acid, mucous, or watery secretion, or with flatulence), but still more in chronic *diarrhœa*, *dysentery*, *lientery*, etc. It has even been supposed, when administered in warm enemas, to check the diarrhœa of *typhoid fever* and the development of *cholera;* but in the absence of adequate and direct clinical proof it should be remembered that these diseases are not localized in the lower portion of the intestinal canal. The presence of fever usually contraindicates it. It is less used, although hardly less efficient, in chronic fluxes of other organs, which, when taken internally, it can influence only through the blood, as *chronic bronchitis*, *whooping cough*, and *phthisis* (*Lancet*, Mar. 1889, p. 493); and even in *influenza* it has seemed to palliate the symptoms (Alison, *Archives gén.*, Aug. 1889, p. 159). It often moderates, or even suspends, the *night-sweats* pulmonary consumption and those of other hectical states. But it is in *hæmorrhages* that tannic acid especially shows its power. Employed originally to restrain *menorrhagia*, it was afterward used successfully in other forms of uterine hæmorrhage, including those produced by organic diseases of the womb. The more passive forms are the most improved by it. In *hæmaturia*, even of organic origin, in passive hæmorrhage from the *stomach* and *bowels*, in some cases of *hæmoptysis*, and also of *hæmophilia*, it has displayed remarkable efficacy. In hæmoptysis it is best employed in an atomized solution. Not only in forms of *albuminuria* with copious urination, but in those in which the secretion is scanty, or perhaps chiefly in these, it is said to have been useful. Hiller, who tested the tannate of sodium in these cases, found it to be quite unavailing to lessen the albuminuria (*Zeitsch. klin. Med.*, vi. 489).

It is very efficient as a direct or local hæmostatic when finely powdered and applied to a bleeding part. It is neither painful nor irritating. It is, therefore, a convenient application in *hæmorrhage* from the nose, vagina, or rectum, from leech-bites, varicose veins, etc. Its constringing operation is of great value in producing the contraction of various soft tissues. A concentrated solution, made with an ounce of fresh tannin and 6 drachms of water, has a syrupy consistence, and is preferable to tannin itself for many topical applications. It is adapted to the treatment of wounds, ulcers, and mucous surfaces. In 1866, Dr. Richardson suggested *styptic colloid*, which consisted of a saturated solution of tannin in alcohol, to which ether and then gun-cotton were added to saturation, and when applied to a part rapidly condensed and grew firm, so as to arrest the discharge of blood, serum, or pus. It was also used after the surfaces of wounds, fractures, etc. had been coaptated, to keep their edges from being displaced. More recently (*Asclepiad*, July, 1885), he had prepared, with ether boiling at 90° F., a saturated solution of tannin, which was afterward treated with collodion nearly to saturation. It was applied as a spray, and its purpose was to maintain by its astringency the contraction of the tissues begun by cold. It was found to be very efficient, whether in this form or as a liquid. Tannin forms a good dressing for *burns*. (*Jour. Amer. Med. Assoc.*, viii. 487). A solution of tannic acid in tincture of benzoin (1 part to 4) tends to repress the development of *variolous* pustules. A powder made with 1 grain of tannin and 30 grains of orris- or marshmallow-root has been used as a snuff to arrest acute *coryza* in its forming stage; and an ointment containing 1 grain of tannin and 2 drachms of simple ointment has been applied to the nostrils, on a roll of soft linen or paper, for the same purpose in infants. Powdered tannin may be used as a snuff in chronic *coryza*, and in the treatment of nasal *polypi* a 10 per cent. solution in water has also been employed. B. W. Richardson recommended tannin-wool (made by soaking cotton-wool in water at 140° F., saturated with tannin, and drying the wool) for treating *ozæna* and other diseases attended with fætor (*Med. News*, lii. 411). A watery solution is a useful application to sore *nipples*, and an

ointment of tannin, or suppositories containing it, is a palliative in *anal fissure*, *hæmorrhoids*, and *prolapsus ani*. A solution of from 15 to 60 grains of tannin in about 4 fluidounces of water, injected into the bladder, has sometimes cured obstinate *vesical catarrh*. Aphthous *ulcers of the mouth*, *mercurial salivation*, *spongy gums*, and a relaxed condition of the mucous membrane of the *pharynx*, are all benefited by this astringent. Introduced into a carious cavity, it often allays *toothache*. In coryza and the other forms of chronic mucous inflammation mentioned the glycerite of tannin has been employed, but it is probably less efficient than the watery solution. Injections of a solution of tannic acid have been successfully used in *gleet* and *leucorrhœa*; in the latter disease they are very useful, but less so than the more prolonged application of tampons or sponges saturated with the solution. Tannic-acid hip-baths have been recommended as more eligible than these injections, etc. The latter method often cures *prolapsus of the uterus* due to relaxation of the vagina. Chronic inflammations of the *conjunctiva*, especially the granular form, and *pannus*, have been successfully treated with very finely-powdered tannin; and injections of a solution of this substance into vascular *erectile tumors* have been followed by their permanent contraction. A concentrated solution of tannin is one of the best applications to *ingrown toe-nail*, especially when there are fungous growths. A dentifrice containing tannin and charcoal in equal proportions is very efficient in removing the discoloration of the *teeth* produced by preparations of iron.

The *dose* of tannic acid is from Gm. 0.20–0.60 (gr. iij–x), repeated according to the urgency of the case. It is best administered in pill, except in cases of hæmorrhage, when it should be dissolved in pure water sweetened and flavored. Lewin recommends, in order to lessen the tendency of tannic acid to disorder the digestive organs, that it be given as follows: R. Solut. tannic acid in water (2 per cent.), f℥v; the white of one egg. Incorporate by shaking. The energy of this mixture appears to be very slight if a prompt astringent action is desired; it may be useful in the few cases which call for a continuous administration of the medicine. Externally, tannic acid is employed in a watery solution containing Gm. 0.20–0.60 to Gm. 30 (gr. iij–x to the ounce). Its incorporation in an ointment or with glycerin impairs its astringent action; but it is said that 2 parts of tannic and 1 part of gallic acid in water are more astringent than tannic acid alone.

ACIDUM TARTARICUM, *U. S., Br., P. G.*—Tartaric Acid.

Sal essentiali tartari.—Dioxysuccinic acid, E.: *Acide tartrique, Acide du tartre*, Fr.; *Weinsäure, Weinsteinsäure*, G.; *Acido tartarico*, It., Sp.

Formula $H_2C_4H_4O_6 = (CHOH)_2.(COOH)_2$. Molecular weight 149.64.

Origin.—It is met with either free or in combination with bases in grapes, sumach-berries, tamarinds, pineapples, and other acidulous fruits; also in other parts of many plants. It was first isolated by Scheele (1769), and by Retzius (1770) obtained in crystals.

Preparation.—The British Pharmacopœia gives the following directions. Take of Acid Potassium Tartrate 45 ounces; Distilled Water a sufficiency; Prepared Chalk 12½ ounces; Calcium Chloride 13½ ounces; Sulphuric Acid 13 fluidounces. Boil the acid potassium tartrate with 2 gallons of the water, and add gradually the chalk, constantly stirring. When the effervescence has ceased add the calcium chloride dissolved in 2 pints of the water. When the calcium tartrate has subsided pour off the liquid and wash the tartrate with distilled water until it is rendered tasteless. Pour the sulphuric acid, first diluted with 3 pints of the water, on the calcium tartrate; mix thoroughly, boil for half an hour with repeated stirring, and filter through calico. Evaporate the filtrate at a gentle heat until it acquires the specific gravity 1.21; allow it to cool, and then separate and reject the crystals of calcium sulphate which have formed. Again evaporate the clear liquor until a film forms on its surface, and allow it to cool and crystallize. Lastly, purify the crystals by solution, filtration if necessary, and recrystallization.

This process is the one which in its main features is followed in preparing tartaric acid on the large scale. An excess of sulphuric acid is necessary for the decomposition of the calcium tartrate to ensure the complete removal of the calcium, since tartaric acid does not crystallize properly from a solution of acid calcium tartrate. Boiling the precipitate with the sulphuric acid is avoided, and digestion for two or three days substituted. After concentration in the vacuum-pan the liquid is heated with wood charcoal or pure animal charcoal to remove coloring matter, filtered, and crystallized. The last crystallizations

are more or less colored, and, like the mother-liquor, are purified by digestion with wood charcoal. Should the free sulphuric acid accumulate in the mother-liquor, its partial removal with milk of lime will be necessary. Where calcium chloride cannot be used as a waste product for the decomposition of the potassium tartrate, the cheaper calcium sulphate is used for the purpose.

The rationale of this process is as follows: Acid potassium tartrate yields with calcium carbonate insoluble calcium tartrate and soluble potassium tartrate. The solution of the latter reacts with the calcium chloride or sulphate, furnishing an additional quantity of insoluble calcium tartrate and soluble potassium chloride or sulphate, which is removed by washing. The calcium tartrate, when digested with sulphuric acid, yields sparingly soluble calcium sulphate, which precipitates, and tartaric acid, which, being freely soluble in water, remains in solution and is recovered by crystallization. Large clear and colorless crystals are best obtained in the presence of a minute quantity of free sulphuric acid.

A process was patented by Goldenberg in 1878, according to which 226 parts of normal potassium tartrate, dissolved in 1800 parts of water, are mixed with 112 parts of burned lime previously slaked with 16 parts of water; the decomposition is effected at ordinary temperatures, the greater part of the calcium tartrate being deposited as a powder, from which the potassa solution is easily filtered; the filtrate retains calcium tartrate, which on boiling is separated in flocks.

The decomposition of argols by lime is effected by heat, when the nitrogenous principles present are decomposed, with the evolution of ammonia, and the calcium tartrate is separated in a gelatinous form, changing, however, to finely pulverulent on neutralizing the alkaline liquid with hydrochloric or sulphuric acid. The brown calcium tartrate is collected on a filter, washed, expressed, and decomposed by sulphuric acid, and the solution of tartaric acid treated with boneblack, or once more converted into the calcium salt by boiling with lime and chalk, whereby a much lighter-colored precipitate is obtained.

Tartaric acid is now largely manufactured in the United States; in 1867 over 212,000 pounds were imported; in 1882, only 8 pounds.

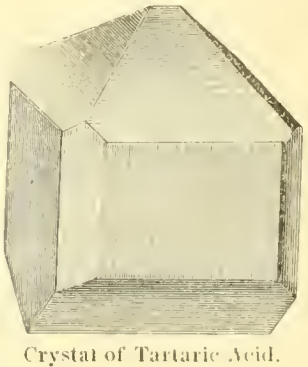
Properties.—Tartaric acid crystallizes in colorless, oblique, rhombic prisms or tables, which are inodorous and have a strongly acid but agreeable taste. They have the specific gravity 1.764, dissolve at 15° C. (59° F.) in about 0.8 part of water, and in 2.5 parts of alcohol; in about 0.5 part of boiling water, and in about 0.2 part of boiling alcohol; also soluble in 250 parts of ether, but nearly insoluble in chloroform, benzene, or benzin (*U. S.*).

We found (1863) the density of aqueous solutions of tartaric acid at 16° C. (60.8° F.) to be as follows:

Tartaric acid, per cent.	Specific gravity.	Tartaric acid, per cent.	Specific gravity.	Tartaric acid, per cent.	Specific gravity.	Tartaric acid, per cent.	Specific gravity.
1.00	1.0044	15.00	1.071	30.00	1.153	45.00	1.240
2.50	1.0114	17.50	1.083	32.50	1.167	47.50	1.255
5.00	1.023	20.00	1.097	35.00	1.181	50.00	1.271
7.50	1.035	22.50	1.111	37.50	1.195	52.50	1.287
10.00	1.047	25.00	1.125	40.00	1.209	55.00	1.304
12.50	1.059	27.50	1.139	42.50	1.224	57.75	1.325

The crystals contain no water of crystallization, are not deliquescent in the air, and may be heated to 135° C. (275° F.) without losing weight (see below), but they melt, and on heating the mass to about 200° C. (392° F.) it is decomposed, with disengagement of water, carbon dioxide, acetic acid, and other compounds, gives off the odor of burning sugar, and leaves a charcoal which ultimately burns without leaving any residue. In American commerce tartaric acid is usually found in the state of powder. The aqueous solutions of tartaric acid and of its salts deviate the plane of polarized light to the right; hence the name of *dextrotartaric acid*. Some grapes appear to contain naturally an acid isomeric with the foregoing, which is called *racemic, uvic, or paratartaric acid*. The same acid is obtained by heating for several days in closed vessels tartaric acid with about 15 per cent. of water to 175° C. (347° F.); its solutions do not affect polarized light, but some of its salts crystallize in two distinct hemihedric forms, one of which contains the ordinary or dextrotartaric acid, while the other contains *levotartaric acid*, another

Fig. 9.



Crystal of Tartaric Acid.

isomeric form, turning the plane of polarized light to the left. When dextrotartrate of cinchonine is heated to 170° C. (338° F.), it is converted into paratartrate, but at the same time a fourth isomeric modification is obtained, the calcium salt of which crystallizes after the calcium paratartrate. This new acid is *meso-* (or *inactive*) *tartaric acid*, so called because its solutions have no effect upon polarized light, and the acid cannot be resolved into dextro- and lævotartaric acids under the same circumstances as racemic acid. Finally, a fifth isomeric acid may be obtained from tartaric acid by fusion, which occurs between 170° and 180° C. (338° and 356° F.), when without loss in weight *metatartaric acid* is formed, whose solution has the same influence upon polarized light as that of the acid from which it was made; but it is deliquescent, and its salts dissolve more freely in water and crystallize in forms different from the dextrotartrates. L. Pasteur was engaged during the years 1847 to 1853 in investigating most of these facts. These isomeric compounds are, however, little known.

Tartaric acid is a strong bibasic acid, forming normal and acid salts, most of which are readily obtained in crystals; all are blackened by heat, and evolve an odor similar to that of burning sugar.

The normal tartrates, with the exception of those with an alkaline base, are nearly all insoluble or slightly soluble in water, but dissolve in diluted nitric acid. Calcium tartrate is almost insoluble in water, but dissolves in ammonium chloride, acetic acid, and cold potassa solution, being precipitated from the latter on boiling. Tartaric acid, added to the concentrated solution of a potassium salt, produces a precipitate of acid potassium tartrate; a similar precipitate, which is rather more soluble in water, is produced with ammonium salts; the same precipitates are obtained with solutions of acid tartrates or with neutral tartrates dissolved in diluted hydrochloric acid.

Impurities.—Tartaric acid, heated upon platinum-foil, should be consumed without leaving more than a trace of ash (mineral impurities). It should completely dissolve in 3 parts of alcohol (saline impurities). Its solution in 10 parts of water is not precipitated or colored dark by hydrogen sulphide (lead, copper, etc.), and is not precipitated by barium chloride (sulphuric acid), by calcium sulphate (oxalic or racemic acid), or by ammonium oxalate (calcium salts). 1.50 Gm. of tartaric acid dissolved in alcohol, and the solution mixed with half its bulk of water and of concentrated solution of potassium tartrate, yields a precipitate of potassium bitartrate, which, after washing with diluted alcohol and drying, weighs 1.88 Gm. A mixture of solutions of 1 part each of tartaric acid and of potassium acetate, in 3 parts of cold water, on being mixed with an equal bulk of alcohol, yields a precipitate which, if collected after two hours and washed and dried as stated before, should weigh between 1.25 and 1.26 parts. A solution of 0.75 Gm. of tartaric acid requires for exact neutralization 10 Cc. of the volumetric solution of soda, or 75 grains of the former need 990 grain-measures of the latter (*Br.*).

Action and Uses.—Given to dogs in large and concentrated doses, it acts poisonously, quickening the pulse and respiration, and causing debility, spasm, paralysis, and death, after which the blood remains liquid, but the stomach is not inflamed. It is in part excreted unchanged with the urine. It has been given to cats in large doses without striking consequences. In man, an ounce of tartaric acid dissolved in half a pint of warm water is said to have acted like a corrosive poison, causing violent burning pain in the throat and stomach, followed by obstinate vomiting, and death at the end of nine days. Nearly the whole of the alimentary canal was found highly inflamed. But in another case 6 drachms of the acid were taken within twenty-four hours without the least inconvenience. The alleged poisonous action in the first case is therefore open to doubt.

Tartaric acid is hardly ever prescribed alone, but generally in combination with alkalies or their carbonates or with carbonate of magnesium. It may be used to prepare whey, which is thought to be febrifuge and diuretic; and it is said to modify the unpleasant taste of the liquid preparations of cinchona, senna, and rhubarb. Associated with sugar, mucilage, and some flavoring extract, it serves to moisten the throat in *pharyngitis* and *pulmonary catarrh*; and it is even alleged to be capable of dissolving the false membranes of *diphtheria* (*Med. News and Abstract*, Sept. 1881, p. 536). It is said to correct the *fetor of the feet* to which some persons are subject, when it is strewn as a dry powder in the stockings. Dose, Gm. 0.60–2.00 (gr. x–xxx).

ACIDUM VALERIANICUM, *F. It.*—Valerianic Acid.

Acidum valericum.—Acide valérianique, Acide valérique, Fr.; *Baldriansäure, Valeriansäure*, G.; *Acido valerianico*, F. It., Sp.

Formula $HC_5H_9O_2 = (CH_3)_2.CH.CH_2.COOH$. Molecular weight 101.77.

Origin and Formation.—Valerianic acid has received its name from valerian-root, from which it was obtained and recognized as a distinct acid by Grote (1830); it has been found in the flowers of Anthemis nobilis, in wormwood, angelica-root, etc., and in dolphin oil, obtained from Delphinus globiceps, *Cuvier*, by Chevreul (1817), who named it *delphinic acid;* it is found among the products of oxidation of a large number of organic substances, and is prepared for medicinal purposes almost exclusively by oxidizing amylic alcohol with potassium dichromate and sulphuric acid, a process recommended by Balard (1845).

Preparation.—Valerian-root is distilled with water, the oil is removed from the acid distillate, the latter neutralized with soda, and evaporated to dryness. 5 parts of this residue are, according to Wittstein (1845), dissolved in 5 parts of water, and distilled with 4 parts of sulphuric acid diluted with 8 parts of water. The oily portion of the distillate is purified by fractional distillation. The yield is increased if potassium dichromate and sulphuric acid are added to the water distilled with the root (Lefort, 1846).

In the preparation of valerianic acid from fusel oil sodium valerianate is prepared as the first step (for details, see Sodii Valerianas), and this is then distilled with sulphuric acid. To obtain a concentrated acid B. J. Crew (1860) manipulates as follows: 8 parts of sodium valerianate and 3 parts of water are mixed, and 3½ parts of sulphuric acid gradually added to the mixture. Sodium sulphate is formed, and the liberated valerianic acid rises as an oily layer to the surface. The latter is separated, and repeatedly agitated with small portions of oil of vitriol to deprive it of water, which cannot be separated by distillation. When the specific gravity of the oily layer has been reduced to below 0.950, it is distilled, and that portion of the distillate having the specific gravity 0.940 or more is collected by itself, to be dehydrated by sulphuric acid as before. The remaining portion of the distillate, rather more than half the quantity of the whole, will have the required specific gravity, 0.935. The weaker but heavier acid comes over first, and may be readily brought to the specific gravity 0.945 by oil of vitriol, when it is again ready for fractional distillation (F. C. Musgiller, 1868).

Properties.—Valerianic acid is a colorless, thin oily liquid, of a disagreeable odor resembling that of valerian and of old cheese, and has a sour, acrid, unpleasant taste, producing upon the lips and tongue the sensation of burning; diluted with water, the taste is less disagreeable, with a sweet after-taste. When heated, valerianic acid evaporates without residue, and ignited burns with a luminous flame. It is soluble at 15° C. in 30 parts of water, and by agitation with a small quantity of that liquid takes up about 20 per cent. of its weight, without losing its oily consistence. It dissolves in all proportions in alcohol, ether, chloroform, carbon bisulphide, and volatile oils, the hydrated acid, however, producing a turbid mixture with the last-named liquids. The specific gravity is 0.935, which increases if the acid becomes more hydrated; its boiling-point is 175° C. (347° F.). Musgiller ascertained that an acid of 0.933 specific gravity boils between 177.2° and 178.9° C. (351° and 354° F.); if of greater density the boiling-point is lower. The hydrate, $C_5H_{10}O_2.H_2O$, has the density 0.945, and requires only 25 parts of cold water for solution.

The composition of valerianic acid, $C_5H_{10}O_2$, bears to amylic alcohol, $C_5H_{12}O$, the same relation as acetic acid does to ordinary alcohol. (See Acetum.) Hydrogen being eliminated from the alcohol in the form of water under the influence of oxidizing agents, the remaining molecule is oxidized to the acid; $C_5H_{12}O + O_2$ yields $HC_5H_9O_2 + H_2O$. The officinal acid is *isopropylacetic acid*. Three other acids of the same ultimate composition may be prepared, which, however, differ from the preceding in their specific gravities, boiling-points, behavior to polarized light, and the solubility in water of their barium and silver salts.

The *normal salts* of valerianic acid, when perfectly dry, are inodorous; in the presence of moisture, and still more in contact with carbonic acid, they have the odor of the acid; their taste is decidedly sweet. Most of the salts are soluble in water, several dissolve also in alcohol; from these solutions valerianic acid is liberated by nearly all the mineral and organic acids, even by acetic acid.

Impurities.—The solubility of valerianic acid, in not less than twenty-six and not over thirty times its weight of water, affords a ready means of discovering the presence

of certain impurities. Alcohol decreases, and water, acetic acid, and butyric acid increase, the density of valerianic acid, and render it more soluble in water, while it becomes less soluble and of less density through the presence of amylic alcohol, amylic aldehyd, amyl valerianate, and fixed oils. On adding ammonia-water slightly in excess to valerianic acid a clear solution should be produced; this is turbid or separates an oily layer in the presence of one or more of the four compounds last mentioned. Butyric acid, if present, will, according to Laroque and Hurant, produce with concentrated solution of acetate of copper pale-blue scales of copper butyrate, while pure valerianic acid mixed with the same solution yields a mixture which is transparent for several minutes, then separates oily drops of copper valerianate, which are gradually converted into a greenish-blue crystalline powder. Acetic acid is readily detected by neutralizing the acid with ammonia and adding to the cold clear liquid a slight excess of diluted ferric chloride or subsulphate, when ferric valerianate will be precipitated and ferric acetate form a deep brown-red solution. Admixtures of hydrochloric or sulphuric acid are detected in the aqueous solution of valerianic acid, after adding a little nitric acid, by the nitrates of silver and of barium.

Action and Uses.—According to Reissner's experiments on animals, it coagulates albumen, blood-serum, and milk, and is slightly irritating to the integuments. Its odor is not imparted to the urine or the blood, but may be perceived in the peritoneal cavity. It quickens but weakens the heart's action and the respiration, produces debility and then paralysis of the limbs, and spasms before death; after which, if it takes places rapidly, the gastric mucous membrane is pale, but if slowly this membrane and that of the intestine are inflamed, the kidneys congested, and the urine is turbid and bloody. The acid is not used in medicine except in combination, but it is very doubtful if it gives any special properties to the bases with which it is associated, unless it does so in valerianate of ammonium. *Amylo-valerianic ether* is said to possess all the peculiar virtues of valerianic acid, besides being anæsthetic, and therefore indicated in a variety of nervous and neuralgic disorders; *e. g. gastralgia, dysmenorrhœa, asthma, etc.*

ACONITINA, *Br. F. Cod.*—Aconitine.

Aconitia, Aconitinum.—Aconitine, Fr.; *Aconitin*, G.; *Aconitina*, It., Sp.

Formula $C_{33}H_{45}NO_{12}$ (Dunstan 1891). Molecular weight 645.54.

Preparation.—The outlines of the process recognized by the British Pharmacopœia are as follows: Coarsely-powdered aconite-root is exhausted with alcohol by heating to ebullition, then cooling, and finally percolating; the tincture is completely freed from alcohol by distillation and evaporation; the extract is mixed with twice its weight of boiling distilled water; the mixture allowed to cool and filtered; the filtrate is precipitated by ammonia in slight excess, and the mixture heated gently over a water-bath, whereby the precipitate forms a mass which is readily separated by a filter, and after drying reduced to a coarse powder, which is exhausted with pure ether; the ethereal liquid is distilled, the impure alkaloid dissolved in warm distilled water acidulated with sulphuric acid, and when the solution is cold ammonia diluted with four times its bulk of distilled water is cautiously added; the precipitate is collected on a filter, washed with a small quantity of distilled water, and dried by slight pressure between folds of filtering-paper.

The process proposed by Prof. Procter (1861) as a modification of that previously suggested by Headland, and adopted by the U. S. Pharmacopœia previous to 1880, yielded a less pure product.

Duquesnel (1872) showed that the use of mineral acids in the preparation of aconitine causes the production of amorphous alkaloids, while aconitine is not decomposed by tartaric acid; his process is recognized by the French Codex, and, modified by Wright (1876, 1880), is as follows: Powdered aconite-root is exhausted with alcohol containing 0.5 per cent. of tartaric acid; the alcohol is distilled and evaporated at a low temperature or *in vacuo;* the extract is diluted with its own bulk of water, filtered from the oil and resin, agitated with ether or petroleum naphtha, whereby more resin is removed, and then precipitated by excess of potassium carbonate; the alkaline liquid retains the amorphous bases in solution, while the washed precipitate, after dissolving in ether, mixing this solution with petroleum naphtha, and evaporating, yields crystallized aconitine, which still retains a small proportion of the amorphous alkaloids, from which it can be completely freed only by a tedious and very wasteful process.

In Hottot and Liégeois's process (1864) sulphuric acid is used and the alkaloids are precipitated by magnesia.

In order to avoid the possibility of any change during the process of preparation, Professor Dunstan (1892, 1893) has devised the following method: Exhaust the powdered drug with cold rectified fusel oil; shake the liquids with water containing 1 per cent. of H_2SO_4; agitate the acid solution with chloroform to remove resin; make alkaline with ammonia and shake with ether, which extracts aconitine together with some *isaconitine* and other bases, while *aconine*, the greater part of isaconitine, and other bases may be extracted from the watery solution by chloroform. The impure aconitine is purified by recrystallization as hydrobromide.

Wright (1876) obtained from aconite-root .03 to .04 per cent. of his nearly pure aconitine, or about one-third of the total yield of alkaloid (Groves). Dunstan (1893) states that the quantity of aconitine is subject to considerable variation.

Properties.—Aconitine, as obtained by the process of the British Pharmacopœia, is a white, usually amorphous solid, soluble in 150 parts of cold and 50 of hot water, and much more soluble in alcohol and in ether, and in chloroform; it is strongly alkaline to reddened litmus, neutralizing acids; its salts are precipitated by the caustic alkalies, but not by ammonium carbonate or sodium or potassium bicarbonate. It melts with heat and burns with a smoky flame, leaving no residue when burned with free access of air. When rubbed on the skin it causes a tingling sensation, followed by prolonged numbness. Commercial aconitine is usually colored orange-yellow by sulphuric acid, changing to brown and colorless, and previously mixed with sugar, it becomes rose-red with sulphuric acid. But pure aconitine gives no characteristic color reactions with acids or oxidizing agents (Groves).

From his researches, reported to the British Pharmaceutical Conference (1866 to 1874), Mr. T. B. Groves concluded that pure aconitine occurs in two modifications, a crystalline and an amorphous, differing mainly in their behavior to solvents. But C. R. Alder Wright (1875 to 1880) showed that the physiologically active and crystallizable aconitine when heated with water to 140° or 150° C. (284° or 302° F.), or saponified with an alkali, is decomposed into benzoic acid (18.92 per cent.) and amorphous *aconine*, which is bitter, not acrid, almost insoluble in ether, dissolves readily in water, alcohol, and chloroform, and is identical with *acolyctine*. That much of the commercial aconitine both amorphous and crystalline, is more or less contaminated with isaconitine and aconine has been again shown by Dunstan and Carr (1893). These and other amorphous bases are with great difficulty removed by repeated crystallization from ether or ether and petroleum naphtha, and are best eliminated by crystallization as nitrate or hydrobromide. The pure alkaloid has an acrid, benumbing taste, is nearly insoluble in benzin, dissolves at 22° C. in 4430 parts of water or in 37 of alcohol, is soluble in ether, and more freely in chloroform and benzene; it melts at 188° to 189° C., and its hydrobromide at 163°, the melting-point being lowered and the color more darkened by the presence of amorphous bases. When heated with aqueous alkalies or mineral acids aconitine is readily decomposed. On being dissolved in ether, and the solvent allowed to evaporate spontaneously, the last drop of it should dry up to crystals; the acid obtained on saponification, on being fused at 250° C. with potassa, the mass treated with hydrochloric acid and ether, and the ethereal solution evaporated, should not give a green color to ferric chloride (absence of pseudaconitine).

Pseudaconitine, $C_{36}H_{49}NO_{12}$ (see ACONITUM), which has been sometimes sold for aconitine, closely resembles the latter base in appearance and behavior, but may be distinguished from it by requiring about 230 parts of chloroform, 100 parts of boiling ether, and 1508 to 2600 parts of diluted ammonia of 1¼ per cent. strength for solution; by its lower melting-point (104° to 105° C.); and by yielding on saponification with alcoholic potassa 26.49 per cent. of veratric acid. Its nitrate crystallizes only from strongly acid solutions (Groves).

Liégeois and Hottot found that aconitine precipitated from cold solutions contains 25 per cent. of water, which is given off at 85° C. (185° F.), and Hager (1875) has directed attention to this as one source of the variable strength of commercial aconitine.

Dr. Squibb (*Ephemeris*, i. 135) suggests that no aconitine should be accepted which, will not give within fifteen minutes a distinct aconite sensation, not amounting to tingling but very suggestive of it, from $\frac{1}{800}$ of a grain (.00008 Gm.) diluted to the measure of 1 fluiddrachm (3.7 Cc.), after holding the solution for 1 minute in the anterior part of the previously well-rinsed mouth. Tested in this manner, he found 1 grain of good aconite-root to be represented by 1, $\frac{1}{8}$, $\frac{1}{83}$ (Merck's pseudaconitine), and $\frac{1}{111}$ (Duquesnel's crystallized aconitine) grain of different commercial samples of aconitine. The last-named

sample (Duquesnel's) was ascertained (*Ephemeris*, i. 167) to be a nitrate containing not over 80.7 per cent. of the hydrated alkaloid.

Owing to the variable composition of the commercial article, and the difficulty of obtaining it quite pure, aconitine has not been admitted in the U. S. and other pharmacopœias.

Action and Uses.—When applied to the sound skin in an ointment or in alcoholic solution aconitine produces itching and prickling, followed by anæsthesia of the part without redness or heat. In contact with the derm it causes an intense and prolonged burning, and it violently irritates the conjunctiva. Its action on the tongue, fauces, and stomach produces burning and tingling sensations. The order in which the different organs are paralyzed by aconitine is said to be the sensory, and then the motor nerves, the sympathetic nerve, and finally the muscles. The respiratory apparatus and the heart are affected through the nervous system, and death is due to a suspension of the respiration caused by the action of the poison upon the medulla oblongata. These results have been substantiated by Mackenzie. They also agree essentially with those of Harley's, the most interesting and lucid of all. His experiments were performed on the horse, dog, cat, and on man. Their results in the lower animals were, summarily, these: Paralysis of the external muscles of respiration which dilate the chest; intermittent spasm of the muscles attached to the upper part of the chest, and of those of the respiratory passages; incomplete paralysis of the diaphragm; increased frequency of the heart-beat proportioned to the impediment to the circulation; persistence of the heart-beat after respiratory death; spasm of the pharynx and œsophagus; and general debility, but no muscular paralysis. Those conclusions were confirmed by Ringer (1880). On dissection the lungs are collapsed and pale; the heart retains its irritability for some time; its left cavities are empty and contracted; and the right side, as well as the large veins leading to it, is distended with dark blood.

Fothergill's experiments on rabbits, guinea-pigs, and cats show that a lethal dose of aconitine ceases to be so if the animals have had an appropriate dose of digitalin from five to nine hours previously. In like manner, the lethal effects of aconitine are prevented by atropine and also by strychnine. "While aconitine kills by paralyzing the respiration, atropine and strychnine, which act very powerfully on the respiratory centres, are potent to prevent death." According to Oulmont, aconitine displays physiological and therapeutical action in the dose of a quarter of a milligram (gr. $\frac{1}{256}$), but may be gradually increased to 1 and even 2 milligrams (gr. $\frac{1}{64}$ to $\frac{1}{32}$) a day without injury.

The action of aconitine upon man is illustrated by Harley's observations. One-two-hundredth of a grain of aconitine taken internally caused slight tingling in the mouth and face, lasting for several hours. (Dr. Squibb observed a like effect from $\frac{1}{2000}$ grain dissolved in a fluidrachm of distilled water.) The one-hundred-and-fiftieth of a grain occasioned also a sense of glowing and numbness and a tendency to sleep. One-fiftieth of a grain produced the following effects: langnor, giddiness, sleepiness, hazy vision, nausea in the erect posture, dysphagia, pain in the back of the neck and behind the jaws, a glowing, tingling feeling over the whole body, and burning heat in the gullet. The sense of numbness and muscular weakness is comparable to that induced by conium. A physician who took an over-dose of the alkaloid mentions among the symptoms "a feeling as if a bar of iron extending from head to foot rendered the body rigid" (*Bull. de Thérap.*, cvii. 30). To these symptoms may be added colic, spasmodic vomiting, and dysphagia; in some cases darting pains in the branches of the fifth nerve; dilatation of the pupils; acceleration, followed by progressive irregularity and debility, of the heart; and a corresponding infrequency of the respiratory movements and lowering of the temperature. In fatal cases the pulse is small, weak, and, above all, irregular; the rate and rhythm of the respiratory movements are similarly affected; the skin is cold and clammy; the pupils contracted; vision is impaired; there is a burning pain in the mouth, extending along the gullet; a swollen tongue, dysphagia, and great præcordial anxiety; vomiting usually occurs, and convulsions, and consciousness is more or less impaired. Post-mortem examination shows hyperæmia of the stomach and small intestines, and the viscera generally are charged with blood. Cases of fatal poisoning by aconitine are very rare (Stevenson, *Guy's H. R.*, xli. 307; Laborde et Duquesnel, *Des Aconits et de l'Aconitine*, 1883; *Med. News*, lii. 345). Oleate of aconitine, 2 per cent. strong, applied to the skin of the upper eyelid, occasioned, in the course of an hour, a sense of heat in the part, and profuse lachrymation from the eye and nostril of the same side (Heyl). Napelline appears to be nearly identical with aconitine in the nature of its

effects, but their intensity is "incomparably less" than those of crystallized aconitine. It is alleged to be a soporific.

The internal employment of this alkaloid ought rarely to be resorted to, on account of its dangerous activity as a poison. Aconitine has been administered in febrile diseases for the same reason that aconite and other sedatives of the heart have been employed, and the result has been that, although the medicine lessened the frequency of the pulse, it exerted no appreciable influence upon the course or issue of the disease. Such was a result of Harley's use of the medicine in *scarlet* and *typhus fevers*, although it appeared to him that in typhus treated by this medicine the crisis occurred early. It has also been administered advantageously for the cure of *neuralgia* in the dose of Gm. 0.0005 (gr. $\frac{1}{123}$), and probably in neuralgia of the fifth pair there is no remedy more efficient. It is said to have arrested the paroxysms in cases which had resisted all other remedies. The cure of some extremely aggravated cases of facial neuralgia has been accomplished by doses of aconitine, beginning with Gm. 0.0004 (gr. $\frac{1}{140}$), and gradually increased to Gm. 0.007 (gr. $\frac{1}{96}$) three times a day (*e. g.* Weir, *Philad. Med. Times*, x. 48). But it is chiefly in recent cases produced by cold that its efficacy is displayed, and particularly in neuralgia of the superficial nerves, including those of the scalp and face, and the branches of the spinal nerves. The topical use of the remedy should be tried before it is given internally. According to Oulmont and Gubler, the pain and fever of acute articular *rheumatism* are rapidly reduced by aconitine given daily to the amount of Gm. 0.0005 (gr. $\frac{1}{120}$). The efficacy of the medicine is not, however, accepted as proven, and *its dangerous qualities should deter from its unnecessary use*, which we hold the treatment of rheumatism by its means to be. Owing to the varying degrees of strength of the alkaloid as found in the shops, the primary dose should not exceed Gm. 0.0002 (gr. $\frac{1}{250}$). It may be repeated two or three times a day, and given less or more frequently, and in smaller or larger doses, according to its effects. The maximum dose is stated to be Gm. 0.001 (gr. $\frac{1}{64}$). Its efficiency is, however, much greater in the form of an ointment, which may contain Gm. 0.13–0.30 in Gm. 4 (2, or from that to 5, grains in a drachm) of lard, or in the form of a solution made by dissolving 1 grain of aconitine in 2 fluidrachms of alcohol, Gm. 0.06 in Gm. 8.00. Its mixture or solution is facilitated by chloroform. Either preparation should be applied with a soft brush or with the finger protected by a glove. Gubler used the medicine hypodermically in the dose of Gm. 0.0005 (gr. $\frac{1}{128}$) twice a day.

ACONITUM, *U. S.*—Aconite.

Monkshood, *Wolfsbane*, E.; *Aconit napel*, Fr. Cod.; *Coqueluchon*, Fr.; *Eisenhut*, *Sturmhut*, G.; *Aconito*, F. It., Sp.

Aconitum Napellus, *Linné*, s. Ac. variabile, *Hayne*, s. Ac. vulgare, *De Candolle*. Bentley and Trimen, *Med. Plants*, 5, 6, and 7.

Nat. Ord.—Ranunculaceæ, Helleboreæ.

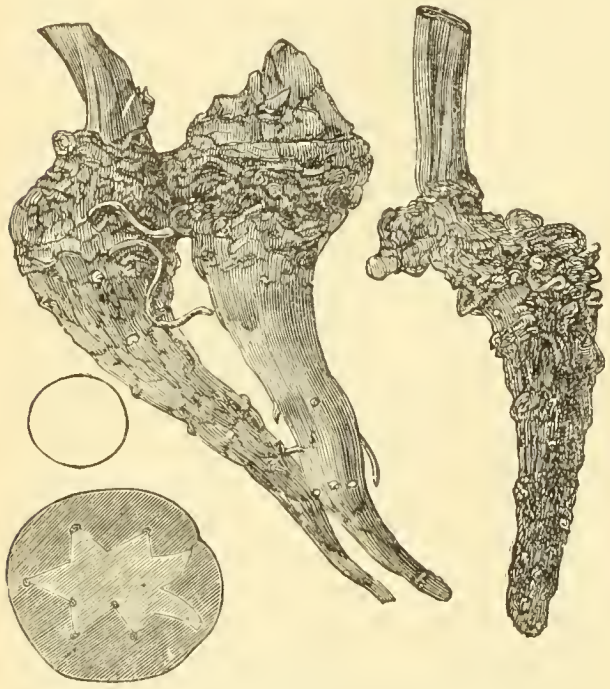
Official Parts.—1. Aconitum, *U. S.*, *s. Aconiti radix*, *Br.*, *P. A.*; *Tubera aconiti*, *P. G.*—Aconite-root, *E.*; Racine d'aconit, *Fr.*; Akonitknollen, *G.* The tuberous root. —2. Aconiti Folia, *Br.*, *s. Herba aconiti*.—Aconite-leaves, *E.*; Feuilles d'aconit, *Fr.*; Akonitblätter, *G.* The leaves and tops, gathered when about one-third of the flowers are expanded.—*Br.*

Origin.—The plant, which attains a height of about 1 M. (40 inches), and is very variable in appearance, as indicated by one of its specific names, is met with throughout the greater portion of Asia and Europe, mostly in mountainous regions. It grows in the Himalaya Mountains at an altitude of from 3000 to 5000 M. (10,800 to 16,400 feet), and from there north and west in Siberia, and in Europe south to the Alps and Pyrenees. It is frequently cultivated for ornament and for medicinal use, but Schroff (1853) found the cultivated plant far less active than the one grown wild. The poisonous properties of aconite had been known in ancient times, when the Greek name, *akoniton*, was applied to several species. Aconite was introduced into medicine by Stoerck (1762).

Description.—1. Aconite-root. The subterraneous portion of the plant consists of a tuber, which is contracted below into a conical root; from a lateral bud of the tuber a short rhizome is produced, developing at its end again into a tuber, bearing a bud at its top from which the stem for the succeeding year will be produced. This second tuber is fully developed in the fall of the first year, and withers a year afterward, by which time it has produced fruit and developed another (the third) tuber. The parent tuber and its offspring are often met with in the commercial article still united by the

short rhizome, or, if detached, showing the scar and often a portion of this branch. As met with in commerce, it is of a conical shape, 50 to 75 Mm. (2 to 3 inches) in length, and 10 to 20 Mm. ($\frac{2}{5}$ to $\frac{4}{5}$ inch) in thickness at the crown; the numerous rootlets are mostly broken off, giving the tuber a tuberculated appearance from the remnants of the radicles. At the top it is crowned with a short portion of the stem or with the terminal bud. It is of a dark-brown color externally, longitudinally wrinkled, and breaks with a short, non-fibrous fracture; internally, it is compact and whitish if of latest growth, or brownish, porous, and often hollow if of the previous year's growth. The transverse section shows a thick bark, enclosing a star-shaped six to eight-rayed axis, having a thin, vascular bundle in each ray. The radish-like odor of the fresh root disappears on drying; the taste is at first sweetish, then acrid and burning, with a persistent sense of numbness; which effect furnishes a good criterion of the quality of aconite-root; the shrivelled and porous tubers are usually less efficient. The degree of impression produced upon the tongue by aconite-roots taken at random from a larger quantity is regarded by Dr. Squibb as an approximate test of its value. Dr. A. B. Lyons (1882) has modified this test by preparing a tincture representing 10 per cent. of the root, and applying a single drop of this to the tongue. By the intensity and the duration of the effect produced one can judge pretty correctly of the value of a given sample.

Fig. 10.



Tubers of Aconitum napellus, *Linné*, with a transverse section.

Admixtures.—Dr. Stoerck appears to have used the two following blue flowering species of aconite, which are still collected with the typical form. The tubers of Aconitum Cammarum, *Jacquin* (s. Ac. variegatem, *Linné*), are globular-ovate, smaller than the preceding, the central axis about five-rayed and the rays rounded. Those of Aconitum Stoerckeanum, *Reichenbach* (s. Ac. Cammarum, *Linné*, s. Ac. Napellus, *Stoerck*), are often 3 to 5, attached to the parent tuber, of a slender conical shape, and have the centre roundish pentagonal in outline. The root of Imperatoria Ostruthium, *Linné*, or European masterwort, resembles aconite-tubers in shape, but has an aromatic odor and pungent taste, and exhibits upon transverse section numerous oil-cells arranged in several circles.

Fig. 11.

Aconite Leaf.

2. Aconite-leaves. They are alternate, smooth, petiolate, 5 to 10 Cm. (2–4 inches) in length, nearly orbicular in outline, somewhat heart-shaped at the base and divided to the base, the lower into five, the upper into three, segments, each of which is again three or sometimes five-cleft; the last divisions are linear-lanceolate, often toothed, and show a prominent rib beneath and a furrow above, which extends into the petiole, this being of about the length of the leaf. The texture of aconite-leaves is somewhat leathery, their color rather bright-green, and somewhat shining above and paler beneath. In the dry state they have a slight herb-

aceous odor and a taste which soon becomes bitter and acrid, producing tingling upon the tongue. The leaves are usually mixed with a portion of the handsome purplish-blue flowers, which grow in terminal racemes, have the upper sepal helmet-shaped, ending in a short point curved upward, and enclosing two long-stalked but short-bladed petals, and contain numerous hypogynous stamens and three short, slightly divergent ovaries.

The leaves of Aconitum Stoerckeanum, *Reichenb.*, are similar in appearance, but the segments are broader; those of Ac. Cammarum, *Jacq.*, are less deeply incised and have nearly rhomboid segments.

Other Species of Aconite.—Bish or Bikh Root, (*aconit féroce*, F. Cod., also called Nepaul aconite-root, obtained from Aconitum ferox, *Wallich*, s. A. virosum, *Don*, and perhaps from other species of aconitum indigenous to the Himalayas, is occasionally met with in commerce. It is conical in shape, (2 to 4 inches) 5–10 Cm. long, about 25 Mm. (1 inch) in its upper diameter, longitudinally wrinkled, externally of a brownish-black color, internally somewhat spongy or compact, and either farinaceous or of a resinous or hoary, somewhat translucent appearance upon the short fracture. Its taste is intensely acrid.

Aconitum Heterophyllum, *Wallich*. The conical or fusiform roots of this Himalayan species have a mucilaginous bitter taste without acridity, and are used in India, under the name of *atis*, for their tonic and antiperiodic properties. They are of a yellowish-gray color, rough from the numerous root-scars, internally white and mealy, and contain about $\frac{1}{2}$ per cent. of a bitter non-poisonous alkaloid, *atisine*, which appears to be combined with aconitic acid, and acquires a purple color with sulphuric acid. It was discovered by Broughton, and further examined by Wright (1878) and Wasowicz (1879).

Aconitum Palmatum, *Don*. The tubers, which are occasionally met with in India, are called *bishma* or *bikhma*, resemble the bish tubers, but are branched, light-brown, and not acrid, but persistently bitter; they appear to be tonic in doses of 0.5 Gm.

Aconitum Lycoctonum, *Linné*. Von Schroff (1875) recalled attention to the fact that the aconite-leaves which are used in Lapland as a potherb are from a blue-flowering variety of this species, the *Ac. septentrionale* of Koelle, which contains only a very minute quantity of bitter alkaloid in the leaves, though more in the rhizome and rootlets.

Aconitum Anthora, *Linné*, a yellowish and white-flowering species of Europe, has bitter roots, which were formerly used as a tonic, and, according to Hooker, the roots of the allied *Acon. multifidum*, as also those of *Acon. rotundifolium*, indigenous to India, are eatable.

Aconitum Chinense, *Siebold*, Ac. Japonicum, *Thunberg*, and perhaps other species yield Chinese and Japanese aconite-root, which vary in shape, size, and poisonous properties, and appear in the Eastern market in the dried and salted condition and preserved by steeping in vinegar. Their poisonous properties and their constituents vary according to origin and mode of preservation. Geerts (1880) states that the most toxic Japanese aconite-root consists of the young tubers of Ac. Fischeri, *Reich*. Paul and Kingzets have isolated *japaconitine*, which was found by Wright to closely resemble his aconitine, and by Mandelin (1885) as being identical with *benzoylaconine*.

Constituents.—The important medicinal constituent of both aconite-root and leaves is the acrid alkaloid *aconitine* or *napaconitine*, combined in the herb with aconitic acid, and associated with bitter amorphous alkaloids, one of which, *napelline*, was discovered by Hübschmann (1857), and subsequently (1867) found by him to be identical with *acolyctine*, one of the alkaloids obtained by him from Aconitum Lycoctonum, *Linné*, which plant contains a second alkaloid, *lycoctonine*, but no aconitine. Wright has shown (1877) that these two alkaloids should be regarded as decomposition-products—namely, acolyctine from aconitine, and lycoctonine from the principal acrid alkaloid of bikh-tubers, which has been named *pseudaconitine*. The last-named alkaloid is also present in very small quantity in aconite-root, from which T. and H. Smith obtained (1864), by almost neutralizing the acid solution of crude aconitine with carbonate of sodium, a crystallizable non-poisonous alkaloid, bearing in its behavior a close resemblance to narcotine, and for which the name of *aconelline* has been proposed. Groves failed (1866) to obtain it, and Wright did not observe it; but the latter proved the existence of two amorphous alkaloids which are soluble in solution of potassium carbonate. One of these, *picraconitine*, has a bitter taste free from acridity; its composition is represented by the formula $C_{31}H_{45}NO_{10}$, and upon saponification with an alkali it splits into benzoic acid and *picraconine*, $C_{24}H_{41}NO_9$, the latter resembling the analogous derivative of aconitine. The salts of picraconitine are crystallizable. Wright determined the formula of aconitine to be $C_{33}H_{43}NO_{12}$, and its saponification product to be benzoic acid and *aconine*, $C_{20}H_{39}NO_{11}$. Ehrenberg and Purfürst (1892), by boiling aconitine, $C_{32}H_{43}NO_{11}$, with water, obtained benzoic acid and *picraconitine*, $C_{25}H_{39}NO_{11}$, the latter being ultimately converted into methyl alcohol and napelline, $C_{24}H_{37}NO_{10}$; on saponifying the latter acetic acid and *aconine*, $C_{22}H_{35}NO_9$, were obtained. Dunstan and Ince adopted (1891) for aconitine the formula $C_{33}H_{45}NO_{12}$; the products of hydrolysis are benzoic acid and *aconine*, $C_{26}H_{41}NO_{11}$. Picra-

conitine, for which also the name *napelline* has been suggested, when pure, was found by Dunstan and Harrison (1893) to have the same composition as aconitine; hence the name *aconitine* is proposed for it. Though it yields also the same decomposition products, it is not poisonous like aconitine, and the cause of this difference is still to be ascertained.

Wright's total yield of crystalline and non-crystalline alkaloids from 200 cwt. of aconite-root was 0.07 per cent. Hottot (1864) obtained 0.06, and Hager (1863) between 0.64 and 1.25 per cent. Proctor (1863), by testing with Mayer's solution, showed a total of 0.93 per cent. of alkaloids from aconite-root cultivated at Lebanon, N. Y., and 0.44 per cent. from commercial European aconite-root, but by actual experiment he obtained only 0.42 and 0.20 per cent. respectively.

The herb from which Geiger and Hesse (1833) first isolated the mixed alkaloids usually contains a small percentage thereof, the fresh herb yielding to Wright 0.011 per cent., equal to about 0.05 per cent. of total alkaloids from the dry herb.

Aconite-leaves contain also albumen, gum, chlorophyll, extractive matter, and salts. In aconite-tubers, resin, fat, mannit, cane- and grape-sugar have been found; the absence of a volatile alkaloid was demonstrated by Groves (1866).

Aconitic acid, $H_3C_6H_3O_6$, is also a constituent of larkspur, yarrow, sorghum, equisetum, etc., and is prepared from citric acid by heating it rapidly in a retort until oily streaks have appeared in the neck, when the residue is exhausted with ether to free it from the undecomposed citric acid. $C_6H_8O_7$ (citric acid) yields H_2O and $H_3C_6H_3O_6$. Aconite acid crystallizes in colorless laminæ, or warts, which are easily soluble in water, alcohol, and ether. Its calcium salt, on fermentation with cheese, yields succinic acid.

Nepaul aconite contains an alkaloid which was at first supposed to be identical with aconitine, but was afterward described under various names, like *acraconitine* (Ludwig, 1869), *napelline* (Wiggers, 1857), and *nepaline* (Flückiger, 1869). The name *pseudaconitine* or *feraconitine* is now given to this substance, which, according to Groves (1870–74), exists in two modifications, one crystalline, but yielding uncrystallizable salts, the other amorphous; the latter becomes sticky in boiling water, while the former coheres and becomes plastic only if treated with boiling water immediately after having been precipitated by ammonia. Another alkaloid, resembling Hübschmann's napelline, but probably differing from it, is likewise met with in bikh-root. Duquesnel (1871) and Patrouillard (1872) regarded pseudaconitine and aconitine as identical, differing from each other merely in the amount of other inert constituents contained in them. C. R. A. Wright (1875–80), however, proved the former to have the composition $C_{36}H_{49}NO_{12}$, and when acted upon by alcoholic solution of soda at 100° C. (212° F.) observed it to be decomposed into *dimethyl-protocatechuic* (*veratric*) *acid*, $C_9H_{10}O_4$, and an uncrystallizable base, *pseudaconine*, $C_{27}H_{41}NO_9$, which prevents also the crystallization of pseudaconitine; the latter is closely related to the opium alkaloids narceine and narcotine, which give rise to derivatives of dimethyl-protocatechuic acid. The same author regards Hübschmann's lycoctonine merely as a mixture of these two alkaloids, pseudaconine predominating. According to Mandelin (1885), aconine and pseudaconine are poisonous, but far less so than aconitine and pseudaconitine.

Pharmaceutical Preparations.—Emplastrum Aconiti (U. S. 1870). Exhaust 16 ozs. of aconite-root with alcohol, evaporate the tincture to a soft extract, and mix with sufficient resin plaster to obtain 16 ozs. of plaster.

Glyceritum Aconiti. Extract of aconite 1 part; glycerite of starch 9 parts. Mix thoroughly.

Action and Uses.—In man the following effects have been noted, chiefly in the very numerous cases in which aconite has been prescribed in an overdose or been taken by mistake: After a dose of 5 minims of the tincture there is felt a tingling, numb sensation in the lips and tongue and in the tips of the fingers, with a sense of muscular weakness and depression; the pulse falls in frequency and force and the breathing is somewhat slower. A dose of 10 minims produces the same symptoms, greatly intensified and more prolonged. Beyond this dose the effects become poisonous; besides tingling of the skin, there may be lancinating pains in the joints; there is vertigo with dimness of vision, alarming debility, and a pulse of between 30 and 40 in a minute, which afterward grows frequent and irregular. The skin is cool and moist, nausea and vomiting occur, and the sickness and depression may last for several days. (For illustrative cases see *Edinb. Med. Jour.*, xxviii. 653; Reichert, *Phila. Med. Times*, xii. 105; *Med. Record*, xxxii. 761). In poisonous doses which yet have not proved fatal the preceding symptoms occur in an intensified degree. If the dose is a fatal one, there is complete loss of sight, hearing, and speech, yet consciousness may still be retained; the pupils are dilated,

the muscles are tremulous or convulsed, the pulse is imperceptible at the wrist, and may be so even in the axilla; the skin is cold, and death usually takes place by syncope. No characteristic lesions are found after death, but the heart is generally arrested in diastole, and most frequently is filled with dark blood. Large doses of aconite are said to leave behind them general debility, tremulousness, photophobia, feverishness, impaired digestion, and sometimes a tendency to jaundice. Experiments made to determine the influence of aconite on the secretion of urine (Mackenzie, *Practitioner*, xxiv. 1) appear to show that in obstructive heart or kidney disease it neither maintains the action of the kidneys nor evacuates dropsical fluid, but that where these conditions do not exist, and in certain febrile states, it has a tendency to increase the urinary secretion. (Further information regarding the action of this drug will be found under ACONITIA.) A case has been published of nearly fatal poisoning by the application of tincture of aconite to the skin; but its statements have been controverted (*Med. Record*, xxiv. 243, 451).

Aconite has been proclaimed by not a few writers of authority to be a potent remedy for *rheumatism;* it may be admitted to possess some value as a sedative of arterial action, and even as a direct anodyne, but it is in no proper sense a remedy for the disease. Indeed, it falls so far short of alkalies in the articular, and of iodide of potassium in the muscular, variety of rheumatism that its practical value is next to nothing, and it does not enter into the catalogue of remedies which are prescribed for the disease by judicious practitioners. It is of still less utility in *gout* than in rheumatism, But in both affections it may be employed as a topical application for mitigating pain. So far as the internal use of aconite in *neuralgia* is concerned, a somewhat analogous judgment may be given. Undoubtedly it sometimes palliates severe suffering in this disease affecting the nerves of the face or the chest, especially when it is at the same time applied, in the form of a strong tincture over the superficial and painful nervous branches. Aconite plaster, which is no longer officinal, may be used in similar manner, and as a sedative of local pain in chronic *rheumatism*, *white swelling*, etc. In the greater number of cases of neuralgia, not the direct effect of external causes, the affection depends upon states of the system which must be remedied by quinine, arsenic, iron, etc., and in which the sole indication for aconite is fulfilled by its local application. It may, however, conspire with them to secure relief. So in *sciatica*, and in gouty and rheumatic neuralgia of the axillary and brachial nerves, it has been used with success when associated with colchicum, belladonna, and cimicifuga (Metcalfe, *Boston Med. and Surg. Jour.*, Jan. 1887, p. 87). It is sometimes very efficient in relieving *toothache* when introduced into a carious cavity. But the risk of poisoning in such cases outweighs the advantages of the medicine. The same reflection is suggested by its use in the *vomiting of pregnancy*, and in *palpitation* of the heart, whether nervous or arising from organic disease of that organ, in *dysentery*, *amenorrhœa*, etc. In traumatic *tetanus* a like consideration should forbid its use, in spite of certain cases in which it seems to have been advantageous.

The statements which have been made respecting the virtues of aconite in purely inflammatory affections and fevers—*e. g. pneumonia*, *tonsillitis*, *rheumatism*, *erysipelas*, *typhoid fever*, *puerperal fever*, *remittent fever*, and *traumatic fever*—have not been supported by concurrent experience. Probably the medicine is more efficient in acute *tonsillitis* than in the other diseases enumerated, But if certain reports of its use in *pneumonia* (*e. g.* Spark, *Practitioner*, xxii. 196; Dobie, *ibid.*, p. 401) were to be taken as a guide, it has effected what no other medicine can do. It is said to have cut short the disease within from one to four days of its commencement. Evidently, the reporters have overlooked the fact that pneumonia sometimes does not go beyond the first or congestive stage. Like various other sedatives and more numerous stimulants, aconite will sometimes prevent the development of certain diseases, such as coryza, tonsillitis, laryngeal and bronchial catarrhs, and even nervous asthma. Walshe commended the use of aconite in *pericarditis* when the general conditions are sthenic and the disease is at its onset; and yet he admited that an overdose of it will dangerously accelerate the heart's action and lessen its power. The risks greatly outweigh the benefits of its administration in this as in all other internal diseases. The action of aconite in inflammations has been compared to that of venesection; but the analogy is not a real one. Venesection relieves the engorged organ, and at the same time enables the heart to act with more freedom and vigor; but aconite and its congeners weaken the heart, without in the least lightening the labor it has to perform. The above remarks are particularly applicable to the use of this agent in the diseases of children. It should be banished from them as unnecessary and unsafe. When employed in fevers and inflammations, it should always be given in very small and frequently repeated doses, such as half a minim of the fluid extract every quarter or

half hour until some of its characteristic effects appear, when the dose should be diminished or given at longer intervals.

The treatment of *poisoning* by aconite consists in evacuating the stomach with mechanical emetics and the stomach-pump, and sustaining vitality by means of the galvanic battery and by the administration of stimulants, including alcoholic liquids, coffee, and external heat. Oxygen has apparently tended to revive failing life, and hence artificial respiration is indicated. Strychnine is regarded as indicated physiologically; and digitalis, or, preferably, digitalin and atropine, may be given for their sustaining operation upon the heart. (For the use of these agents in poisoning by aconite see ATROPINA and DIGITALIS.) Two cases occurred (O'Brien, *Med. Record*, xv. 128; Clark, *ibid.*, xvii. 6) which demonstrate the power of *morphine*, hypodermically administered, to rescue from impending death persons poisoned by aconite, and others have been recorded. To assist in preventing syncope the patient's head should be kept low. According to Harley, death results from asphyxia and progressive collapse of the lung, the former being due to the spasmodic closure of the respiratory passages and paralysis of the muscles of inspiration, and notably of the diaphragm.

The dose of the powdered leaves or root, is Gm. 0.06–0.13 (gr. j–ij) as a minimum, but aconite is seldom employed in this form. The fluid extract and tincture are preferable for internal administration; and for the local effects of the medicine either the tincture, fluid extract, aconite plaster, or aconitine may be employed. It must not be forgotten that alarming symptoms have been produced by a dose of Gm. 0.02 (♏ iij) of the saturated tincture of aconite-root.

Aconitum ferox appears to possess only the virtues of the officinal plant, but in a far higher degree. *A. heterophyllum* it said to be destitute of poisonous qualities, but to be tonic and aphrodisiac. *A. lycoctonum* resembles the officinal species in all essential particulars, but the action of its alkaloid, acolyctine, identical with napelline, is much milder. *Lycoctonine* is said to resemble curare in its action. *A. Chinense* s. *Japonicum* acts much more mildly, both topically and internally. *A. Fischeri*, an American species, examined by Dr. Bartholow, differs essentially from *A. napellus* in not affecting the sense of touch or pain, although it produces a sensation of tingling, and in causing death by arresting respiration through the motor centres of the cord (*Amer. Jour. Med. Sci.*, Jan. 1886, p. 261).

Napelline (probably Hübschmann's) is alleged by Laborde to produce essentially the same effects as aconitine, but only when given in a much larger dose than the latter. Thus, while half a milligram (gr. $\frac{1}{120}$) of aconitine fatally poisons a dog, it requires 3 or 4 centigrams (gr. $\frac{1}{2}$ to $\frac{3}{4}$) of napelline to produce any effect on a similar animal. It is also asserted that napelline induces a calm and refreshing sleep, like that occasioned by narceine (*Bull. de Thérap.*, ciii. 94). It would be a singular fact if a derivative of aconite should possess soporific qualities that do not belong to the drug itself. In doses of half a grain napelline is said to have been a very efficient palliative of *neuralgia* of the fifth nerve. It has also been given for the relief of this affection in doses of one-twenty-fourth of a grain every two hours (*ibid.*, cv. 220). Grognot claims to have relieved toothache in many cases by the internal administration of Gm. 0.005 (gr. $\frac{1}{12}$) of napelline (Laborde's) every fifteen minutes (*ibid.*, cix. 64).

ACTÆA SPICATA, *Linné*.—BANEBERRY.

Radix Christophorianæ.—*Racine de Saint Christophe*, Fr.; *Christophswurz*, *Wolfswurz*, G.

Nat. Ord.—Ranunculaceæ, Helleboreæ.

Origin.—The plant is a native of Central Asia and Europe, and a variety with red berries (A. rubra, *Bigelow*) is indigenous to the Northern United States and Canada. The leaves are twice or thrice ternately compound, with ovate or oblong, sharply cleft or toothed leaflets. The whitish flowers are in short, dense racemes. The fruit of the European variety is glossy black. Another American species, A. alba, *Bigelow*, is taller and has longer racemes and white berries.

Description.—The rhizome and rootlets closely resemble the corresponding parts of cimicifuga, but are shorter, thinner, and of a blackish-gray color. When dry they are nearly inodorous; their taste is bitter, afterward acrid and sweetish. The constituents are similar to those of cimicifuga.

Action and Uses.—A. spicata, or baneberry, and A. alba and A. rubra, are sometimes used in domestic medicine where they flourish—the first in Europe, the others in

this country. They are probably very analogous, if not identical, in their mode of action, which is that of an irritant emeto-cathartic. The berries of the European species are said to occasion violent and even fatal delirium, as well as gastro-intestinal disorder. They destroy the life of hens and ducks, but sheep, asses, and goats devour the green leaves without injury. The powder and decoction are used to kill *fleas* and *lice*. The fresh root of the plant has been used in veterinary medicine, and was formerly regarded as a remedy for *asthma*. Whatever virtues belong to either of these species probably exist more perfectly in cimicifuga. A. spicata is administered in an infusion made with Gm. 2 (gr. xxx), to be taken in one day.

ADANSONIA DIGITATA, *Linné*.—Baobab.

Nat. Ord.—Malvaceæ, Bombaceæ.

Description.—The tree is indigenous to tropical Africa, and has been introduced and naturalized in various parts of the East and West Indies. It is remarkable for its enormous size, the trunk being about 4.5 M. (15 feet) high up to the branches, but attaining a circumference of 30 M. (100 feet) and more, and being divided into branches 15–21 M. (50 to 70 feet) long. It has a smooth, gray bark; palmate leaves, with 5 to 7 obovate or elliptic rather acute and somewhat dentate leaflets. The flowers are about 10 Cm. (4 inches) long and wide, have 5 thickish, obovate, white petals and numerous stamens, with the lower half of the filaments united into a tube, and produce a roundish, oblong fruit about 25–30 Cm. (10 to 12 inches) long, and containing about 50 blackish, subreniform seeds, which are covered with a whitish, acidulous pulp. The bark, leaves, and flowers have a mucilaginous taste. The fruit is known as *monkey-bread* (*Pain de singes*, Fr.; *Affenbrot*, G.), *Ethiopian sour-gourd*, and in Southern Africa as *cream-of-tartar fruit;* the latter is probably the smaller fruit of *A. Madagascariensis*, Baillon. The pulp surrounding the seeds contains, according to F. L. Slocum (1880), acid potassium malate, pectin, and glucose; Millard (1890) found also a little tartaric acid, and Heckel and Schlagdenhauffen (1889) no malates.

The Australian species, A. Gregorii, *F. v. Mueller*, is of smaller dimensions.

Action and Uses.—The bark of the baobab does not appear to affect any of the functions, except perhaps by increasing the appetite. The natives of Senegal are said to use it for its emollient qualities, and to mix the powder of its leaves with their food. It at first attracted attention in consequence of its alleged power of curing *intermittent fever*, but no confirmation of the original assertion is accessible, and it is quite improbable that a mucilaginous plant should possess such a virtue. A decoction is made with Gm. 32 in 1000 (an ounce of baobab-bark and a quart of water), reduced by boiling to a pint and a half.

ADEPS, *U. S.*—Lard.

Adeps præparatus, Br.; *Adeps suillus*, P. G.; *Axungia*, *Axungia porci s. porcina.—Prepared lard*, *Hog's lard*, E.; *Axonge*, *Graisse de porc*, *Saindoux*, Fr.; *Schweineschmalz*, G.; *Manteca de cerdo*, Sp.; *Grasso suino*, It.

The prepared or purified internal fat of the abdomen of the hog, Sus scrofa, *Linné*.

Class Mammalia; order Pachydermata.

Preparation.—For medicinal purposes the fat attached to the mesentery, omentum, and kidneys of the hog killed during the winter or spring should be selected, as this has a higher fusing-point than if obtained during the summer or from other parts of the body. It is that portion which is ordinarily called the "leaves," and should be as free from blood as possible. Hogs which have been fed on corn and similar amylaceous food appear to yield a more solid lard than hogs fed on the refuse of the kitchen. The British Pharmacopœia gives the following directions for preparing lard: Take of the internal fat of the abdomen of the hog, perfectly fresh, any convenient quantity. Remove as much of the external membranes as possible, and suspend the fat so that it shall be freely exposed to the air for some hours; then cut it into small pieces, and beat these in a stone mortar until they are thus, or by some equivalent process, reduced to a uniform mass in which the membranous vesicles are completely broken. Put the mass thus produced into a vessel surrounded by warm water, and apply a temperature not exceeding 130° F. (54.4° C.) until the fat has melted and separated from the membranous matter. Finally, strain the melted fat through flannel.—*Br.*

Perfumers obtain it inodorous, or nearly so, by adding to every pound of the fused lard about 15 grains of powdered alum and 30 grains of table-salt, and continuing the

heat until a scum rises, which is to be carefully removed, and the fat is uniform in appearance; it is then allowed to cool, and worked upon a slab or in a mortar while a slow stream of clear water passes over it, whereby the salts are completely removed. The fat is then remelted and the heat maintained until the water has completely separated or evaporated.

Properties.—Lard is a soft white fat, having a faint odor, entirely free from rancidity, a bland taste and a neutral reaction; like other fats it dissolves completely in ether, benzin, benzene, carbon disulphide, chloroform, and volatile oils. It has a density of about 0.932 at 15° C., fuses at 38° to 40° C. (100.4° to 104° F.) to a clear, nearly colorless liquid, and at or below 30° C. (86° F.) is a soft solid. In contact with the air, particularly when exposed to the light, it speedily oxidizes and becomes rancid, acquiring an acid reaction, a disagreeable odor, and an acrid taste; this change is accelerated by the presence of alkalies.

As met with in commerce, lard often has a rancid odor, and is then unfit for medicinal use. Salt is often added to prevent it from becoming rancid, but should be carefully removed by fusing the lard and stirring it in hot water, and afterward washing it until the fat is tasteless or silver nitrate ceases to produce a precipitate with the washings. Potassium carbonate is used to impart an artificial whiteness to commercial lard and to incorporate with it considerable proportions of water; such lard is to be purified by remelting and washing with water. Adulterations with mucilaginous jellies are removed in the same manner.

Constituents.—Lard is a mixture of olein, palmitin, and stearin, the last two fats being obtainable to the amount of 30 to 40 per cent. by subjecting the lard to pressure near the freezing-point of water. The expressed liquid is known in commerce as *lard oil*, and is extensively used for various purposes; it furnishes a cheap adulterant for some of the more costly non-drying oils. The solid portion is called *stearin*, and is employed for making candles, soap, etc. When melted lard is allowed to cool slowly a portion of the solid fats separates in granules; hence lard and all its preparations should be constantly stirred while cooling, to obtain them of uniform smoothness.

Preservation and Tests.—Lard should be preserved in glass, porcelain, or other well-glazed vessels, which must be entirely impervious to fat; the vessels should be well filled and protected from the access of air and light. Rancidity is readily ascertained by the acid reaction which alcohol acquires on being agitated with melted lard. On melting lard in a narrow test-tube, the oily liquid should be perfectly transparent and not separate a stratum of water. The adulterations mentioned above are detected by ether or chloroform, in which they are insoluble; distilled water, on being boiled with lard, should not acquire an alkaline reaction (alkali carbonates), and after separating the fat the liquid should not form a precipitate with silver nitrate (sodium chloride) or assume a blue color on the addition of compound solution of iodine (absence of starch). The pharmacopœial limit of free fatty acids is ascertained in a chloroform solution of 10 Gm. of lard, to which 10 Cc. of alcohol and 1 drop of phenolphtalein solution have been added; 0.2 Cc. of normal potassa solution should produce a pink tint after shaking. An admixture of more than 5 per cent. of cotton-seed oil is readily detected by mixing 5 Cc. of melted and filtered lard, while warm, with 5 Cc. of alcoholic solution of silver nitrate (1 Gm. $AgNO_3$, 100 Cc. deodorized alcohol, and 0.5 Cc. nitric acid), shaking the tube well and heating in a water-bath for five minutes: the liquid fat should not acquire a reddish or brown color (*U. S.*).

ADEPS BENZOINATUS, *U. S.*—Benzoinated Lard.

Adeps benzoatus, Br., P. G.; *Unguentum benzoini*, *Axungia balsamica s. benzoinata s. benzoata.*—*Benzoated lard*, *Ointment of benzoin*, E.; *Axonge* (*Graisse*) *benzoinée* (*balsamique*), Fr.; *Benzoe Schmalz*, G.; *Grasso con benzoino*, F. It.; *Manteca con benjui*, Sp.

Hog's lard impregnated with benzoic acid and the odorous principle of benzoin.

Preparation.—Benzoin, in coarse powder, 20 Gm.; Lard, 1000 Gm. Melt the lard by means of a water-bath, and, having loosely tied the benzoin in a piece of coarse muslin, suspend it in the melted lard, and, stirring them together frequently, continue the heat for two hours, covering the vessel and not allowing the temperature to rise above 60° C. (140° F.). Lastly, having removed the benzoin, strain the lard, and stir while cooling. When benzoinated lard is to be kept or used during warm weather, 5 per cent. of the lard should be replaced by white wax.—*U. S.*

Take of prepared Lard 1 pound; Benzoin, reduced to coarse powder, 160 grains. Melt the lard by the heat of a water-bath, add the benzoin, and, frequently stirring them together, continue the application of heat for two hours; finally, remove the residual benzoin by straining.—*Br.* Dissolve 1 part of benzoic acid in 99 parts of lard, previously melted on a water-bath.—*P. G.*

The result of the U. S. and Br. processes is practically identical, though the first formula directs for 1 pound avoirdupois only 140 grains of benzoin. By enclosing the latter in a muslin bag and regulating the temperature the benzoin is more thoroughly exhausted than if it was allowed to melt, and empyreuma is prevented. As prepared by the U. S. Pharmacopœia of 1870, by mixing 2 fluidounces of tincture of benzoin with 16 troyounces of melted lard, it was necessary to strain after the evaporation of the alcohol, so as to remove the resin, which has an irritating effect on tender surfaces.

Fixed oils dissolve the benzoic acid and odorous principles contained in benzoin. Pure benzoic acid is said to have no preservative influence on lard; that property appears to be due solely to the balsamic principle of benzoin and similar bodies. Hence the rancidity of lard may be prevented by impregnating it with the balsamic principles of storax, Peru or Tolu balsam, in the proportion of 1 or 2 parts of balsam to 100 parts of lard: the latter constitutes the so-called *balsamic lard* (Proctor, 1863). In a similar manner *populinated lard* (*Unguentum populi s. populeum*) is obtained by digesting 1 part of poplar-buds and 2 parts of lard until the moisture has evaporated, when the undissolved matter is removed by expressing and straining. B. F. Scholl (1883) ascertained that for the preservation of fats a larger amount of storax is required than of benzoin. Groves found (1866) that volatile oils generally preserve fats from rancidity to some extent, and that the oils of cloves, allspice, and sassafras are best adapted for this purpose, in the proportion of 4 drops to 1 ounce of fat.

Pharmaceutical Uses and Preparations.—Lard and benzoinated lard are used as ingredients in ointments, cerates, and sometimes also in plasters, as a substitute for olive or other oil.

Action and Uses.—Lard is used in medicine chiefly on account of the property it possesses in common with all unctuous substances of facilitating manual and mechanical operations by its lubricating qualities, and also because it shares the same property of protecting exposed tender surfaces from the action of the air. That lard is absorbed by the skin is not proven; but if, as it is believed by some, lanolin is so absorbed when applied with friction, there would seem to be a probability that other fats and oils may be absorbable in the same manner. Like, them, it is difficult of digestion, and therefore is sometimes used as a laxative for children and for its protective power in *diarrhœa*, *dysentery*, etc. Enemata of melted fresh lard are extremely soothing in acute dysentery. It has been proposed as a substitute for cod-liver oil in the treatment of *phthisis*, but its indigestible nature unfits it for this purpose. It has been employed externally in the same disease by inunction of the chest, and probably with the advantage of protecting the lungs from the external impression of cold. In the treatment of bronchial and laryngeal *catarrh* in children, and indeed of all pulmonary affections of early life, this simple application is valuable, not only for the reason assigned, but because it seems, when the cough is dry and urgent, to render expectoration freer. The same may be said of its use in *coryza*, in which the ointment should be applied on the bridge of the nose. In *scarlet fever* inunction of the whole body protects the skin from the atmosphere, and thereby lessens the burning and itching, and both directly and indirectly lowers the temperature and the pulse-rate. It also tends to prevent a sudden chill on exposure to the air, and hence diminishes the occurrence of scarlatinous *dropsy*. The application must be continued for some time after the fever has disappeared. It is thought that the anginose symptoms of scarlet fever may be palliated by keeping the neck enveloped in well-greased flannel cloths, but of this the evidence is slender. In *measles* it is probable that the *bronchitis* may be moderated by similar applications upon the chest. The best form in which lard can be used for the above purposes is simple ointment. The strongest objections to its use are the necessity of soiling much body- and bed-clothing, and the repugnance which is generally manifested by patients to its frequent repetition. Benzoated lard, especially with a modicum of glycerin, is preferable to prepared lard or simple ointment when a mild stimulant action is desired besides the protective influence.

ADEPS LANÆ HYDROSUS, *U. S., Br., Add.*—Hydrous Wool Fat.

Lanolin, E.; *Wollfett, Lanolin*, G.; *Lanolina*, It.

The purified fat of the wool of the sheep, mixed with not more than 30 per cent. of water. *U. S.*

Melt 7 ounces of Wool Fat in a warm mortar, gradually stir in 3 ounces of Water, and mix thoroughly.—*Br.*

Origin.—The wool of sheep contains a natural grease known as *suint*, which consists largely of insoluble soapy matter and a soluble salt containing variable proportions (15–35 per cent.) of potash; this wool fat is readily removed in the process of washing the wool, and in an impure condition was used centuries ago under the name of *œsypum*. As first obtained, it contains about 30 per cent. of free fatty acids besides numerous fatty-acid ethers of glyceryl and cholesterin; the latter are the constituents sought for the production of commercial lanolin.

Preparation.—Although lanolin is manufactured by processes never as yet fully published, it is known that the chief treatment consists in emulsionizing the crude fat with weak alkaline solutions and then separating the creamy mixture in centrifugal machines: the upper layer will contain the cholesterin fats, while the lower layer consists of a soap solution of the impure fatty acids. By treating the upper creamy layer with calcium chloride crude lanolin mixed with calcium soap is precipitated; by repeatedly melting and washing the precipitate, and finally extracting it with acetone, pure lanolin is obtained in an anhydrous condition: this is the wool fat (adeps lanæ) of the British Pharmacopœia. Anhydrous wool fat is of a yellowish-brown color, characteristic odor, readily soluble in ether, acetone, chloroform, and benzene, but only partly soluble in alcohol. When mixed with 30 per cent. of water (by kneading process) it constitutes the hydrous wool fat of the Pharmacopœia. Its chemical composition is a mixture of fatty acid ethers, of two isomeric alcohols, cholesterin, and isocholesterin; it contains no glycerin and is saponified with difficulty.

Properties.—Hydrous wool fat occurs as a nearly white ointment-like mass of faint peculiar odor; although insoluble in water, it can be readily mixed with twice its weight and more of water; it forms neutral turbid mixtures with chloroform and ether. It melts at about 40° C. (104° F.), and when heated on a water-bath to constant weight should leave not less than 70 per cent. of residue. When heated with five times its weight of water the latter should yield no glycerin upon evaporation, nor should it emit ammonia if heated with potassium hydroxide. If 0.1 Gm. be dissolved in 3 or 4 Cc. of acetic anhydride (not anhydrous acetic acid), and to the solution be added 6 drops of concentrated sulphuric acid, a pink coloration will ensue, soon changing to green or blue (*Liebermann's cholestol reaction*). If deprived of water, a solution (1 in 50) in chloroform will gradually develop a deep brown color if allowed to flow on the surface of concentrated sulphuric acid. Free alkalies and free fatty acids can be detected with phenolphtalein; the former in a 20 per cent. solution in ether should remain colorless, and the latter in the same solution, upon addition of 1 drop of normal potassa solution, should become pink.

Pharmaceutical Uses.—Hydrous wool fat is employed as a base for ointments where it is desired to incorporate large quantities of water or aqueous solutions of other medicinal agents.

Thilanin.—Under this name a sulphurated lanolin has been placed before the medical profession: it contains about 3 per cent. of sulphur, and is made by allowing sulphur to act on anhydrous lanolin with the aid of heat. It is a yellowish-brown substance and free from irritating properties. According to Saalfeld, thilanin relieves the itching of a number of skin diseases, and is particularly beneficial in cases of sycosis, herpes, acne, and psoriasis; for use upon the scalp thilanin should be diluted with oil or aqueous liquids.

Action and Uses.—The medicinal employment of the fat obtained from sheep's wool is very ancient. Pliny says that its uses are numberless, and he describes the manner of procuring it from the wool beneath the forelegs and thighs of the animal by boiling the wool in water and skimming off the floating fat (*Hist. Nat.*, xxix. 10). These directions were rehearsed from age to age. In the seventeenth century they were repeated by Culpepper. More recently, according to Strumpf (*Handbuch*, i. 128), this fat had a place in the Spanish Pharmacopœia, and uncleansed wool was employed as a dressing for scrofulous and other swellings and also in gout and rheumatism. In 1853, Simpson contended for the absorption of animal oils by the skin, citing cases of rapid

increase of weight through the external application of oil; and his contention was confirmed by Thompson. In 1885 the therapeutical qualities of lanolin were pointed out by Liebreich. The value of lanolin in medicine is due to its power of absorbing its own weight of water and nearly twice its weight of glycerin. It does not tend to grow rancid, is not at all irritating to the skin, but it does not render it as supple as some other emollients do. The former property makes it a valuable excipient for many medicines which are applied to the skin, including metallic mercury and mercurial salts, iodoform, potassium iodide, chrysarobin, etc. After friction with a lanolin ointment containing $\frac{1}{100}$ of corrosive sublimate a metallic taste may be perceived in the mouth; and a 5 per cent. carbolic-acid ointment prepared with it occasions a sense of numbness in the skin in the course of a few minutes, but does not irritate it. Rubbed with the finger upon the back of the hand, it promptly disappeared, leaving the skin dry and with a feeling of tension. Similar observations have been made by many, including Doyon (*Med. Record*, xxx. 603), Baratinisky (*Med. News*, xlix. 289), and Guttmann (*Zeitschr. f. klin Med.*, xii. 276), who, however, conclude that lanolin has no superiority over other animal fats in promoting the cutaneous absorption of medicines. There are some, however, who hold that lanolin is more rapidly taken up by the skin than any other fat (Stelwagon). (Compare Unna, *Ther. Monath.*, iv. 79, 173, 387: Liebreich, *ibid*, iv. 341: Paschkis, *Cent. f. Therap.* viii. 578).

Lassar (*Berlin. klin. Wochenschrift*, 1886, No. 5) made use of lanolin ointments in 400 cases of diseases of the skin. *Eczema* of the scalp and face has been cured in a week by a 2 per cent. lanolin-salicylic ointment, and the same disease of other parts is benefited by an ointment of boracic acid ʒij and lanolin ℥j. A case of contagious *impetigo* was cured in ten days by means of a paste composed of salicylic acid 2 parts, lanolin 50 parts, and oxide of zinc and starch, of each 24 parts. *Pityriasis versicolor* with extreme itching was successfully treated by means of an ointment containing salicylic acid 2, sulphur 10, and lanolin 88 parts. In many cases of inveterate *scabies*, in *tylosis*, and especially in *sycosis* and other acneiform eruptions, it is often of great service, and in all affections in which the epidermis is thickened or hard it lessens this obstacle to cure. The following paste is particularly recommended in scabies: Naphthol 5–10, green soap, chalk, sulphur, and lanolin, of each 25 parts; and in *psoriasis* an ointment made with lanolin and 25 per cent. of chrysarobin. In many other cutaneous diseases, including *seborrhœa*, *favus*, *herpes tonsurans*, *acne*, *prurigo*, etc., it has been found the best vehicle for curative remedies, as well as in itself a palliative. Lanolin forms the most appropriate excipient for ointments of iodine, potassium iodide, etc., to be applied by friction to *glandular swellings;* for all such as are applied to the *hairy scalp;* and also for those employed in *seborrhœa*, *rheumatism*, *chilblain*, *chapped hands*, *pruritus ani aut vulvæ*, etc. If the object be to render the skin softer, it may be desirable sometimes to dilute the thicker ointment with 20 per cent. of vaseline; but in superficial affections and where a lenitive and protective action is desired, lanolin may be applied alone after thoroughly cleansing the skin with warm water and soap, bran, or Indian corn meal.

The results obtained by Lassar have been fully confirmed by those of O. Liebreich, who tested the virtues of lanolin clinically. He recommends it, on account of its unirritating qualities, as the best unguent for *massage*. It appears to form the best excipient for chrysarobin in the treatment of *favus*. A number of formulæ for the use of this preparation have been published by Liebreich (*Brit. Med. Jour.*, Feb. 1886, p. 282; and *Braithwaite's Retrospect*, xciii. 159). One by Helbing consists of anhydrous lanolin 65 parts, liquid paraffin 30 parts, cerisin 5 parts, melted and kneaded in water 30 parts. Paschkis gives the following: lanolin 66 parts; liquid paraffin 6; cerisin 1; water 65. *Thilanin* has been used as a substitute for lanolin (*adeps lanæ*) as an application in various forms of skin disease.

ADIANTUM.—Maidenhair.

Herba capillorum veneris.—Capillaire, Fr. Cod.; *Frauenhaar*, *Venushaar*, G.; *Capelvenere*, It.; *Culantrillo*, Sp.

The frond of Adiantum capillus Veneris, *Linné*, and A. pedatum, *Linné*.

Nat. Ord.—Filices, Polypodiaceæ.

Origin.—The first species is indigenous to Southern Europe, Northern Africa, and the southern part of North America, westward to California, and grows in moist rocky places; the second is common in rich moist woods of North America, from Carolina northward, and is recognized by the French Codex as *Capillaire du Canada*, the former species as *Capillaire de Montpellier*.

Description.—Maidenhair has a polished, blackish-brown stipe about 30 Cm. (a foot) high. The first species has the fronds tri- or bipinnate below, pinnate above, and the leaflets short-stalked, irregular, roundish wedge-shaped, oblique at the base, obtusely lobed, and with linear marginal fruit-dots. The second species is forked at the summit, each branch recurved and with 6 or 7 pinnate branches; the leaflets are triangular oblong on the lower margin, entire, the upper margin cleft and fruit-bearing; otherwise resembling the preceding. Both have a faintly astringent, sweetish, and slightly bitter taste; the American maidenhair has also a faint aromatic odor. Their constituents are a small quantity of tannin, a bitter principle, mucilage, sugar, and a trace of volatile oil.

Pharmaceutical Uses.—Syrupus adianti, s. capillorum veneris.—Syrup of maidenhair, *E.* Make an infusion with 1 part of the drug and 15 parts of boiling water, and dissolve in 10 parts of the strained liquid 18 parts of sugar.—*F. Cod.*

Allied Species.—Other species indigenous to Mexico and South America are employed there for similar purposes. Asplenium Adiantum nigrum, *Linne*, was formerly known in Europe as *black maidenhair*, and Aspl. ruta muraria, *Linne*, as *white maidenhair*; the latter is also a native of the United States.

Uses.—The indigenous species of maidenhair is reputed to be useful in the same affection for which its European congener has long been celebrated—viz. in *pulmonary catarrh;* and a syrup made with the latter species is, in France, an ordinary flavoring addition to expectorant mixtures. It is demulcent and slightly stimulant.

ADONIS.—Adonis.

Pheasant's eye, E.; *Adonide*, Fr., It.; *Adonisröschen*, G.

The herb of Adonis vernalis, A. æstivalis, and A. autumnalis. *Linné.*

Nat. Ord.—Ranunculaceæ, Anemoneæ.

Origin.—The first two species are met with in most parts of Europe, and also in Asia; the last-mentioned species is indigenous to Southern Europe, and, like A. æstivalis, is an annual plant, while A. vernalis is perennial.

Description.—These plants attain a height of about 25 Cm. (10 inches), and have the light-green leaves repeatedly pinnatifid, the final divisions being quite narrow and almost capillary. On the lower part of the stem of A. vernalis the leaves are reduced to oblong membranous scales, and, like the calyx, are pubescent; its flowers are of a golden-yellow color. The other two species are nearly glabrous, and have yellowish-red (A. æstivalis) or crimson flowers (A. autumnalis). These plants have but little odor and a somewhat acrid and bitter taste.

Constituents.—F. Linderos obtained (1876) from the herb nearly 10 per cent. of aconitic acid, combined with potassium and calcium. The medicinal principle, *adonidin*, was isolated by Cervello (1882) from the precipitate produced by tannin. Mordagne (1885) obtained 2 Gm. from 10 kilos of the herb. Adonidin is a whitish crystalline powder, having a purely bitter taste, and acquiring a yellow color when kept over sulphuric acid, and a brown color on being heated in a water-bath. It is nearly insoluble in chloroform, benzene, and oil of turpentine; sparingly soluble in ether, but freely soluble in water and alcohol. Placed upon moistened blue litmus-paper, it changes the color to red. The watery solution is precipitated by tannin and basic lead acetate, but not by normal lead acetate. Sulphuric acid imparts a brown color, changing to violet. This medicinal adonidin was ascertained by Podwissotzki (1888) to be a mixture of yellow *adonidoquercitrin*, *adonidodulcit*, *adonitic acid*, and a brown glucoside with the active principle *picradonidin*, which is an amorphous glucoside, soluble in water, alcohol, and ether, strongly bitter, and a powerful heart-poison; its solution is not disturbed by lead salts, but is precipitated by tannin.

Action and Uses.—Adonis vernalis acts upon the frog's heart very much like digitalis, producing a tonic contraction of the organ and a diminished pulse-rate (Bubnow, 1880; Cervello, 1882). Clinical observation leads to a similar conclusion, for the medicine restores its rhythm to the arhythmical heart, rendering the pulse slower, fuller, and stronger. It augments the urinary secretion by increasing the proportion of water in it while diminishing its solid ingredients. In cardiac *dropsy* it therefore palliates all the symptoms depending upon obstruction of the heart—viz. those due to the heart itself and those occasioned by the dropsy—and measurably it has analogous effects in renal dropsy, unless the effusion is very large and the kidney lesion very general. The same is true of it in hepatic and splenic dropsy. Adonis is useless in functional disease

of the heart. The infusion is made with from Gm. 2–8 (½ drachm to 2 drachms) in Gm. 150 (6 fluidounces) of water. *Dose*, a tablespoonful every one, two, or three hours (Botkin, *Centralblatt f. g. Ther.*, i. 361).

ÆTHER, *U. S., Br., P. G.*—Ether.

Æther sulphuricus, Naphtha vitrioli.—Sulphuric ether, E.; *Ether hydrique s. vinique s. sulfurique*, Fr.; *Æther, Schwefeläther*, G.; *Etere*, F. It; *Eter sulfurico*, Sp.

Ether of the specific gravity 0.725–0.728 (*U. S.*), 0.735 (*Br.*), 0.720 (*P. G.*), 0.720–0.725 (*F. Cod., F. It.*).

Formula $(C_2H_5)_2O$. Molecular weight 73.84.

Preparation.—Take of Rectified Spirit 50 fluidounces; Sulphuric Acid 10 fluidounces; Chloride of Calcium 10 ounces; Slaked Lime ½ ounce; Distilled Water 13 fluidounces. Mix the sulphuric acid with 12 fluidounces of the spirit in a glass matrass capable of containing at least 2 pints, and, not allowing the mixture to cool, connect the matrass, by means of a bent glass tube, with a Liebig's condenser, and distil with a heat sufficient to maintain the liquid in brisk ebullition. As soon as the ethereal fluid begins to pass over, supply fresh spirit through a tube into the matrass in a continuous stream, and in such quantity as to equal the volume of the fluid which distils over. For this purpose use a tube furnished with a stopcock to regulate the supply, connecting one end of the tube with a vessel containing the spirit raised above the level of the matrass, and passing the other end through a cork fitted into the matrass. When the whole of the spirit has been added and 42 fluidounces have distilled over the process may be stopped. Dissolve the chloride of calcium in the water, add the lime, and agitate the mixture in a bottle with the impure ether. Leave the mixture at rest for 10 minutes, pour off the light supernatant fluid, and distil it with a gentle heat until a glass bead of specific gravity 0.735, placed in the receiver, begins to float. The ether and spirit retained by the chloride of calcium and by the residue of each rectification may be recovered by distillation and used in a subsequent operation.—*Br.*

A detailed account of the process of ether manufacture in this country will be found in Squibb's *Ephemeris*, vol. ii. fol. 590 *et seq.* In outline it may be stated as follows: A mixture of alcohol and sulphuric acid is heated in a suitable still to about 130° C. (266° F.), and when the distillation of ether has begun, a continuous supply of fresh alcohol is turned into the still, and so regulated as to keep the mixture at a constant quantity and temperature. The vapors are passed through two purifiers, the first containing a solution of potassa for the purpose of thoroughly washing the vapors in alkaline liquid; the second purifier is provided with a bed of pebble-stones, and here the alcoholic and other vapors having a higher boiling-point than ether are condensed and removed. In order that no ether may be lost, both purifiers are kept heated, and the purified ether vapor is finally condensed in a large worm surrounded by water.

The theoretical yield of absolute ether is never wholly obtained, and the quantity will vary with the care and attention bestowed. It is important that the temperature be carefully kept between 130° and 138° C. (266° and 280° F.); if it fall below 130° C., an excess of alcohol vapor will distil over, and if it rises above 138° C., the deficiency of alcohol in the still causes other products to be formed. Since in the formation of ether sulphuric acid is continually regenerated, its power of etherification is theoretically unlimited, but in practice it will be found that the impurities in the alcohol will set a limit, and gradually the acid becomes dark and tarry, and the mixture in the still liable to frothing. According to Squibb, a charge of 360 pounds of sulphuric acid will etherify about 120 barrels of alcohol, provided the latter be clean and of good quality.

Etherification.—When alcohol and sulphuric acid are mixed, 1 molecule of each compound unites to form ethylsulphuric (sulphovinic) acid and water; $C_2H_6O + H_2SO_4$ yields $C_2H_5HSO_4$ (ethylsulphuric acid) + H_2O. On the application of heat and in the presence of a fresh portion of alcohol a further reaction takes place, whereby sulphuric acid is reproduced and ether formed, the latter distilling over; $C_2H_5HSO_4 + C_2H_6O$ yields H_2SO_4 and $(C_2H_5)_2O$. The apparent result of the entire reaction, it will be noticed, consists in the abstraction of 1 molecule of water from 2 molecules of alcohol, the remaining elements forming 1 molecule of ether, while the sulphuric acid remains free, merely determining by its affinity for water the decomposition of the alcohol. The incorrectness of such an explanation of etherification is readily demonstrated by the different products of decomposition obtained in case the supply of alcohol is insufficient or the

sulphuric acid is used in excess, when oil of wine, sulphurous acid, olefiant and other gases, are generated. (See OLEUM ÆTHEREUM.)

The crude ether obtained by the usual process consists of ether, alcohol, and water, but contains, besides these, variable proportions of other decomposition-products, among which sulphurous acid, oil of wine, and occasionally acetic acid, are found. The acids are removed by agitating the crude product with an alkali—potassa or lime—in the presence of water, the latter serving also the purpose of abstracting much of the alcohol from the ethereal liquid. To avoid the loss of too large a quantity of ether, the potassa is dissolved in a small quantity of water, or, as directed by the British Pharmacopœia, a larger proportion of a nearly concentrated solution of calcium chloride containing slaked lime is used, which dissolves the alcohol, but only a small quantity of ether. When the aqueous liquid after sufficient agitation has subsided, the ether is drawn off and rectified until the distillate has the proper specific gravity, which is conveniently ascertained, according to the British Pharmacopœia, by keeping in the receiver a glass bead of the proper density, which will begin to float as soon as the density of the distillate is the same. This rectification is best performed by placing the retort in a water-bath, then heating the bath and carefully regulating the heat, so that the ebullition never becomes violent, in which case the vapors are apt to escape condensation and to become ignited. The condenser should be capacious and well cooled whenever ether is distilled.

Older Theories.—Ether, or a mixture of ether and alcohol, was probably obtained by the alchemists in the thirteenth century, but a process for its preparation from equal parts of oil of vitriol and alcohol was first devised, in the sixteenth century, by Valerius Cordus, who called it *oleum vitrioli dulce verum*. The name "ether" (spiritus ætherens) was first used for this liquid by Frobenius in England (1730). Fourcroy and Vauquelin (1797) regarded ether as alcohol deprived of water by the action of sulphuric acid, and Valentin Rose proved (1800) that ether contains neither sulphur nor an acid. Berzelius explained the action of sulphuric acid upon alcohol by catalytic force. Liebig regarded sulphovinic acid as a double sulphate of water and ethylic oxide (ether), which is decomposed by heat, with the liberation of ether. Rose explained this decomposition by water displacing the ether from the compound mentioned. Graham ascribed the result to the polymerizing power of sulphuric or sulphovinic acid, whereby alcohol $= C_2H_2 + HO$ (old notation) is converted into ether $= C_4H_4 + HO$. According to Robiquet (1854), carbylic sulphate $= C_2H_42SO_3$ and water are first formed, and these, with alcohol, yield ether and sulphuric acid; thus: $C_2H_42SO_3 + 2H_2O + C_2H_6O = C_4H_{10}O + 2H_2SO_4$. The theory explained at the beginning of this article was first advanced by Williamson (1850–54), and is supported by the discovery of ethers containing two distinct alcohol radicals.

PURE ETHER.—Æther purus, *Br.*; Pure ether, *E.*; Ether hydrique pur, *Fr.*; Reiner Æther, *G.*

Take of Ether and Distilled Water, each 2 pints; Lime recently burned ¼ ounce; Calcium Chloride 4 ounces. Put the ether with 1 pint of the water into a bottle, and shake them together; allow them to remain at rest for a few minutes, and when the two liquids have separated decant off the supernatant ether; mix this with the remainder of the water, and again, after separation, decant as before. Put now the washed ether, together with the lime and calcium chloride, into a retort to which a receiver is closely attached; let them stand for twenty-four hours, then distil with the aid of a gentle heat.—*Br.* This ether has a specific gravity not exceeding 0.720 at 60° F.

The process of the U. S. Pharmacopœia of 1870 differed from the preceding one in this, that the ether was agitated with an equal bulk of water, then decanted, agitated with calcium chloride and lime in powder, set aside for twenty-four hours, decanted, and distilled until about one-half had been recovered, the remainder yielding a weaker distillate.

The object of these processes is the removal of alcohol by agitating the ether with water, the last portions of which, together with nearly the whole of the remaining alcohol, are afterward separated by the calcium chloride and lime, the latter of which should be used unslaked. The distillation may be continued as long as ether of the proper specific gravity is obtained. The weaker ether, recovered by continuing the distillation, may be reserved for a subsequent operation.

Properties.—1. ABSOLUTE ETHER. It is a colorless, very limpid, not solidifiable liquid, of a strong refractive power, and having a specific gravity 0.710 at 20° C. (68° F., Richter), to 0.712 at 25° C. (77° F., Gay-Lussac), of 0.7188 at 15° C. (59° F., Squibb). It has a peculiar penetrating odor and a sweetish, pungent taste. It boils at 34° to 35° C. (93° to 95° F.), the vapors having a specific gravity of 2.58, and volatilizes very rapidly at ordinary temperature, thereby producing a considerable diminution of tempera-

ture. It is easily ignited, and burns with a bright flame, yielding water and carbon dioxide. Its vapor, mixed with a large quantity of air, if ignited, explodes with great violence. In consequence of this property and of the great density of its vapor great care should be exercised in handling ether or manipulating with it in the vicinity of a flame. It dissolves phosphorus, sulphur, iodine, bromine, some metallic sulphides, chlorides, bromides, and iodides, bromoform, iodoform, chloroform, alcohols, benzene, benzin, fats, volatile oils, many resins, most alkaloids, and some organic acids. W. H. Greene (1879) observed that on mixing 20 Gm. of absolute ether with 43 Gm. of chloroform the temperature rises 15° C. and little contraction in volume takes place; the mixture begins to boil at 50° C. and may be separated into its constituents by repeated fractional distillation. When shaken with an equal bulk of water, absolute ether loses one-fourteenth of its volume, which is dissolved by the water, a little of this liquid being dissolved by the ether (Boullay). The presence of water and alcohol is detected by mixing the ether with an equal bulk of carbon disulphide, which should result in a perfectly clear liquid; a piece of potassa kept in the ether for twenty-four hours becomes coated with a yellowish film and imparts a yellowish color to the liquid if alcohol be present (Boettger, 1872). Aniline-violet is insoluble in absolute ether, but in the presence of 1 per cent. of alcohol colors the liquid distinctly (Stefanelli, 1875). Well-dried powdered tannin remains pulverulent in absolute ether, but in the presence of water forms a tough mass or thick solution. Frederking (1870) recommended glycerin for the detection of water and alcohol.

Ether has a neutral reaction to test-paper, but when kept for a long time in partly-filled bottles acquires an acid reaction from free acetic acid; this is regarded as the result of oxidation, facilitated by the presence of moisture, or, as suggested by N. E. Henry, to the decomposition of a little acetic ether assumed to be present in ether. According to Lieben (1873), alcohol is very slowly regenerated when ether is left in contact with water. That ether is capable of forming a hydrate was shown by Tanret (1878), who on filtering an ethereal liquid observed on the upper part of the filter a frost-like congelation having the temperature —3.5° C. (25.7° F.) and after removing adhering ether by blowing upon it, yielding 17 to 18 parts of water for 37 of ether; the formula $(C_2H_5)_2O.2H_2O$ requires 18 parts.

2. U. S. P. Ether has a density of 0.725 to 0.728 at 15° C. (59° F.), or 0.714 to 0.717 at 25° C. (77° F.), and is composed of about 96 per cent. of ethyloxide (absolute ether) and about 4 per cent. of alcohol containing a little water; it boils at 37° C. (98.5° F.), and dissolves in 10 times its volume of water at 15° C. (59° F.). The specific gravity of ether required by other pharmacopœias is not exceeding 0.735 at 60° F. (*Br.*), 0.720 to 0.725 at 15° C. (*F. Cod.*), 0.720 at 15° C. (*P. G.*).

If a piece of pale-blue litmus-paper moistened with water be immersed ten minutes in a portion of the ether, the color should not change. On evaporating at least 50 Cc. in a glass vessel no fixed residue should appear, and on evaporating a portion dropped upon blotting-paper no foreign odor should be developed. Ether shaken occasionally, within one hour, with one-tenth of its volume of normal potassium hydroxide solution should not develop any color, showing the absence of aldehyde, etc.

The U. S. Pharmacopœia recognizes but one variety of ether, as does also the German, the British Ph. still continuing two varieties, differing from each other only to the extent of about 4 per cent. $(C_2H_5)_2O$. The commercial varieties known as "washed" and "concentrated" ether will no doubt continue in the market, but should never be employed for medicinal purposes, as their composition and degree of purity are not stated; there is surely no pharmaceutical use to which ether can be put for which the pharmacopœial ether could not be employed.

Hager gives the following table, showing the percentage by weight of ether of the specific gravity 0.7185, contained in the alcoholic distillates obtained in the rectification of ether; temperature 17.5° C. (68.5° F.):

Per ct. ether.	Specific gravity.	Per ct. ether.	Specific gravity.	Per ct. ether.	Specific gravity.	Per ct. ether.	Specific gravity.	Per ct. ether.	Specific gravity.
99	0.7198	89	0.7290	79	0.7397	69	0.7516	59	0.7640
98	0.7206	88	0.7300	78	0.7408	68	0.7528	58	0.7653
97	0.7215	87	0.7310	77	0.7420	67	0.7540	57	0.7666
96	0.7224	86	0.7320	76	0.7432	66	0.7552	56	0.7680
95	0.7233	85	0.7331	75	0.7444	65	0.7564	55	0.7693
94	0.7242	84	0.7342	74	0.7456	64	0.7576	54	0.7707
93	0.7251	83	0.7353	73	0.7468	63	0.7588	53	0.7721
92	0.7260	82	0.7364	72	0.7480	62	0.7601	52	0.7735
91	0.7270	81	0.7375	71	0.7492	61	0.7614	51	0.7750
90	0.7280	80	0.7386	70	0.7504	60	0.7627	50	0.7764

According to the same author, 100 measures of water dissolve the following measures of ether of the densities stated: 8 meas. ether, sp. gr. 0.719–0.721; 10 meas. ether, sp. gr. 0.724–0.726; 13 meas. ether, sp. gr. 0.729–0.731; 16 meas. ether, sp. gr. 0.733–0.735; 20 meas. ether, sp. gr. 0.738–0.741; 23 meas. ether, sp. gr. 0.743–0.746; 26 meas. ether, sp. gr. 0.748–0.750.

Allied Compounds.—Æther Formicicus, Formic ether, *E.*; Ameisenäther, *G.*—$C_2H_5CHO_2$. Mol. weight 73.83. It was first obtained by Bucholz (1782), and may be prepared by distilling a mixture of 8 parts of dry sodium formate, 7 parts of alcohol (88 per cent.), and 11 parts of strong sulphuric acid. Usually sufficient heat is produced upon addition of the acid to volatilize the ether, and the distillate, if acid, is shaken with milk of lime or magnesia, and finally rectified from calcium chloride. Formic ether is a thin, colorless, inflammable liquid of strong agreeable odor and pungent taste. Its spec. grav. is 0.918 at 17° C. (62.80 F.), and its boiling-point 55° C. (131° F.); it is soluble in 9 parts of water and in all proportions in alcohol, ether, fixed and volatile oils. When inhaled, it lowers the temperature as much as 3.5° C. (6.3° F.), inducing signs of asphyxia, and causes muscular relaxation and anæsthesia. In man 6 or 8 Gm. occasion no other symptom than drowsiness.

Æther Methylicus.—Methylic ether, Methyl oxide, *E.*; Methyläther, Holzäther, *G.*—$(CH_3)_2O$, Mol. weight 45.90. It was discovered by Dumas and Peligot (1835), and is prepared by distilling a mixture of 1 part of methylic alcohol and 4 parts of sulphuric acid; the vapors are washed by passing through potassa solution or milk of lime, whereby carbon and sulphur dioxides, as well as methyl sulphuric ether, are removed. The latter body, having a garlic-like odor, is decomposed. Methylic ether is a colorless, inflammable gas, heavier than air, of an ethereal odor and aromatic taste. At — 36° C. (— 32.8° F.) it forms a colorless liquid which boils at —21° C. (— 5.8° F.). Water dissolves 35 volumes of the gas, acquiring its odor and taste, and evolving it again at a moderate heat. It is more soluble in sulphuric acid, and still more freely in alcohol, methylic alcohol and ether. A solution in the latter liquid saturated at 0° C. (32° F.), has been recommended by Dr. B. W. Richardson under the name of methylic-ethylic ether (see below) as a safe, rapidly-acting anæsthetic; it should be kept in well-corked bottles in a cool place.

Æther Methylethylicus.—Methyl-ethyl ether, Methyl-ethyloxide, *E.*; Methylaethyläther, *G.* $CH_3C_2H_5O$. This compound, which must not be confounded with the solution of Dr. Richardson mentioned above, was first obtained by Williamson by the action of ethyl iodide upon sodium methylate, and this has proven to be the best method since. The two substances are made to react in a retort, and the vapors made to pass through a weak soda solution cooled to 15° C. (59° F.), whereby volatile by-products are removed, the methyl-ethyl ether being finally condensed in a well-cooled receiver. It is a colorless liquid, very inflammable, of peculiar characteristic odor, boiling at 11° C. (51.8° F.). Its use as an anæsthetic has been very limited.

Methylal. Methylen-dimethyl ether.—$CH_2(OCH_3)_2$. This body, belonging to the group known as "acetals," was first obtained pure by Malaguti (1839). It is prepared by acting on methyl alcohol with a mixture of manganese dioxide and sulphuric acid, the resulting distillate being purified by fractional distillation and dehydration. It is a colorless, limpid liquid, of penetrating ethereal odor, boiling at 42° C. (106.6° F.), and having a specific gravity of 0.855. It is soluble in 13 parts of water, also in alcohol, ether, and fixed and volatile oils. Sulphuric acid decomposes it, but alkalies are without effect. Methylal has been used as an anæsthetic and as a hypnotic in doses of 1 or 1¼ drachms mixed with syrup and water. The information regarding its actions is meagre.

Action and Uses.—On man the primary impression of ether, even when smelled, is that of an agreeable nervous stimulant. On the skin it excites coolness if allowed to evaporate, but irritates if confined. When swallowed, it creates burning heat in the throat, œsophagus, and stomach, and a rapid intoxication like that of alcohol, but more intense and of shorter duration. When inhaled, pure ether excites at first cough and dyspnœa, and then a prickling of the hands and feet and exhilaration of the spirits, with a peculiar perception of lightness, while all the senses become perverted or blunted: that of touch much less so than the sense of pain, so that severe injuries may be received without their being felt, and brief operations may at this stage be advantangeously performed. The muscular system gradually becomes relaxed, while consciousness is growing more perverted or obscured. Meanwhile, the pulse and respiration are generally quickened, the skin becomes warm and moist, and the pupils are contracted; but as complete unconsciousness and anæsthesia supervene, general relaxation is more or less rapidly displayed, the pupils are dilated, the respiration is slow and deep, the pulse infrequent and feeble, the skin cool and moist, and sometimes cyanotic. Drs. Leidy, Jr., and Hare have found that during various surgical operations under ether the temperature fell several degrees (*Therap. Gaz.*, xii. 317). This state continues only for a few moments after the vapor ceases to be inhaled; consciousness returns almost suddenly, but numbness and weakness remain for some time longer. Of occasional after-effects of anæsthesia from ether may be mentioned vomiting, congestion of the brain or lungs, various hysterical phenomena,

and more rarely epileptiform or tetanoid symptoms, but these effects are exceedingly rare when the ether is pure and skilfully given. The first, vomiting, is less usual than after chloroform. The sensory and psychical effects of ether are various: rushing and roaring noises are heard, phantasmagorial visions are beheld, and these seem to prompt certain unconscious acts, for sometimes a pugnacious disposition is developed, sometimes an amorous, and even a lascivious, tendency, and, again, an irrepressible tendency to say things which under normal circumstances would have been kept profoundly secret, or to use indecorous and even indecent language. Several cases of mania following upon the surgical use of ether have been reported by Dr. Shepard (*Amer. Jour. Med. Sci.*, Dec. 1888, p. 591); and one by Dr. Homans in which dementia was attributed to this cause (*Boston Med and Surg. Jour.* Aug. 1889, p. 110). Ether drunkenness, like chloral intoxication, numbers a great many victims, most of whom, but for fanatical notions of temperance, would have become the prey of alcohol. It appears to be less permanently injurious than the more usual and brutal vice, for if some deaths are attributed to it, there are instances of its habitual indulgence without serious injury. In the case of a lad addicted to it the usual doses at last amounted to between 1 and 2 pints daily, without apparently impairing his mind (*Boston Med. and Surg. Jour.*, Sept. 1881, p. 262; May, 1889, p. 522; *Med. Record*, xxiv. 459).

In appropriate cases, and properly administered, we believe pure sulphuric ether to be beyond all comparison the safest of the anæsthetic agents employed in general surgery, and that *when these conditions have been observed* there is not a single authenticated example of its having destroyed life. Unfortunately, it is not always possible to determine beforehand in what cases this anæsthetic is appropriate. The danger may lie in a special susceptibility of the heart or of the central nervous system. The practical superiority of ether over chloroform is that in cases suitable for the anæsthetic use of either agent the pulse early gives warning of danger from ether, but in death by chloroform no such signal can be relied on. In 1880 a committee of the British Medical Association presented a report upon anæsthetics, in which the following statements occur: "The danger with ether approaches from the pulmonary rather than the cardiac side, so that by establishing artificial respiration we have a means of warding off death;" and again: "The advantages which chloroform possesses over ether are more than counterbalanced by its additional dangers." This verdict is supported by the testimony of competent witnesses. In November, 1884, Mr. Braine of London made a comparative study of the several surgical anæsthetics, and awarded to ether a superiority over all except for very short operations (*Times and Gaz.*, Nov. 1884, p. 758). In the following year Dr. Brunton reached substantially the same conclusion, even while addmitting that in rare instances ether might cause death by syncope (*ibid.*, Aug. 1885, p. 251). The testimony of Dr. Squire of the use of ether during the English campaign in Egypt is very pertinent. He found that in the climate of that country chloroform depressed the patients, but ether stimulated them, so that they suffered little from the shock of operations. He used an inhaler and gave the ethereal vapor without any admixture of atmospheric air (*ibid.*, Nov. 1885, p. 631). Among later testimony upon the subject may be cited that of Dumont in Berne, Switzerland, who maintains the practical superiority of ether on the grounds that it is not more unpleasant than chloroform, nor is its administration more complicated (especially if a mask is used); it is not so apt to occasion vomiting, and its effects are as prolonged as those of chloroform, and are less dangerous, because the former primarily and as a rule affects the lungs, but the latter the heart (*Therap. Monatshefte*, Feb. 1889, p. 87; compare Stockwell, *Therap. Gaz.*, xiv. 590; Wood, *Med. News*, lvii. 121; Silex, *Centralbl. f. Therap.*, viii. 229; Butter, *ibid.* p. 294). There is no doubt that ether is more liable than chloroform to occasion pulmonary congestion and renal irritation (*Med. Record*, xxxi. 122, 199, 254), but these are not direct effects of its administration; yet it should be cautiously used when the lungs or the kidneys are not sound. It is not eligible for very fat persons whose breathing capacity is restricted. It may be mentioned that the convenience afforded by ether (or other anæsthetic) may tempt surgeons to operate too soon when the shock of an accident has been sustained, and too deliberately as well, so that the physical depression of the system is unduly prolonged (Cheever, *Boston Med. and Surg. Jour.*, Sept. 1888, p. 293).

The statement must not, however, be omitted that within a comparatively recent period deaths from ether have occurred with precisely the same phenomena as those caused by chloroform (*Med. News*, xliv. 78; xlv. 345; l. 89, 109, 166; *Boston Med. and Surg. Jour.*, July, 1884, p. 3; *Lancet*, Apr. 1889, p. 800; *ibid.*, Sept. 1890, pp. 584, 587; *Med. Record*, xxxvii. 71).

The inhalation of the vapor of ether has in a great measure supplanted its earlier administration in a liquid form, but the latter should not be neglected. It may be given to alleviate nervous *headache* and the pain of flatulent, renal, and hepatic *colic*, spasmodic *vomiting*, including that of *pregnancy* and sea-sickness, and *asthma*, and also to prevent or subdue the paroxysms of *hysteria*. Even puerperal *mania* has been held in check by ethereal enemata. It is occasionally indicated as an adjuvant to alcohol in the *typhoid state* of febrile affections, particularly when some temporary exhaustion calls for a transient but vigorous stimulation. In comparatively recent years ether has been administered hypodermically as a stimulant in cases of exhaustion from *hæmorrhage*, in the *adynamic* stage of fevers (*Bull. et Mém. de la Soc. de Thérap.*, 1882, p. 127); but it is not quite clear that its administration by the mouth or the rectum would not have been as efficient. In urgent cases the ordinary hypodermic syringeful has been injected, and the operation repeated at intervals of several hours. It would appear that abscesses are very apt to follow this operation. In the treatment of *tape-worm* a full dose of ether to benumb the parasite, so as to facilitate its expulsion by means of castor oil, given directly afterward, is sometimes successful; and so are enemata of ether in destroying *ascarides* of the rectum, and lotions of it for removing *crab-lice* (*pediculi pubis*). Ether has been used for a long time in conjunction with oil of turpentine and also with castor oil with a view of removing *biliary calculi* by dissolving them. The efficacy of the treatment, if real, may depend in part upon the local anæsthetic action of the medicine, but some authorities entitled to respect maintain the reality of its solvent operation also. Whatever view of its mode of action may be entertained, it is certain that ether very frequently removes the symptoms of biliary calculi. The difficulty of digesting cod-liver oil and other forms of fatty food in pulmonary *phthisis* has been supposed to depend upon a deficiency of pancreatic juice and the crude condition in which such food is brought into contact with that secretion. It is claimed that ether, by emulsifying the oil, and also stimulating the stomach and duodenum, and thereby increasing the flow of pancreatic juice, renders the aliment much more assimilable than it would otherwise be. It is also claimed that these views have received the confirmation of experience, and that by the use of ether after taking the food in question it is fully and easily digested, and that the objects of its administration, the increase of the patient's weight and the abatement of the pulmonary symptoms, are secured. The scientific adaptation of the medicine to the purpose in view is very complete, but, like other remedies proposed on similar ground, and by their proposers regarded as fulfilling their object, this one does not appear to have been found successful. On the contrary, the unpleasant taste of ether, whether given separately or combined with oil, and the offensive eructations to which it gives rise, render a continued use of it difficult, if not impossible, and evidence is wanting to confirm the results at one time attributed to it. The rectal administration of ethereal vapor has been claimed as a successful method of treating *cholera;* but this extravagant pretension has not been sustained. In small doses it may sometimes be advantageous as a diffusible stimulant. Similar enemas have been found useful in the treatment of *lead colic*.

Besides being taken internally, ether in its liquid form is applied externally to produce anæsthesia or by the cold it occasions in evaporating to cause a contraction of the tissues. With the former object it is familiarly used to relieve the pain of neuralgic *headache*, and also when applied over the superficial portions of nerves to palliate *neuralgia*. It affords prompt relief in *toothache* from carious cavities, especially when associated with camphor, and also in *earache* when applied on cotton with oil or in the form of vapor. In some cases of *deafness* due to a rheumatic condition of the auditory canal it is said to have been curative. In irritative congestion of the retina, and *photophobia* generally, a little ether allowed to evaporate from cotton-wood, so placed in the hollow of the hand as to cover the eye at the distance of an inch or two, affords decided relief. The refrigerant action of ether is best shown in some cases of *hernia* strangulated by a mere excess of blood in the tumor; it contracts the tissues, expels the blood, and permits the reduction of the bowel. The *vomiting of pregnancy*, which, as above stated, has sometimes been arrested by the inhalation of ether, is also said to have been subdued "by freezing the pneumogastric nerve under the sterno-mastoid on both sides of the neck alternately" (Lester). A similar application "first to the epigastrium, and then for five minutes on both sides of the throat," is stated to have relieved obstinate *hiccup* (Regoni). It is claimed that ether spray can arrest the development of *malignant pustule* and *carbuncle* (Zimberlin), and also of *tonsillitis* (Concato).

Ethereal inhalation is employed to produce anæsthesia, and thereby, according to its degree, to relieve pain, relax muscular tension and spasm, or produce unconsciousness. In

surgery it permits the performance of operations which would without it be inexpedient or impracticable, both by abolishing the sense of pain and preventing the struggles of the patient, and hence it has probably diminished the mortality of grave surgical operations. It has been successfully administered for this purpose while the patient remained asleep (*Jour. Am. Med. Assoc.*, i. 244). Age is no contraindication to its use, but it should rarely be employed when there is disease of the kidneys, lungs, brain, or heart, or when the sensations of the patient are needful to guide the surgeon's hand. Operations upon the fauces and nasal passages involving the flow of blood are embarrassed, and may be rendered dangerous, by anæsthesia; it is unfavorable to success whenever the voluntary muscular action of the patient is required; it is unnecessary when the duration of an operation is short or its severity is insignificant. In general, the severer the operation the less danger of accident is there from inhaling ether; in the greater number of cases when alarming symptoms have occurred the operation was trivial, as in extracting teeth, opening abscesses, etc. In obstetrics the inhalation of ether robs the throes of *labor* of their acutest pain, and hence lessens the exhaustion of the patient; and in tedious and complicated labors, in cases of great tenderness or rigidity of the maternal organs, of unusual susceptibility to pain and great nervous irritability, in labors requiring manual or instrumental interference, and in *puerperal convulsions*, anæsthesia by ether has long been and continues to be a precious remedy. It does not involve any risk of injury either to child or mother if judiciously employed, while, by lessening the rigidity of the os uteri and perineum without impairing the strength of the expulsive efforts, it facilitates and shortens labor. For these purposes it is most valuable in the first and in the last stages of labor. It is seldom necessary or proper to maintain its action throughout this process. It is the best palliative for *after-pains*. For all of the purposes mentioned except those which involve operations on the interior of the uterus, it is unnecessary to produce the narcotic degree of anæsthesia. It is proper, however, to observe that during childbirth a degree of anæsthesia, by any of the agents employed, may be produced without danger which, under other circumstances, and especially in surgical operations, might be attended with risk. This peculiar immunity of the parturient woman is probably due to the high nervous tension which her state involves.

The diseases which call for anæsthesia include all painful and spasmodic affections; *e. g. dysmenorrhœa*, *gout in the stomach*, *biliary* and *nephritic colic*, *tetanus*, *hydrophobia*, *chorea*, *hysteria*, puerperal and other reflex *convulsions*, *whooping cough*, *spasmodic croup*, *laryngismus stridulus*, *delirium tremens*, *mania*, etc. In all of these it eliminates one or the other, or both, of the symptoms which tend to exhaust the patient. In some local affections of a painful nature, such as *lumbago*, *sciatica*, and other forms of *neuralgia*, ether has been employed hypodermically with advantage. The dose at first should not usually exceed 10 or 15 minims; subsequently it may be increased.

Local anæsthesia may be produced by projecting upon the skin a stream of atomized pure ether or of ether and chloroform. The former is preferable, from the rapidity of its action and the complete congelation it produces, so that a variety of surgical *operations* may be performed by its aid without inflicting pain. Among them are not only such minor ones as opening abscesses, the evulsion of nails, the excision of nævi, hæmorrhoids, and other small tumors, and the amputation of fingers, the incision of carbuncles, fistulæ, etc., but this method has also been applied to the removal of large tumors of the skin, breast, etc., to amputations, ovariotomy, Cæsarean section, etc. The latter uses indicate rather the extreme limits of its application than its practical utility. Local anæsthesia of the lumbo-sacral region by ethereal vapor has been used to mitigate the throes of *labor;* of the hypogastric region to arrest uterine hæmorrhage and promote contraction of the uterus; to facilitate the reduction of *hernia* (*Amer. Jour. Med. Sci.*, Nov. 1889, p. 527; *Lancet*, April, etc. 1889, pp. 836, 910, 1031); of *intestinal obstruction* (*Bull. de Thérap.*, cxvii. 574) and of *paraphimosis;* to relieve the pain of *neuralgia* by a direct action, and the spasms of *chorea* and other spasmodic affections by its application to the spine. The local use of ether as an anodyne antedates the discovery of anæsthesia by the inhalation of ether.

The hypodermic use of ether has been largely extended. About 1 Ccm. has been generally injected at a time, and the operation repeated as often as necessary. It causes a smarting and burning pain for a short time, but usually no further ill effects, provided the instrument does not penetrate beyond the subcutaneous connective tissue. Deeper wounds have sometimes occasioned paralysis of parts beyond the point of puncture, which has been attributed to a solvent action upon the nerve-structure (*Practitioner*, xxxix. 62; *Centralbl. f. Therap.*, vi. 484; *Univers. Med. Mag.*, iii. 42). This method

has been found singularly efficient in cases of collapse, however arising, when the patient is unable to swallow; *e. g.* in *cholera*, *typhoid fever*, *pneumonia*, *pulmonary œdema*, *capillary bronchitis*, *infantile* and *puerperal convulsions*, post-partum and other *hæmorrhages*, the collapse of *opium-* and *chloral-poisoning*, etc. Bamberger used for subcutaneous injection a syringeful of ether in cases of venous stasis and dropsy due to *feeble heart* and threatening death by asphyxia. Not only were the cardiac distress and the pulmonary congestion promptly relieved, but the secretion of urine was immediately increased while the dropsy declined (*Centralbl. f. Ther.*, vi. 526). The last-named effect had already been described by Zuelzer (*ibid.*, i. 472). The same expedient was equally successful in the hands of Heitler and of Hœgerstedt (*ibid.*, p. 641). *Sebaceous tumors* of the scalp have been successfully treated by injecting into them with a hypodermic syringe from 5 to 10 drops of ether three or four times, at intervals of several days, until the contents of the cyst were liquefied and its walls inflamed, when the dissolved sebaceous matter and the pus were pressed out (*Bull. de Thérap.*, cv. 454).

Administration.—The average dose of sulphuric ether is a fluidrachm (Gm. 4). It may be administered upon powdered sugar and rapidly swallowed with a mouthful of water. Smaller doses may be given by incorporating it with syrup or spermaceti, and diluting the mixture with water or mucilage, which should be made cold by ice if possible. It has also been administered in gelatin capsules. For producing anæsthesia ether should be administered by some one familiar with it, and who will attend to nothing else. Artificial teeth and all other foreign bodies should be removed from the mouth. Ether should not be used while the stomach contains food; no alcoholic drink of any kind should be given to the patient before the operation, nor should he be kept under the influence of the anæsthetic longer than is absolutely necessary. According to Mr. Osborn, chloroformist to St. Thomas's Hospital, London, "Valvular disease of the heart, shown by cardiac murmurs, need be no hindrance to the administration of ether, a fatty heart which is not diagnoscible by any auscultatory signs being the form of heart disease which is the most dangerous." Feebleness of pulse also is not a contraindication to the inhalation of ether; indeed, a depressed pulse frequently acquires strength and volume under its influence. Ether should not be given to the production of narcotism in persons whose urine is albuminous. It is most conveniently employed by means of a sponge saturated with ether and enclosed in a cone made of a napkin or of coarse paper, large enough to cover the nose and mouth of the patient and open at the smaller end. Or if the napkin alone be employed, the ether may be poured freely upon its internal surface. It has been held that a capital precept in etherization is to produce anæsthesia as rapidly as possible by overwhelming the patient with as much of the vapor as he can possibly inhale. This method has been generally preferred by American surgeons, but Mr. Osborn, above referred to, would apply to all anæsthetics the same law, that the first inhalations of the vapor should be freely diluted with air, for large quantities of it suddenly placed over the patient's mouth and nostrils occasion gasping, choking, and struggling for breath. The use of an inhaler is to be recommended, but it is less commonly employed than it should be. It not only economizes ether, but protects the operator and assistants from the nauseating and intoxicating influence of the vapor. It also greatly hastens the anæsthetic state. If during the initial stage the patient breathe through the nostrils only, he will be less apt to cough or to have laryngeal spasm than if he breathed by the mouth, and for this purpose he should be taught how to breathe regularly before any ether is introduced into the inhaler. At first its vapor should be mixed with air, but as soon as the anæsthetic action begins only the pure ethereal vapor should be inhaled. (For fuller details compare Parkinson, *Boston Med. and Surg. Jour.*, April, 1885, p. 406; *ibid.*, Feb. 1889, p. 154; Müller, *Med. News*, April, 1885, p. 374; Lovett, *Boston Med. and Surg. Jour.*, Dec. 1888, p. 548; Shrady, *Med. Record*, xxxv. 204.) Care must be taken not to allow the contact of flame with the ethereal vapor.

A mixture of one part of alcohol, two parts of chloroform, and three of ether has been widely used, but has not fulfilled the expectations entertained of its superiority, which were based on the supposed antagonism of alcohol and ether to chloroform. It has occasioned death, and apparently in the same manner as undiluted chloroform (*Med. News*, l. 38).

From an experimental study of arrested breathing under ether, Drs. Martin and Hare (*Med. News*, liv. 236) concluded that drawing the tongue forward by the tip is a very insufficient mode of rendering free the opening of the larynx, and that traction-pressure should be applied to the dorsum of the tongue behind the anterior half-arches while the head is extended on the neck at an angle of 45° and the horns of the hyoid bone are

thrust forward. This manipulation appears not to apply to the "spasmodic apnœa" which Dr. Silk describes as peculiar to the first stage of etherization (*Lancet*, Feb. 1889, p. 319), but to that which he denominates "paralytic apnœa," due to paresis of the larnyx itself or of the nerve-centres controlling it. It is generally gradual in its approach. Evidently, the spasmodic form may be controlled by suspending the use of the anæsthetic, and both forms by a dash of cold water or by the evaporation (Hare) of ether from the surface of the abdomen.

ÆTHER FORMICICUS.—Byasson made experiments with formic ether compound upon dogs, rats, and guinea-pigs. He regarded it as readily undergoing decomposition into alcohol and alkaline formiates through the alkali of the blood. When inhaled, it lowers the temperature as much as 3½° C., induces signs of asphyxia, but not so marked as those caused by chloroform, and causes muscular relaxation and anæsthesia. The effects persist for several hours. Hypodermic injections of Gm. 1–2 in guinea-pigs and rats, and of Gm. 4–6 in dogs, produce a less degree of asphyxia, but more somnolence, lowering of temperature, and a diminution, but not a complete suppression, of sensiblility. In man 6 or 8 Gm. occasion no other symptom than drowsiness. The urine contains formic acid.

ÆTHER METHYLICUS.—Being gaseous and only feebly held in solution by alcohol, methylic ether is more readily absorbed than this liquid into the blood. Its anæsthetic operation is somewhat peculiar. A pigeon under a bell-glass filled with the vapor of methylic ether, or made to inhale it from a kind of respirator, falls into a quiet sleep without agitation or convulsion. Dr. Richardson, experimenting upon himself, observed that there was no preliminary spasm excited by it in the larynx or elsewhere—no rigidity, lividity, or other change of color. The pulse rose to 96; the anæsthesia was perfect, and was not preceded by convulsion or followed by nausea. In some further experiments (upon guinea-pigs) the anæsthesia was carried as far as possible, and the respiration ceased several minutes before the heart stopped. After death the lungs were not congested, but the pulmonary veins and both sides of the heart were filled with fluid blood, which was dark on the left side. In death by bichloride of methylene the blood in the same cavity is light red. The repletion of the heart contrasts with the emptiness of its cavities in death by chloroform. According to Richardson, it is a safe anæsthetic, yet is objectionable because it rapidly volatilizes from its solution, and its odor is more unpleasant than that of ether, chloroform, or bichloride of methylene.

METHYLAL.—Dr. B. W. Richardson originally described this compound as anæsthetic and narcotic, and suggested that it might be used with alcohol or ether to relieve *colic*, *asthma*, *angina pectoris*, or *tetanus*. Mairet and Combemale used it for the *insane* in daily doses of Gm. 1–8 (15 grs. to 120 grs.), but it was efficient only in the later periods of the acute attack, and rapidly created tolerance. They found it inoperative in *mania à potu* and *syphilitic mania*. Lemoine testified to the same effect (*Gaz. Méd. de Paris*, No. 18, 1887), and so did Kraft-Ebing, who, however, thought it useful in *delirium tremens* (*Centralbl. f. Ther.*, vi. 275); but since the latter disease nearly always subsides spontaneously, if not aggravated by unwise treatment, and as the doses of the medicine used by the last named-reporter (one or two grains) could not have been operative, although given hypodermically, the claim in behalf of the medicine can hardly be sustained. Personali advised it for *neuralgic* and other pains of the bowels. Richardson prescribed methylal as follows: R. Methylal ʒvj; Syr. of orange-flower water fʒiv; distilled water, to fʒvj. S. One to four tablespoonfuls in a wineglassful of water. Personali suggested an ointment or liniment 1 : 6 as an analgesic; but the rapid evaporation of the anodyne ingredient renders this an ineligible form.

ÆTHER ACETICUS, *U. S., Br., F. Cod., P. G.*—ACETIC ETHER.

Naphtha aceti.—Ethyl acetate, E.; *Éther acétique, Acétate d'éthyle*, Fr.; *Essigäther, Essignaphtha*, G.; *Etere acetico*, F. It.

Formula $C_2H_5C_2H_3O_2$. Molecular weight 87.8.

Preparation.—Add slowly 32½ fluidounces of sulphuric acid to 32¼ fluidounces of rectified spirit; cool, add 40 ounces of sodium acetate, and distil 45 fluidounces. Digest the distillate three days with 6 ounces of well-dried potassium carbonate; separate the fluid; distil all but about 4 fluidounces. Preserve in a well-closed bottle in a cool place.—*Br.*

Acetic ether is also prepared on a large scale by causing a mixture of equal volumes of 96 per cent. alcohol and 94 per cent. acetic acid to flow into a mixture of 15 parts of

sulphuric acid and 6 parts of alcohol contained in a retort and heated to 130°–135° C. (266°–275° F.), and subsequently purifying the distillate by appropriate means, as stated below. Hager recommends the following plan, which we have tried with marked success; it is easily followed, and admirably adapted to the manufacture of acetic ether in small lots: 63 parts by weight of alcohol (U. S. Ph. spec. grav. 0.820) are carefully mixed with 109 parts by weight of 94 per cent. sulphuric acid, and the mixture set aside for a day or two in a well-closed flask, so that ethyl-sulphuric acid may be formed; having prepared anhydrous sodium acetate by heating at 130° C. (266° F.) to constant weight, 82 parts of the powdered acetate are put into a retort and the acid alcohol mixture carefully added. The retort is heated in a water-bath, and the vapors are condensed in a well-cooled receiver as long as reaction continues brisk: the final distillate is collected separately, as it is apt to contain more acetic acid. 46 parts of absolute alcohol with 98 parts of absolute sulphuric acid theoretically will suffice for 82 parts of anhydrous sodium acetate, but in practice a slightly increased amount has been found advantageous.

Crude acetic ether usually contains acetic acid, alcohol, and water, and to remove these it is first well shaken with one-third of its volume of an aqueous solution containing 20 per cent. sodium chloride and 2 per cent. sodium carbonate; caustic alkalies or milk of lime are inadmissible. The washing is repeated two or three times, and the ether is then freed from water by shaking with freshly ignited potassium carbonate, and is finally distilled; calcium chloride is not suitable for dehydration, as it is apt to combine chemically with the acetic ether.

Some years ago a method was suggested for preparing acetic ether by passing carbon dioxide into an alcoholic solution of potassium acetate: while, theoretically, a simple and perfect plan, it has been found impracticable, owing to the sparing solubility of potassium acetate in absolute alcohol, which latter is necessary to ensure a good yield of ether and perfect precipitation of the newly-formed potassium carbonate.

In the above manipulations ethyl-sulphuric acid is first formed (see page 129), 1 molecule of which reacts with 1 molecule of sodium acetate, producing acid sodium sulphate and acetic ether, according to the equation $C_2H_5HSO_4 + NaC_2H_3O_2 = NaHSO_4 + C_2H_5C_2H_3O_2$, (acetic ether.)

The weights of the different ingredients given in the formula of the British Pharmacopœia are very nearly the theoretical proportions. An excess of sodium acetate would cause the distillate to be contaminated with free acetic acid, while an excess of sulphuric acid and alcohol would result in the production of ethyl oxide (ether). Any other acetate in an equivalent proportion may be substituted for the sodium acetate.

In acetic ether the basylous H of acetic acid is replaced by the basylous radical C_2H_5, forming a compound having the above formula.

Properties and Tests.—Acetic ether is a colorless, limpid, volatile liquid having an agreeable, refreshing, ethereal and somewhat acetous odor and taste. The pure ether has a density of 0.9104 at 0° C. (Kopp), and of 0.8981 at 15° C. (Mendelejeff; water at 4° C.); the densities given by the Pharmacopœias are: 0.893 to 0.895 at 15° C. (59° F.) (*U. S.*), 0.900 to 0.904 (*P. G.*), and 0.900 (*Br.*). The density is no evidence of purity, since acetic ether dissolves ether, alcohol, and chloroform in all proportions, and at 15° C. one-twenty-fourth of its volume of water. It is also soluble in water, requiring of that menstruum, at 0° C., 8 volumes, and at 15° C. 9 volumes, or 10 parts by weight (Clark), about 10 parts, *Br.*, about 8 parts, *U. S.* It boils between 74° and 76° C. (165° and 168.8° F.), *P. G.*, at 74.5° C. (166° F.), *Br.*, at about 76° C., *U. S.* It is very inflammable, though less so than ether, and burns with a yellowish-white flame and the odor of acetic-acid vapors. It has a neutral reaction to test-paper, but if kept in contact with the air, and particularly in the presence of water, free acetic acid is formed. Solutions of potassa, soda, and other oxides decompose it gradually or rapidly, if heated, into acetic acid and alcohol; but metallic sodium does not act upon acetic ether in the cold, except in the presence of water or alcohol (Wanklyn; Ladenburg). It dissolves a little phosphorus and sulphur, and is a good solvent for volatile and fixed oils, many resins, cantharidin, and other organic compounds.

The *purity* of acetic ether is determined by its neutral reaction, its specific gravity, its volatility without residue, and its behavior to water: when 10 Cc. of it are agitated with an equal volume of water in a graduated tube, the ethereal layer, after its separation, should not measure less than 9 Cc. If acetic ether is allowed to flow carefully upon an equal volume of concentrated sulphuric acid, no dark color should be formed at the line of contact of the two liquids. *U. S.*, *P. G.*

Action and Uses.—According to Dr. H. C. Wood, in pigeons and rabbits acetic ether produces unconsciousness, without as much previous struggling as when sulphuric ether is used, and has the advantage over that compound of being less inflammable. On the other hand, its volatility is less. On accounts of its pungency and agreeable odor and its stimulant and antispasmodic qualities it is used for several of the minor purposes of sulphuric ether, and especially to stimulate the nasal passages in cases of *syncope* and *nervous agitation*. Its vapor may also be inhaled under similar circumstances, and to allay *laryngeal and bronchial irritation* and *nervous cough*. It may be given internally for the relief of *colic* and *flatulence* in the dose of Gm. 2 (ℳxxx), or more, properly diluted. Externally, it may be applied in all the cases in which sulphuric ether is appropriate.

ÆTHYLENI BICHLORIDUM.—Ethylene Bichloride.

Æthylenum chloratum, Elaylum chloratum, Liquor Hollandicus.—Ethene chloride, Dutch Liquid, E.; *Liqueur des Hollandais, Huile du gas oléfiant*, F.; *Æthylenchlorid, Elaylchlorid*, G.

Formula $C_2H_4Cl_2$ or $CH_2Cl.CH_2Cl$. Molecular weight 98.68.

Preparation.—Olefiant gas and Dutch liquid were discovered by Dieman, Troostwyk, Bondt, and Lauwernburgh (1795). The latter is produced on bringing the former in contact with chlorine gas. 1 part of strong alcohol is mixed with 3 or 4 parts of sulphuric acid and sufficient sand to form a thick mixture, which is heated, and the gas passed successively through sulphuric acid, solution of potassa, and sulphuric acid, whereby it is deprived of alcohol, ether, and sulphur and carbon dioxides. The gas thus purified is conducted into a retort containing a mixture of 2 parts of manganese dioxide, 3 of common salt, 4 of water, and 5 of sulphuric acid. The retort is at first very moderately warmed, and afterward heated and the liquid distils. The distillate is washed with water and rectified over calcium chloride.

Properties.—It is a colorless, thin, oily liquid, having an ethereal odor resembling that of chloroform, and a sweetish ethereal taste; it has the specific gravity 1.27 at 0° C. (32° F.) or 1.253 at 15° C. (59° F.), boils at 85° C. (185° F.), is sparingly soluble in water and freely soluble in alcohol and ether. It is inflammable, and burns with a yellowish flame having a green border, and giving off vapors containing hydrochloric acid. When agitated with water the latter does not acquire an acid reaction to litmus-paper, and when agitated with sulphuric acid the mixture is not blackened. On being mixed with alcoholic solution of potassa, water and potassium chloride are formed, and gaseous *chlorethyline*, CH_2CHCl, is given off at a moderate temperature; this gas condenses at −18° C. (−.4° F.).

Allied Compounds.—By the action of chlorine upon Dutch liquid a number of chlorinated compounds may be obtained, which are isomeric with the chlorinated compounds produced under similar circumstances from *ethyl chloride, chlorethane*, or, as it is frequently termed, *muriatic (hydrochloric) ether*

Ethyl Chloride, C_2H_5Cl or $CH_3.CH_2Cl$ (molecular weight 64.4), is obtained by passing dry hydrochloric acid gas into cold strong alcohol, distilling at a very moderate heat, washing the distillate with water and a weak alkaline solution, and rectifying. It is a thin, colorless, inflammable liquid, having an ethereal odor and a sweetish aromatic afterward somewhat alliaceous taste. It dissolves in about 50 parts of water, boils at 12.5° C. (53.6° F.), and at 0° C. (32° F.) has the density 0.9214. If chlorine, not in excess, acts upon it,

Monochlorinated Hydrochloric Ether (*ethylidene chloride, ethydene chloride*), $C_2H_4Cl_2$ or $CH_3.CHCl_2$, is produced. It is isomeric with ethylene bichloride, which it resembles in odor, but its density is only 1.198; it boils at 57.5° C. (135.5° F.), is decomposed by strong sulphuric acid, and when heated with alcoholic solution of potassa distils almost without change.

On continuing the action of chlorine, the following isomeric compounds are obtained from

	Ethyl chloride.	*Ethylene chloride*
$C_2H_3Cl_3$.	Sp. gr. 1.372; boiling-point 75° C. (167° F.).	Sp. gr. 1.442; boiling-point 115° C. (239° F.).
$C_2H_2Cl_4$.	" 1.530; " " 127.5° C. (261.5° F.).	" 1.576; " " 147° C. (296.6° F.).
C_2HCl_5.	" 1.644; " " 158° C. (316.4° F.).	" 1.663; " " 158° C. (316.4° F.).

C_2Cl_6. Prisms; fuse at 160° C. (320° F.), boil at 182° C. (360° F.); odor aromatic, camphoraceous.

Action and Uses.—When bichloride of ethylene was tested by Simpson, he found that although it was capable of producing anæsthesia without excitement of the pulse or subsequent headache, yet it caused so great irritation of the throat that few persons could persevere in breathing it long enough to induce the anæsthetic state. Other experimenters have reached the same conclusions, but it is generally agreed that the liquid does not tend to induce the dangerous collapse which constitutes the chief objection to chloroform. This conclusion has been fully sustained by the experiments of Dr.

Reichert (*Phila. Med. Times*, xi. 492), which prove that death from this agent invariably takes place from failure of the respiration, and not from any direct action upon the heart. In regard to its administration, Dr. Reichert insists that while it does possess irritant properties, and does cause distress when first inhaled, the distress is not much, if any, worse than that caused by the inhalation of ether. As a local anæsthetic this preparation has been applied to the seat of pain in *neuralgia* and other limited painful parts, such as exist in *cancer*, etc. The dose required to produce anæsthesia is about the same as that of chloroform.

Chloride of ethyl has been used to congeal tissues, to render painless certain minor operations, and relieve local pains; *e. g.* the opening of *abscesses*, the curetting of *lupoid tumors*, the extraction of *teeth*, the excision of *small tumors*, the relief of *neuralgia*, etc. For such uses the liquid is contained in a small bulb furnished with a tube having a capillary opening. The warmth of the hand suffices to cause a fine jet of the liquid which rapidly congeals the skin upon which it falls. Drs. Wood and Cerna showed by experiments on animals that it has a directly depressing action upon the heart; and it has occasioned threatening effects when accidentally inhaled (*Therap. Gaz.*, xvii. 251). Its volatility and inflammability render its use near an open flame dangerous. Internally it has been given in the dose of Gm. 0.60–2.00 (gtt. x–xxx) in sweetened water or in a little wine or spirit and water.

Ethydene chloride was employed by a committee of the British Medical Association in six experiments. Its odor is agreeable, it produces rapid narcosis without much previous excitement, and its use is rarely followed by nausea and vomiting. It appears to render the pulse more, and then less, frequent. In from eight to twelve minutes complete anæsthesia and muscular relaxation are produced, the respiration going on regularly, but slowly, the pulse being full and slow. There is neither pallor nor blueness of the face. Such results were also obtained by Bird (*Times and Gaz.*, Jan. 1879, p. 62) in patients operated upon for diseases of the eye. The phenomena were those occasioned by a strong stimulant of the heart's action, and the reporter's only apprehension was lest, "if it always proved such a stimulant," the reaction might be excessive. But Ringer declares, without qualification, that "ethydene dichloride affects the ventricle just like chloroform" (*Practitioner*, xxvii. 13). If this declaration refers to degree as well as to kind, it is discordant with the statements just made, and also with the latest result obtained by the committee of the British Association, among which the following are included: vomiting is occassioned by ethydene as well as by chloroform, but is more persistent after chloroform; with both the pulse falls as the respirations increase, but with chloroform the effect is more frequent and more marked, and chloroform retards the heart-beats more, and oftener produces dicrotism; chloroform and ethydene reduce the blood-pressure in animals, but chloroform more rapidly, irregularly, and to a greater degree; in no single experiment with ethydene was there an absolute cessation of the heart's action or of respiration; as regards comparative danger to life, chloroform stands first, and then ethydene, and lastly ether (*Amer. Jour. of Med. Sci.*, April, 1881, p. 555). The final judgment of the same committee is, that ethydene is free from the disadvantages of ether and the dangers of chloroform. The use of this anæsthetic by Macphail in minor surgical operations led him to analogous conclusions (*Edinb. Med. Jour.*, xxxv. 220).

Clinical experience with ethydene has quite reversed the judgment concerning it based almost exclusively upon physiological experiments. Reichert finds a record of about 3000 administrations with a list of 3 deaths, and 4 cases in which the most alarming symptoms ensued. In all of these cases, except one of which no details are given, death took place by failure of the heart. He also states that ethydene was abandoned by Snow on account of its danger, and that it is probably more dangerous than chloroform, notwithstanding the views entertained of its physiological action (*Med. News*, xl. 206). As lately as 1883 a death from it occurred in England during a very slight surgical operation (*Phila. Med. Times*, xiii. 420). It is administered by pouring the liquid on a piece of lint placed in a tumbler which is held over the mouth and nose, or by "Junker's apparatus," employed for inhaling chloroform. From Gm. 4–30 (f℥j–f℥j) has been employed in several operations.

ÆTHYL BROMIDUM.—Ethyl Bromide.

Æther bromatus, P. G.; *Æther hydrobromicus.—Monobromo ethane, Hydrobromic ether*, E.; *Bromure d'éthyle, Ether hydrobromique* (*bromhydrique*), Fr.; *Æthylbromid, Bromäthyl, Bromwasserstoffäther*, G.

Formula C_2H_5Br. Molecular weight 108.70.

Preparation.—Serullas (1827), the discoverer of this ether, recommended its preparation by the action of bromine upon alcohol in the presence of phosphorus. Personne (1861) replaced the latter by amorphous phosphorus. The German Pharmacopœia gives the following directions for its manufacture: To a well-cooled mixture of 12 parts of sulphuric acid and 7 parts of alcohol (spec. grav. 0.816), 12 parts of potassium bromide in powder form are gradually added, and the mixture then distilled on a sand-bath; the distillate is well washed by agitation, first with a 5 per cent. solution of potassium carbonate, and then three or four times with an equal volume of water; finally, it is dehydrated with calcium chloride and redistilled on a water-bath. This process involves a double reaction: first, the formation of ethylsulphuric acid, $C_2H_5OH + H_2SO_4 = C_2H_5HSO_4 + H_2O$; and secondly, the formation of ethyl bromide, $C_2H_5HSO_4 + KBr = C_2H_5Br + KHSO_4$.

Properties.—Ethyl bromide is a colorless, highly refractive, very volatile liquid of a strong ethereal odor and a sweetish and warm taste. It has the density 1.445–1.450 at 15° C. (59° F.), boils at 38°–40° C. (100.4°–104° F.), burns with some difficulty with a green, non-sooty flame, is sparingly soluble in water, and dissolves in all proportions in alcohol and ether.

It has a neutral reaction, and if shaken with an equal volume of pure concentrated sulphuric acid, no color should be produced after twenty-four hours (absence of ethylene and amyl compounds).

Ethyl bromide is easily decomposed by light and air, turning brown, and then containing hydrobromic acid and free bromine. The presence of 1 per cent. of alcohol or 3 per cent. of ether renders the liquid more stable.

This preparation should not be confounded with *ethylene bromide*, $C_2H_4Br_2$, a faintly brown-colored liquid, with chloroform-like odor and a sweet taste, followed by a burning sensation. Its spec. grav. at 21° C. (69.8° F.) is 2.163, and boiling-point at 131° C. (267.8° F.); at 0° C. (32° F.) it solidifies to a snow-white crystalline mass. When inhaled, marked poisonous effects have been produced. Ethylene bromide has been used successfully for epilepsy.

Action.—The taste of this liquid is rather sweet and pleasant, but it is irritating to mucous surfaces. Internally, in doses of from 5 to 30 drops, well diluted, it produces only a slight drowsiness, and, inhaled, it is represented as "the most agreeable and rapid anæsthetic yet brought before the medical profession." Similar virtues were attributed it by Dr. Levis, to whom its vogue as a surgical anæsthetic was chiefly due. According to Turnbull, its advantages are a rapid elimination by the lungs and an "increase of pulse and respiration." In 1880 he pronounced it safe when used with care, claiming that the heart and respiration are but slightly affected by it unless it is employed in excessive quantities, and that it is rapidly eliminated by the kidneys, as well as by the lungs; he dwelt upon the advantage due to its agreeable odor, its non-inflammability, its slight tendency to cause vomiting or headache, salivation, or bronchial flux, as compared with chloroform or ether, and noted the rapidity with which its effects pass off (*Trans. Amer. Med. Assoc.*, xxxi. 261). It is true that some surgeons, like Prof. Agnew, found it even more liable than chloroform to cause vomiting (*Phila. Med. Times*, x. 372). This tendency was also noted by Terillon. Describing its anæsthetic properties, he says that "it causes relaxation rapidly, without asphyxia and without excitement, if largely administered from the first. During the anæsthetic stage, unlike chloroform, it causes suffusion of the face and neck, frequency of the pulse, and dilatation of the pupils; consciousness returns promptly. On the whole, although its seems to require less careful supervision than chloroform, yet it certainly ought not to be used by unskilful hands" (*Bull. de Thérap.*, xcviii. 402). Yet Terillon expressly states that he witnessed no tendency to suspension of the heart's action, and only apprehended danger from respiratory embarrassment. Some reporters have declared that its action upon the circulation is similar to that of ether, and that it causes increased frequency and strength of the pulse. One assures us that no greater toxic effects are produced upon the system than would result from the administration of ether or alcohol (*Med. Record*, xviii. 67). The frequency of the pulse under its use has also been pointed out by Reeve (*Med. News*, xlii. 317). Getz found

it less efficient and more disturbing than chloroform in ordinary obstetrical practice, and in prolonged operations not so good as ether (*Jour. Amer. Med. Assoc.*, v. 401). The garlicky odor it gives to the breath of the patient, and even to the infant during delivery, is objectionable.

Deplorable experience has shown how unreliable are all such judgments. Several cases of death occurred under the administration of this agent so much lauded for its superior safety, and many other cases in which death was certainly imminent. (Compare *Therap. Monatsh.*, iii. 385, 390; *Lancet*, Mar. 1890, p. 717; Sept. 1890, p. 631; *Med. Record*, xxxviii. 412). In the fatal cases the result was usually due to syncope, but in in one of them did not take place for several days, and then by exhaustion from vomiting. In cases that did not terminate fatally the phenomena were usually those of cardiac syncope or obstruction. In one instance pleasant intoxication, excitement, and spasm were followed by sleep, and then by a sudden cessation of the pulse (*Med Record*, xvii. 554). In another the pulse suddenly failed, the face grew cyanotic, the respiratory movements imperceptible, the eyes upturned and fixed, the jaws locked, and the whole body stiffened (*Phila. Med. Times*, x. 430) In a third case the head was jerked back and spasms affected all the muscles, the breathing was rapid, and the pulse small (*Med. Record*, xvii. 469). In a fourth case, several hours after the extraction of teeth the patient turned deathly pale, vomited, and had severe headache with noises in the ears *Therap. Monatsheft.*, Dec. 1888, p. 556).

It appears probable that bromide of ethyl may be dangerous in two ways: first, as a compound, and then by its decomposition in the body. In the former of these modes of action it resembles chloroform, and destroys life by arresting the heart. The possibility of the latter operation has been suggested by Dr. Squibb (*Trans. Amer. Med. Assoc.*, xxxi. 285), who pointed out that the danger from anæsthetics is in proportion to the noxiousness of their radicals. Those which are the most readily tolerated are so in proportion to the simplicity and innocuousness of the elements of which they are composed. Bromine is an irritant poison, and bromide of ethyl is very easily decomposed, and its 73 per cent. of bromine, an active irritant, is disseminated through the system. According to Squibb, chloroform, although it contains 89 per cent. of chlorine, does not produce as toxic effects as ethyl bromide, simply because 2 atoms of chlorine are not as poisonous as 1 atom of bromine. The danger from either anæsthetic is by no means passed when consciousness returns; the chlorine in the one case and the bromine in the other remains behind, and may still induce grave and even fatal effects. In some cases the remote phenomena are disnctly those of irritant poison. In corroboration of the last statement may be quoted Reichert's reference to Nunnelly's experiments with ethylene bibromide and ethyl iodide, in which the animals appeared perfectly well after the experiments, but some hours later perished from blood-poisoning (*Amer. Jour. of Med. Sci.*, July, 1881, p. 556; Falk, *Therap. Monatsch.*, iv. 463).

Uses.—When first introduced, this anæsthetic was cordially welcomed by many surgeons as being more agreeable and prompt than ether and less dangerous than chloroform; and one of its leading but still cautious advocates declared that his "continued experience with it in the *surgery* of a large general hospital and in private practice impressed him with the conviction that it is the best anæsthetic known to the profession" (*Phila. Med. Times*, x. 247). The disasters that followed soon after this and similar declarations seem to have discouraged its advocates and led to its disuse in general surgery. Even in *parturition*, for which it was declared peculiarly adapted, it did not find acceptance, although it continued to be used by some accoucheurs (*Med. News*, xlii. 329; *Amer. Jour. Obstetr.*, June, 1885); but in *epilepsy*, *hysteria*, and *angina pectoris*, for which it at first was employed, it has almost ceased to be recommended as a remedy. In neuralgic *headache* it has the same advantages as other anæsthetics, with the special disqualifications that have been named. As a local anæsthetic, applied with a hand-atomizer, it was used by Terillon and others in operations for opening *abscesses*, *extraction of teeth*, removing *vegetations*, for *circumcision*, *fistula* and forcible dilatation of the *anus*, flexion of *ankylosed joints*, etc. This method appears to be preferable to inhalation in such cases.

Bromide of ethyl may be administered in the same manner as sulphuric ether and chloroform. Those most active in promoting its use urged that unless the first portions "were crowded on the patient" it was not apt to act promptly; one also said, "I prefer always to make a rapid and decided impression, with the lint and napkin held closely over the nose and mouth of the patient." After it became known that its mode of action, and therefore its dangers, are of the same kind as those of chloroform, such

advice could hardly have been given. It has been proposed to induce the first stage of anæsthesia by means of this agent, and then to maintain its effects by means of ether or chloroform. In this manner, at least, the dangers of its prolonged inhalation may be greatly reduced. The quantity used has varied from 1 fluidrachm in short and trivial operations to 11 fluidrachms in an operation of forty minutes' duration. The same precautions should be used as in the case of other anæsthetics relating to repletion of the stomach, the position of the patient, his breathing deeply, and preventing pressure on his neck or chest. Quite as important, if not more so, is it that the surgeon should be certified by a competent physician that the patient is not affected with any organic disease tending to increase his risk. It has happened that, for want of such a precaution, patients have been allowed to take this agent or chloroform while laboring under disease of the brain or lungs or a convulsive disorder. (Compare *Medical News*, lxi. 667.) In using it to produce a local anæsthesia the orifice of the atomizer should be large and not nearer than about three inches from the skin, and the spray should not be very fine. About three minutes are required to produce congelation.

Bromide of Ethylene is stated by Bonome and Mazza to produce narcotic and anæsthetic effects, but very slowly, whether inhaled or given hypodermically. Others deny that it possesses anæsthetic powers.

ÆTHYL IODIDUM.—Ethyl Iodide.

Æther hydriodicus, *Hydriodic ether*, E.; *Iodure d'éthyle*, *Éther hydriodique*, Fr.; *Jodäthyl*, *Jodwasserstoffäther*, G.

Formula C_2H_5I. Molecular weight 155.47.

Preparation.—This compound was prepared by its discoverer, Gay-Lussac (1815), by distilling a mixture of absolute alcohol and concentrated hydriodic acid, and separating the ether from the distillate by means of water. Much better results are obtained by distilling a mixture of alcohol, phosphorus, and iodine, as proposed by Serullas (1827); and the substitution of amorphous for ordinary phosphorus, first used by Personne (1861), affords still greater advantages. Reith and Beilstein (1863) obtained the best results by macerating for twenty-four hours a mixture of 10 parts of amorphous phosphorus, 50 parts of alcohol, specific gravity 0.83, and 100 parts of iodine, the latter added in small quantities; the mixture is then distilled, the distillate decolorized by a little solution of soda, and freed from water by rectification over calcium chloride. The residue in the retort from the first distillation consists of phosphoric acid, the reaction occurring according to the following equation: $5I_2 + P_2 + 10C_2H_6O$ yields $10C_2H_5I + 2H_3PO_4 + 2H_2O$.

Properties.—Ethyl iodide is a colorless, non-inflammable liquid having a peculiar penetrating odor. It is freely soluble in alcohol, nearly insoluble in water, does not react upon litmus, boils near 72° C. (161.6° F.), and has at 15° C. (59° F.) the specific gravity 1.93. Exposed to air and light, it liberates iodine, and is gradually colored red and brown; the presence of metallic mercury, or preferably silver, prevents the coloration, but not the decomposition. Iodine is also liberated by chlorine gas, nitric acid, and strong sulphuric acid.

Action and Uses.—More than forty years ago (1849) Nunnelly reported as a result of experiment that three out of four animals were rendered insensible by this preparation, and that all of them died. He even declared that, although the animals were not made insensible, the effect of the inhalation was generally fatal. For these reasons, probably, the use of the compound was for a long time suspended, and, as it now appears, unnecessarily. Iodide of ethyl has been used by inhalation to bring the system speedly under the influence of iodine, and especially in chronic *bronchitis* and pulmonary *phthisis*. It doubtless contributes to diminish the bronchial secretions, though, according to some, it increases them. But its more demonstrable and useful property consists in its rendering the act of breathing deeper and easier, while it exhilarates somewhat, but has no soporific or anæsthetic effect, nor does it depress any of the functions. Of the different forms of *dyspnœa* in which it gives more or less relief, spasmodic *asthma* is the one in which it is most efficient (Lawrence, *Med. Record*, xvii. 688; xxiii. 58). If the iodine contained in the compound has a share in its action, it is probably a subordinate one. It has been used with benefit in chronic *laryngitis*. Gm. 0.60–1.00 (10 or 15 drops) may be inhaled several times a day from a handkerchief or an appropriate respirator. It is conveniently preserved in glass capsules, which may be crushed in a handkerchief when used.

AGARICINUM, *P. G.*—Agaricin.

Agaric acid, *Laricin*, E.; *Agaricinsäure*, G.

A principle obtained from white agaric, Polyporus officinalis, *Fries*, s. Boletus laricis, *Jacquin*, s. B. purgans, *Persoon* (Fungi, Polyporei).

Preparation.—White agaric, when treated with alcohol, yields to it four resinous principles, which are separated by evaporation of the alcohol, when three white resins are precipitated, the other, red-colored resin, remaining in solution. The precipitate is collected, and treated with alcoholic potassium hydroxide solution, which dissolves only the α- resin. The residue, containing the β and the γ resin, is treated with water, when only the former as potassium salt is dissolved. This aqueous solution is precipitated with barium chloride, the precipitate collected, dissolved in boiling dilute alcohol, and the resin freed by sulphuric acid. The alcoholic filtrate yields on cooling agaricin, which may be obtained in the crystalline state from 30 per cent. alcohol, which the *P. G.*, however, does not require.

Properties.—Agaricin forms either a white amorphous or crystalline powder; the microscope shows the latter to be made up of quadrangular plates. It fuses near 140° C. (284° F.) to a yellow liquid, which, when heated to a higher temperature, throws out white fumes and chars with a caramel-like odor; lastly, it burns, leaving no or only a trace of residue. It is soluble in 130 parts cold and 10 parts warm alcohol, more soluble in warm acetic acid, and only slightly soluble in ether, chloroform, benzene, and cold water; in hot water it swells, and when boiled dissolves, forming an opalescent and strongly-foaming solution, which shows an acid reaction with litmus-paper, and on cooling becomes turbid. Ammonia and potassium-hydroxide solution should dissolve agaricin. 0.1 Gm. agaricin, dissolved in 15 Cc. absolute alcohol, yields with alcoholic potassium solution a white precipitate which should be soluble in water. According to Schmieder, agaricin has the formula $C_{16}H_{30}O_5 + H_2O$, and represents a bivalent hydroxyacid.

White agaric, E.; *Agaric blanc*, Fr.; *Lärchenschwamm*, G.; *Agarico bianco*, F. It., Sp.
Polyporus officinalis, *Fries*, s. Boletus laricis, *Jacquin*, s. B. purgans, *Persoon*.
Nat. Ord.—Fungi, Polyporei.

Origin.—This fungus grows on old trunks of the European larch in Central and Southern Europe, and on Larix sibirica, *Ledebour*, in the northern section of Asia, whence it is brought into commerce. It is without a stalk, hoof-shaped or irregularly conical, 10–20 Cm. (4 to 8 inches) broad, 5–10 Cm. (2 to 4 inches) thick, and sometimes 20–30 Cm. (8 to 12 inches) high, externally grayish or yellowish: the hymenium on the lower side is in the form of small yellowish pores. It is collected in autumn and winter, and deprived of the firm outer rind. In commerce it occurs in irregular pieces of the size of a fist, and frequently much larger. It is white, light, somewhat spongy, very friable, but not readily pulverizable; has a faint odor and a sweetish afterward acrid and lastingly bitter taste.

Action and Uses.—The ancients used agaric as a purgative in large doses and as an astringent in small doses. In the former way, and owing probably to its resin, it is said to have produced watery stools and colic, with nausea and vomiting in some cases; and in the latter it was employed to check *diarrhœa* and restrain *sweating*. It is for the last-mentioned purposes that it is now occasionally used, as well as to diminish excessive *bronchial secretions*. These three indications are often associated in pulmonary consumption, and it undoubtedly is one of the best palliatives that can be used of the symptoms mentioned. Murrell (*Practitioner*, xxix. 321) traces its use to DeHaen in 1767, who learned it from an old woman. From that time it has been employed successfully to check colliquative sweating, and in pulmonary phthisis it also palliates the cough and promotes sleep, perhaps indirectly. In 1826, Toel advocated its use for this purpose, and pointed out that the arrest of sweating by its means was apt to imply the increase or the production of a diarrhœa (Richter, *Ausführlich. Arzneim.*, ii. 76). It is said to hasten the drying up of the *milk* in weaning. Agaric may be given in pill in the dose of Gm. 0.12–0.20 (gr. ij–iij), and repeated hourly or less frequently, according to the urgency of the case. Wolfenden (*Times and Gaz.*, Oct. 1881, p. 442) recommends 20-grain doses of powdered agaric, but owing to its dryness, lightness, and bitterness it is taken with difficulty in this form. Murrell gave pills made of the extract, each pill of 3 grains being equivalent to 9 grains of powder. A tincture and a fluid extract have also been found efficient. Prepared agaric is useful as an application to leech-bites and similar wounds to arrest hæmorrhage, and formed into cylinders it serves for moxas.

Agaric acid is a local irritant, and in doses of Gm. 0.50–1 (gr. vij–xv) occasions diarrhœa and vomiting. In cold-blooded animals it depresses the central nervous system

and the heart. In the rabbit it induces somnolence, debility, and retarded circulation and respiration (Hoffmeister, *Therap. Gaz.*, xiii. 50, 267, 536). In 1883, Seifert tested the virtues of *agaricine* (agaric acid) in counteracting colliquative *sweats*, and found it very efficient in doses of Gm. 0.004–0.02 (gr. $\frac{1}{16}$–$\frac{1}{3}$). The associated symptoms, thirst, diarrhœa, cough, etc., were also ameliorated (*Centralbl. f. d. g. Ther.*, i. 524). Riegel estimated that Gm. 0.01 (gr. $\frac{1}{6}$) of agaricine had the antihydrotic power of Gm. 0.05 (gr. $\frac{3}{4}$) of atropine. He also noted that when continuously used it did not derange the nervous or the digestive system (*ibid.*, ii. 165). Pribräm remarked that the first doses were less efficient than the subsequent ones, and that their influence was maintained for several days after they were suspended (*ibid.*, ii. 499). Seifert, and also Pribräm, thought that five or six hours were required for the full development of the effects of the medicine, but Riegel believed that its action was almost immediate. Agaricine, if used continuously, tends to cause diarrhœa; therefore Lauschmann associated it with small doses of Dover's powder, and others have used sulphuric acid to reinforce its action.

AGAVE.—American Aloe.

Century-plant, E.; *Maguey*, E., Fr. Sp.; *Agave*, G., Sp.

Agave americana, *Linné*.

Nat. Ord.—Amaryllidaceæ.

Description.—The plant is indigenous to the tropical portion of America, has been introduced and naturalized in Southern Florida, and is frequently met with in cultivation in all parts of the globe, and to some extent naturalized in the warmer portions thereof. The leaves are all radical, curving backward, about 6 feet (5.4 M.) long, thick and fleshy, lanceolate in shape, and at the apex and margins armed with sharp spines. The plant flowers in its native localities usually in about 10 years, but attains a considerable age before flowering in temperate climates, hence the name "century-plant;" the rapidly-growing flowering scape reaches a height of 30 to 40 feet (9–12 M.).

Agave mexicana, *Lamarck*, and A. vivipara, *Linné*, are closely-allied Mexican species.

Uses.—A translucent gum is obtained from it, known as *gum-maguey*, which is partly soluble in water, the solution containing malate of calcium, besides a substance resembling arabin. The fibres of the leaves, known as *pita*, are strong and valuable for cordage. The juice of the plant, *aguamiel*, or honey-water, is saccharine, and is either evaporated to the consistence of honey, or more frequently fermented to yield a vinous acidulous beverage, which in Mexico is called *pulqué*, and by distillation a kind of brandy known as *mezcal* or *aguardiente de maguey*. The roots are regarded as possessing alterative properties. (For papers on the uses of Agave the reader is referred to *Amer. Journ. Pharm.*, 1875, p. 78, and 1876, p. 301.)

Agave virginica, *Linné*, of the Southern United States, produces a scape about 4 or 5 feet (1.2–1.5 M.) high. Its roots are very bitter.

Action and Uses.—The fresh juice of this plant is acidulous or acrid, and is said to be laxative and diuretic. Like all such plants, its juice is an admirable remedy for *scurvy*. G. Perin, Asst. Surg.-Gen. U. S. A., published (1886) illustrations of its value to the army on the Mexican frontier. A decoction of the root was formerly used as a depurative in *scrofulous* and *syphilitic* diseases, and the juice is said to be efficacious in "Bright's disease" (*Therap. Gaz.*, xii. 425), but the testimony in its favor is not conclusive. A nearly-allied species furnishes a juice from which, as above stated, the Mexican alcoholic drink *pulque* is prepared; and in the Southern States of this country a tincture is made from the roots of A. Virginica and used for the relief of *colic* and as an antidote to the *rattlesnake's bite*. The plant is known as the *rattlesnake's master*.

AGRIMONIA.—Agrimony.

Herba agrimoniæ.—Aigremoine, Eupatoire des Grecs, Fr.; *Odermennig, Leberklette*, G.

Agrimonia Eupatoria, *Linné*.

Nat. Ord.—Rosaceæ, Roseæ.

Description.—An herbaceous perennial, about 2 feet (60 Cm.) high, indigenous to Europe and North America, and growing along roadsides and the border of woods. The root is fibrous, several-headed, and brown; the stem almost simple; the leaves about 5 inches (13 Cm.) long below, pinnate, with 4 to 8 pairs of elliptic-oblong, coarsely-toothed leaflets, intermixed with several pairs of minute ones; the stipules semi-cordate, clasping, and coarsely serrate. The yellow flowers are rather small, in slender spicate racemes, and have a

persistent top-shaped calyx, which is covered with hooked bristles. The plant is collected while flowering from June to September and deprived of the coarse stems. It has a very faint aromatic odor and a bitterish, mildly astringent taste, which is stronger in the root.

The closely-allied Agr. parviflora, *Aiton*, indigenous to the United States, is distinguished by smaller flowers and by crowded lanceolate leaflets, of which there are 11 to 19 pairs, intermixed with smaller ones.

Constituents.—H. K. Bowman (1869) determined agrimony to contain 4.75 per cent. of tannin; the other constituents are unknown.

Action and Uses.—Common agrimony is astringent and stimulant, and is chiefly employed in popular medicine in gargles for *sore throat*, as a wash for *ulcers* in man and beast, and internally for the cure of *intermittent fever*, *chronic fluxes* of the bowels, bladder, vagina, etc., and for passive *hæmorrhages*. It is said to be used instead of Chinese tea by the peasantry of the north of France. It may be given in an infusion made with from Gm. 4–16 (1 to 4 drachms) in a pint of water. Externally, it may be employed in fomentations, poultices, injections, or gargles, and in the last form with the addition of honey, vinegar, borax, or chlorate of potassium. According to Nicholson, it is an efficient *tæniacide*, when given pounded to a pulp and followed several hours afterward by a dose of jalap, and also an active diuretic and *antiscorbutic* (*Times and Gaz.*, Sept. 1879, p. 367).

AILANTHUS.—Tree of Heaven.

Chinese sumach, E.; *Götterbaum*, G.

Nat. Ord.—Simarubaceæ.

Description.—Three species are medicinally employed, of which two are natives of India, and one, indigenous to China, is much cultivated in the United States and Europe as an ornamental tree. The latter is Ailanthus glandulosa, *Desfontaines*. It is of rapid growth, producing a straight trunk, which is covered with a nearly smooth, brown-gray, internally yellowish, fibrous bark. The leaves are .9–1.2 M. (3 or 4 feet) long, oddly pinnate, with about 15 pairs of leaflets, which are shortly petiolate, oblong or ovate-lanceolate, with a few teeth near the base. The greenish polygamous flowers are in terminal panicles, and exhale an odor which is disagreeable to many persons. The pistillate flowers produce 3 to 5 linear-oblong, one-seeded samaras. This tree is known in France as *vernis des japon*, which name is also used for Rhus Vernix, *Linné*.

The leaves are the favorite food of the silk-worm, Bombyx cynthia; the barks of the trunk and of the root have been employed medicinally; both have a persistently bitter taste.

Ail. excelsa, *Roxburgh*, is a similar tree, with larger and broader leaflets. The bark, which is used as a tonic and febrifuge in India, is of a reddish or orange color internally, and has a very bitter taste.

Ail. malabarica, *De Candolle*, has obliquely oblong and entire leaflets and obtusely winged fruits. When incised the bark yields a gum-resin which has an aromatic odor and is used as incense in India and medicinally in dysentery.

Constituents.—An analysis by Alonzo Lilly (1861) of the bark of the first species determined the presence of tannin and a trace of volatile oil, besides the widely-distributed vegetable principles; the bitter principle was not isolated. The bark of the second species was analyzed by Marayan Daji (1870), who found the bitter taste to be due to the calcium salt of *ailanthic acid*, which like the lead salt is yellow and soluble in water. The acid is uncrystallizable, freely soluble in water, insoluble in other solvents, of a waxy consistence and reddish-brown color.

Action and Uses.—The infusion, decoction, and tincture of the bark are stated (Daji)to be useful in *anorexia*, *dyspepsia*, and atonic conditions generally of the digestive organs, such as those for which gentian, quassia, etc. are prescribed. The acid is said to provoke the secretion of bile when it is deficient. An infusion of the leaves has been employed in *dysentery*. Ailanthus has been used in the treatment of *tænia* in dogs, and also in man under the form of a powder of the bark or leaves, and also as a watery or an alcoholic extract of the bark, a resin, and an oleo-resin. It has caused the expulsion of the parasite when given in substance in the dose of Gm. 0.50 (gr. viii) or Gm. 0.25 (gr. iv) of the watery extract, or Gm. 0.20 (gr. iij) of the oleo-resin. The resin alone is nearly inert. The extract occasions slight colic and moderate purging, and does not exhaust or depress like pomegranate or kousso.

ALBUMEN OVI, *Br.*—Egg Albumen.

White of egg, E.; *Blanc d'œuf*, Fr.; *Eiweiss*, G.

The liquid white of the egg of Gallus Bankiva, var. domesticus, *Temminck*. (See Vitellus.)

Action and Uses.—It forms insoluble and inert compounds with corrosive sublimate and sulphate of copper, and is therefore a convenient and efficient antidote in *poisoning* by these substances. Agitated with powdered alum, it coagulates, and thus forms a convenient and very grateful poultice for local *erythemas*, *burns*, *contusions*, *excoriations*, *bites* and *stings* of insects, etc.; and, confined in a thin bag, it is a popular and useful application for acute inflammations of the *conjunctiva*. Diluted with water or added to milk, it forms a valuable article of food in the acute and chronic *diarrhœal* complaints of children and adults. It is an appropriate article of food in albuminuria, being very nutritious and not tending to increase the proportion of albumen in the urine (Loewenmeyer, *Zeitschrift f. klin. Med.*, x. 254). It should be remembered that for some persons eggs are an irritant poison (*British Med. Jour.*, May, 1886, p. 1018). According to Ewald, the yolk of egg in emulsion, and slightly salted, and administered by enema, has a high nutritive value (*Annuaire de Thérap.*, 1888, p. 272). The injection should not exceed half a pint, and should be administered cautiously through a rectal tube an hour after cleansing the bowel by a simple enema.

ALCOHOL, *U. S.*—Alcohol.

Spiritus, P. G.; *Spiritus rectificatus*, Br.; *Spiritus vini rectificatissimus*, *Alcohol vini.*—*Rectified spirit*, E.; *Alcool*, F. It., Fr.; *Weingeist*, *Alkohol*, G.

Spirit of the specific gravity 0.820 at 15° C. (59° F.) or 0.812 at 25° C. (77° F.) *U. S.*, 0.838 *Br.*, 0.830 to 0.834 *P. G.* Containing per cent., by weight, of absolute alcohol 91 *U. S.*, 84 *Br.*, 87.2 to 85.6 *P. G.* Containing per cent., by volume, of absolute alcohol 94 *U. S.*, 88.7 *Br.*, 91.2 to 90 *P. G.*

Diluted alcohol has the specific gravity 0.938 at 15° C. (59° F.) *U. S.*, 0.920 *Br.*, 0.892 to 0.896 *P. G.* Contains per cent., by weight, of absolute alcohol 41 *U. S.*, 49 *Br.*, 61 to 60 *P. G.* Contains per cent. by volume, of absolute alcohol 48.6 *U. S.*, 57 *Br.*, 69 to 68 *P. G.*

Absolute alcohol, *U. S. P.*, has a specific gravity not higher than 0.797 at 15° C. (59° F.) or 0.789 at 25° C. (77° F.).

Ethylic alcohol, *Br. P.*, has a specific gravity from 0.797 to 0.800 at 60° F. The former contains not less than 99 per cent. by weight of ethylic hydroxide (C_2H_5OH), while the latter contains 98 or 99 per cent.

Deodorized alcohol, *U. S. P.*, has a specific gravity of about 0.816 at 15° C. (59° F.) or 0.808 at 25° C. (77° F.), and contains 92.5 per cent., by weight, or 95.5 per cent., by volume, of absolute alcohol.

Formula of absolute alcohol, C_2H_5OH. Molecular weight 45.9.

Origin.—Alcohol may be obtained synthetically by first preparing acetylene, C_2H_2, by direct union of its elements, converting this into ethene, C_2H_2, and by combination with the elements of water forming alcohol. It has been detected by Dr. Gutzeit (1875) in the juice of a number of plants; Béchamp (1880) proved its presence in the urine and in the muscles of animals, and in putrid meat; and Muentz (1882) showed it to be contained in minute quantities in air, river-water, and cultivated soil. It is extensively prepared by the fermentation of saccharine liquids.

Fermentation.—Although the knowledge of various fermented alcoholic liquids dates back to remote antiquity, alcohol does not appear to have been separated from the spirituous beverages until about the eighth century of the present era, and soon afterward its strength was increased by repeated distillation. Under the name of *fermentation* various processes of decomposition are embraced, apparently depending upon the mere presence of a certain substance or compound, called the *ferment*, which does not enter into chemical composition with the fermenting substance or its products, and is capable of producing a large, if not unlimited, quantity of the latter. The several varieties of fermentation are distinguished from each other by the products obtained. Accordingly, we speak of *saccharine* fermentation when starch is converted into dextrin and sugar by diastase; of *lactic* fermentation when milk-sugar is transformed into lactic acid by casein; of *butyric* fermentation when milk-sugar and lactic acid yield butyric acid in the presence of the same compound; of *mucic* fermentation when cane-sugar is changed into mucus and mannit

by protein compounds; of *alcoholic* or *vinous* fermentation, when grape-sugar, or fruit-sugar, is split into alcohol and carbon dioxide under the influence of yeast; and of *acetic* fermentation when alcohol is oxidized to acetic acid, for which process some investigators consider the appearance of Mycoderma aceti as a ferment necessary. The decomposition of the numerous class of organic compounds known as glucosides by the action of emulsin, myrosin, and similar protein compounds, and the action of ptyalin upon starch, of pancreatin upon fat, and of pepsin upon albumen, etc., are other instances of fermentation induced and completed by the substances named, which are the ferments.

The exact manner in which these ferments act has not yet been determined, and with respect even to the vinous fermentation is still a subject of controversy, notwithstanding the numerous experiments performed with the view of solving the problem. When, in 1810, Gay-Lussac demonstrated that sugar solutions would ferment only in the presence of atmospheric air, the process was regarded as depending upon the action of oxygen. Although the presence of organisms in yeast was afterward demonstrated (see FERMENTUM), their connection with the process itself was not ascertained. Liebig (1839) perfected and enlarged the theory which was advanced by Stahl during the preceding century, and regarded fermentation as a metamorphosis induced by nitrogenized substances in a state of decomposition or putrefaction. Chiefly through Pasteur's investigations, which have been continued since 1858, it is now generally conceded that under ordinary circumstances the ferment of alcoholic fermentation is of vegetable origin, and consists of the so-called yeast-cells or yeast-plant, Saccharomyces (Torula, *Turpin*) cerevisiæ, *Meyen*, the sporules of which are widely diffused in the air, and are thus easily supplied to all liquids capable of vinous fermentation; hence, if these spores are destroyed by boiling the liquid, and if their further supply is arrested by admitting only air which has been filtered or passed through sulphuric acid, vinous fermentation does not take place. Alcohol and the other compounds formed during fermentation are not merely regarded as decomposition-products of sugar, but they result from the growth and multiplication of the yeast-plant, the existence of which depends upon the presence of sugar and protein, and by whose cells the new compounds are generated.

The formation of alcohol from sugar is expressed by the equation $C_6H_{12}O_6$ (grape-sugar) $= 2CO_2 + 2C_2H_6O$ (alcohol); but the process does not appear to be so simple, since small quantities of succinic acid (about 0.6 per cent.), glycerin (3 per cent.), and cellulose (1 per cent.) are always formed, according to Pasteur. Amylic and other homologous alcohols are likewise produced in vinous fermentation.

Berthelot observed that mannit, glycerin, milk-sugar, and other carbohydrates yield alcohol very slowly when in contact with water, chalk, and casein.

Preparation.—Cane-sugar is not directly fermentable until after it has been inverted, either by the action of a ferment or of a diluted acid. (See SACCHARUM.) Nearly all the ordinary alcohol is obtained from starchy substances, such as corn, rye, potatoes, etc., which require to be *mashed*, during which process, by the gluten contained in grain or by the diastase of the malt added with this object in view, the starch is converted into *maltose* (see AMYLUM), and finally completely changed into dextrose, or grape-sugar, when it becomes fermentable. This being accomplished, fermentation will speedily set in on the addition of yeast if the temperature is kept at 22° C. (71.6° F.) or within the limits of 18° and 28° C. (64.4° and 82.4° F.). At a lower temperature fermentation proceeds slowly, and at a higher temperature mucilage and lactic acid are apt to be formed. If too large a quantity of sugar is present, the fermentation will be arrested after some time, in consequence of the destruction of the vitality of the yeast-plant by the alcohol formed. A very favorable proportion is 1 part of sugar to 4 of water. It is obvious that grape-sugar or fruit-sugar, from whatever source obtained, may be used in the manufacture of alcohol.

On subjecting the fermented liquid to distillation a weak spirit is obtained, which requires rectification and contains small quantities of homologous alcohols or ethers, varying with the source from which the spirit has been obtained. *Potato spirit* contains amylic alcohol; *whiskey*, obtained from grain, contains, besides amylic alcohol, some œnanthic and other ethers; *brandy*, the distillate of wine, owes its odor to œnanthic and perhaps propylic and allied ethers; *rum*, from fermented molasses, to butyric ether; and *arrack*, from fermented rice, to an unknown compound. The odor of *gin* is imparted by distilling spirit with juniper-berries; that of the so-called *kirsch*, or *kirschwasser*, by the seeds of cherries or plums added before fermentation: in this case it is due to hydrocyanic acid and oil of bitter almonds.

The *purification* of spirit is effected by percolating it through recently burned and granulated charcoal, by which the fusel oil is retained; this process is called *leaching*, and

is most effectually accomplished if the spirit has been previously diluted. Distillation with various chemicals, with the view of destroying the fusel oil, has been suggested, and small quantities of manganates and permanganates have been used with success (manganate of sodium for Atwood's alcohol). A small quantity of silver nitrate (not more than from 2 to 5 Gm. for 1000 litres of crude spirit) has been recommended for the same purpose; the silver may obviously be recovered without difficulty. Usually, however, the purification and concentration of the spirit are effected in one operation by distilling it and passing the vapors through a series of condensers kept at different temperatures, or through an upright column in the lower part of which the fusel oil and water are condensed at a temperature at which the alcohol is not liquefied, but this is recovered subsequently in an ordinary condenser. The apparatus is constructed so as to permit an uninterrupted distillation until the water finally has accumulated in the still.

Naudin (1882) has devised a process by means of which the odorous compounds, particularly the aldehydes, are changed into alcohols through nascent hydrogen, generated by electrolysis.

The last traces of foreign odor are difficult to remove by re-rectification, but are said to be completely separated by pure sodium acetate, on distilling the alcohol over about 2 per cent. or less of this salt which has been previously deprived of water by fusion.

Alcohol ethylicum, *Br.*—Ethylic alcohol, Absolute alcohol.

The Br. Pharm. directs that 2 oz. of anhydrous potassium carbonate be added to 1 pint (imperial) of rectified spirit, and the mixture macerated in a stoppered bottle for twenty-four hours, with frequent agitation. Decant the spirit into a flask containing 1 pound of recently ignited and cooled calcium chloride in small pieces, and again set aside for twenty-four hours, with frequent agitation. Finally, distil about 2 fluidounces, which should be returned to the flask, and then continue distillation until 15 fluidounces have been recovered.

The spirit, as obtained by the different processes of distillation, contains water, the first distillate being stronger, the later portions weaker, in alcohol; the strongest spirit obtainable from an ordinary still with a single condenser has the specific gravity 0.825; with a system of condensers alcohol of the density 0.815 to 0.817 is obtainable. The last portions of water can be removed only by treating the alcohol with a substance having great affinity for water, for which purpose calcium chloride and other deliquescent salts, anhydrous copper sulphate, burned lime, etc. have been proposed. If calcium chloride is used, the distillation must be slow and repeated two or three times. Lime is better adapted for the purpose if broken into pieces and digested with the alcohol for a day or two, or boiled with it for an hour previous to distillation. The distillate, the first part of which is weaker than the subsequent portions, contains lime which has been mechanically carried over, and will be left in the retort if the alcohol is again rectified with the addition of a little tartaric acid. The recommendations of Mendelejeff for the use of recently-burned lime in the dehydration of alcohol are followed by the manufacturers of absolute alcohol in this country. By careful treatment with lime and subsequent distillation in a partial vacuum it is possible to remove all water but a small fraction of 1 per cent. For some practical observations on the rectification of alcohol by means of lime the reader is referred to the *Amer. Jour. of Pharmacy*, 1872, p. 111, and 1874, p. 184).

Alcohol dilutum, *U. S.;* Spiritus tenuior, *Br.;* Spiritus dilutus, s. Spiritus vini rectificatus, *P. G.*—Diluted alcohol, Proof spirit, *E.;* Alcool dilué, *Fr.;* Verdünnter Spiritus, *G.*

Alcohol 500 Cc., Distilled water 500 Cc. Mix them. Or Alcohol 410 Gm., Distilled water 500 Gm. Mix them.—*U. S.* When alcohol and water are mixed the liquid suffers contraction of volume, which amounts to about 2.9 per cent. at a temperature of 15.6° C. (60° F.); for instance, if 32 fluidounces each of alcohol and water be measured at 60° F. and then mixed, the resulting liquid will measure only $62\frac{1}{7}$ fluidounces at the same temperature. The mixture must be allowed to cool to the original temperature, as some heat is invariably developed whenever condensation of volume results from a mixture of two or more liquids.

The rise in temperature when alcohol and water are mixed will be greatest if 30 parts by weight of absolute alcohol be mixed with 70 parts by weight of water; it amounts to 9° C. (16.2° F.); contraction of volume will be greatest if 58 parts of absolute alcohol be mixed with 54 parts of water, both by volume; this mixture will yield at 15° C. (59° F.) 108 volumes instead of 112, having suffered a loss of 4 volumes (3.57 + per cent.) by condensation (Flückiger).

Rules for making an alcohol of any required *lower* percentage from an alcohol of any given *higher* percentage:

I. By Volume.—Designate the volume-percentage of the stronger alcohol by V, and that of the weaker alcohol by v.

Rule.—Mix v volumes of the stronger alcohol with pure water to make V volumes of product. Allow the mixture to stand until full contraction has taken place and until it has cooled, then make up any deficiency in the V volumes by adding some more water.

Example.—An alcohol of 30 per cent. by volume is to be made from an alcohol of 94 per cent. by volume: Take 30 volumes of the 94 per cent. alcohol, and add enough pure water to produce 94 volumes.

II. By Weight.—Designate the weight-percentage of the stronger alcohol by W, and that of the weaker by w.

Rule.—Mix w parts by weight of the stronger alcohol with pure water to make W parts by weight of product.

Example.—An alcohol of 50 per cent. by weight is to be made from an alcohol of 91 per cent. by weight: Take 50 parts by weight of the 91 per cent. alcohol, and add enough pure water to produce 91 parts by weight.

Properties.—Spirit containing 50 per cent. *by volume* of absolute alcohol and water, and having the specific gravity 0.936 at 15.55° C. (60° F.), has been adopted as the standard *proof spirit* of the United States custom-house and internal revenue service. The terms *second proof* (52½ per cent. alcohol, spec. grav. 0.931), *third proof* (55½ per cent., spec. grav. 0.925), and *fourth proof* (58 per cent., spec. grav. 0.920), are at present less frequently used than formerly. The British proof spirit has the specific gravity 0.920 (.9198), and contains 49.24 per cent. *by weight* of absolute alcohol. Spirits stronger than this standard are lighter, and are said to be *over proof;* they are 20 over proof if 100 measures require to be diluted with water to 120 measures to become reduced to proof strength. 100 measures of rectified spirit, sp. gr. .838, when mixed with 60 measures of water yield 156 measures of proof spirit; rectified spirit is therefore said to be 56 per cent. over proof. A spirit which is weaker than the standard is heavier, and is said to be *under proof;* it is 20 under proof if 100 measures require the addition of alcohol sp. gr. .825 (the strongest obtainable by simple distillation) to make 120 measures of proof spirit.

The strength of alcoholic liquids is conveniently determined by their specific gravities. A modification of the hydrometer, called the *alcoholometer*, has been constructed by which the percentage strength by volume or by weight may be directly ascertained. As the density increases appreciably with a diminution of temperature, and decreases in about the same ratio with an elevation of temperature, alcoholometers are constructed with reference to a standard temperature, which is either 15° C. or 60° F.; every degree of variation indicates a difference of .27 for the former and .15 for the latter scale, which must be added if the alcohol tested was below, or subtracted if it was above, the standard temperature.

In the United States and Germany the scale of Tralles, and in France that of Gay-Lussac, are in use. Both instruments are practically identical; they sink in distilled water to 0 and in absolute alcohol to 100, each intervening division indicating a volumetric percentum of absolute alcohol. Richter's alcoholometer is essentially that of Tralles combined with a scale indicating also the percentage by weight of absolute alcohol. The alcoholometer employed in the British revenue system is that of Sykes; its stem is divided into 10 parts, but by means of nine accurately adjusted weights which may be attached to the lower part of the instrument the scale is practically very considerably extended; the indications thus obtained are by means of tables converted into the percentage strength over proof or under proof.

The table on pp. 151–152 is a condensation of the one by Dr. E. R. Squibb, as found in the U. S. Pharmacopœia.

1. Alcohol absolutum, *U. S.;* Alcool assoluto, *F. It.*—This is a colorless limpid liquid, which does not congeal, but acquires an oily consistence when cooled to —90° C. (—130° F.). It has a refreshing odor and a very pungent taste, a burning impression being produced upon the palate by the union with water, for which it has great avidity. Its specific gravity at 15.55° C. (60° F.) is 0.7938, and it boils at 78.3° C. (174° F.) (Mendelejeff). It has a neutral reaction to test-paper, and does not cause anhydrous copper sulphate to assume a blue color when left in contact with it (absence of water). It dissolves iodine, bromine, a little phosphorus and sulphur, the alkalies and alkaline earths, the chlorides, iodides, and nitrates of many metals, many organic acids, and nearly all alkaloids, resins, volatile oils, camphor, and fixed oils. With water

Specific Gravity. (Pure water at 15⅝° C.=60° F. taken as unity.)		Percentage.			Weight of one pint at 15⅝° C. = 60° F.		Specific Gravity. (Pure water at 15⅝° C. = 60° F. taken as unity.)		Percentage.			Weight of one pint at 15⅝° C. = 60° F.	
At 15⅝° C. = 60° F.	At 25° C. = 77° F.	By weight.	By volume.	Of proof spirit. (U. S. Revenue.)	In Grms.	In Grs.	At 15⅝° C. = 60° F.	At 25° C. = 77° F.	By weight.	By volume.	Of proof spirit. (U. S. Revenue.)	In Grms.	In Grs.
0.9985	0.9970		1	2	471.68	7279	0.9314	0.9237	44		103	439.99	6790
0.9981	0.9966	1			471.49	7276	0.9303	0.9226		52	104	439.47	6782
0.9970	0.9953		2	4	470.98	7268	0.9292	0.9214	45		105	438.95	6774
0.9965	0.9948	2		5	470.74	7264	0.9283	0.9205		53	106	438.52	6767
0.9956	0.9938		3	6	470.31	7258	0.9270	0.9192	46		107	437.91	6758
0.9947	0.9927	3		7	469.89	7251	0.9262	0.9184		54	108	437.53	6752
0.9942	0.9922		4	8	469.66	7248	0.9249	0.9171	47		109	436.92	6742
0.9930	0.9909	4	5	10	469.09	7239	0.9242	0.9164		55	110	436.58	6737
0.9914	0.9893	5	6	12	468.33	7227	0.9228	0.9150	48		111	435.93	6727
0.9898	0.9876	6	7	14	467.58	7216	0.9221	0.9143		56	112	435.60	6722
0.9890	0.9868		8	16	467.19	7210	0.9206	0.9128	49			434.88	6711
0.9884	0.9862	7		17	466.91	7205	0.9200	0.9122		57	114	434.60	6707
0.9878	0.9855		9	18	466.63	7201	0.9184	0.9106	50			433.85	6695
0.9869	0.9846	8	10	20	466.21	7194	0.9178	0.9100		58	116	433.56	6691
0.9855	0.9831	9	11	22	465.54	7184	0.9160	0.9081	51	59	118	432.71	6678
0.9841	0.9816	10	12	24	464.89	7174	0.9135	0.9056	52	60	120	431.53	6659
0.9828	0.9801	11	13	27	464.27	7165	0.9113	0.9034	53	61	122	430.49	6643
0.9821	0.9793		14	28	463.94	7159	0.9090	0.9011	54	62	124	429.41	6627
0.9815	0.9787	12	15	29	463.65	7155	0.9069	0.8989	55	63	126	428.41	6611
0.9802	0.9773	13	16	32	463.04	7146	0.9047	0.8969	56	64	128	427.37	6595
0.9789	0.9759	14	17	34	462.42	7136	0.9025	0.8947	57	65	129	426.34	6579
0.9778	0.9746	15	18	36	461.90	7128	0.9001	0.8923	58	66	132	425.20	6562
0.9766	0.9733	16	19	39	461.34	7119	0.8979	0.8901	59			424.17	6546
0.9753	0.9719	17	21	41	460.72	7110	0.8973	0.8895		67	134	423.88	6541
0.9741	0.9706	18	22	44	460.16	7101	0.8956	0.8878	60		135	423.07	6529
0.9728	0.9692	19	23	47	459.55	7092	0.8949	0.8870		68	136	422.75	6524
0.9716	0.9678	20	24	49	458.98	7083	0.8932	0.8853	61			421.94	6511
0.9709	0.9668		25		458.65	7078	0.8925	0.8846		69	138	421.62	6506
0.9704	0.9661	21		51	458.41	7074	0.8908	0.8829	62			420.81	6494
0.9698	0.9655		26	52	458.13	7070	0.8900	0.8821		70	140	420.43	6488
0.9691	0.9646	22	27	54	457.80	7065	0.8886	0.8807	63		141	419.77	6478
0.9678	0.9631	23	28	56	457.18	7055	0.8875	0.8796		71	142	419.25	6470
0.9665	0.9617	24	29	58	456.57	7046	0.8863	0.8784	64		143	418.68	6461
0.9652	0.9603	25	30	60	455.95	7036	0.8850	0.8771		72	144	418.07	6452
0.9643	0.9594		31	62	455.53	7030	0.8840	0.8761	65		145	417.60	6444
0.9638	0.9590	26		63	455.30	7026	0.8825	0.8746		73	146	416.88	6433
0.9631	0.9582		32	64	454.96	7021	0.8816	0.8736	66			416.46	6427
0.9623	0.9574	27		65	454.58	7015	0.8799	0.8719		74	148	415.66	6414
0.9618	0.9567		33	66	454.35	7011	0.8793	0.8713	67		149	415.38	6410
0.9609	0.9556	28	34	67	453.93	7005	0.8769	0.8689	68	75	150	414.25	6393
0.9593	0.9538	29	35	70	453.17	6993	0.8745	0.8665	69	76	152	413.11	6375
0.9578	0.9521	30	36	72	452.46	6982	0.8721	0.8641	70	77	154	411.98	6358
0.9565	0.9507		37		451.84	6973	0.8696	0.8616	71	78		410.79	6339
0.9560	0.9500	31		74	451.61	6969	0.8672	0.8591	72		158	409.66	6322
0.9550	0.9489		38	76	451.14	6962	0.8664	0.8583		79		409.28	6316
0.9544	0.9482	32		77	450.86	6958	0.8649	0.8568	73		159	408.57	6305
0.9535	0.9473		39	78	450.43	6951	0.8639	0.8558		80	160	408.10	6298
0.9528	0.9465	33		79	450.09	6946	0.8625	0.8544	74			407.44	6288
0.9519	0.9456		40	80	449.67	6939	0.8611	0.8530		81	162	406.78	6277
0.9511	0.9446	34		81	449.29	6933	0.8603	0.8522	75		163	406.40	6272
0.9503	0.9438		41	82	448.91	6928	0.8581	0.8500	76	82	164	405.36	6255
0.9490	0.9424	35	42	84	448.30	6918	0.8557	0.8476	77	83		404.22	6238
0.9470	0.9402	36	43	86	447.36	6904	0.8533	0.8452	78			403.09	6220
0.9452	0.9382	37	44	88	446.51	6890	0.8526	0.8444		84	168	402.77	6215
0.9434	0.9363	38	45	90	445.66	6877	0.8508	0.8426	79		169	401.92	6202
0.9416	0.9343	39	46	92	444.81	6864	0.8496	0.8414		85		401.35	6194
0.9396	0.9323	40	47	94	443.86	6850	0.8483	0.8401	80		171	400.73	6184
0.9381	0.9307		48	96	443.15	6839	0.8466	0.8384		86	172	399.93	6172
0.9376	0.9302	41			442.92	6835	0.8459	0.8377	81			399.60	6167
0.9362	0.9288		49	98	442.25	6825	0.8434	0.8352	82	87	174	398.42	6148
0.9356	0.9280	42			441.97	6820	0.8408	0.8326	83	88		397.19	6129
0.9343	0.9267		50	100	441.35	6811	0.8382	0.8300	84			395.96	6110
0.9335	0.9259	43		101	440.98	6805	0.8373	0.8291		89	178	395.53	6104
0.9323	0.9246		51	102	440.42	6796	0.8357	0.8275	85		179	394.78	6092

Specific Gravity. (Pure water at 15⅝° C. = 60° F. taken as unity.)		Percentage.			Weight of one pint at 15⅝° C. = 60° F.		Specific Gravity (Pure water at 15⅝° C. = 60° F. taken as unity.)		Percentage.			Weight of one pint at 15⅝° C. = 60° F.	
At 15⅝° C. = 60° F.	At 25° C. = 77° F.	By weight.	By volume.	Of proof spirit. (U. S. Revenue.)	In Grms.	In Grs.	At 15⅝° C. = 60° F.	At 25° C. = 77° F.	By weight.	By volume.	Of proof spirit. (U. S. Revenue.)	In Grms.	In Grs.
0.8340	0.8258		90	180	393.98	6080	0.8125	0.8044		96		383.82	5923
0.8331	0.8249	86			393.55	6073	0.8118	0.8037	94		192	383.49	5918
0.8305	0.8223	87	91	182	392.33	6054	0.8089	0.8008	95			382.12	5897
0.8279	0.8197	88			391.09	6035	0.8084	0.8003		97	194	381.88	5893
0.8272	0.8191		92	184	390.76	6030	0.8061	0.7980	96		195	380.79	5876
0.8254	0.8173	89		185	389.91	6017	0.8041	0.7960		98	196	379.85	5862
0.8237	0.8156		93	186	389.11	6005	0.8031	0.7950	97			379.38	5855
0.8228	0.8147	90			388.69	5998	0.8001	0.7920	98			377.96	5833
0.8199	0.8118	91	94	188	387.32	5977	0.7995	0.7914		99		377.68	5828
0.8172	0.8091	92			386.04	5957	0.7969	0.7888	99		199	376.45	5809
0.8164	0.8083		95	190	385.66	5951	0.7946	0.7865		100	200	375.37	5793
0.8145	0.8064	93			384.77	5938	0.7938	0.7858	100			374.98	5787

and ether it unites in all proportions without becoming turbid. It is entirely volatilized by heat, is readily inflammable, and burns with a non-luminous blue flame and without smoke, yielding carbon dioxide and water. Commercial absolute alcohol generally contains a minute quantity of water, to detect which Debrunner (1879) proposed crystallized potassium permanganate, which he found to be totally insoluble in anhydrous alcohol, but to impart a red tinge to it in the presence of .05 per cent. of water. Ethylic alcohol, *Br.*, should have the spec. grav. 0.797 to 0.800.

2. Absolute alcohol, *U. S.*, and Deodorized alcohol, *U. S.*, differ from each other chiefly in the amount of water present, the former having a specific gravity not higher than 0.797 at 15° C. (59° F.), and containing not more than 1 per cent. by weight of water, while the latter has a specific gravity of about 0.816 at 15° C. (59° F.), and contains about 7.5 per cent. by weight of water.

3. Alcohol of the present Pharmacopœia is the *Stronger alcohol* of the Pharmacopœia of 1870. It has all the properties of absolute alcohol except the specific gravity, which is .820 at 15° C. (59° F.) and .812 at 25° C. (77° F.), and it contains 9 per cent. by weight of water, the presence of which is shown by the tests mentioned above. Castor oil is freely soluble in it, but most of the other fixed oils dissolve only to a limited extent. It boils at 78.2° C. (172.4° F.).

Alcohol, *Br.*, has the density 0.838, and dissolves a smaller quantity of castor oil, oil of turpentine, various resins, and other compounds than the preceding.

For use in the arts and for various laboratory purposes *methylated spirit* is not subject to taxation in Great Britain. It is a mixture of 90 per cent. of alcohol and 10 per cent. of wood-spirit or methylic alcohol, which addition renders it unfit for internal administration.

4. Diluted alcohol of the different Pharmacopœias varies in density between 0.892 (*P. G.*), .920 (*Br.*,), and 0.938 (*U. S.*). Its solvent powers for iodine, most of the alkaloids, the volatile oils, resins, and fixed oils are inferior to those of alcohol. Its freedom from impurities is ascertained in the same manner as for a stronger spirit; its boiling-point is 82° C. (179.6° F.).

The French Codex gives for every preparation the volumetric strength of the alcohol to be employed.

Composition.—Alcohol has the empirical formula C_2H_6O, and is the hydroxide of the univalent radical *ethyl*, C_2H_5; its rational formula is therefore C_2H_5OH. It is the most common, and may be regarded as the type of a homologous series of alcohols which are distinguished by prefixing the name of the radical contained in them; hence, *ethylic* or *ethyl alcohol* for the alcohol under consideration. Under the influence of oxidizing agents the alcohols first part with 2 atoms of hydrogen, being converted into *aldehydes*, and by combining afterward with 1 atom of oxygen are converted into a monobasic acid —in this case *acetic acid*. The ethers derived from these alcohols contain 1 molecule of the radical in place of the single atom of hydrogen in the above formula; the following will explain this relation:

Ethyl.	Ethyl oxide (ether).	Ethylhydroxide (alcohol).	Aldehyde.	Acid (acetic).
C_2H_5	$(C_2H_5)_2O$	C_2H_5OH	C_2H_4O	$C_2H_4O_2$.

Tests.—The purity of the different official alcohols is determined by their odor, specific gravity, miscibility with water, complete volatility, neutral reaction, and their behavior to silver nitrate. If a portion of at least 50 Cc. be evaporated to dryness in a glass vessel, no residue or color should appear. If mixed with one-third of its volume of water, a piece of blotting-paper, on being wet with the mixture, after the vapor of alcohol has wholly disappeared, should give no irritating or foreign odor (fusel oil). And if a portion be evaporated to one-fifth its volume, the residue should not turn reddish upon the addition of an equal volume of sulphuric acid (amyl alcohol). When treated in a test-tube with one-third its volume of solution of potassa there should not be an immediate darkening of the liquid (methyl alcohol, aldehyde, and oak tannin). If 20 Cc. are shaken in a glass-stoppered vial, previously well rinsed with the same alcohol, with 1 Cc. of test-solution of silver nitrate, the mixture should not be rendered more than faintly opalescent during six hours' exposure to diffused sunlight (absence of more than traces of foreign organic matters, fusel oil, etc.)—*U. S.*

Potassium permanganate is also readily decolorized by aldehyde and many other organic compounds. Fusel oil is readily detected by adding 10 drops of potassa solution to 50 Gm. of the alcohol, evaporating in a water-bath to about 5 Gm., and acidulating with sulphuric acid, when the odor of fusel oil will be plainly observed. Marquardt (1882) proposed to dilute the alcohol to about .980, agitate with pure chloroform, and evaporate the chloroformic solution spontaneously, when the residue, treated with oxidizing agents, will give the odor of valerianic acid; by combining this with baryta the fusel oil may be determined quantitatively.

Pharmaceutical Uses and Preparation.—Alcohol is employed on account of its solvent properties in the manufacture of alkaloids and other proximate principles, of resins, numerous extracts, some plasters and chemicals, and is a permanent ingredient of all tinctures, spirits, most fluid extracts, some mixtures, liniments, solutions, a few infusions, syrups, wines, etc.

Action and Uses.—Experiments and observations made to determine the mode of action of alcohol in the economy have too generally referred to excessive doses rather than to such as are employed in dietetics and in medicine. Hence a dispute has arisen whether alcohol raises or depresses the animal temperature, when it is of daily experience that moderate doses augment the heat and excessive doses diminish it. In febrile disease it is quite possible that the dose which in health would have been excessive, and even destructive of life, may, by limiting heat-production, tend to preserve the tissues upon which life depends. If, as is altogether probable, this effect is due to a power in alcohol of stimulating the exhausted nervous system, and thereby exciting the distended capillary blood-vessels to contract, it is evident that less blood will reach the tissues, that less heat will be developed, and less waste of tissue result. This diminished waste is represented by the smaller amount of carbonic acid exhaled from the lungs and of urea excreted by the kidneys. Simanowsky has shown experimentally that alcohol diminishes tissue-waste at least one-half (*Centralbl. f. d. g. Therap.*, ii. 232) and Bodländer that it restrains perspiration due to debility (*Zeitsch. f. klin Med.*, xiii. 402). These conclusions have been abundantly confirmed by Mohilausky (*Amer. Jour. Phar.*, lxi. 622), and Reichert (*Therap. Gaz.*, xiv. 73; *University Med. Mag.*, ii. 638). The special effect of alcohol in a given case depends upon its dose and upon the time during which it has been operating. The primary effect may be stimulating, and be indicated by an increased activity of cerebration; it corresponds to the turgescence and throbbing noted by Dr. M. P. Jacobi in her experiments in a case of exposed brain; but the secondary effect is the very opposite of this, and is accompanied by passive venous congestion. It is probable that alcohol reduces febrile temperature partly by lessening the oxidizing power of the red corpuscles. The use of alcohol in every age and by every nation in the world demonstrates that it satisfies a natural instinct, that it literally refreshes the system exhausted by physcial or mental labor, and that it not only quickens the appetite for food and aids in its digestion, but that it spares the digestive organs by limiting the amount of solid food which would otherwise be required, while it relieves pain and disposes to sleep. But in accomplishing this salutary end it does not act as a mere condiment. It is also food—in this sense at least, that it offers itself in the blood as a substitute for the tissues which would otherwise be destroyed. "Alcohol," says Moleschott, "is the savings bank of the tissues. He who eats little and drinks alcohol in moderation retains as much in his blood and tissues as he who eats more and drinks no alcohol." It is certain that of any amount of alcohol ingested, not in excess of what the system requires, only a minute fraction can be recovered from any of the secretions; the remainder undergoes meta-

morphosis and is eliminated in a new form. The notion that alcohol is unassimilable, and is chiefly eliminated through the lungs, rested upon the familiar fact that all alcoholic beverages contain ethereal elements which are so eliminated, and thus infect the breath. But it results from the careful observations and experiments of Anstie, Binz, and others that alcohol is not exhaled by the lungs and skin or excreted with the urine unless the body be supersaturated with it. In that case it may be found in the blood, in exhaled serum, etc. These views which we have from time to time expressed have been amply confirmed by investigation and experience (*e. g.* Warren, *Boston Jour.*, July, 1887, p. 1 and p. 25). According to some experimenters, a portion of alcohol in the blood is transformed into acetic acid, which forms acetates that are subsequently decomposed into water and carbonic acid. The doctrine that alcohol is food is probably true, not only indirectly by its preventing tissue-waste, but in the more literal sense of its favoring the formation of fatty products, especially by increasing the amount of adipose tissue, and in a morbid sense by tending to produce fatty liver and kidney, gall-stones, and atheroma. This, in fact, is the only sense in which itself is food; it does not add a single fibre to muscle nor a single cell to the brain and nerve-centres. The practical value of alcohol as food has been illustrated by the experience of Arctic explorers. All of these conclusions have been so amply confirmed by a continuous succession of observers and experimenters as to leave no doubt of their correctness.

In the form of wine or distilled spirits alcohol is the universal and familiar remedy for *debility* of every kind, whether it be due to exhaustion produced by *shock*, *fatigue*, or *prolonged sickness*, or shown by *syncope* arising from a nervously feeble or an exhausted heart, to wasting chronic disease, or to the tissue-destruction of acute febrile affections. In *typhus fever* and *typhoid fever*, and in the *typhoid state* of numerous diseases, including *pyæmia*, *pneumonia*, *erysipelas*, *etc.*, the usefulness and appropriateness of the medicine are demonstrated, not only by its diminishing the frequency and increasing the strength of the pulse, and by the decline of the symptoms which denote capillary stasis, but also by the very large quantities of it which may be taken without producing intoxicating effects. This tolerance may be added to the facts already stated to confirm the doctrine that alcohol is consumed in the body and subserves some of the purposes of food (Bodländer, *Zeitsch. f. klin. Med.*, xi. 548). The special conditions which call for the use of alcohol, and without which, or some of which, it is apt to be injurious rather than useful, are the following: constitutional *debility*, and especially that which is due to advanced life; a compressible, slow, or irregular *pulse*, with a feeble impulse and first sound of the *heart;* a tendency to *syncope;* a sluggish capillary circulation and a *dry tongue;* wandering *delirium*, *febrile stupor*, *tremor*, or *subsultus*, and involuntary dejections. In the fevers above mentioned there are both loss of power and nervous disorders (adynamia and ataxia); in some other diseases there is adynamia alone, or, as it is more specifically termed, asthenia—diseases in which the spinal nervous system appears exhausted, and debility and even paralysis of the muscles, both voluntary and involuntary, may occur. These accidents happen in the fevers already mentioned, and also, but less frequently, in the *eruptive fevers*, in *relapsing fever*, and in *diphtheria*, in all of which the first threatening of their approach should be met with alcoholic and other stimulants. It should always, in acute febrile disease, be administered in divided doses and its effects upon the symptoms noted. If it moderate such as have been enumerated, it may be regarded as useful, and may be continued in doses varied by its effects. The essential point in its administration is that it shall never be allowed to produce intoxication, even by abnormally exciting, and still less by stupefying. It is absolutely contraindicated in febrile diseases with scanty and albuminous urine of low specific gravity. Alcohol in any of its forms is seldom necessary in diseases affecting children, and then only in very small quantities and as a transient stimulant. In old age, on the other hand, its utility is very great, and, indeed, it is often indispensable. Of the several forms of alcohol appropriate in low and asthenic diseases, the best is usually the one to which (if to any) the patient is accustomed. In general, sound wine is preferable to distilled liquors, and, of the latter, brandy, when pure, is far better than whiskey. Sparkling are superior to still wines for this purpose, and white to red wines, except during convalescence. In these cases alcohol is to be used as a stimulant, and not for its alleged antipyretic action, which is wholly a secondary effect.

The rules just stated should govern the use of alcohol in *pulmonary consumption*. If it improves digestion, increases the weight and strength, reduces the fever, and lessens the cough, expectoration, and sweating, it may be regarded as exerting its most favorable influences. But, unfortunately, these salutary effects cannot be confidently anticipated; too often it increases fever, diminishes appetite, and impairs digestion. Two conditions

appear to be essential to its utility: first, that the phthisis shall be primary and chronic, and not the consequence of a previous pleurisy or lobar pneumonia; and secondly, that the patient shall use muscular exercise in the open air proportioned to his strength. Under these circumstances it is the best adjuvant of cod-liver oil, which, indeed, so far as alcohol is a nutrient, it resembles in its mode of action. In *delirium tremens* alcohol in the form of malt liquor, wine, or distilled liquor is a direct antidote to this peculiar effect of intemperance. As the morning dram steadies the tremulous hand and tottering gait of the sot, so alcohol reduces to co-ordination the distracted ideas, perceptions, and movements of the victim of delirium tremens; and the more certainly, speedily, and with a smaller dose in proportion as it is aided in its operation by physical fatigue produced by walking. It must not be forgotten that this delirium is usually the result of an abrupt cessation of the habit of drinking, either by the stomach giving out or by some suddenly depressing influence, such as a surgical injury. In poisoning by venomous *serpents* and by *narcotics* alcohol is often used to sustain life until the elimination of the poison has been accomplished. In some cases of the former kind very large doses of alcohol have been tolerated—whether owing to the poison itself or to the patient's excitement may be questioned. Alcohol is not a direct antidote to *serpent poison*. The full effects of this liquid have proved sufficient for the cure of *traumatic tetanus;* its slightly stimulant action, on the other hand, has been resorted to for preventing *epileptiform* attacks, and by the same mechanism doubtless it prevents, and even arrests, reflex *convulsions*, such as occur during *dentition*, the *vomiting of pregnancy*, and the paroxysms of *neuralgia*, when thus administered in small doses.

As an external application alcohol, either in its natural or its distilled form, has always been used as a dressing for *wounds*. The ancient use of oil and wine for this purpose is well known. In the seventeenth and eighteenth centuries alcohol was applied as a dressing to incised and other clean wounds, and also to those attacked with gangrene. Recent observations attest its excellence in arresting hæmorrhage, coagulating the albumen of exuded plasma, preventing the putrefaction of discharges, and promoting cicatrization.

In 1870, Dr. Blair, a Scottish physician, published an account of the use of strong whiskey as a popular dressing for wounds among his countrymen, and of his having then recently seen it employed in the Parisian hospitals (*Glasgow Med. Jour.*, ii. 204). From 1872, Perrin employed alcoholic dressings, and proclaimed their superiority in compound and comminuted fractures, especially when complicated with contusion of the soft parts; also in wounds of whatever kind which tended to putrefaction, and he held them to be more efficient, as well as more convenient, than carbolic-acid dressings. He found that alcohol protected such injuries from gangrene, excessive suppuration, and usually from erysipelas, while they rapidly acquired a healthy aspect and the traumatic fever accompanying them was slight. He gave the preference to alcohol over all other applications as a dressing for surgical wounds, including amputations (*Bull. de Thérap.*, xcvi. 308). In 1874, and again in 1880 and in 1882, the whiskey dressing was highly recommended by Suesserott (*Phila. Med. Times*, ii. 774; xi. 138; xii. 872); and in 1882, Gosselin used diluted alcohol to promote the cure of *abscesses*. Having been opened by a small incision, they were evacuated as far as possible, and washed out with alcohol, and also dressed with it. The purulent discharge rapidly became serous, the abscess contracted, and healed more rapidly than by any other method (*Times and Gaz.*, March, 1882, p. 311). Plessing injected with good results a superficial *aneurism* of the occipital artery. He used at first a 30 per cent., and afterward a 75 per cent., dilution (*Therap. Gaz.*, xi. 103). Holgate employed the same method of treating vascular *nævus* (*Med. Record*, xxxvi. 346). In dressing wounds, after removing foreign substances and clotted blood, the part is bathed with the alcoholic liquid and covered with compresses saturated with the same and protected by some impermeable covering. It should be kept moist with the liquor for several days, during which it should, if possible, remain undisturbed. Afterward the dressing may be changed daily or less frequently, according to circumstances. It is an efficient dressing for atonic *ulcers* and *gangrenous* lesions, tends to prevent and heal fissure of the *nipples* and excoriation of the *feet* by walking, and is the best of all applications to recent *bruises* and *sprains* and superficial inflammations, and as a vehicle for other agents fitted for this purpose and for stimulating *paralyzed limbs*. Alcohol has been used to remove *polypi* of the nostrils and of the middle and external ear. It does so by abstracting the water of which they largely consist and coagulating their albumen. In the case of the ear it is recommended that the auditory canal should be filled with the liquid two or three times a day, allowing it to remain in place from five to fifteen minutes; but to this expedient it is objected that the tympanum becomes perma-

nently dry and the hearing impaired. It has been injected into angiomatous and other soft *tumors* to cure them by hardening them (*Virch. Arch.*, lxxxv. 172); hypodermic injections of alcohol have been used to cure *varicocele*. The anæsthetic power of alcohol has long been known, as exhibited by the greater or less insensibility of intoxicated persons who meet with accident and of women who unconsciously give birth to children while drunk. It was even employed to diminish the shock of *surgical operations* and to facilitate the reduction of *dislocations*. It was formerly the custom before operations to administer a draught of alcohol and laudanum; and even since the introduction of anæsthetics it has often been found that their depressing effects are in this manner prevented, while their soporific action is more decided and occurs more promptly (Mason, *Jour. of Inebriety*, Oct. 1882).

In the treatment of alcoholic poisoning the stomach should first be emptied by means of a mustard emetic, administered by the stomach-pump if necessary. Cold water may be dashed against the breast and spine and applied to the head, while various mechanical expedients are employed to keep the patient awake. In some cases, even of dead-drunkenness, a few drops of water of ammonia instilled into the throat or held under the patient's nostrils will suffice to dissipate the stupor.

ALCOHOL AMYLICUM, *Br.*—Amyl Alcohol.

Fusel oil, *Primary amyl alcohol*, *Pentyl alcohol*, E.; *Alcool amylique*, *Huile de grain*, Fr.; *Amyl-alkohol*, *Fuselöl*, G.; *Alcool isoamilico*, F. It.

Formula $C_5H_{11}OH$. Molecular weight 87.81.

A peculiar alcohol obtained from fermented grain or potatoes by continuing the process of distillation after the ordinary spirit has ceased to come over.

Preparation.—During the alcoholic fermentation of grain and potatoes some amylic alcohol is produced, the great bulk of which passes over with the last portions of the first distillation, which are milky, and contain besides amylic some ethylic alcohol and water, and variable quantities of propyl alcohol, isobutyl alcohol, and other compounds, differing with the source of the fusel oil. The portion remaining in solution with the distilled spirit is obtained in purifying the latter, either by the process of distillation or leaching. (See Alcohol.) Commercial amylic alcohol contains variable quantities (between 20 and 30 per cent.) of ordinary (ethylic) alcohol, of which it cannot readily be completely deprived by fractional distillation and washing with water. Distillation over calcium chloride, after previous washing with water, removes most of this alcohol, a portion of which will, however, again pass over with the distillate. An effectual and economical method has been proposed by B. Hirsh (1861), who advises crude amylic alcohol to be repeatedly agitated with concentrated aqueous solutions of table-salt until a diminution of its volume is no longer noticed; it still contains a little alcohol, from which it is freed by distilling it with three or four times its volume of water.

Properties and Tests.—It is a colorless, thin, oily liquid, having a penetrating and oppressive odor and a burning, acrid taste. It congeals at —134° C. (—209° F.), crystallizing in laminæ, and has no effect on polarized light when pure. It boils at 132° C. (269.6° F.), and evaporates without leaving any residue. Its specific gravity is 0.818. It is very sparingly soluble in water, to which it imparts its odor and taste. It unites in all proportions with alcohol, ether, glacial acetic acid, benzene, petroleum benzin, fixed and volatile oils. It dissolves iodine freely, a little phosphorus, camphor, many resins, and most alkaloids, yielding the latter again, on agitation, to water acidulated with sulphuric acid. In contact with sulphuric acid it acquires a deep-red color, and reacts violently with concentrated nitric acid. Exposed to air in contact with platinum-black, it is slowly oxidized, yielding valerianic acid. It takes fire with difficulty unless heated to about 55° C. (131° F.), when it burns with a bright flame. As met with in commerce, it contains variable quantities, sometimes 12 per cent., of *active amyl alcohol*, which has the same elementary composition, but turns polarized light to the left and boils at 127° C. (260.6° F.); its barium amyl sulphate is much more soluble in water than the corresponding salt obtained from inactive amyl alcohol. In addition to this, five other amyl alcohols have been prepared artificially, varying in their boiling-points between 97° and 137° C. (206.6° and 278.6° F.).

The *purity* of amyl alcohol is ascertained by its specific gravity, its boiling-point, its volatility without residue, and by its not diminishing in volume when agitated with an equal bulk of solution of calcium or sodium chloride.

Composition.—Amyl alcohol is *amyl hydroxide*, $C_5H_{11}OH$, and yields a series of

compounds homologous with those of ethyl alcohol—namely, amyl ether, $(C_5H_{11})_2O$, amyl aldehyde, or valer-aldehyde $C_5H_{10}O$, and valerianic acid, $C_5H_{10}O_2$.

Pharmaceutical Uses.—Amyl alcohol is the source of valerianic acid and of various compound ethers (fruit-essences), and may be used as a solvent in the manufacture of alkaloids and other proximate principles.

Action and Uses.—The adulteration of alcoholic drinks with *fusel oil* has been supposed to explain the rapid and peculiar intoxication they sometimes produce and the dyspeptic and nervous disorders which follow their habitual use. It is certain that the oil itself will cause, even in small doses, tension and pain in the head, and in large doses insensibility or a profound and death-like sleep. A case is on record (*Lancet*, Dec. 1889, p. 1225) in which about four ounces of the oil were swallowed. The respiration ceased, but the heart continued to beat. Life was revived by stimulants, including hypodermic injections of ether. The breath, etc. exhaled a strong fruity odor. In small doses, on the other hand, it acts as a direct nervous stimulant, and has been employed for the purpose of controlling the nervous weakness and irritability to which confirmed drunkards are subject. We have known it to be habitually prescribed by skilful physicians for the relief, apparently, of some of the symptoms of chronic *phthisis*, but without obvious benefit.

ALCOHOL METHYLICUM.—Methyl Alcohol.

Spiritus pyroxylicus rectificatus.—Pyroligneous (Pyroxylic) spirit or alcohol; Wood naphtha, E.; *Alcool méthylique, Alcool formique, Alcool de bois, Esprit de bois, Esprit pyroligneux*, Fr.; *Holzgeist, Methylalcohol*, G.

Formula CH_3OH. Molecular weight 31.93.

Preparation.—Methyl alcohol was first noticed by Boyle (1661); its difference from ordinary alcohol was observed by P. Taylor (1812), but it was not correctly characterized until investigated by Dumas and Peligot (1834). The aqueous portion of the distillate resulting from the destructive distillation of wood contains about 1 per cent., together with acetic acid, acetone, aldehyde, allyl alcohol, empyreumatic oils, and other compounds; on the addition of chalk, calcium acetate is produced, and the portion distilling below the boiling-point of water furnishes the crude methyl alcohol. To obtain it pure, fused calcium chloride is dissolved in it to saturation, whereby a crystallizable compound, $CaCl_2.4CH_4O$, is formed, which is not decomposed by the heat of a water-bath, but acetone, lignone, and other impurities are found in the distillate. The residue is afterward diluted with water and heated, when dilute methyl alcohol passes over, which is left in contact with burnt lime and then rectified.

Properties.—Pure wood-spirit is a colorless, limpid liquid, of a peculiar odor, resembling alcohol and acetic ether, and of a warm taste. Its density is 0.814 at 0° C. (32° F.), and 0.798 at 20° C. (68° F.); it boils at about 65° C. (149° F.); burns with a pale-blue, scarcely luminous flame; is soluble in all proportions in water, alcohol, and ether; dissolves volatile oils, fats, many resins, and particularly calcium chloride, whereby, as well as by its boiling-point, it is readily distinguished from *acetone*. Crystallized copper sulphate is insoluble in absolute methyl alcohol, but the anhydrous salt yields a blue-green solution, from which, on the addition of a small quantity of water, the crystalline salt is precipitated (Klepl, 1882). The derivatives corresponding with those mentioned under Ethyl Alcohol are methyl ether, $(CH_3)_2O$ (see page 132), methaldehyde or formaldehyde, CH_2O, and formic acid, CH_2O_2 (see page 53). It is easily oxidized by solution of potassium permanganate in the cold, while the color of the latter is more slowly altered by ethyl alcohol. For determining the presence of one or both of these alcohols Riche and Bardy (1875) proposed a process depending upon the differently-colored solutions obtained by the limited oxidation of ethyl and methyl aniline. Berthelot (1876) proposed to mix the alcohol with twice its bulk of concentrated sulphuric acid, when methyl alcohol will yield methylic ether, and ethyl alcohol ethylene gas, which is almost insoluble in water and sulphuric acid, but is readily absorbed by bromine.

Action and Uses.—The vapors of methyl alcohol, diffused in the air, give rise to headache, dizziness, nausea, and loss of appetite. It was at one time employed as a stimulant in *pulmonary consumption, chronic catarrh, dyspepsia*, and *verminous affections*, but is now entirely disused. It was given in doses of from 10 to 20 drops several times a day.

ALETRIS.—Colic-Root.

Starwort, Star-grass, Blazing star, E.; *Alétris farineux*, Fr.; *Mehlige Aletris*, G.

The rhizome of Aletris farinosa, *Linné.*

Nat. Ord.—Hæmodoraceæ.

Origin.—The plant grows in grassy places and sandy woods in the United States, and flowers in July and August. It has a circular cluster of lanceolate, sessile, radical leaves, which are about 125 Mm. (5 inches) long and spread star-like upon the ground, and from the centre of them rises the nearly naked scape, about 60 Gm. (2 feet) high, and bearing a spiked raceme of whitish flowers having a mealy appearance.

Description.—The rhizome is horizontal, about 25-38 Mm. (1 or 1½ inches) long, 3 Mm. (⅛ inch) thick at the lower end, and about 1 Cm. (⅖ inch) at the upper end, flattish or concave on the upper surface, and densely tufted with the fibrous or scaly remnants of the leaves; on the lower surface convex and beset with numerous simple rootlets 50–75 Mm. (2 or 3 inches) long, the older ones being wiry and glossy-blackish or brown, the recent ones softer and whitish. The rhizome consists of four to six rather indistinct joints, is brown-gray externally, white internally, breaks with a mealy fracture, with protruding scattered wood-bundles, is inodorous, and has an amylaceous afterward persistently bitter taste.

Constituents.—The rhizome appears to be from tannin, and to contain starch and a bitter principle which is more freely soluble in alcohol than in water.

Adulterations.—We have occasionally seen it adulterated with upright and horizontal rhizomes of other monocotyledonous plants, from which, however, it is easily distinguished.

Action and Uses.—This humble plant, if we may credit the published accounts of its virtues, is at once tonic, emetic, purgative, diuretic, carminative, sialagogue, and antirheumatic, besides being "the most powerful of uterine stimulants," and a remedy for "spermatorrhœa." It is probably little more than a simple bitter, and as such produces various effects according to its dose and mode of administration—in substance, in warm or cold infusion, in tincture, etc. The infusion is made with Gm. 32 (℥j) to a pint of water, and may be given in doses of a tablespoonful. The average dose of the powder is about Gm. 0.60 (gr. x).

ALISMA.—Water Plantain.

Plantain d'eau, Pain de grenouilles, Fr.; *Froschlöffel, Wasserwegerich*, G.

Alisma Plantago, *Linné.*

Nat. Ord.—Alismaceæ.

Origin.—The plant is indigenous to Europe and North America, grows in swampy places and on the edges of ponds and rivers, and flowers from July to September. The American plant is regarded as a variety, Alisma americanum, *Gray.*

Description.—The rhizome consists of two or three united fleshy tuberous pieces, which vary in shape from oblong to subglobular, are externally of a blackish color and beset with numerous radicles, internally white and with scattered wood-bundles, and in the fresh state of a disagreeable sharp odor and taste. The leaves are on long petioles, ovate oblong or lanceolate, acute, frequently with a heart-shaped base, five- to nine-nerved, light-green, and of an acrid taste. The scape is about 2 feet (60 Cm.) high, three-edged, and bears a loose panicle of whitish perfect flowers, having six stamens and numerous pistils upon a flattish receptacle. The rhizome and leaves have been used medicinally.

Constituents.—Water plantain contains a butyraceous pungent volatile oil, of which Zuch (1818) obtained .6 per cent. Neljubin found in it also an acrid resin.

Action and Uses.—A singular commentary on the virtues of this plant may be found in the statement that it was once regarded as an infallible cure for hydrophobia. Whatever powers it possesses are probably due to an acrid principle which exists in the fresh leaves and is strong enough to irritate the skin. It has been supposed to be useful in *calculous* renal affections, in *dysentery*, *diarrhœa*, *chorea*, and *epilepsy*, and as an application to recent *bruises*, *swellings*, and *sores*. The powder of the leaves may be prescribed in doses of about Gm. 4 (℥j); the powder of the root has been used in half that quantity, and a decoction of the leaves is made with "a handful" in a pint of water, and may be given in doses of a wineglassful.

ALKEKENGI.—Winter Cherry.

Alkékenge, Coqueret, Fr.; *Judenkirsche, Schlutte*, G.; *Alkekenges*, Sp.

The fruit of Physalis Alkekengi, *Linné.*

Nat. Ord.—Solanaceæ.

Origin.—It is a perennial herb, indigenous to Middle and Southern Europe, and to some extent cultivated and naturalized in this country under the name of *strawberry tomato.* It is more or less soft-hairy, has a nearly simple stem, broadly ovate and pointed leaves with a somewhat wedge-shaped base, and bell-shaped greenish-white unspotted flowers.

Description.—The fruit is spherical, of the size of a cherry, scarlet-red, shining, and remains enclosed in the inflated orange-colored permanent calyx. It is two-celled, and contains numerous white flattish ovate seeds attached to a central placenta. In the fresh state the fruit is very juicy and has a sweet and acidulous taste; it shrivels considerably on drying.

Constituents.—Dessaignes and Chautard (1852) found sugar and citric acid in the berries, and in the leaves and calyx an amorphous bitter principle *physalin*, $C_{14}H_{16}O_5$, which is obtained as a whitish powder on agitating the cold aqueous infusion with chloroform, and is soluble in chloroform and alcohol, but sparingly so in ether, cold water, and diluted acids.

Allied Species.—Physalis viscosa, *Linné*, a clammy, pubescent North American plant, with ovate or oblong, slightly cordate and somewhat toothed leaves, and purplish-brown flowers. The fruit is an orange-colored or reddish berry, remaining in the inflated calyx.

Phys. pennsylvanica, *Linné.* It resembles the preceding, but is not clammy, the leaves are usually entire, the corolla is veined in the centre, and the berry has a red color.

Phys. peruviana, *Linné*, Ph. pubescens, *Linné*, and Nicandra physaloides, *Gærtner*, are indigenous to South America, and in Mexico are known as tomate. The last-named species is occasionally found wild in the United States, where it is known as *apple of Peru.*

Withania coagulans, *Dun.*, is indigenous to India, and is there often confounded with alkekengi. The fruit, or a decoction of the same, is used for coagulating milk.

Action and Uses.—The herb is used in Europe as tonic, antiperiodic, and depurative, and the fruit as febrifuge and diuretic. Like many other bitter plants, this one is sometimes successful in arresting the paroxysms of *intermittent fever*, and is used for that purpose by the peasantry. The berries eaten when ripe and fresh, and when dried and used to prepare a decoction, and also their expressed juice, are regarded as having decided diuretic virtues, and are frequently employed in *jaundice, gravel, dysury, retention of urine*, and *dropsy.* It is recommended to give the fresh berries to the extent of several ounces a day; of the expressed juice, 2 or 3 fluidounces; and an infusion of the dried berries, made with an ounce Gm. 32 (℥j) in a pint of hot water, to the extent of 2 or more pints a day. The powder of the plant is used in doses of Gm. 4 (℥j) or more. The allied species appear to resemble winter cherry in their qualities.

Withania coagulans contains a prineiple which possesses strong coagulating powers, and has been used in India as a substitute for animal rennet in the preparation of cheese (*Jour. Amer. Med Assoc.*, ii. 346).

ALLIUM, *U. S.*—Garlic.

Bulbus allii.—Ail, Fr.; *Knoblauch*, G.

The bulb of Allium (Porrum, *Reichenbach*) sativum, *Linné.* Bentley and Trimen, *Med. Plants*, 280.

Nat. Ord.—Liliaceæ.

Origin.—All the plants belonging to this genus are bulbous, resemble each other in their odor and taste, and contain similar if not identical volatile oils. The officinal species is indigenous to Central Asia, and perhaps also to the basin of the Mediterranean, but is cultivated for culinary purposes in other sections of Europe and North America. By cultivation and hybridization several varieties have been formed, one of which, of frequent occurrence here, was proved by R. P. Thomas (1860) to be a hybrid of A. sativum and A. Porrum, *Linné*, which is distinguished by its larger bulb, higher stem, and the absence of proliferous bulbs from the flowering heads.

Description.—Garlic is a sub-globular compound bulb, surrounded by a few dry membranaceous scales, which cover the remnant of the upright stem and the 5 to 8 small bulbs or cloves arranged in a circle around its base. These bulblets are oblong in outline.

compressed from both sides, wedge-shaped toward the stem, and rounded upon the back, They consist of a few thick fleshy scales and a short fleshy axis. Garlic has a peculiar pungent and disagreeable odor and an acrid, burning taste. It is used in the fresh state only.

Constituents.—Besides the cellular tissue, garlic contains between 50 and 60 per cent. of water, 35 per cent. of mucilage, some albumen, sugar, starch, and about ¼ per cent. of volatile oil, to which its odor and taste are due. In its crude state *oil of garlic* is of a dark brown-yellow color, heavier than water, of a very repulsive taste, and consists of oxide and sulphides of allyl. The rectified oil consists mainly of the sulphide, $(C_3H_5)_2S$, is colorless, lighter than water, and may be obtained artificially by treating an alcoholic solution of potassium sulphide with allyl iodide. It dissolves easily in alcohol and ether, and sparingly in water; with silver nitrate, mercuric chloride, and other metallic salts it forms crystalline compounds. Garlic, macerated in water or vinegar, yields its virtues to these liquids.

Allyl Tribromide.—Tribromhydrin $C_3H_5Br_3 = CH_2Br.CHBr.CH_2Br$, a body closely allied to oil of garlic, is made by allowing bromine (1½ parts) to act on allyliodide, C_3H_5I. (1 part) which is cooled by a freezing mixture. The liquid is filtered after twenty-four hours and the filtrate purified by distillation, the tribromide boiling at 217° C. (422° F.). It has the sp. gr. 2.407 (Henry). On subjecting to cold the tribromide congeals in the form of prisms fusing at 16–17° C. (60-61.5° F.).

Preservation.—Garlic is best preserved in a dry place at a moderate temperature, in which it slowly parts with its water. A. P. Sharp proposed (1864) to put the fresh and clean bulblets into a jar and add a small quantity of alcohol—about 2 ounces to a quart jar. The vitality of the bulbs is destroyed, and they retain their properties in the closed vessel for a long period, but change in color, acquiring a brownish somewhat diaphanous appearance.

Allied Species.—The following species of Allium are more or less cultivated for culinary purposes; their bulbs and leaves possess a garlic-like but mostly milder odor, which is dependent upon similar volatile oils. Medicinally, they appear to have the same properties, though in a milder degree:

Allium Cepa, *Linné;* Onion, *E.;* Oignon, *Fr.;* Zwiebel, *G.*
Al. Porrum, *Linné;* Leek, *E.;* Porreau, *Fr.;* Lauch, *G.*
Al. Ascalonicum, *Linné;* Shallott, *E.;* Echallotte, *Fr.;* Schallotte, *G.*
Al. Schœnoprasum, *Linné;* Chives, *E.;* Civette, *Fr.;* Schnittlauch, *G.*

Action and Uses.—Garlic, as well as leek and onion, is a stimulant to the part to which it is directly applied and to the whole system. Its odorous element may be perceived on the breath and its taste in the mouth when the briused bulb has been applied to the skin. When eaten raw its odor exhales from many parts of the body, and, given to nursing women, it taints their *milk*, so that their infants refuse the breast. It reddens the skin, and may even vesicate it. Internally, it stimulates the digestive organs, and is everywhere used, but principally in southern countries, as a condiment for various kinds of food. Excessive quantities of it produce nausea, vomiting, colic, and diarrhœa. The odor of garlic is popularly employed to revive persons from a *swoon* or from *hysterical* insensibility. It is a vermifuge not to be neglected in the treatment of *lumbricoid worms* when given by the mouth, and for destroying *ascarides* when administered by the rectum. Many cases of *dropsy*, particularly of anasarca produced by cold, have been cured by a diet of bread and raw onions. This regimen will sometimes produce copious diuresis. Onions boiled in milk have been used successfully for a like purpose. Anciently, bruised cloves of garlic were applied to wounds made by *venomous serpents* and *insects* and *mad dogs* (Adams, *Comm. on Paulus Ægineta;* Ebn. Baithar), and their prescriptions were repeated by mediæval physicians. Poultices of boiled onion are admirable remedies for chronic *bronchitis* in children. They should be applied over the whole front of the chest. Internally, garlic is a very useful agent in the same affection. It is also a domestic remedy for *whooping cough*. Onion poultices are particularly applicable to *abscesses*; the core of a roasted onion relieves *earache* when introduced into the auditory canal. Onion and garlic cataplasms applied to the perineum relieve *strangury*. The *dose* of bruised or chopped garlic or of the expressed juice is about Gm. 2 (gr. xxx).

Allyl tribromide has been administered in capsules, each containing 5 drops, for the relief of various spasmodic disorders, including *agina pectoris*, *asthma*, *hysteria*, and *infantile convulsions*.

ALNUS.—Alder-Bark.

Black Alder, E.; *Écorce d'aune, Aune noir*, Fr.; *Erlenrinde, Schwarzerle, Eller*, G.; *Aile*, Sp.

The bark of Alnus glutinosa, *Gærtner*, s. Betula Alnus, *Linné*, and of Alnus serrulata, *Aiton*.

Nat. Ord.—Cupuliferæ.

Origin.—The first species is a tree about 9 M. (30 feet) high, indigenous to Europe and Northern Asia; the second is a native of the United States, and attains a height of about 3 M. (10 feet). Both grow in moist localities.

Description.—The bark is in quills or curved pieces about 1.2 Mm. ($\frac{1}{20}$ inch) thick, smooth on both sides, of a brownish ash-gray color externally, the young bark with reddish-brown dots, brownish-orange on the inner surface, inodorous, and of an astringent somewhat bitter taste. It is brittle, and breaks with an uneven, not splintery, fracture. The bark of the American species, which is called *black alder*, resembles the preceding, but is of a blackish-gray externally; has small suberous warts, which become somewhat confluent transversely, and is marked with a few coarse longitudinal striæ upon the orange-brown inner surface.

Constituents.—Alder-bark contains tannin, that of the black alder about 4 per cent. and the aments of the same species 1.5 per cent. (Bowman, 1869). These results were obtained by precipitation with gelatin. According to Stenhouse (1843), the tannin of the European alder-bark is precipitated by gelatin, but not by tartar emetic; ferric acetate yields a purplish-blue, and ferrous chloride a dark olive-green, precipitate.

Action and Uses.—The American species of alder is said to be "astringent and diuretic," which may be doubted, since astringents are seldom diuretics. Its astringency resides in the leaves, as well as in the bark, with both of which decoctions are prepared for the treatment of *diarrhœa* and *hæmaturia*; and the former, when bruised, are applied to *contusions*, *sprains*, and *ulcers*. The inner bark is said to be emetic. The European species possesses almost identical virtues. Its decoction is employed for the purposes above mentioned, and as a gargle in *sore throat*, as a mouth-wash for *ulceration* of the gums, etc., as an injection in *leucorrhœa*, etc.; and the bruised leaves are sometimes applied to the mammæ to lessen the secretion of *milk* or dissipate *indurations* during lactation. Internally, the bark has been used in *intermittent fever*. The *dose* of the powdered bark is Gm. 0.60 (gr. x) several times a day. The decoction or infusion may be made with Gm. 16 (℥ss) to Gm. 500 (Oj) of water.

The bark of *Alnus viridis* is said to be used as a remedy for dropsy by the Indians living near Hudson's Bay (Spaydon, *Therap. Gaz.*, viii. 398).

ALOE, *U. S., Br., P. G., F. It.*—Aloes.

Aloès, Fr.; *Aloe*, G.; *Acibar*, Sp.

The inspissated juice of the leaves of different species of Aloe. Bentley and Trimen, *Med. Plants*, 282, 283, 284.

Nat. Ord.—Liliaceæ.

Official Varieties. — 1. Aloe Barbadensis, *Br., U. S.*—Barbadoes aloes, Hepatic aloes, *E.*; Aloés hépatique des Barbades, *Fr.*; Barbadoes Aloe, *G.*—From Aloe vera (*Linné*), *Webb*, s. A. vulgaris, *Lamarck*.

2. Aloe Capensis, *U. S.* 1870; Aloe, *P. G.*, Aloe lucida.—Cape aloes. *E.*; Aloés du Cap, Aloés lucide, *Fr.*; Capaloe, *G.*—From Aloe ferox, *Lamarck*, A. spicata, *Thunberg*, A. Lingua, *Linné*, s. Gasteria Lingua, *Willdenow*, and of other species of Aloe.

3. Aloe Socotrina, *Br., U. S.*—Aloe, *U. S.* 1878, Aloe socotrina.—Socotrine aloes, *E.*; Aloés sucotrin, A. sucotrin, *Fr.*; Socotora Aloe, Socotrinische Aloe, *G.*—From Aloe Perryi, *Baker*.

Origin.—In aspect these plants resemble the so-called century-plant, or American aloe, Agave americana, *Linné*. Of the above-named species, Aloe vera has yellow flowers, and is indigenous to India and North-eastern Africa, and has been naturalized along the shores of the Mediterranean and in the West Indian Islands; A. indica, *Royle*, A. littoralis, *Kœnig*, and several other forms described as distinct species, are now regarded as mere varieties of this. A. socotrina, with orange-red flowers, belongs to the east coast of Africa, near the southern shore of the Red Sea, and to the neighboring islands of the Indian Ocean. A. purpurascens, *Haworth*, A. rubescens, *De Candolle*, and A. officinalis, *Forskal*, which are indigenous to tropical or Southern Africa, have been referred to this

species as varieties. A. spicata, with yellowish and orange-colored flowers, and A. ferox, with reddish or yellowish flowers, are indigenous to the southern part of Africa, together with A. africana, *Miller*, A. linguæformis, *Linné*, A. aborescens, *Miller*, and other species, which are used in preparing some of the commercial aloes. The aloes-plant of the island of Socotra, according to Balfour (1882), is Aloe Perryi, *Baker*, a species quite distinct from A. socotrina. Aloe abyssinica, *Lamarck*, is probably the source of Jafferabad aloes, met with in commerce in Bombay.

Fig. 11.

Aloes vulgaris, *Lamarck*.

Preparation.—The large fleshy leaves of these plants contain in their central part an insipid, thick, mucilaginous juice, and a bitter yellowish juice in distinct, elongated, thin-walled ducts situated near the surface. To obtain this bitter juice the leaves are cut off near their base, and then placed in suitable vessels, into which their cut ends project. The vessel used in Barbadoes and other West Indian Islands is an inclined trough from which the juice flows into other vessels, where it is preserved until it can be evaporated. In the Cape Colony a shallow ditch is dug into the ground and covered with a goat-skin, which, when nearly filled, is emptied at once into an iron kettle, and without much attention boiled down to the proper consistence. Greater care is bestowed upon the evaporation of the juice in Barbadoes and Curaçao, the impurities being removed during the evaporation, and when of sufficient consistence the juice is poured into boxes or gourds, where it solidifies on cooling. Socotrine aloes seems to be mostly derived from Zanzibar and other places farther north on the east coast of Africa. It enters commerce by way of Bombay. Nothing is known of the method pursued in its manufacture, except that the juice appears to be inspissated by spontaneous evaporation. The importation of all kinds of aloes into the United States varies between 96,500 pounds in 1876 and 230,624 pounds in 1882.

Aloe Purificata, *U. S.*—Purified aloes, *E.*; Aloès depuré, *Fr.*; Gereinigte Aloe, *G.*

Socotrine Aloes 1000 Gm. Alcohol 200 Cc. Heat the aloes, by means of a water-bath, until it is completely melted. Then add the alcohol, and, having stirred the mixture thoroughly, strain it through a No. 60 sieve which has just been dipped into boiling water. Evaporate the strained mixture by means of a water-bath, constantly stirring, until a thread of the liquid becomes brittle on cooling. Lastly, break the product, when cold, into pieces of convenient size, and keep it in well-stopped bottles.—*U. S.*

The process remains the same as heretofore; its object is the removal of fragments of leaves, wood, stones, pieces of skin, and other extraneous matter, which are always found in larger or smaller proportion in Socotrine as well as in Cape aloes. If the heat is regulated by means of a water-bath, there is no danger of impairing the virtues of aloes by overheating. The melted aloes is rendered sufficiently fluid, by the addition of the alcohol, to pass without difficulty through the sieve, if this has been previously warmed. The impurities remain upon the sieve, and the strained liquid may be at once evaporated. If the operation has been carefully performed, purified aloes will be dull-brown or reddish-brown, brittle, of the peculiar aromatic odor of Socotrine aloes, and will yield a bright brownish-yellow powder.

Description.—1. Barbadoes Aloes. It is usually imported in gourds, and has a deep-brown or orange-brown color, which in thin pieces has a decidedly yellow or reddish-yellow tinge; it is opaque in mass, translucent in thin splinters, and breaks with a smooth scarcely conchoidal, waxy fracture. When breathed upon it has a strong saffron-like odor, which is, however, distinct from that of Socotrine aloes. With nitric acid it acquires a red color, and on mixing with sulphuric acid, and then blowing the vapor of

nitric acid over the mixture, it should remain colorless or assume only a greenish-blue tint (difference from Natal aloes). Ether dissolves about 10 per cent. of Barbadoes aloes.

Similar in appearance, but rather darker and more glossy, are *Curaçao* and *Bonaire aloes;* their fracture is more conchoidal and their odor less agreeable.

2. Cape Aloes. This is readily distinguished from the other kinds by its dark, blackish-brown color (which is frequently of an olive tint), its glossy appearance, and its large conchoidal fracture. It is transparent on the edge, with a red-brown color, and has a saffron-like but disagreeable sourish odor. It affords a light yellowish-brown or greenish-brown powder, and yields to ether from 1.5 to 6.5 per cent. of soluble matter. It is imported in cases, and varies more or less in the shade of color and in the brilliancy of its fracture.

3. Socotrine or Zanzibar Aloes. This is put up in skins, and of late years also in kegs and tin-lined boxes. It is sometimes met with in the liquid state, and separates then into two distinct layers, of which the upper one is transparent, while the lower consists of a brown-yellow crystalline mass. Even when quite hard externally the interior of the packages is often found in a soft or semi-fluid state. When carefully dried it has a conchoidal, dull fracture, and is of a yellowish orange-brown color, destitute of the greenish hue of Cape aloes. On exposure the color darkens considerably upon the surface. The powder is of a bright brownish yellow, and when dried and then heated to 100° C. (212° F.) it should not cake. When breathed upon it emits an aromatic saffron-like odor, more pleasant than that of the other varieties. From 4 to 5.5 per cent. of Socotrine aloes is soluble in ether. Socotrine aloes assumes with nitric acid a reddish-brown color, and on blowing the vapor of nitric acid over a mixture of this aloes and sulphuric acid, it should not become blue.

4. Other Varieties of Aloes. Under the name of *hepatic aloes* a variety of Socotrine aloes was formerly known in Europe, which came into commerce from the East Indies. The name was afterward applied to any opaque liver-colored variety. In the United States this name has been used to designate Barbadoes aloes. *Natal aloes* is an opaque variety of a brownish-gray or light brownish-yellow color, differing very considerably in appearance from the preceding varieties. It is prepared from an undetermined species in the interior of Natal, the juice being concentrated by careful boiling. *Jafferabad aloes* is of a black pitch-like color and lustre, a glassy somewhat porous fracture, and, in powder, of a pale-brown hue; its odor and taste are less agreeable than those of Socotrine aloes. An inferior kind, known in European commerce as *Moka aloes*, comes from the interior of Arabia; it is opaque, almost black, of irregular fracture and disagreeable odor, and yields a pale reddish-brown powder. By the name of *Caballine* or *horse aloes* European writers used to designate the inferior, impure, and fetid kinds of different origin.

The difference in the sensible properties of the different varieties of aloes must in part be referred to the species from which they are derived, and to the climate and soil in which the plants grow; and it must depend to a considerable extent upon the care bestowed upon obtaining the bitter juice free from the insipid mucilaginous contents of the cells of the interior parenchyma, upon the manner in which concentration is effected, and upon its freedom from accidental impurities. These latter are perhaps never absent, but are sometimes present in considerable proportion, although not readily observable on the examination of the aloes; hence the U. S. Pharmacopœia orders the purification of Socotrine aloes. The opaqueness of some sorts of aloes is due to the crystallization of one of the principles. The glossy and transparent kinds do not contain such a crystallized principle, but are nearly homogeneous. The odor of aloes is best observed when a sample is breathed upon; it resembles strongly saffron, associated with another odor, which is distinct for each kind. The taste of aloes is disagreeably bitter and very persistent.

Aloes dissolves almost completely in alcohol and in boiling water, the latter solution separating, on cooling, about 40 to 60 per cent. of the so-called *resin of aloes*, which is taken up by alkalies and reprecipitated by acids. Chloroform in contact with aloes remains uncolored even when heated to boiling; pure ether acquires only a slight yellowish color.

Constituents.—None of the older analyses have thrown any light upon the composition of aloes beyond establishing the degree of solubility of different samples in several solvents and the behavior of these solutions with different reagents. T. and H. Smith of Edinburgh succeeded (1851) in isolating from Barbadoes aloes a crystalline principle, which was then named *aloin*, but is now called *barbaloin*, to distinguish it from the crystalline principles of other varieties. Socotrine aloes, containing a large number of crystals, was noticed by Pereira in 1852, and the crystalline principle was isolated by Groves (1856), but then regarded as being identical with barbaloin, until their difference

was shown by Histed (1871). Groves's process consists in dissolving 1 part of aloes in 10 parts of boiling water, decanting after cooling from the sediment, and acidulating slightly with hydrochloric acid. Tilden (1870) prefers acidulating the water with sulphuric, sulphurous, or hydrochloric acid before dissolving the aloes, and allowing to rest overnight; the clear liquid is then rapidly evaporated to about 2 parts, and set aside in a cool place to crystallize; the crystals are purified by recrystallization from very dilute alcohol. Nataloin was obtained by Flückiger (1871) by triturating Natal aloes with an equal weight of alcohol at a temperature not exceeding 48° C. (118° F.), when the amorphous portion will be dissolved; the residuary crystalline mass, after washing with cold alcohol, is recrystallized from hot methylic or ethylic alcohol. Socaloin, being soluble in cold spirit almost as freely as the amorphous constituents, cannot be obtained in the same manner; but Histed succeeded in preparing it with little loss by mixing powdered Socotrine aloes with a little alcohol (sp. gr. .960), expressing strongly between calico, and crystallizing the press-cake from warm weak alcohol. The same process yields also the aloin of Jafferabad aloes (Shenstone, 1882).

Aloinum, *U. S.*, *Br.*, is barbaloin or socaloin.

Barbaloin, $C_{17}H_{20}O_7$, occurs in small yellow prismatic needles, which dissolve at 15° C. (59° F.) in 60 parts of water, 20 parts of alcohol, and 470 parts of ether. Bromine-water produces in its solution a yellow precipitate of *bromaloin*, which crystallizes in needles. Heated with nitric acid, barbaloin yields chrysammic, aloetic, picric, and oxalic acids. Barbaloin, added to a drop of nitric acid, produces a crimson color, which rapidly fades. According to Hanausek (1881), the aloin from Curaçao aloes has the same behavior to reagents, but its composition is $C_{15}H_{17}O_7$.

Socaloin or *Zanaloin*, $C_{15}H_{16}O_7$, crystallizes in small yellow needles, which dissolve in 30 parts of absolute alcohol, 60 of water, 380 of ether, 9 of acetic ether, and freely in methylic alcohol. Cold nitric acid has little effect upon socaloin, but upon heating imparts to it an orange-red color, and oxidizes it to the same acids which are obtained with barbaloin. Precisely the same effect was observed by Shenstone with the aloin from Jafferabad aloes; hence these three aloins form a well-defined group quite distinct from nataloin. An aqueous solution of aloin is colored greenish-black by ferric chloride and slowly precipitated by basic lead acetate.

Nataloin, $C_{16}H_{18}O_7$, crystallizes best from methylic alcohol in thin pale-yellow rectangular scales, which dissolve at 15.5° C. (60° F.) in 35 parts of methylic alcohol, 50 of acetic ether, 230 of absolute alcohol, and 1236 of ether. It is sparingly soluble in hot and cold water and in about 60 parts of alcohol. Nitric acid does not convert it into chrysammic acid, but yields oxalic and picric acids. Nataloin, added to a drop of nitric acid, produces a crimson color, which is more permanent than the similar color produced with barbaloin. If nataloin is added to a drop of sulphuric acid and the vapor of fuming nitric acid is passed over the surface, the orange-colored liquid will assume a fine green color, quickly changing to red and blue (Histed, *Transac. Br. Pharm. Conf. 1871*, p. 580).

Aloetic acid, $C_7H_2(NO_2)_2O$, is an orange-red powder. *Chrysammic acid*, $C_{14}H_4(NO_2)_4(OH)_2O$, forms bright golden-yellow laminæ, yields crystallizable salts having a metallic lustre, and by nascent hydrogen and other deoxidizing agents is converted into *hydrochrysamide*, which is sublimable, and crystallizes in indigo-colored needles.

The above formulas for the three aloins are those of Sommaruga and Egger (1874), and if correct would prove these principles to be homologous. Stenhouse's formula for crystallized barbaloin is $C_{34}H_{36}O_{14}.H_2O$; Tilden's formula for nataloin $= C_{25}H_{28}O_{11}$; Flückiger's formula for socaloin $= C_{34}H_{38}O_{15} + 5H_2O$. Tilden (1875) considers barbaloin and socaloin, although differing in chemical and some physical properties, to have the composition $C_{16}H_{18}O_7$, but to unite with different proportions of water of crystallization. These results were confirmed by E. Schmidt (1876). On pouring a solution of aloin into an excess of bromine-water, a precipitate of *bromaloin*, $C_{16}H_{15}Br_3O_7$, is obtained, which crystallizes from alcohol in beautiful yellow needles. Nataloin does not yield a similar bromine compound.

Kosmann did not succeed (1863) in obtaining a crystallizable body from Cape aloes; he assigned to the yellow amorphous portion, soluble in water and alcohol, the formula $C_{34}H_{22}O_{20}$, and stated that the insoluble portion had nearly the same composition, and that both were glucosides.

Tilden and Rammell examined (1872) the so-called resin from Barbadoes and Socotrine aloes, and observed that by continued boiling a portion of it can be rendered permanently soluble in water. This and the insoluble portion are nearly alike in composition, and appear to differ from barbaloin merely by the elements of water, and, for the insoluble

resin also, by containing less hydrogen. This view is somewhat supported by the change into an amorphous substance when aloin is boiled for a long time with water, or more rapidly in the presence of a little alkali, while small quantities of acid prevent this change. The amorphous *aloetin*, *aloeresin*, and *aloebitter* of older investigators must have been aloin similarly modified.

By continued boiling of Socotrine aloes with alkali, Czumpelick (1861) obtained, among other compounds, crystals of an acid which Hlasiwetz (1865) procured by boiling aloes with dilute sulphuric acid, and named *paracumaric acid;* on fusing this with potassa, *para-oxybenzoic acid* is formed. The latter is also yielded by the same process from aloes, together with oxalic acid, volatile fatty acids, and orcin, and, according to Weselsky (1872), *aloreinic acid*. The latter is soluble in alcohol and ether, sublimable, and acquires a transient purplish-violet color with chlorinated soda.

On distilling aloes with zinc-dust, Graebe and Liebermann (1868) obtained *anthracene*, $C_{14}H_{10}$, and E. Schmidt also *methylanthracene*. On distilling aloes with lime, Robiquet (1846) separated a colorless or yellowish oil, *aloïsol*, of an odor resembling that of amyl alcohol and oil of bitter almond. Rembold (1866) ascertained this aloïsol to be a variable mixture of acetone, xylenol, and other compounds. When incinerated, aloes yields from 1 to 4 per cent. of ash.

Pulvis Aloes et Canellæ, *Hiera Picra*.—Rub together and mix thoroughly Socotrine Aloes 4 ounces, Canella 1 ounce.—*U. S.* 1870.

Action and Uses.—Aloes is presumed to act decidedly upon the lower bowels, since it causes an increase of the hæmorrhoidal flux when it exists, and tends to bring on or augment the menstrual flow. Genital irritation is sometimes manifested. The general belief that aloes tends to produce hæmorrhoids is contradicted by the results of experience: these bodies probably arise from the constipation which aloes is given to relieve. The evident stimulation of the pelvic organs by aloes has led to its use as an abortifacient, but there is no case on record which conclusively proves it to be so. Associated with sodium bicarbonate in watery solution and exposed to the air, aloes loses, in a great degree, its bitterness and its purgative properties. It is held by some that *aloin* is two or three times as active as good aloes. Its cathartic action is said to be uniform, rather more speedy than that of crude aloes, and unattended by griping.

The action of aloes upon the stomach and indirectly on the liver, and its slow and moderate operation as a purgative, have led to its use in habitual *constipation;* and it enters into numberless compounds devised for the relief of that condition, especially as it presents itself in persons of sedentary habits, on the approach of old age, as an effect of repeated pregnancy, etc. It is said to be contraindicated by a plethoric, bilious, or hæmorrhagic constitution, when the liver is congested, during pregnancy, and when hæmorrhoids exist; but these statements are not justified by experience. As regards *hæmorrhoids*, those attended with a mucous discharge are most apt to be benefited by aloes. *Ascarides* of the rectum may often be destroyed by enemas of aloes, of which the best consists of aloes dissolved in an infusion of quassia. *Jaundice* from "hepatic torpor" or congestion may be successfully treated with purgative doses of aloes combined with blue pill. The condition so called, however, usually depends on constipation. In simple *amenorrhœa* of the torpid sort aloetic purgatives are very efficient, especially in the form of tincture, or of the pill of aloes and myrrh, or of the powder of aloes and canella. Aloes and iron are equally valuable in cases of *menorrhagia* arising from debility, and enemas of aloes and soap have been found serviceable in curing atonic *uterine catarrh*. Aloetic laxatives will sometimes arrest *gleet*. Powdered aloes, which is used in veterinary surgery, has been of great service in treating lacerated *wounds* (Millett). The other local applications of aloes are described in connection with the tinctures into which it enters.

Aloes in pilular form is best administered alone, or simply associated with soap or with an alkaline carbonate to promote its solution. As a laxative it may be given in the dose of from Gm. 0.20–0.60 (gr. iij–x). Custom has, however, sanctioned its use in combination with mastic for this purpose; or one of the pills alluded to above, so compounded that its several constituents shall be fitted to act upon the several divisions of the intestinal canal. In these preparations the proportion of aloes should not exceed two or three grains in each dose. The tincture and the wine of aloes are occasionally used as purgatives. Its combinations with myrrh, with asafœtida, and with cannella are especially adapted to the treatment of derangements of the catamenia, and those with benzoin are used as internal and also as local stimulants. Aloin may be substituted for aloes in the various pills containing the latter. As a prescription for the relief of habitual constipation due to sluggishness of the bowels or torpor of the liver the following formulæ have

been recommended; ℞. Aloes gr. ¼; Ferri sulph. exsic. gr. iss; Quiniæ sulph. gr. j; Capsici gr. ¼; Ext. nucis vomic. gr. ss; Ext. gentianæ q. s. ut ft. pil. To be taken two or three times a day, after meals. ℞. Aloes gr. ¼; Strychninæ gr. $\frac{1}{60}$; Ext. belladonnæ gr. ⅛; Ipecacuanhæ gr. $\frac{1}{16}$. M. ft. pil. S. at bed-time.

ALSTONIA.—Dita-Bark.

Écorce de dita, Fr.; *Ditarinde*, G.

The bark of Alstonia (Echites, *Linné*) scholaris, *R. Brown*. Bentley and Trimen, *Med. Plants*, 173.

Nat. Ord.—Apocynaceæ.

Origin.—Dita-bark comes from a stately forest tree indigenous to the East Indies, Eastern Australia, the Philippines, and other neighboring islands. The wood is soft and white, and the greenish-white flowers have, in the night, a strongly aromatic odor.

Description.—The bark is in thick curved pieces, usually about 2 or 4 inches (5 to 10 Cm.) long, ½ an inch (12 Mm.) broad, and ⅛ to ⅓ inch (3 to 8 Mm.) thick. It is externally of a leather color, has a scaly appearance from its longitudinal and transverse fissures, and is not unfrequently marked with small black spots. Internally it is light yellowish-brown, the inner surface brown-gray and longitudinally striate. The bark breaks with a short, or rather horny, somewhat porous fracture, showing in the outer layer groups of yellow stone-cells, and in the inner layer narrow wavy medullary rays, and yields a yellowish-gray powder, which is inodorous and has a slightly bitter not unpleasant taste.

Constituents.—G. Gruppe of Manilla obtained from dita-bark about 2 to 5 per cent. of *ditaine*, which was uncrystallizable, very hygroscopic, and bitter. Jobst and Hesse (1875) obtained from the aqueous solution of the alcoholic extract by lead acetate a precipitate containing a crystalline and an oily acid, by lead subatetate a precipitate containing resin-like bodies, and by phosphotungstic acid a precipitate containing the alkaloid *ditamine*, $C_{16}H_{19}O_2$, which is a white bitter powder soluble in ether, alcohol, chloroform, and benzene, and by sulphuric acid is colored red, on warming violet-red; by nitric acid yellow, on warming dark-green to violet. Only .02 per cent. of the alkaloid was obtained, which yields very bitter salts. The bark yields to petroleum benzin several fatty and resinous substances, named *echicaoutchin*, *echiretin*, *echicerin*, *echitin*, and *echitein*, and the three last of which are crystallizable. Harnack (1877) isolated a crystalline alkaloid, *ditaine*, which Hesse (1881) named *echitamine*, $C_{22}H_{28}N_2O_4$. It forms glossy prisms containing $4H_2O$, is a strong base, is almost insoluble in benzene and benzin, and dissolves readily in water, alcohol, and, if freshly precipitated, also in ether and chloroform. Its hydrochlorate is sparingly soluble in cold water and nearly insoluble in hydrochloric acid and in alkali chlorides. Sulphuric acid imparts a deep purplish-red color, changing to green. Hesse obtained also a third alkaloid, *echitenine*, $C_{20}H_{27}NO_4$, which is amorphous, brown, easily soluble in alcohol, less so in water, and is colored reddish-violet by sulphuric acid, and purple, afterward green and yellow, by nitric acid.

Allied Drug.—The closely allied *poele-bark* of Java, which comes from Alstonia spectabilis, *R. Brown*, yielded to Hesse 0.8 per cent. of echitamine, or fully six times the quantity contained in dita-bark; it contains also the other alkaloids in larger proportion than the latter; and in addition thereto *alstonamine*, which resembles ditamine in behavior, but is crystallizable; it was isolated by A. Scharlée in 1862, and then named *alstonine*, but this name is now used for one of the alkaloids of Australian alstonia-bark.

Alstonia-bark, from Alstonia constricta, *F. Mueller*, a native of Australia, differs greatly in appearance from the dita-bark in being 3 to 5 Cm. (1¼ to 2 inches) thick, deeply furrowed, externally brown-gray, or after abrasion ochrey-yellow, and ridged upon the inner surface; the bast-layer is about 6 Mm. (¼ inch) broad, yellow, tough and fibrous, and is covered by the thick, spongy, and friable corky layer, which is composed of alternating bands of lighter and darker ochre color, these bands being present also in the much thinner bark from young wood, with a relatively thin periderm; the powder is grayish-yellow, odor slight, taste persistently bitter.

The bark was described and its origin determined by Charles Mohr (1879). Palm (1863) found in it a neutral bitter principle, *alstonin:* Hesse (1865) two alkaloids, *chlorogenine* and *porphyrine:* Mueller and Rummel described an alkaloid, *alstonine:* and Oberlin and Schlagdenhauffen (1879) a second uncrystallizable alkaloid, *alstonicine*. The alkaloids characterized by Hesse in 1881 are: *alstonine* (chlorogenine), $C_{21}H_{20}N_2O_4$, brownish-yellow, amorphous, readily soluble in alcohol, and, when freshly precipitated, also in chloroform and water, sparingly soluble in ether; its salts are insoluble in dilute acids; *porphyrine*, $C_{21}H_{25}N_3O_2$, white, amorphous, soluble in petroleum naphtha, freely soluble in ether, alcohol, and chloroform, the acid solutions of a

blue fluorescence: sulphuric or nitric acid dissolves it with a purple color, that with nitric acid changing to yellowish and brownish green; *alstonidine* crystallizes from its solutions in chloroform, ether, alcohol, acetone, and hot petroleum naphtha; is not colored by sulphuric or nitric acid, but its solutions show blue fluorescence. One or more other alkaloids are present in minute quantity.

Allied Species.—In the East Indies the root of Echites malabarica, *Lamarck*, is used as a febrifuge, and the leaves as an application to carbuncles; the leaves of Ech. caryophyllata, *Roxburgh*, in arthritic fevers; and the bark of Ech. pubescens, *Buchanan*, and Ech. antidysenterica, *Roxburgh*, like the Brazilian Ech. Cururu, *Martius*, Ech. insignis, *Sprengel*, and Ech. longiflora, *Desfontaines*, in diarrhœa and dysentery. Ech. syphilitica, *Linné filius*, of Surinam, is used there in syphilitic complaints.

Under the name of *conessi-bark* the bark of one or two of the above species has sometimes been used; but true conessi-bark is referred to Wrightia (Holarrhena) antidysenterica, *R. Brown*. It contains an alkaloid which was discovered by Haines (1858), but obtained pure by Stenhouse (1864), and has been named *conessine*, *wrightine*, and *kurchicine*: it is white, amorphous, bitter, and readily soluble in alcohol, ether, and dilute acids.

Action and Uses.—Dita-bark and also its alkaloid are reported to have been used successfully in *intermittent fever* in the East Indies, where also curare is employed for the same purpose. According to Cathcart, "the bitter bark of Alstonia constricta, sometimes called native quinine, is in common use by the shepherds in the interior of Southern Australia as a domestic remedy for malarial fevers" (*Amer. Jour. Phar.*, Aug. 1879, p. 405). *Anderjoia or Concassi* bark has long been used in the East Indies in the treatment of *dysenteric* affections, and generally as a bitter tonic. In the disorders named it has been compared with ipecacuanha. It has also been employed to cure *periodical fevers*, and locally the fresh juice of the tree was applied as a dressing to wounds.

ALTHÆA, *U. S.*—Marshmallow-Root, Althea.

Radix althææ, P. A., P. G.—*Guimauve*, Fr. Cod.; *Althee, Eibisch*, G.; *Altea, Malvavisco*, Sp.

The root of Althæa officinalis, *Linné*. Woodville, *Med. Bot.*, 198; Bentley and Trimen, *Med. Plants*, 35.

Nat. Ord.—Malvaceæ.

Origin.—This perennial herb is indigenous to the temperate portion of Northern and Western Asia and to the greater part of Europe, and has been naturalized in the salt-marshes along the coast of New England and New York. For medicinal purposes the root of the cultivated plant is generally employed; and in Europe the leaves, and occasionally the flowers, are likewise used.

Description.—The root is fit for use when 2 or 3 years old; of older roots only the fleshy branches are used, the woody main root being rejected. It is collected early in the spring or in autumn, and deprived of the radicles and of its brown-yellow cork and outer bark by peeling. It forms nearly cylindrical or obtusely angular and furrowed, somewhat tapering, pieces about 7 to 20 Cm. (3–8 inches) long, and about 12 Mm. ($\frac{1}{2}$ an inch) thick. It is of a white color externally and yellowish-white internally, and breaks with a short and granular fracture, which is fibrous only in the cortical portion from the long slender bast-fibres, visible also upon the surface of the commercial article and imparting to it a somewhat hairy appearance. The surface is marked with the brownish circular scars of the radicles; the internal bark, in diameter about one-tenth of the root, contains bast-fibres in small groups and arranged somewhat in concentric circles, and is separated by the brown cambium-line from the slightly radiate meditullium, having narrow medullary rays and small vascular bundles indistinct to the naked eye, and consisting of a few wood-cells and 3 or 4 ducts marked with circular or elongated dots. The thin-walled parenchyma contains starch, with scattered cells containing crystalline clusters of calcium oxalate, and larger cells filled with mucilage. Marshmallow-root has a faint, peculiar aromatic odor and a sweetish mucilaginous taste.

Young and peeled *belladonna-roots* bear some resemblance to marshmallow, but are readily distinguished by the absence of the hair-like bast-fibres upon the surface and by the yellowish wood-bundles which are plainly visible. Old and discolored roots have been sometimes whitened by lime or calcium sulphate, which is readily recognized in the sediment resulting on leaving the root in contact with water. The infusion of the root is yellowish, mucilaginous, somewhat aromatic, and of an insipid taste; the cooled decoction (but not the cold infusion) is colored blue by solution of iodine.

Powdered marshmallow-root, being very absorbent, is advantageously used to impart to soft pill-masses the proper consistence.

Constituents.—A. Buchner obtained (1832) from marshmallow-root 37.5 per cent. starch, 35.6 mucilage, 11 pectin, also asparagin, sugar, fixed oil, glutinous matter, cellulose, and salts. Cold water will take up the mucilage, sugar, and asparagin, while the decoction will, in addition thereto, contain starch.

Asparagin, $C_4H_8N_2O_3H_2O$, was discovered (1805) by Vauquelin and Robiquet in asparagus, by Bacon (1826) in marshmallow-root, and more recently in many other plants. L. A. Buchner obtained it (1862) in a convenient manner by dialyzing the mucilaginous infusion in water and concentrating this solution to the crystallizing point. The yield is about 2 per cent. (Plisson). It forms colorless, inodorous, and nearly tasteless crystals, which are insoluble in strong alcohol and ether. It unites with both acids and alkalies, and when boiled with them is converted into *aspartic* or *amido-succinic acid*, $C_4H_7NO_4$, and ammonia; hence asparagin is *amido-succinamide*. Nitrous acid converts it into malic acid, $C_4H_6O_4$, water, and nitrogen.

Allied Drugs.—Folia althææ, *P. A.*, *P. G.*; Feuilles de Guimauve, *F. Cod.* Marshmallow-leaves are petiolate, 5 to 8 Cm. (2–3 inches) long, roundish-ovate or subcordate, three- or five-lobed, irregularly crenately toothed, of a grayish-green color, and both sides velvety-downy with stellate hairs; their taste is mucilaginous.

Fleurs de Guimauve, *F. Cod.*—The medium-sized *flowers* have a nine-leaved downy involucre, 5 sepals and petals, the latter rose-colored and retuse above; stamens numerous, united in a column and with the short claws of the petals; taste mucilaginous.

Allied Species.—Most plants of the order Malvaceæ possess mucilaginous properties, and many are employed in their native countries in regular or domestic practice. The following appear to deserve a passing notice:

Althæa (Alcea, *Linné*) rosea, *Cavanilles*, Hollyhock, *E.*; Rose-trémière, Passe-rose, *Fr.*; Stockrose, Stockmalve, *G.*, is indigenous to the Levant, frequently cultivated in gardens. The flowers, *Flores malvæ arboreæ*, are nearly sessile, 7 to 10 Cm. (3 or 4 inches) in diameter, have a tomentose calyx, a six-cleft involucre, and 5 broad or retuse petals, which are connected at the base with the column of the united stamens. The purple-colored flowers are generally preferred.

Malva sylvestris, *Linné*, High mallow, *E.*; Mauve sauvage. Grande mauve, *Fr.*; Käsepappel, Waldmalve, *G.* It is a native of Europe, somewhat naturalized in North America, has an erect or decumbent stem .75 M. (about 2½ feet) high, roundish-reniform, five- or seven-lobed and crenately-toothed leaves, and purplish, dark-veined flowers, which resemble the preceding, but are only 25 Mm. (1 inch) wide, and have a pubescent three-leaved involucre. The dried flowers, *Flores malvæ* (*vulgaris*), P. A., P. G., are bluish, and turn green with ammonia and red with acids.

Malva vulgaris, *Fries*, s. M. neglecta, *Wallroth*, resembles the preceding, but the stem is procumbent, the leaves are smaller and obtusely lobed, and the petals rose-colored or whitish. The leaves of this and the preceding species constitute the *Folia* (*herba*) *malvæ*, (P. A.) P. G.; *Mallow-leaves*, E.; *Feuilles de mauve*, Fr.; *Malvenblätter*, G.; *Malva*, Sp.

Malva rotundifolia, *Linné*, Common mallow, *E.*; Petite mauve, *F. Cod.*; Käsekraut, *G.*; is indigenous to Europe, extensively naturalized in America; has a procumbent stem, round, heart-shaped somewhat lobed and crenate leaves, whitish flowers with slightly retuse rather short petals, and numerous wrinkled one-seeded carpels circularly arranged.

Hibiscus (Abelmoschus, *Guillemin et Perrottet*) esculentus, *Linné* (cancellatus, *Roxburgh*, variety), Okra or Gombo. Bentley and Trimen, *Med. Plants*, 36.—It is indigenous to tropical Africa, and cultivated in most tropical and subtropical countries. The heart-shaped about five-lobed toothed leaves and the unripe capsules are used. The latter are about 6–25 Cm. (2½ and sometimes 10 inches) long, about five-angled, narrow cylindrical, tapering above, hairy, often curved, and contain one row of roundish reniform seeds in each cell. The pericarp abounds in mucilage.

Hibiscus Abelmoschus, *Linné*, Abelmoschus moschatus, *Moench*, indigenous to India and Egypt, naturalized in tropical America, yields *Semen abelmoschi s. Grana moschata*—*Musk-seed*, E.; *Ambretta*, *Graine de musc*, Fr.: *Moschuskoerner*, *Bisamkoerner*, G.—These seeds are flattish reniform, about 3 Mm. (⅛ inch) long, grayish-brown, concentrically striate, blackish at the hilum, internally whitish and oily, and have a thin endosperm and curved embryo. The strong musk-like odor resides in the testa, and becomes more apparent on rubbing or warming. The seeds are used in perfumery as a substitute for musk. The distilled oil contains acetic and palmitic acids, and when freed from the fat acid remains liquid at 0° C.

Hibiscus Sabdariffa, *Linné*, Red sorrel, Rozelle, *E.*; Oseille de Guinée, Ketmie acide, *Fr.*—It is indigenous to Africa, and cultivated and naturalized in the tropics. The yellow and red calyx is provided with a twelve-cleft light-red involucre, and is used on account of its mucilage and free tartaric and malic (or oxalic?) acids. In Mexico and in Texas it is known as *jamaica*.

Hibiscus Rosa-sinensis, *Linné*, China rose, *E.*, *G.*; Rose de Chine, *Fr.*—Cultivated. The root is used in the East like marshmallow. The stem-bark is said to be emmenagogue.

Abutilon avicennæ, *Gærtner*, s. Sida Abutilon, *Linné*, indigenous to India, naturalized in America, and known as *velvet leaf*. The roundish-cordate leaves and yellow flowers are mucilaginous. Abutilon indicum, *Don*, is employed in India.

Several species of Hibiscus yield valuable textile fibres; also several species of Sida, of which genus S. cordifolia, S. spinosa, *Linné*, and others are medicinally used in India, and S. floribunda, S. rhombifolia, *Linné*, and others in South America.

Pharmaceutical Preparations.—Species althææ. Althea-leaves 100; althea-root 50; glycyrrhiza 25; mallow-flowers 10 parts—*P. A.*

Species emollientes. Althea-leaves, mallow-leaves, melilot, German chamomile, and flaxseed, in coarse powder, equal parts.—*P. G.* Chamomile is omitted and flaxseed doubled in quantity by *P. A.*

Species pectorales, *P. G.*; Pectoral tea, *E.*; Espèces pectorales, *Fr.*; Brustthee, *G.* A mixture of cut althea-root 8 parts, peeled liquorice-root 3, orris-root 1, colt's-foot leaves 4, mullein-flowers 2, and anise 2 parts.—*P. G.* Althea-leaves 200; glycyrrhiza 150; althea-root 50; pearl barley 50; mullein-flowers 10; mallow-flowers 10; red poppy 10; star-anise 10 parts.—*P. A.* Equal parts of the flowers of mallow, marshmallow, mouse-ear, colt's-foot, red poppy, violet, and mullein.—*F. Cod.* Although composed of seven flowers, it is known in France as *quatres-fleurs*.

Action and Uses.—Marshallow is an emollient protective, and is somewhat nutritious. It is employed in Europe as a *demulcent* in all *inflammatory* and irritable conditions of the mucous membrane of the respiratory, digestive, and urinary organs, and poultices formed of the bruised or powdered root are applied to *inflammations of the skin* and local eruptions—*e. g. herpes, palmar psoriasis*. An ointment prepared with the fresh leaves is well adapted to these purposes. The decoction has been used as an injection to allay irritation of the *vagina* and of the *rectum*. It is prepared by adding the sliced root to hot water, to the production of a mucilage of the required thickness. The root is made use of in France, as orris-root is elsewhere, for teething children to bite upon. The so-called marshmallow paste contains no marshmallow. All the other plants above enumerated may be used, like marshmallow, as demulcents.

Sida floribunda was found by Martinet of Lima to possess vermicidal properties, which he attributes to the mechanical action of the minute stiff spines that beset its leaves. He was indebted for this alleged discovery to the instinct of a dog (*Nouveaux Remèdes*, Juill. 1887).

ALUMEN, *U. S., P. G.*—Alum.

Aluminii et potassii sulphas, U. S. 1870; *Sulphas aluminico-potassicus.—Potassium alum, Aluminum and potassium sulphate*, E.; *Alun, Sulfate d'alumine et de potasse*, Fr.; *Alaun, Kalialaun*, G.; *Solfato di alluminio e di potassio*, F. It.; *Alumbre*, Sp.

Formula $K_2Al_2(SO_4)_4 24H_2O$. Molecular weight 946.46.

Alumen, Br.; *Alumini et ammonii sulphas, Sulphas aluminico-ammonicus.—Alum, Ammonium alum*, E.; *Alun ammoniacal*, Fr.; *Ammoniakalaun*, G.

Formula $(NH_4)_2Al_2(SO_4)_4 24H_2O$. Molecular weight 904.42.

Origin.—Alums are compound sulphates, readily crystallizing in cubes and octahedrons of the regular system, and containing 24 molecules of water of crystallization, and 2 atoms each of a univalent and trivalent basylous radical. The most important trivalent radicals which are capable of forming alums are aluminum, chromium, and iron, and the univalent radicals potassium, sodium, and ammonium. Ordinarily, the name *alum* is indiscriminately used for the alumino-ammonium and for the alumino-potassium alum, both kinds being recognized as such by the British Pharmacopœia, while the United States, French, and German Pharmacopœias recognize the latter only.

Salts possessing a styptic taste (among them alum) were known and employed in ancient times. In the Lipari Islands it appears to have been found as the product of disintegration of alum-stone and alum-slate, and in the sixth century B. C. it was employed by the Phœnicians in dyeing. But the ancient Greek name, *stypteria*, and the Latin, *alumen*, were given alike to various minerals and different products, and afterward the latter were insufficiently distinguished for many centuries. The earthy constituent of alum was first shown by Marggraf (1754) to be distinct from lime. Agricola and Libavius in the sixteenth century had recognized the necessity of using putrid urine (ammonia compounds) for the production of alum. Marggraf had observed that alumina and sulphuric acid would not produce alum until after the addition of potash; but the existence of alkali in alum was first proven by Lavoisier (1777), and by Chaptal and Vauquelin (1797), the latter showing that either potash or ammonia may be present. Soda alum was first prepared by Macintosh at the beginning of the present century. The exact composition of alum was further determined by Vauquelin, Thénard, Berzelius, and others.

The minerals most largely used in the manufacture of alum are *alum-stone*, or *alunite*, and *alum-slate*. The former contains aluminum and potassium sulphates and aluminum hydroxide; the latter consists mainly (about two-thirds) of clay or aluminum silicate, the remainder being pyrites (iron sulphide) and bituminous matter, together with small quantities of lime, manganese, etc.

Preparation.—When calcined clay containing but little iron (pipe-clay) is treated with sulphuric acid until a pasty mass is obtained, this, on exposure to the air, will be gradually converted into aluminum sulphate, which needs merely to be mixed, while in solution, with ammonium or potassium sulphate to obtain crystals of alum. Previous to calcination the clay is often mixed with 12 to 15 per cent. of charcoal or coke, after which the combination with the sulphuric acid is more readily effected. This is one of the processes employed in the United States, where alum is also made from cryolite by heating it with strong sulphuric acid, washing with a little cold water, dissolving the aluminum sulphate in hot water, and adding potassium or ammonium sulphate.

To prepare alum from alum-stone, this is calcined and then made into heaps, which are kept moist; after several months it has become disintegrated and converted into alum, which is extracted by water and crystallized.

Alum-slate or shale is broken up and made into heaps, which are exposed to the air for several months or years; or, if the mineral be very hard, it is first subjected to a process of slow roasting by stratifying it with wood or coal, setting fire to the heaps, and covering it more or less in order to prevent too great a rise of temperature. During the exposure the sulphur of the pyrites is oxidized to sulphuric acid, aluminum and iron sulphates being formed, which are obtained in solution by lixiviating the heaps with water. This solution is concentrated, and while hot mixed with potassium chloride, which, reacting with the ferric sulphate, yields potassium sulphate and ferric chloride, the latter remaining in solution in the mother-liquor, from which the alum separates on cooling as a crystalline powder. If the lixivium of the alum-heaps does not contain sufficient ferric sulphate, the potassium chloride is partly replaced by the sulphate. It is obvious that by this process potassium alum is obtained, or ammonium alum if the corresponding ammonium compound is substituted for the potassium salt. The alum is purified by one or two recrystallizations, the last one being performed in large vats which can be taken apart.

The potassium chloride necessary in this process is obtained as soap-boiler's waste and as the refuse of saltpetre-refineries. The ammonium sulphate is cheaply obtained from the liquor of gas-works.

Alum is extensively manufactured in the United States, but its consumption in the arts is so great that over 8,500,000 pounds of the different commercial kinds were imported in 1878, the importation having been reduced since 1880 to less than 2,500,000 pounds.

Properties.—The two official alums are similar in every respect, except that the ammonium alum gives the odor of ammonia on the addition of an excess of potassium hydroxide or carbonate, and, when heated to full redness, leaves finally alumina. Potassium alum, at a white heat, leaves a mixture of alumina and potassium sulphate; but if mixed with one-third its weight of sugar or similar organic matter, the mixture carbonized and afterward heated to redness in a flask, contact with air being avoided, a powder known as *Homberg's pyrophorus* is obtained, which consists of an intimate mixture of alumina, charcoal, and potassium sulphide, and which ignites spontaneously on exposure to the air.

Alum crystallizes in colorless, inodorous, transparent regular octahedrons, which are usually combined with the cube. Its specific gravity is 1.724—of ammonium alum, only 1.631. It has an acidulous sweetish and astringent taste, and an acid reaction to test-paper. Its aqueous solution dissolves iron, zinc, and other metals which are soluble in diluted sulphuric acid, with the evolution of hydrogen. It is insoluble in alcohol or ether, effloresces slightly on exposure to the air, losing at 40° C. (104° F.) 2.7 per cent., and at 47° C. (116.6° F.) 9.6 per cent. of water; when heated to about 92° C. (197.6° F.) it fuses, and loses all of its water of crystallization (45.52 per cent.) at 200° C. (392° F.), leaving a voluminous white mass. (See ALUMEN EXSICCATUM). Ammonium alum loses all its water of crystallization (47.6 per cent.) at above 205° C. (401° F.). At a full red heat both are decomposed, but to effect the complete decomposition of potassium alum a white heat is required, when sulphuric and sulphurous anhydride and oxygen are given off. According to Poggiale (1843), 100 parts of water dissolve at—

	0°	10°	20°	30°	40°	50°	80°	100° C.
Ammonium alum,	5.22	9.16	13.66	19.29	27.27	36.51	103.08	421.9 parts.
Potassium alum,	3.9	9.52	15.13	22.01	30.92	44.11	134.47	357.48 "

The determinations made by Mulder (1864) closely agree with those of Poggiale for ammonium alum, but differ considerably for potassium alum. 1 part of the latter, according to Redtenbacher (1865), dissolves at 17° C. (62.6° F.) in 7.41 parts, and, according to Poggiale, at 20° C. (68° F.) in 6.61 parts, and at 10° C. (50° F.) in 10.5 parts of water; this last figure is given by both the British and German Pharmacopœias as the solubility of alum at 15° C. (59° F.), while Mulder's results at the same temperature are 10.9 parts.

The U. S. Pharm. gives the solubility of potassium alum at 15° C. (59° F.) at 1 in 9 parts of water, and as 3 in 1 part of boiling water; it is also freely soluble in warm glycerin.

Tests.—The alkalies and alkali carbonates precipitate white gelatinous aluminum hydroxide, which is insoluble in ammonia and the carbonated alkalies, but dissolves in an excess of caustic soda and potassa. Commercial alum always contains a little iron, from which it cannot be completely freed by recrystallization. It is owing to its presence that solutions of alum become blue on the addition of potassium ferrocyanide, and yield a grayish precipitate with ammonium sulphide. The limit of this impurity is thus ascertained: A solution of 1 Gm. of alum in 20 Cc. of water should not at once assume a blue color on the addition of 5 drops of test-solution of potassium ferrocyanide.—*U. S.* The German Pharmacopœia requires the same limit. The solution of alum in caustic potassa or soda should not give off the odor of ammonia (absence of more than traces of ammonium alum), nor should it yield a precipitate with hydrogen or ammonium sulphide (absence of zinc and other metals).

Action and Uses.—Primarily, alum constringes all organic fibres, and hence tends to diminish blood-supply and secretion in living parts; but, secondarily, it increases both as a result of its continued use. This operation it is of the utmost importance to remember in its therapeutical applications. It is said to exert a destructive action upon the enamel of the teeth. Alum is absorbed from the stomach, and is found in the urine, liver, and spleen (Orfila); but its local action is that of an irritant, whereby it readily excites vomiting when freely administered. Its operation is not violent, however, and it does not occasion nausea. In other words, it is a mechanical emetic.

Alum is of advantage in severe *hæmorrhages*, and particularly in those of a passive type. Thus, in gastric and intestinal hæmorrhages its efficacy will depend upon whether the blood is rapidly or slowly extravasated; in pulmonary hæmorrhage, which is generally active, its efficiency is not very great; while in *menorrhagia* and *hæmaturia* it is appropriately and beneficially employed. In various *fluxes* its astringent operation is advantageous. In *gastric* and *intestinal catarrh* it represses the secretion of mucus and the vomiting or diarrhœa that results therefrom. The *diarrhœa* of *typhoid fever* is better treated by alum than by any other astringent, except, perhaps, acetate of lead. In chronic *dysentery* it is a valuable remedy for occasional use, and even in the acute form of the disease alum enemata have been found efficient. In other fluxes it may lessen the discharge, as in *diabetes*, but its utility is not very great. In *diabetes insipidus* or *polyuria* it would probably be more useful. Formerly, it had much repute in chronic *bronchial fluxes*, and it is still found advantageous in diminishing excessive secretion from the air-passages, and not merely in chronic but also in acute bronchitis, and especially in that form which occurs as an element of *whooping cough* and is attended with a profuse expectoration of ropy mucus. Probably its utility is due to its action in constringing the mucous membrane at the orifice of the larynx and blunting its sensibility. Strangely enough from a rational point of view, some forms of *constipation* are favorably affected by alum, as that in which the condition depends upon atony of the bowels maintained by habitual distension of them by flatus. It is still more singular that in *lead colic*, a disease in which the intestine is spasmodically contracted, alum has been proved efficient in overcoming the constipation. For this purpose it should be given in doses of from Gm. 4–12 (ʒj–iij) daily, dissolved in a large quantitity of water slightly acidulated with sulphuric acid. As an emetic alum may be employed whenever mechanical emetics are indicated, and particularly in *pseudo-membranous laryngitis*, or true *croup*, a disease in which such emetics are peculiarly indicated, but in which nauseants are exceedingly mischievous. In *narcotic poisoning* similar evacuants are indicated, and none is better than alum, especially in children. It probably operates not only as an emetic, but by its astringent action on the gastric mucous membrane it checks the absorption of the poison. Alum is one of the many remedies that occasionally cure *intermittent fever*, even after the failure of quinine. It is still used in India, where burnt alum is preferred, and given by some in doses of Gm. 0.50 (gr. viij) three hours before the expected paroxysm,

while others prescribe powdered alum, from 50 to 100 grains a day, divided into six doses (Uhle, *Bull. de Thérap.*, cix. 229).

The topical uses of alum are numerous. It is extensively employed to arrest *hæmorrhage*. As a local hæmostatic it is used to check bleeding from the nostrils, gums, anus, vagina, bladder, and rectum, from leech-bites and from the sockets of extracted teeth, etc. In all such cases it may be applied in powder or in a strong solution upon sponge or lint. The solution should be used warm, and allowed to cool where it is applied. Lotions of alum-water are useful in repressing local and general *sweats*, and particularly the fetid secretions of the feet, armpits, etc.; the solution should not be strong, and should be applied warm; it is improved by the addition of salicylic acid. In *ophthalmia* a solution of Gm. 0.25 (gr. iv–v) to the ounce of water may be instilled into the eye, but a much better method is to apply a poultice made by stirring finely powdered alum and white of egg together, and enclosing the coagulated albumen in a cambric bag. This application is a most excellent one for recent *ecchymoses*. *Aphonia* from laryngeal atony is diminished by gargles of a drachm of alum or Gm. 4 in Gm. 100 (℥j in f℥iij) of barley-water; and the same remedy is of constant use for the relief of *sore throat*, especially of that form of *tonsillitis* in which the soft parts are tumid. In the graver forms of *angina*, and especially in *diphtheria* and *gangrenous pharyngitis*, gargles, insufflations, and atomized solutions of alum have been much employed; they probaby tend to promote the separation of the exudation, if not to check its formation. As far as the local treatment of the diseases in question goes, alum is useful, although less so than other agents; but they, and especially diphtheria, are not merely local affections, and cannot be cured by such treatment alone. Alum washes are useful in all the forms of *stomatitis*, but especially in the ulcerative form. In subacute, in mild acute, and in chronic *laryngitis* gargles containing alum are of decided advantage, but the medicine is still more useful when it is applied to the interior of the larynx in an atomized solution. Finely-powdered alum or burnt alum is one of the best applications for *ingrowing teeth*, as when a posterior molar tooth of the lower jaw becomes partially covered by the gum, subjecting it to contusion and irritation and producing a very painful sore. The overhanging flesh should be first cut away with a gum-lancet. In the analogous affection, *ingrown toe-nail*, the same application is of great use if ulceration with granulation has already taken place; but it is essential that scraped lint should be introduced between the nail and the sore, and that the movement of the parts should be restricted by a narrow roller of adhesive plaster. The stimulant and astringent action of alum makes it a useful application in *chilblains*. In all cases of morbid and exuberant action of mucous membranes besides those above noticed alum renders important services. For indolent *ulcers*, whether arising from *burns* or otherwise, and for all profuse mucous and purulent discharges from mucous membranes, when the inflammatory element is not active and the parts are relaxed, it is one of the best remedies. Its efficacy is shown conspicuously in cases of *relaxation* of the *gums*, *uvula*, *pharynx*, *vagina*, and *anus*. In vaginal *leucorrhœa* alum injections are better than any others, and washes of the same in leucorrhœa of the vulva. In the former of these two affections a tampon of cotton coated with finely-powdered alum may be applied by means of a speculum, or a cylinder of cotton cloth saturated with a solution of alum, of which the strength should vary with the grade of inflammation present. Injections of a solution of alum may be used in the treatment of *gonorrhœa* and *gleet* in the male, a weak solution being generally the most efficient. Some physicians, however, give a preference to a saturated solution. A mixture of alum, mucilage, and sulphuric ether has been applied to carious cavities for the relief of *toothache*.

Administration.—Alum may be administered internally in doses of Gm. 0.30–2.60 (gr. v–xl), mixed with powdered sugar or with syrup. A few grains of some aromatic prevent its nauseating effects. The emetic dose is Gm. 4–8 (℥j–ij) given in syrup; when retching commences vomiting may be promoted by warm water. *Alum whey* is made by boiling Gm. 8 (℥ij) of powdered alum in a pint of milk, and straining; the *curd* left behind is applicable to the purposes already mentioned, and may be prepared with white of egg instead of milk. Alum *gargles* are made with Gm. 15–30 (℥ss–j) of alum in a pint of water, which may be sweetened with honey. Vaginal injections may be used of about the same strength. As in the case of other irritants employed in this manner, care must be taken not to throw the injection into the uterus. For *collyria* a solution of Gm. 0.10–0.20 (gr. ij–iij) of alum in an ounce of water is usually sufficient; for *hæmostatic* uses a hot saturated solution is preferable.

Aceto-tartrate of *aluminum* is caustic and disinfectant. It has been employed in watery

solution in various affections of the face, nostrils, and pharynx. It may be applied on a mop in a 25 per cent. watery solution, or mixed with an equal quantity of some inert powder (Holste).

ALUMEN EXSICCATUM, *U. S., Br.*—Dried Alum.

Alumen ustum, P. G.—*Burnt alum*, E.; *Alun calciné, A. desséché, A. brulé*, Fr.; *Gebrannter Alaun*, G.; *Allume usto*, It.

Formula $K_2Al_2(SO_4)_4$. Molecular weight 515.42.

Preparation.—Alum, in small pieces, 100 Gm.; to make 55 Gm. Place the alum in a shallow porcelain capsule, so as to form a thin layer, and heat it on a sand-bath until it liquefies. Then continue the application of a moderate heat, with constant stirring, until aqueous vapor ceases to be disengaged, and a dry, white, porous mass is obtained, weighing 55 grammes. When cold, reduce the product to a fine powder, and preserve it in well-stoppered bottles.—*U. S.*

The British Pharm. gives the same process, simply adding that the temperature shall not be allowed to rise above 204.4° C. (400° F.).

Properties.—After exsiccation, dried alum forms a light porous mass which is easily rubbed into a white granular powder. It is very slowly (but completely) soluble in cold water, 20 parts, *U. S.*, 30 parts *P. G.*, at 15° C. (59° F.), but dissolves in a short time in seven-tenths of its weight of boiling water (*U. S.*), these tests being sufficient to prove its faultless preparation. Owing to its slow solubility, its taste is at first slight, but soon becomes more styptic than that of crystallized alum. *Impurities* may be detected in the same manner as in alum.

Action and Uses.—Dried alum is a powerful astringent and stimulant, and when applied to tissues in process of growth may become escharotic. Hence, as was more particularly pointed out in the preceding article, it is used to repress *fungous granulations* and stimulate indolent and sanious *ulcers*, as well as mucous membranes tending to hypertrophy, and with morbid secretions. Powdered dried alum is peculiarly fitted for insufflation.

ALUMINI HYDRAS, *U. S.*—Aluminum Hydrate.

Alumina hydrata, P. G. 1872; *Argilla pura s. hydrata.—Aluminum hydroxide, Hydrated alumina*, E.; *Hydrate d'alumine*, Fr.; *Thonerdehydrat*, G.

Formula $Al_2(OH)_6$. Molecular weight 155.84.

Origin.—Aluminum hydroxide is occasionally found native, forming the rare crystalline mineral *gibbsite*, $Al_2(OH)_6$, of North America, and *diaspore*, $Al_2(OH)_2O_2$, of Eastern Europe. For use in medicine it is prepared by precipitating the solution of an aluminum salt with an alkali or alkali carbonate. Alumina is more frequently found in the ashes of cryptogamous plants than those of phænogams.

Preparation.—Alum 100 Gm.; Sodium Carbonate 100 Gm.; Distilled Water a sufficient quantity. Dissolve each salt in 1000 cubic centimeters of distilled water; filter the solutions and heat them to boiling. Then, having poured the hot solution of sodium carbonate into a capacious vessel, gradually pour in the hot solution of alum with constant stirring, and add an equal volume of boiling distilled water. Let the precipitate subside, decant the clear liquid, and pour upon the precipitate 2000 Cc. of hot distilled water. Again decant, transfer the precipitate to a strainer, and wash it with hot distilled water until the washings give but a faint cloudiness with test-solution of barium chloride. Then allow it to drain, dry it at a temperature not exceeding 40° C. (104° F.), and reduce it to a uniform powder.—*U. S.*

On mixing solutions of sodium carbonate and alum a decomposition takes place, resulting in the formation of sodium sulphate and potassium sulphate, which remain in solution; aluminum hydroxide, which is precipitated; and carbon dioxide, which escapes; $3Na_2CO_3 + Al_2K_2(SO_4)_4 + 3H_2O$ yields $3Na_2SO_4 + K_2SO_4 + Al_2(OH)_6 + 3CO_2$. If ammonium alum be used, ammonium sulphate remains in solution in place of potassium sulphate; the sodium carbonate may be replaced by an equivalent quantity of potassium or ammonium carbonate. On adding the alkali carbonate to the alum solution the precipitated aluminum hydroxide persistently retains sulphuric acid and alkali; but on slowly adding the alum solution to the alkali carbonate, so that the latter remains continually in excess, only a minute amount of basic sulphate will enter into the precipitate, and will be almost completely decomposed by digesting the latter with the alkaline liquid. In

order to obtain it absolutely free from sulphate, Berzelius found it necessary to redissolve the washed aluminum hydroxide in hydrochloric acid, and to precipitate this solution with an excess of ammonia. For the washing of the precipitate hot (not boiling) water is directed—a precaution necessary to avoid decomposition of the hydroxide. Sainte-Gille (1855) determined that by prolonged contact with boiling water the hydroxide, $Al_2(OH)_2O_2$, is formed, which is insoluble in dilute acids. Drying the aluminum hydroxide at a low temperature leaves it in a smooth condition and prevents it from becoming gritty. Most of the details of the above process were elaborated by Prof. Lloyd (1879). The yield is 1.8 parts.

Nearly pure aluminum hydroxide is prepared from cryolite. The sodium aluminate obtained in the manufacture of sodium carbonate (see SODII CARBONAS) is treated with milk of lime, resulting in the production of sodium hydroxide and a precipitate of calcium aluminate (see SODA); on dissolving a portion of the latter in hydrochloric acid, chlorides of aluminum and calcium are formed, and this solution, on being digested with another portion of the precipitate, yields more calcium chloride, which remains in solution, and aluminum hydroxide: $Al_2Cl_6 + Al_2(O_2Ca)_3 + 6H_2O$ yields $3CaCl_2 + 2Al_2(OH)_6$.

Properties.—Aluminum hydroxide is "a white, light, amorphous powder, permanent in dry air, odorless, and tasteless and insoluble in water or alcohol; soluble without residue, in (dilute) hydrochloric or sulphuric acid, and also in solution of potassa or of soda. When heated to redness it loses 34.6 per cent. of water of hydration."—*U. S.* A portion of the water is given off already at a temperature a little above 100° C. (212° F.), but for expelling the last 10 or 12 per cent. of it a full red heat is required, when *aluminum oxide*, Al_2O_3, is obtained. Its solution in a mineral acid is not precipitated or colored by hydrogen sulphide, and shows toward alkalies and alkali carbonates the behavior described under ALUMEN. When added to a turbid or colored liquid the impurities suspended and the coloring matter contained therein are precipitated; freshly-precipitated aluminum hydroxide (*alumine engelée*, Fr.) is best adapted for this purpose; hence its use for the clarification of vegetable juices and the preparation of *lakes*, which consist of aluminum hydroxide united with and tinged by pigments.

Tests.—Aluminum hydroxide is liable to be contaminated with alkali carbonate or sulphate and a trace of iron derived from the alum; zinc and other metals can only be present through great carelessness. The allowable limits of these impurities are thus ascertained: A solution of 1 Gm. of aluminum hydroxide in 20 Cc. of diluted hydrochloric acid should not be colored blue by a drop of test-solution of potassium ferrocyanide (iron), and should not give more than a faint cloudiness with test-solution of barium chloride (limit of sulphate). When dissolved in solution of potassa or of soda it should yield no precipitate with hydrogen sulphide (zinc or lead). When boiled with 20 parts of water and filtered, the filtrate should not leave more than a slight residue on evaporation (limit of salts of alkalies).—*U. S.* The presence of calcium compounds is determined by dissolving the aluminum hydroxide in diluted hydrochloric acid, precipitating the solution with an excess of ammonia, adding to the filtrate ammonium carbonate, and boiling, when carbonate of calcium and of other alkaline earths will be precipitated.

Allied Compounds.—CORUNDUM, *E.*, Corindon, *Fr.*, Korund, *G.*, is a mineral consisting of Al_2O_3. It varies in color, forms rhombohedric crystals, is nearly as hard as diamond, and has the specific gravity 3.9. Transparent varieties of it are the gems *ruby* (rubis, *Fr.*, Rubin, *G.*), which is colored red by chromium; the *sapphire* (saphir, *Fr.*, *G.*), which is blue, or if yellow is known as *Oriental topaz*, if green as *Oriental emerald*, and if violet-colored as *Oriental amethyst*. A coarse variety of corundum is known as—

LAPIS SMIRIDIS, S. SMYRIS; Emery, *E.*; Emeril, Corindon granuleux ferrifère, *Fr.*; Smirgel, Schmirgel, *G.* Its English and French names are derived from Cape Emeri on the island of Naxos, where the mineral has been mined from ancient times. It is also found in other parts of Europe and in the United States. Owing to its hardness, it is largely employed for cutting and polishing glass, metals, and other hard substances, and is prepared for this purpose by crushing under stampers, sifting, and, for delicate operations, by elutriation. Its color varies between gray, bluish, and brown.

The metal *aluminum* was first obtained by Woehler (1827) by fusing aluminum chloride together with potassium. St. Claire-Deville (1854) was enabled to prepare it in larger quantities by heating a mixture of 100 parts of aluminum sodium chloride, 35 parts of sodium, and 40 parts of cryolite. Of late years, metallic aluminum has been prepared by electrolysis of the double chloride before mentioned ($AlCl_3.NaCl$); and recently a still more promising process has been patented, which consists in the electrolysis of aluminum oxide, in the form of corundum, in a bath of molten cryolite contained in carbon crucibles. Pure aluminum resembles tin in appearance; its specific

gravity varies between 2.50 and 2.79. It is very ductile, melts at about 700° C. (1292° F.), is not volatile, and is not tarnished on exposure, even at an elevated temperature; but in the form of powder or thin foil it burns to alumina when heated in oxygen, and slowly evolves hydrogen with boiling water.

Action and Uses.—*Hydrate of aluminum* appears to resemble the oxide of bismuth and also magnesia in its action and uses. Like the former, it is absorbent and protective, and, like the latter, antacid. It is suitable for the treatment of *dyspepsia* and of *diarrhœa* when they depend upon an excess of acid in the digestive canal. In Germany it is used in infantile disorders of the stomach and bowels. It may be given in doses of from Gm. 0.20–0.40 (gr. iij–vj). It may be applied externally as a substitute for oxide of zinc, oxide of bismuth, and similar protectives in cases of *intertrigo*, *superficial burns*, etc.

ALUMINI SULPHAS, *U. S.*—Aluminum Sulphate.

Aluminium sulfuricum, P. G.—*Sulfate d'alumine*, Fr.; *Aluminiumsulfat, Schwefelsaure Thonerde*, G.

Formula (crystallized) $Al_2(SO_4)_3 + 16H_2O$. Molecular weight 628.9.

Preparation.—Aluminum sulphate is occasionally found as an efflorescence near volcanoes and upon alum-slate. For medicinal use it should be prepared from aluminum hydroxide, which need not be previously dried, by dissolving it in the requisite quantity of dilute sulphuric acid. 6 parts of strong sulphuric acid, diluted with 35 to 40 parts of water, will be sufficient for combining with the aluminum hydroxide obtained by the process described under Alumini Hydras from 19 parts of ammonium alum or 20 parts of potassium alum; the gelatinous hydroxide will dissolve quite readily. The solution is filtered, and evaporated until a pellicle begins to form, when the vessel should be removed to a water-bath and the evaporation continued until a dry salt remains. Several soluble and insoluble basic aluminum sulphates being known to exist, an excess of aluminum hydroxide should be avoided. Quite as objectionable, or still more so, is an excess of sulphuric acid; the total absence of uncombined acid is readily ascertained by testing the clear solution with sodium thiosulphate, when it should not become turbid by the separation of sulphur, and should not evolve sulphur dioxide.

For use in the arts aluminum sulphate is prepared by heating ammonium alum to a dull-red heat, when the ammonium sulphate is decomposed and expelled, leaving anhydrous aluminum sulphate; or it is made from shale and other aluminous silicates, and is known to dyers as *concentrated alum* or *cake-alum*.

Properties.—Aluminum sulphate may, with some difficulty, be obtained in thin pearly lamellar crystals, but usually forms a white crystalline mass or granular powder. It melts readily in its water of crystallization, and loses it completely when heated to about 200° C. (392° F.), leaving 54.3 per cent. of a light porous mass, consisting of the anhydrous salt, $Al_2(SO_4)_3$. When heated to bright redness, oxygen and sulphuric acid are given off, and alumina is finally left. The salt is quite freely soluble in water, 1.2 parts at 15° C. (59° F.), U. S., and P. G., the solution having an acid reaction to test-paper; according to Poggiale (1843), 100 parts of water dissolve—

At 0°	10°	20°	30°	40°	50°	60°	80°	100° C.
86.85	95.8	107.35	127.6	167.6	201.4	262.6	467.3	1132 parts.

Anhydrous aluminum sulphate is less freely soluble in water. The dilute aqueous solution of the crystallized salt is precipitated by alcohol in pearly flakes, having the composition $Al_2(SO_4)_3 10H_2O$, which, according to Hauer (1854), attract water on exposure to a damp atmosphere and are converted into the official salt. This has an acid, styptic, and, at the same time, sweetish taste. Its aqueous solution shows the presence of sulphuric acid by barium chloride; it is precipitated by caustic potassa or soda, the precipitate being soluble in an excess, but is again separated upon addition of sufficient ammonium chloride solution.

Tests.—The salt generally contains a small quantity of sodium or other alkali sulphate, and often a trace of iron, derived from the alum. The allowable limit of the latter impurity is thus determined: A solution of 1 Gm. of the salt in 20 Cc. of water should not at once give a blue color with 5 drops of test-solution of potassium ferrocyanide. A 10 per cent. solution of the salt should not be affected by hydrogen sulphide (absence of zinc, lead, or copper), nor should it show more than a slight opalescence

within five minutes with an equal volume of decinormal sodium thiosulphate solution (limit of free acid). 1 Gm. of the salt gently heated with 5 Cc. of solution of soda or potassa should not evolve the odor of ammonia.—*U. S.*

Other Preparations of Aluminum.—ALUMINI ACETAS.—Aluminum acetate, *E.:* Acétate d'alumine, *Fr.;* Aluminium acetat, *G.*, $Al_2(C_2H_3O_2)_6+Aq$.—Prepared by dissolving aluminum hydroxide in cold acetic acid; or by decomposing aluminum sulphate with lead acetate, and evaporating at a low temperature, it is obtained as a gum-like mass having an acid reaction and a styptic taste. The solution, heated in the presence of other salts, is decomposed, with the separation of basic aluminum acetate.

An impure solution of the salt, containing also potassium or ammonium sulphate, obtained by mixing the aqueous solutions of 6 parts of sugar of lead and 5 parts of alum, and filtering from the precipitated lead sulphate, is extensively employed in dyeing as a mordant and is serviceable as a disinfectant.

ALUMINI ACETO-TARTRAS, ALUMINUM ACETICO-TARTARICUM—ALUMINUM ACETO-TARTRATE, *E.;* ESSIG-WEINSAURE THONERDE, *G.*—This compound was first prepared by *Athenstadt*, and the process for its manufacture has been patented in Germany. 5 parts of basic aluminum acetate are dissolved in a sufficient quantity of water by aid of 2 parts of tartaric acid, and the solution evaporated to dryness. It occurs in shining almost colorless amorphous masses, with faint acetous odor and an acidulous astringent taste. It forms with water an acid solution, but is insoluble in alcohol. According to *Fresenius*, it is a true chemical compound, having the following average composition: Alumina 23.67; acetic anhydride 30.77; tartaric acid 27.17; water 18.08. The salt has been used in aqueous solution as a non-toxic reliable antiseptic and astringent.

LIQUOR ALUMINI ACETATIS (*Acetici*, P. G.). Solution of aluminum acetate, *E.;* Soluté d'acétate d'alumine, *Fr.;* Aluminiumacetat-Lösung, *G.*—Dissolve aluminum sulphate 30 parts in water 80 parts; add acetic acid (sp. gr. 1.041) 36 parts; triturate calcium carbonate 13 parts with water 20 parts, and add this mixture slowly and with continued stirring to the first solution; set the whole aside for twenty-four hours without applying heat, and stir occasionally; then strain, press the precipitate without washing it, and filter the liquid. It is a clear colorless liquid, having the spec. grav. 1.044 to 1.046, a faint odor of acetic acid, an acid reaction, and a sweetish, astringent taste. On adding to it one-fiftieth of its weight of potassium sulphate and heating it in a water-bath, it coagulates, but after cooling becomes clear again in a short time. The solution is not colored by hydrogen sulphide, and on being mixed with twice its volume of alcohol becomes opalescent, but does not produce a precipitate. On precipitating 10 Gm. of the solution with ammonia, 0.25 to 0.30 Gm. of alumina should be obtained, proving 7.5 to 8 per cent. of basic aluminum acetate.—*P. G.*

The formula of this compound is $Al_2(OH)_2(C_2H_3O_2)_4$; its molecular weight 323.44. The above process is more simple, and yields more uniform results, than the one devised by Hager (1874), in which aluminum sulphate was decomposed by basic lead acetate.

ALUMINI NITRAS. Aluminum nitrate, *E.:* Azotate d'alumine, *Fr.;* Salpetersaure Thonerde, *G.* Formula $Al_2(NO_3)_6.18H_2O$. Molecular weight 748.70. The gelatinous aluminum hydroxide obtained from 33 parts of potassium alum or from 31.5 parts of ammonium alum, when dissolved in 20 parts of official nitric acid, yields a solution containing 26 parts of this salt; diluted with water to 260 parts, the solution contains 10 per cent. of the salt, which is with difficulty obtained in deliquescent crystals, soluble also in alcohol.

ALUMINUM CHLORIDE, in an impure state, has been used to some extent. A solution sufficiently pure for disinfecting purposes is obtained by mixing the solutions of 2 parts of alum and 1 part of anhydrous calcium chloride and filtering from the precipitated calcium sulphate. The pure salt, Al_2Cl_6, is best prepared by dissolving aluminum hydroxide in hydrochloric acid and evaporating carefully, when crystals containing $12H_2O$ are obtained, which are readily soluble in water and alcohol and are decomposed by heat. In the anhydrous state, however, aluminum chloride is volatile.

ULTRAMARINE, *E., Fr.:* Outremer, *Fr.;* Ultramarin, *G.*, is a pigment which was formerly obtained from *lapis-lazuli* or *lazulite*, a mineral found chiefly in Asia, and composed of sulphur compounds and silicates of aluminium and sodium. The preparation of artificial ultramarine was first made known by C. Gmelin in 1828, and about the same time discovered by Guimet. Shortly afterward it was manufactured on a large scale, and its consumption, which was 3,500,000 kilos in 1862 and 8,500,000 kilos in 1872 (R. Hoffmann), was estimated by R. Wagner in 1880 to be 30,000,000 kilos. It is prepared by heating in crucibles a mixture of clay, sodium sulphate, and charcoal nearly to a white heat for several hours. A white compound is first formed, called *white* ultramarine; this passes into *green* ultramarine, which is employed in the arts to a certain extent, but mostly converted into *blue* ultramarine, usually by roasting it in the presence of sulphur. By increasing the amount of silica in the first operation the product acquires a more purplish tint, and by treating these products at an elevated temperature with acids *violet* and *red* ultramarines are prepared. All these compounds are decomposed by acetic acid, which does not affect lazulite. Mineral acids decompose them, separating gelatinous silicic acid, sulphur, and hydrosulphuric acid; red ultramarine evolves sulphurous acid gas on being treated with acids. The exact composition is still unknown. Ultramarine blue is largely used for whiting—that is, neutralizing—the yellow tint of sugar, starch, paper, etc.

Action and Uses.—On account of the acid taste of this preparation it is seldom used alone internally, but is either combined with zinc or is saturated with gelatinous hydrate of aluminium and mixed with the soluble constituents of benzoin. As a topical application a solution of 1 part of the sulphate in about 20 parts of water has been used to promote the healing of ulcers and to correct the fetor of discharges, especially in certain cases of *leucorrhœa* and chronic *dysentery*, and to cure *ulcers* of the cervix uteri. The addition of benzoin to the solution for these purposes also has been recommended. In a concentrated state sulphate of aluminium is a powerful astringent, and in some degree a caustic also. It has been used for destroying exuberant growths, and even *cancerous* tumors. Its free acid corrodes textile fabrics and metals. To mitigate this effect the excess of acid has been neutralized by zinc, and a sulphate of aluminium and zinc formed, which in a pure state acts as a caustic, and either in this condition or mitigated with glycerin may be used to repress fungous granulations, to destroy imperfectly organized tissues and certain hypertrophies, such as *cancers*, vascular *nævi*, and *polypoid* growths, and to stimulate tissues *chronically inflamed*, as those of the nostrils, throat, vagina, rectum, urethra, etc. This double salt has been used for injecting dead bodies, which it preserves unchanged for a long time.

Acetate of aluminium resembles alum in its general astringent action, contracting the tissues and restraining secretion. When 30 or 40 drops of a solution of 1 part of the salt to 8 of water are taken internally, a sense of warmth is excited in the stomach, and if the doses are reiterated some fulness of the head and confusion of the senses result. Added to putrescible mixtures, it restrains or prevents putrefaction, and it has been used to deodorize fetid secretions of sweat, pus, mucus, etc. It has been used in solution (1 : 4) to abort *furuncles* of the auditory canal. The liquid was instilled into the passage every four hours. As a lotion or injection 1 part of a 10 per cent. solution mixed with 100 or 200 parts of water may be employed. It is said to have been the agent employed by Gannal for embalming the dead, and more recently its preservative power has been attributed to its germicide virtue. Burow found it admirably adapted to the treatment of *gangrenous* parts, destroying their fetor and renovating the injured tissues and preventing pyæmia. These earlier results have been confirmed by the more recent statements of Rose, who recommends a 3 per cent. solution prepared by Bruns—viz.: R. Alum, 72 parts; Acetate of lead, 115 parts; Water, 1000 parts. Mix and filter. This solution may be diluted according to circumstances (*Therap. Gaz.*, ix. 727). An *aceto-tartrate* and an *aceto-glycerinate* of aluminium are reported to possess analogous properties, and to have proved useful in *ozæna* and kindred diseases (*Am. Jour. Med. Sci.*, July, 1886, p. 258).

The *chloride* is said to be closely analogous to the acetate of aluminium in its action, and may be used for the same purposes. Under the name of *chloralum* a preparation which contains from 10 to 15 per cent. of chloride of aluminium, besides arsenic and copper as impurities, and which also is said to be a compound of the sulphate and chloride, has been much used of late years as a disinfectant and deodorizer, and as a hæmostatic when applied on cloth or cotton impregnated with it. The cheapness of chloride of aluminium and its freedom from odor fit it well for use in hospitals and private houses.

Nitrate of aluminium has been used in a solution containing Gm. 1 in Gm. 30 (gr. xv in f℥j) of water as a lotion for the relief of *pruritus vulvæ*.

AMBRA GRISEA.—Ambergris.

Ambra cinerea.—Ambre, Ambre gris, Fr.; *Amber, Graue Ambra*, G.

Origin.—Ambergris is regarded as a morbid product of the sperm whale, Physeter macrocephalus, *Linné*, and is found in its intestines as well as floating on the sea. One whale has been known to yield 750 pounds of this product (*Amer. Jour. Pharm.*, 1859, p. 183).

Description.—It comes in irregular pieces, varying considerably in size, is opaque, of a gray or gray-brown color, with lighter and darker-colored streaks and spots, lighter than water, friable in the cold, but softening when held in the hand. It is of a waxy appearance, fusible in hot water, mixing with melted fats, and soluble in volatile oils, ether, and hot alcohol. It has a peculiar fragrance, is nearly tasteless, and on ignition leaves but little ash.

Composition.—Ambergris consists mainly (about 85 per cent.) of a fatty substance resembling cholesterin, which Pelletier and Caventou have named *ambreïn*. It crystallizes from hot alcohol in white, shining, tasteless, and inodorous needles, which fuse near

35° C. (95° F.). The remaining constituents, according to John (1818), are some balsamic matter, chloride of sodium, benzoic acid (?), and coloring matter.

Adulterations.—Adulterated and fictitious ambergris can be readily recognized by different physical properties.

Pharmaceutical Uses.—*Tinctura ambræ* of the French Codex is prepared by macerating 10 parts of ambergris, which, according to Stanislas Martin, should be finely powdered by trituration with washed sand, in 100 parts of 80 per cent. alcohol. It is often used for fixing very volatile delicate perfumes.

Action and Uses.—Ambergris, like other strongly odoriferous animal products, has been believed to possess a stimulant action upon the nervous and circulatory systems, with a special direction to the generative organs. It was used in *low fevers* and in spasmodic disorders, especially of the *hysterical* sort, and often associated with musk, castor, and valerian. It was prescribed in substance in the dose of from Gm. 0.30–1.30 (gr. v xx), or more frequently in ethereal solution. It is seldom if ever employed at the present day as a medicine, but it enters into various perfumes.

AMBROSIA.—Ragweed.

Ambrosie, Fr.; *Traubenkraut*, G.

Nat. Ord.—Compositæ, Senecionideæ.

Description.—This genus comprises coarse-looking rough or hairy weeds, with mostly opposite leaves, and with inconspicuous, yellowish, staminate flower-heads arranged in elongated racemes or spikes, at the base of which one to three staminate flowers are situated in the axils of the leaves. The following two, growing in waste places in North America, have been used:

Ambr. trifida, *Linné*, attains a height of 8 feet (2.4 M.) or more, and has entire oval or usually deeply-trilobed leaves with the lobes oval lanceolate and serrate.

Ambr. artemisiæfolia, *Linné*, also known as *bitterweed*, *hogweed*, *Roman wormwood*, is about 3 feet (.9 M.) high: its leaves are thinner, smoother, and of a lighter green than the preceding, and twice pinnatifid, with the divisions lanceolate. It grows southward to Brazil.

Both species have a slight and rather fetid odor and a bitter and slightly astringent taste. Ambr. maritima, *Linné*, of Southern Europe, which resembles the last, but is grayish-pubescent, has an agreeable odor and an aromatic bitter taste.

The constituents of these plants have not been investigated.

Action and Uses.—The two species of Ambrosia, like other bitter herbs, have been employed in the cure of *intermittent* fever. Ambrosia's astringency has caused it to be used to moderate *discharges* of the blood and mucus and to palliate mercurial *salivation*; the stimulant qualities attributed to it are supposed to be shown in the *typhoid state* of febrile affections. An infusion of the tops may be made with Gm. 10–15 in Gm. 500 (℥ij–iv in water 1 pint).

AMMONIACUM, *U. S., Br., P. G.*—Ammoniac.

Gummi-resina ammoniacum.—*Ammoniacum*, E.; *Ammoniaque, Gomme-resine ammoniaque*, Fr.; *Ammoniakgummi*, G.; *Gomma ammoniaco*, F. It., Sp.

A gum-resinous exudation from Dorema Ammoniacum, *Don.* Bentley and Trimen, *Med. Plants*, 129, 130.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin—The plant, which is of a striking appearance, grows to the height of 2 M. (6 or 7 feet); its leaves are all radical; the hollow stem bears a few long leaf-sheaths, and divides toward the apex into about sixteen ascending branches, upon which the small globular short-stalked umbels are borne, the inflorescence forming a paniculate raceme. The root is rich in milk-juice, which rapidly diminishes in quantity when, in about the fifth year, the stem is produced, after which the plant perishes. The gum-resin exudes from the stem and flowering branches from punctures produced by insects; an inferior kind exudes near the base of the stem among the remnants of the leaf-sheaths, and in the soil considerable quantities of hardened milk-juice are often found which has exuded from fissures in the root produced during the hot season.

This species of Dorema prefers a silicious soil, and occurs abundantly in the deserts and barren regions of Persia and Tartary, usually accompanied by Ferula Scorodosma, the Persian asafetida-plant, but growing farther north and north-east than the latter, extending to the southern shore of the Sea of Aral and nearly to the south-eastern

extremity of the Caspian Sea, while its southern limits are near Bahziran, in Southern Khorassan (Borszczow, 1860).

It is not impossible that Dorema Aucheri, *Boissier*, a West-Persian plant, but less frequent than the former may yield some of the commercial ammoniac; but D. robustum, *Loftus*, which is united with the species mentioned by Boissier, affords a gum-resin distinct from ammoniac (*Pharmacographia*).

Description.—The best quality of ammoniac exists in dry tears from 1.5–12 Mm. ($\frac{1}{16}$ to $\frac{1}{2}$ inch) in diameter, which are globular or irregularly roundish in shape, often more or less flattened, externally of a pale brownish-yellow and internally milk-white. Their fracture is somewhat conchoidal and of a waxy lustre. The tears sometimes coalesce and form irregular masses, which when broken show the outlines of the individual grains, without any intervening darker-colored mass.

Cake-ammoniac is an inferior quality, and consists of the tears imbedded in the brown gum-resinous mass obtained from the base of the stem; and a kind is occasionally seen in which the tears are not larger than a pin's head and few in number, the greatest bulk consisting of a plastic brown or greenish-brown mass mixed with vegetable fragments and earthy matter.

Ammoniac softens by the heat of the hand and when triturated in a mortar. It has a peculiar odor, which becomes stronger after heating, and a bitter, acrid, and nauseous aromatic taste. Chlorinated lime imparts to it an orange and potassa a yellowish color. On being triturated with water it readily yields a white emulsion, which, on the addition of caustic soda, acquires a yellow, and finally a brown, color. In contact with hydrochloric acid, ammoniac is not changed in color even when heated to 60° C. (140° F.). Warm concentrated sulphuric acid dissolves ammoniac with a blood-red color, and the solution shows no fluorescence on dilution with water and on the addition of alkali (Schliekum). For medicinal purposes the tears only should be used.

African ammoniac, obtained from Ferula tingitana, *Linné*, is not found in our market; it has a faint but more agreeable odor, somewhat like that of benzoin, and an acrid but not bitter taste. Moss (1873) found in it 68 per cent. of resin, 9 per cent. of soluble gum, 19 per cent. of insoluble matter, and 4 per cent. of moisture and volatile principles. Umbelliferon was obtained from it by Hirschsohn (1875). Goldschmiedt (1878), by fusing with potassa, prepared resorcin and an acid, $C_{10}H_{10}O_6$, the aqueous solution of which strikes a beautiful red color with ferric chloride; officinal ammoniacum does not yield such a compound.

Composition.—According to the analyses of Bucholz, Hagen, and Braconnot, ammoniac contains from 1.8 to 4 per cent. of volatile oil, 70 to 72 per cent. of resin, 18 to 22 per cent. of gum, 1½ to 4 per cent. of bassorin or gluten, and about 6 per cent. of moisture. The volatile oil, of which usually only between ½ and 2 per cent. is obtained, is free from sulphur (Moss, 1873), and its solution in alcohol acquires a reddish hue with ferric chloride (*Pharmacographia*). According to Przeciszewki (1861) the gum is nearly identical with gum-arabic, and the resin is a mixture of an acid and an indifferent resin, of which the one insoluble in ether dissolves readily in volatile and fixed oils.

Fused with caustic potassa, Hlasiwetz and Barth obtained (1864) resorcin and oxalic and a volatile fatty acid. On the dry distillation of ammoniac Sommer failed to obtain umbelliferon.

Pharmaceutical Uses and Preparations.—Ammoniac may be powdered after exposure to cold, or, after having been dried over lime, in the same manner as asafetida, the powder should be preserved over lime. It forms an ingredient in Emplast. ammoniaci, *U. S.*; Empl. ammoniaci cum hydrargyro, *U. S.*, *Br.*; Empl. galbani, *Br.*; Mistura ammoniaci, *U. S.*, *Br.*; Pil. scillæ comp., Pil. ipecacuanhæ cum scilla, *Br.*

Action and Uses.—Ammoniac has always been regarded as a stimulant of the circulation and nutrition. Large doses of it have been said to produce an eruption on the skin, besides vomiting, colic, and diarrhœa. In a plaster it occasions a papular eruption. The above effects have been questioned, but are too well established clinically to be set aside by any experiments upon healthy subjects. It is probable that they depend chiefly upon the volatile oil and partly upon the resin of ammoniac.

The most important internal use of ammoniac is in the treatment of chronic pulmonary catarrh, or *bronchitis*, in which the secretion is excessive and expectoration difficult, and there is an absence of fever. The condition of the bronchia in such cases includes passive congestion, excessive secretion, and feeble action of the circular muscles; all stimulants tend to remove this condition, and those especially which are excreted through

the lungs, including the whole resinous class. The alleged benefits of ammoniac in *asthma* are probably most demonstrable in asthma associated with pituitous and other analogous forms of bronchitis. It tends to remove the exciting cause of the nervous paroxysm, but probably has a minor influence upon the spasmodic element itself. There is a certain acrimony about ammoniac which perhaps explains the fact that its continued use is apt to render the bronchial and laryngeal mucous membrane dry and irritable, and therefore the medicine, if long continued, may increase coughing after having lessened it. It is said to be very useful in *hysterical asthma*, but with the qualification that it should be associated with asafœtida. This gives the credit of the cure to the asafœtida, which is alone entitled to it. Ammoniac has sometimes been employed in chronic catarrh of the *urinary passages*. Externally, it is used as a rubefacient in plasters for the relief of chronic *rheumatism*, especially of the muscular form, for promoting the cure of bronchial *catarrh*, chronic *pleurisy*, and various other affections requiring a superficial and sustained irritation of the skin. In some of these cases the plaster of ammoniac with mercury is eligible on account of the specific action of the metal, which is very apt to display itself. The *dose* of ammoniac is usually stated to be from Gm. 0.60–2.00 (gr. x–xxx); but doses of Gm. 0.12–0.20 (gr. ij–iij) are sufficient if frequently repeated. The acrid taste of the mixture of ammoniac is offensive, and hence the drug should perferably be administered in pill. The compound pill of squill is a convenient and efficient preparation.

AMMONII BENZOAS, *U. S.*, *Br.*—Ammonium Benzoate.

Benzoas ammonicus, F. Cod.; *Ammoniæ benzoas*, *Ammonium benzoicum*.—*Benzoate d'ammoniaque*, Fr.; *Ammoniumbenzoat*, *Benzoësaures Ammonium*, G.

Formula $NH_4C_7H_5O_2$. Molecular weight 138.72.

Preparation.—Take of Benzoic Acid 2 ounces; Solution of Ammonia 3 fluidounces or a sufficiency; Distilled Water 4 fluidounces. Dissolve the benzoic acid in 3 fluidounces of the solution of ammonia, previously mixed with the water; evaporate at a gentle heat, keeping ammonia in slight excess, and set aside that crystals may form.—*Br.*

The formula of the U. S. P. 1870 was identical with the foregoing. During the evaporation of the solution considerable ammonia is given off, and an acid ammonium benzoate would be left. To obtain the neutral salt it is necessary to add sufficient ammonia until an alkaline reaction is obtained, when the liquid is set aside to crystallize, and to avoid heat while drying the crystals.

Properties.—Ammonium benzoate crystallizes in colorless or white thin four-sided laminæ, having a slight odor of benzoic acid, and a saline somewhat bitter taste, with a slight acrid after-taste; it is readily soluble in alcohol and water, requiring 5 parts of water or 28 parts of alcohol at 15° C. (59° F.) and 1.2 parts of boiling water or 7.6 parts of boiling alcohol (*U. S.*). On being strongly heated it fuses, gives off vapors of benzoic acid and ammonia, and finally evaporates without leaving any residue. Its neutral solution gives, with ferric salts, a bulky light brownish-yellow (yellowish, *Br.*, flesh-colored, *U. S.*) precipitate, evolves ammonia when heated with potassa, and, if it be not too dilute, deposits benzoic acid when acidulated with hydrochloric acid. The acid salt is less soluble, requiring about 60 parts of water and 12 parts of alcohol.

The *purity* of the salt is ascertained by its not yielding any carbonaceous mass when heated or leaving a non-volatile residue when ignited. A 10 per cent. solution, acidulated with nitric acid, and filtered, should not be precipitated by barium chloride or silver nitrate (absence of sulphate and chloride).

Action and Uses.—The action of benzoate of ammonium in the system appears to be much the same as that of benzoic acid alone, and the salt possesses over the acid only the advantage of greater solubility. Its chief uses are treated of in the article on Benzoic Acid. In addition it may be stated that this preparation has been used in chronic *gout* and *gravel*. *Dose*, Gm. 0.30–1.30 (gr. v–xx), but doses of Gm. 0.60–1.20 (gr. x–xxx) have been recommended. It is best given in a mixture.

AMMONII BROMIDUM, *U. S.*, *Br.*—Ammonium Bromide.

Ammonium bromatum, P. G.—*Bromure d'ammonium*, Fr.; *Bromammonium*, *Ammonium bromid*, G.; *Bromuro di ammonio*, F. It., Sp.

Formula NH_4Br or AmBr. Molecular weight 97.77.

Preparation.—Ammonium bromide may be prepared by neutralizing hydrobromic acid with ammonia or ammonium carbonate, and evaporating the solution. It may also

be obtained by first preparing ferrous bromide from 4 parts of bromine, 2 parts of iron, and 16 parts of water, and precipitating the greenish solution with a slight excess (about 9 parts) of ammonia-water, when bulky ferrous hydroxide is deposited. Or the above solution of ferrous bromide is mixed first with 1 part of bromine, and afterward with ammonia in excess (about 11 parts), when a dense ferroso-ferric hydroxide is precipitated, which may be readily washed with water; the filtrate is evaporated and allowed to crystallize or the salt is granulated.

But, according to Charles Rice (1873), ammonium bromide prepared by the processes just mentioned is prone to decomposition, bromine being gradually liberated. This change does not occur if the salt is prepared as follows: The solutions of 4 troyounces of potassium bromide in 6 fluidounces of boiling water, and of 3 troyounces of ammonium sulphate in 4½ fluidounces of boiling water, are mixed while boiling hot, and when cool 1½ fluidounces of alcohol are added. After twenty-four hours the clear liquid is decanted from the crystalline deposit of potassium sulphate, the latter washed with a little 18 per cent. alcohol, and the filtrate evaporated as before. Prepared in this manner, the salt contains minute quantities of ammonium and potassium sulphate, the presence of which is avoided by sublimation. For this purpose an intimate mixture of well-dried potassium bromide (20 parts) and exsiccated ammonium sulphate (11 parts) is introduced into a retort with a wide and rather short neck, and heated in a sand-bath.

Properties.—It is either in white granular, cubical, or in larger colorless prismatic crystals, which have a neutral reaction to test-paper and a pungent saline taste. On exposure to air the salt gradually becomes damp and acquires a yellow color and acid reaction. When heated it sublimes without melting. It is soluble in 1.5 parts of water and in 30 parts of alcohol at 15° C. (59° F.), in .7 part of boiling water and in 15 parts of boiling alcohol (*U. S.*). Ether dissolves a minute quantity of the salt. Chlorine-water, carefully added so as to avoid an excess, liberates from the aqueous solution of the salt bromine, which dissolves in carbon disulphide or in chloroform with a yellow, reddish-yellow, or yellowish-brown color, which is free from violet tint (iodine).

Tests.—It may be regarded as pure if, on being heated upon platinum-foil, a non-volatile residue is not left behind. A small portion of the salt placed upon a porcelain tile should not at once acquire a yellow color on the addition of a few drops of diluted sulphuric acid (absence of bromate). Its solution should not be precipitated by barium chloride (absence of sulphate and phosphate), nor by hydrogen sulphide (absence of metals). The solution, mixed with a little mucilage of starch, should not show a blue color (which would indicate iodine) if a drop of chlorine or bromine-water be added on top. If 10 grains of the salt are dissolved in water, and the solution is well mixed with a solution of 17 grains of silver nitrate, a curdy yellowish precipitate will appear, and the clear liquid should be merely rendered cloudy on the further addition of silver nitrate. A white precipitate would indicate the presence of ammonium chloride, which requires a larger quantity of silver nitrate for complete precipitation than the bromide; and if no cloudiness is produced, ammonium iodide may probably be present, which, from its greater molecular weight, is completely precipitated by less silver nitrate. The precipitate of 10 grains of ammonium bromide by sufficient silver nitrate, after washing with water acidulated with nitric acid and drying, will weigh 19.17 grains (1.917 Gm. from 1 Gm. Am.-Br.). The presence of ammonium chloride would increase the weight of the silver precipitate. The allowable limits of the impurities are thus determined: "If 3 Gm. of the well-dried salt be dissolved in distilled water to 100 Cc., and 10 Cc. of this solution treated with a few drops of test-solution of potassium chromate, and then volumetric solution of silver nitrate be added, not more than 30.9 Cc. of the latter should be consumed before the red color ceases to disappear on stirring (absence of more than 1 per cent. of chloride). 20 Cc. of a 5 per cent. aqueous solution of the salt should not at once assume a blue color on the addition of 5 drops of potassium ferrocyanide test-solution (limit of iron)."—*U. S.*

Action and Uses.—"Bromide of ammonium in *almost* every respect has the same action as bromide of potassium." It does not appear to restrain the movements of the heart. According to Chéron and Fouques, this salt moderates reflex action and stimulates the periphery of the nervous system. It has a more acrid taste and is more irritating than potassium bromide. It obtunds the sensibility of the mouth and pharynx, as well as general reflex sensibility. It produces a papular eruption upon the skin, and its prolonged use brings on a sort of hebetude or intellectual dulness. Its unpleasant taste and irritating qualities render it less convenient for administration than bromide of potassium.

Bromide of ammonium, in conjunction with potassium bromide, has been used exten-

tensively in the treatment of *epilepsy;* but while it is held by some authorities that this association diminishes the bad while it increase the good effects of the combination, other observers have failed to recognize in it any advantage, while they object to the unpalatable taste of the bromide of ammonium—a grave defect in a medicine which must be continuously used for a long time in the treatment of disease. The weight of authority, however, appears to be in favor of the opinion that 10 grains of bromide of potassium with 3 to 5 grains of bromide of ammonium produce a greater sedative influence than 12 or 15 grains of either of them administered separately. Erlenmeyer states that the association of the bromides of potassium, sodium, and ammonium in the proportion of $1:1:\frac{1}{2}$ is more efficient than either one alone, and is not so apt to produce acneiform eruptions. This salt has been successfully employed in some cases of *delirium tremens.* It has also been recommended as possessing remarkable virtues in *whooping cough* during the spasmodic stage of the disease, and the success of bromide of potassium in the same affection supports the recommendation. It has been particularly eulogized by Kormann in Germany (*Med. News*, etc., xxxix. 473) and Grinnell in this country (*ibid.*, xl. 294), but without any statement of the duration of the disease under its use. Probably a combination of the two salts would be more efficacious than either alone. In acute articular *rheumatism* this medicine has been supposed to exert a favorable influence; but since it was first proposed eight or ten years have elapsed without eliciting any confirmatory experience. The intolerable itching of *prurigo* is sometimes strikingly diminished by it when it is given in doses of 10 grains three times a day. It has been recommended to prevent *menorrhagia.* The fumes of this salt have been used in the treatment of chronic diseases af the *naso-pharynx* (*Dublin Jour. Med. Sci.*, Mar. 1889.

Dose, for adults from Gm. 0.30–2.00 (gr. v–xxx) three times a day; for children, from 1 to 5 grains. It is conviently administered as a bitter infusion, and especially in hop tea.

Bromide of Rubidium and Ammonium has been proposed by Laufenauer as a substitute for the bromides of sodium, potassium, and ammonium, on the ground that it contains a larger percentage of bromine than the other salts named. In daily doses Gm. 4–7 (gr. lx–c) he conceived it to be more efficient than the related bromine compounds (*Therap. Monatsch.*, iii. 348; iv. 45).

AMMONII CARBONAS, *U. S.*, *Br.*—Ammonium Carbonate.

Ammoniæ sesquicarbonas; Ammonium carbonicum, P. G.; *Carbonas ammonicus, Sal volatile siccum, Alkali volatile.—Volatile salt*, E.; *Carbonate d'ammoniaque, Alkali volatile concret, Sel volatile d'Angleterre*, Fr.; *Ammoniumcarbonat, Kohlensaures Ammonium, Flüchtiges Laugensalz, Reines Hirschhornsalz*, G.; *Carbonato di ammonio*, F. It., Sp.

Formula $NH_4HCO_3NH_4NH_2CO_2 = N_3H_{11}C_2O_5$. Molecular weight 156.77.

Origin.—Ammonium carbonate was first prepared by Raymund Lull, in the thirteenth century, by the distillation of putrid urine, which contains the normal carbonate, $(NH_4)_2CO_3$, formed from urea, CON_2H_4 and $2H_2O$, water. It was subsequently obtained by the dry distillation of horn, bone, blood, and other animal matters, and for a long time purified by resubliming this crude product in the presence of animal charcoal. In the fifteenth century Basilius Valentinus observed its production from sal ammoniac and potassium carbonate, in place of which afterward chalk was employed. At present it is largely manufactured by modifications of this process.

Preparation.—A mixture of powdered sal ammoniac with twice its weight of chalk, or of 4 parts each of ammonium sulphate and chalk with 1 part of charcoal, is gradually heated to dull redness in an iron or earthen retort, the vapors being passed through an iron pipe into a leaden chamber, where they condense. The chalk is used in excess to prevent sublimation of undecomposed ammonium chloride, which would otherwise be apt to contaminate the product. It is then purified by resublimation from iron vessels. The reaction results in the formation of calcium chloride (or sulphate) and neutral ammonium carbonate, which on condensation is converted into a salt of the above composition, water and ammonia being given off; $4NH_4Cl + 2CaCO_3$ yield $2CaCl_2 + N_3H_{11}C_2O_5 + NH_3 + H_2O$. The ammonia is utilized either by passing the uncondensed vapors into water or through a cylinder filled with coke which is impregnated with dilute sulphuric acid, resulting in the formation of ammonium sulphate. Barium carbonate may be employed in the place of chalk, and is advantageously used with ammonium chloride, when barium chloride is obtained at the same time. The ammonium salts used being almost exclusively those obtained from coal-gas liquor, the first sublimate contains tarry

products, from which it is freed by resublimation. Nearly 600,000 pounds were annually imported into this country previous to 1878; since that time, between 300,000 and 500,000 pounds.

Properties.—Ammonium carbonate is found in commerce in white crystalline translucent masses, having a strong ammoniacal odor, an alkaline reaction, and a pungent saline and caustic taste. Exposed to the air, it parts with ammonia and carbon dioxide, becomes opaque, and falls into a white powder of acid ammonium carbonate, NH_4HCO_3; this salt is likewise obtained by washing the powdered official carbonate with a little cold water, which dissolves chiefly ammonium carbamate. The U. S. Ph. states that the salt is slowly but completely soluble in 5 parts of water at 15° C. (59° F.); it is decomposed by hot water, with the elimination of ammonia and carbon dioxide, and is completely dissipated by prolonged boiling with water. Alcohol dissolves ammonium carbamate, and on being heated yields a sublimate of this salt.

Composition.—Of the formula given above, the last one is purely empirical, while the first represents the salt as a compound of 1 molecule of acid ammonium carbonate with 1 of ammonium carbonate, from which a molecule of water has been separated. The last-mentioned compound is regarded as the ammonium salt of carbamic acid (which is unknown in the isolated state), and hence is called *ammonium carbamate*, the formula of which is $NH_4NH_2CO_2$. In its pure state this forms tabular crystals, is deliquescent, volatilizes completely at 59° C. (138.2° F.), with decomposition into ammonia and carbon dioxide, and in aqueous solution is soon converted into normal ammonium carbonate: the solution of the official salt, therefore, contains a mixture of neutral and acid ammonium carbonate.

The salt formerly in the market, which was prepared from animal matters, closely resembled the official salt, but had the composition $N_4H_{16}C_3O_8 = 2NH_4HCO_3.NH_4NH_2CO_2$: according to Divers, it was a mixture of the above salt with acid ammonium carbonate.

Tests.—Ammonium carbonate should be completely volatilized without charring when heated upon platinum-foil (absence of organic matters and non-volatile salts). It should dissolve in diluted acids without residue, and this solution should be free from empyreumatic odor. 1 Gm. of the salt, on being supersaturated with nitric acid and evaporated to dryness by means of a water-bath, should leave a colorless (white) residue, which at a higher heat volatilizes completely. *U. S.—P. G.* Empyreumatic products impart a yellow or brown color to the residue. Ammonium hyposulphite, which may be present from the decomposition of the sulphate during sublimation, is detected by the brown color produced on adding to the aqueous solution of the salt first an excess of solution of silver nitrate and afterward of nitric acid. After dissolving the salt in a slight excess of diluted nitric acid, it should not be precipitated by barium chloride (sulphate), silver nitrate (chloride), or hydrogen sulphide (metals). Traces of iron may frequently be detected in this solution by potassium ferrocyanide or sulphocyanate. The presence of ammonium bicarbonate is indicated by the change of the translucent mass into an opaque pulverulent condition. Occasionally the bicarbonate has been observed (see *American Journal of Pharmacy*, 1874, p. 540) in translucent solid masses mixed with the official article. In this condition it has but a faint odor of ammonia, and dissolves slowly in water at the ordinary temperature, giving off carbon dioxide.

52.3 grains of ammonium carbonate dissolved in 1 ounce of distilled water will be neutralized by 1000 grain-measures (*Br.*) or 2.613 Gm. of the salt by 50 Cc. of the normal volumetric solution of oxalic acid (*U. S.*).

Pharmaceutical Uses and Preparations.—Ammonium carbonate reacts with salts of nearly all inorganic and organic bases, with the exception of sodium and potassium, and is therefore incompatible with such salts. Prescribed with syrup of squill or similar preparations, the annoyance caused by the evolution of carbon dioxide is best overcome by triturating in a mortar the carbonate with a little of the syrup, adding the latter gradually, if admissible, alternately with water or a tincture. The generation of carbon dioxide in many reactions renders it necessary to triturate the ingredients of pill masses containing ammonium carbonate with some strong alcohol until the reaction has been completed, when the excipient may be added. The salt is used in making Liquor ammon. acetat., Spir. ammon. arom., *U. S.*, *Br.*

AMMONII BICARBONAS, NH_4HCO_3, is obtained by treating the powdered official ammonium carbonate with about twice its weight of water, when carbamate will be dissolved, or by keeping the former for two weeks under a bell-glass over sulphuric acid and slaked lime, when the carbamate will evaporate, being decomposed into carbon dioxide, CO_2, and ammonia, NH_3. Ammonium bicarbonate is a white powder, when perfectly

dry free from ammoniacal odor, of a cooling saline taste, insoluble in alcohol, but soluble in 8 parts of water at 15° C. (59° F.); the solution, heated to 36° C. (96.8° F.) begins to give off carbon dioxide. From a concentrated solution clear rhombic prisms of the salt may be obtained. Vogler (1878) ascertained that the salt is not permanent in the air, but is slowly volatilized, with the production of an ammoniacal odor.

Liquor ammonii carbonici and Liquor ammonii carbonici pyro-oleosi, P. G., 1872, are solutions of 1 part of ammonium carbonate or pyro-oleous carbonate in 5 parts of distilled water.

Ammonii carbonas pyro-oleosus, s. *Ammonium carbonicum pyro-oleosum*, P. G., 1872, *Sal volatile cornu cervi*.—32 parts of ammonium carbonate are thoroughly incorporated with 1 part of ethereal animal oil.

Action and Uses.—The direct effect of carbonate of ammonium when taken in doses of from 5 to 10 grains is to cause some increase of the fulness and force of the pulse and a sense of tightness about the head, sometimes with throbbing. It is also said to increase the temperature of the body during health and excite the secretions of the skin, kidneys, and bronchia. It readily enters the blood, increasing its alkaline reaction, and escapes by the breath and sweat, and still more by the urine. In doses of from 10 to 20 grains it excites vomiting. In still larger doses it occasions symptoms of inflammation in the throat, gullet, and stomach, tetanoid convulsions, and death. In a case which proved fatal intense inflammatory lesions were found in the organs last mentioned, and also congestion of the lungs, with œdema. Long-continued use of the salt deranges the stomach, causes diarrhœa, emaciation, and a dissolution of the blood, with symptoms resembling those of scurvy. The last-mentioned effect it displays in common with the other alkaline salts, especially those of sodium.

This medicine has been used in *typhus fever* and in the *typhoid state* of various febrile affections; that is to say, in which nervous disorder is associated with a tendency to dissolution of the blood. Thus it has been found beneficial in the fever just named, in low forms of *typhoid fever*, *typhoid scarlatina*, *measles*, *erysipelas*, *pneumonia*, etc. There is no reason to suppose that it is, in any sense, a specific for those affections, or that a continuous administration of it throughout an attack is beneficial or even justifiable. Like other stimulants, it urges the organs to perform their functions until the poison which is the cause of their debility is eliminated and the tissue-repair advanced, and probably it also quickens their performance of this work. In appropriate doses it has the advantage over alcohol that it leaves no depression behind it, and over turpentine that it is not apt to occasion any local derangements. It is possible that the antifermentative action of ammonia illustrated by Gottbrecht (*Med. News*, lv. 697) may be a factor in this operation. In excessive doses it is perturbative and irritant, and if long continued, even in doses which the stomach will tolerate, it impairs nutrition in the manner stated above. Its efficacy in the treatment of bites of *venomous serpents* and *insects* and in *alcoholic intoxication* is, in a great degree, due to its stimulant action; but the extraordinary rapidity with which, when applied locally, it arrests the pain and inflammation of insect-bites, and when taken internally suspends even a high degree of drunkenness, seems to shows that it exerts also a more direct antidotal power. In various forms of *bronchitis*, both primary and secondary, it may be employed, the cases in which it is most useful being those which have passed the acute stage and which tend to become chronic, with dilatation of the bronchia or with consolidation of the vesicular tissue, constituting the so-called broncho-pneumonia. When this form of disease arises, as it often does, as a consequence of measles, ammoniacal medicines ought never to be neglected. The *dyspepsia* of drunkards is said to be favorably modified by this medicine, probably by its combined antacid and stimulant properties, which counteract the acidity of the stomach and dissolve the tenacious mucus that coats the organ. The antacid property of the salt has led to its use in cases of excessive secretion of *uric acid*; and in *diabetes* it sometimes diminishes the quantity, as well as the saccharine condition, of the urine. Dr. Beale has drawn attention to the great utility of this salt in *cystinuria*, and shown that large doses of it may be safely taken for a long time (*Lancet*, Aug. 30, 1884). Like other volatile ammoniacal preparations, it is useful in alleviating *headache*, whether dependent upon acidity of the stomach or upon exhaustion of the nervous system. Its stimulant quality renders it useful in *faintness*, *syncope*, *nervous spasm*, etc.; and when mixed with sal ammoniac and scented with an aromatic oil it forms the usual smelling-salts employed to relieve the symptoms just referred to, and also to dissipate congestion of the nostrils in commencing *coryza*. Externally, it is sometimes applied to promote the resolution of *glandular swellings*. It has also been administered internally for the same purpose.

Carbonate of ammonium is generally given in a watery solution, and its acrimony is blunted by the use of mucilage, sugar, or liquorice. As a stimulant expectorant its dose is Gm. 0.10–0.15 (gr. ij–iij) or more, repeated every two or three hours. In low fevers Gm. 0.30–0.60 (gr. v–x) should be given every hour or two, until five or six doses are taken, but much larger doses, such as from 20 to 40 grains, have been given several times a days for months together without injury. An emetic effect is said to be produced by Gm. 2 (gr. xxx).

AMMONII CHLORIDUM, *U. S., Br.*—Ammonium Chloride.

Ammonium chloratum, P. G.; *Ammonium muriaticum s. hydrochloratum depuratum*, *Chloruretum Ammonicum*, *Sal ammoniacum*, *Ammoniæ hydrochloras s. murias.*—*Purified ammonium chloride*, *Muriate of ammonia*, *Sal ammoniac*, E.; *Chlorure d'ammonium*, *Sel ammoniac*, *Chlorhydrate d'ammoniaque*, Fr.; *Salmiak*, *Chlorammonium*, *Ammonium chlorid*, *Reiner Salmiak*, G.; *Cloruro di ammonia*, F. It.; *Clorhidrato de amoniaco*, Sp.

Formula NH_4Cl or AmCl. Molecular weight 53.38.

Origin.—The sal ammoniacum of ancient writers was perhaps in all cases rock-salt. In the eighth century Geber prepared sal ammoniac from urine. Subsequently it was manufactured in Egypt from camel's dung and urine, and exported to Europe, where its manufacture was begun in Venice in the seventeenth century, in Great Britain in 1756, and soon after in Germany and France. At present it is obtained from the products of the dry distillation of bones and other animal matters, and of coal. It is frequently met with in the neighborhood of volcanoes, and is a constituent of several mineral springs, such as Hall, Homburg, Wiesbaden, and others.

Preparation.—The so-called coal-gas liquor is a watery liquid condensed in the preparation and purification of illuminating gas from coal, and contains principally ammonium carbonate, besides some sulphide, cyanide, and empyreumatic products. This is either neutralized by hydrochloric acid or decomposed by calcium chloride, in both of which cases a solution of ammonium chloride is obtained, which is evaporated and the dry salt afterward sublimed. In order to avoid the expense attending the evaporation of such dilute solutions the gas-liquor is now frequently treated with lime and the generated ammonia gas conducted into a more concentrated acid. If the gas-liquor is neutralized by sulphuric acid, the resulting solution will yield more or less brown-colored crystals of ammonium sulphate, which are mixed with sodium chloride (table-salt), and the mixture is sublimed from iron pots, the vapors being condensed upon the inside of leaden or iron domes. On the application of heat a mutual decomposition of the ammonium sulphate and sodium chloride occurs, resulting in the formation of ammonium chloride, which sublimes, and sodium sulphate, which remains behind; $(NH_4)_2SO_4 + 2NaCl$ yields $2NH_4Cl + Na_2SO_4$. From the corrosive action of the vapors upon iron the product is always contaminated with chloride of iron.

Instead of using sulphuric acid, the gas-liquor may be digested with powdered gypsum (calcium sulphate), when ammonium sulphate and insoluble calcium carbonate are produced, the latter retaining a considerable amount of the tarry products. Any liquid containing ammonia or ammonium carbonate, like the aqueous liquor obtained on the destructive distillation of bones or other animal matter, may be employed in the same manner as coal-gas liquor. The annual importation of sal ammoniac has increased from less than 800,000 pounds previous to 1879 to nearly 1,500,000 pounds in 1882.

When the crude article is refined by carefully resubliming it, ammonium chloride may be obtained sufficiently pure for medicinal use. Commercial sal ammoniac contains, usually, variable quantities of ferrous and ferric chloride, and should be purified by dissolving 2 parts of it in 3 parts of hot water, adding a small quantity of chlorine-water to convert the ferrous into ferric chloride, and afterward ammonia-water in slight excess, then filtering the hot solution from the precipitated ferric hydroxide. If the sal ammoniac has been otherwise pure, the filtrate may be evaporated to dryness, and the salt granulated by stirring it continually. If, however, it contains other saline impurities besides the iron, it is best to allow the filtrate to cool, stirring it occasionally, and to collect the crystalline powder upon a muslin strainer. The impurities will remain in the mother-liquor.

Properties.—Sal ammoniac is imported in casks, and consists of colorless or whitish translucent masses which are of a fibrous crystalline structure, very tough and difficult to powder. It is free from odor and has a cooling and strongly saline taste. Its specific gravity is 1.53, and it is soluble in about 3 parts of cold and in little more than

its own weight of boiling water. During the solution of the salt in water a considerable reduction of temperature is observed. When the solution is heated with potassa or lime gaseous ammonia is given off, and when treated with silver nitrate a curdy white precipitate soluble in ammonia is produced. It is less freely soluble in spirituous liquids, requiring 14 parts of boiling alcohol for solution. The salt is permanent in the air, but its solution on being boiled evolves a little ammonia and acquires an acid reaction. Ammonium chloride evaporates completely without melting at an elevated temperature, and on cooling is condensed again unchanged. Metals which are dissolved by hydrochloric acid are likewise attacked by the hot solution or the vapor of this salt; hence commercial sal ammoniac contains iron, derived from the vessels in which it has been prepared, and its solution turns blue on the addition of potassium ferrocyanide.

Purified ammonium chloride forms a snow-white granular crystalline powder, the hot solution of which has a faint acid reaction, and does not acquire a bluish-black color by tannin or a blue coloration on the addition of potassium ferrocyanide. The solubility of pure ammonium chloride in water has been ascertained by Alluard (1864) for the following temperatures, and a barometric pressure of 718 Mm., at which 100 parts of water will hold in solution

28.40	32.84	37.28	41.72	46.16	50.60	55.04	59.48	63.92	68.36	72.80	77.24	parts of NH_4Cl.
at 0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°	110°	C.

The U. S. and Germ. Pharmacopœias state that the salt is soluble in 3 parts of water at 15° C. (59° F.), and in its own weight of boiling water.

Gerardin gives (1865) the following figures, indicating the solubility of ammonium chloride in 100 parts of alcohol, specific gravity 0.939: At 4° C., 11.2; at 8°, 12.6; at 27°, 19.4; at 38°, 23.6; and at 56° C., 30.1 parts of NH_4Cl.

Tests.—The salt should be completely volatilized from platinum-foil (non-volatile salts), and should yield a clear solution with 4 parts of water (barium sulphate, lead salts). The solution, in 20 parts of water, should not be affected by hydrogen sulphide (metals), diluted sulphuric acid (barium), barium chloride (sulphate), nor, after acidulating with hydrochloric acid, by ferric chloride; a red color produced with the last test would indicate the presence of sulphocyanate, observed by Warington. The limit of iron, according to the U. S. and Germ. Ph., is to be tested by solution of potassium ferrocyanide (10 per cent.), 5 drops of which should not at once produce a blue color if added to 20 Cc. of a 5 per cent. solution of the salt. Empyreumatic and non-volatile impurities may be detected by moistening 1 Gm. of the salt with nitric acid and drying at the heat of a water-bath, when it should not acquire a brown tint, and on heating to a higher temperature the residue should be completely volatilized.

Pharmaceutical Uses.—Ammonium chloride is used for generating ammonia in preparing aqua ammoniæ.

Ammonii et ferri chloridum *s. Ammonium chloratum ferratum*, P. G., *s. Ferrum ammoniatum;* Ammonio-chloride of iron, ammoniated iron, *E.;* Sel ammoniac martial, *Fr.;* Eisensalmiak, G.—32 parts of ammonium chloride are mixed with 9 parts of solution of ferric chloride (*P. G.*), and evaporated with constant stirring to dryness. It is an orange-colored, somewhat deliquescent powder, having a strongly saline and ferruginous taste, and containing 7.25 per cent. of ferric chloride, Fe_2Cl_6, equal to 12.1 per cent. of crystallized ferric chloride or to 2.5 per cent. of metallic iron. It should yield a clear solution with water, and, being decomposed in the sunlight, should be kept in a dark place.

Action and Uses.—The effects of from 5 to 20 grains of ammonium chloride, given at intervals of several hours, are a sense of oppression, warmth, and uneasiness in the stomach, some fulness of the head, and an increased tendency to urinate. If it is used for many days together in full doses, it disturbs the digestion, coats the tongue, and impairs the appetite; it may even occasion gastric pain, vomiting, and diarrhœa. Its prolonged use is said to cause emaciation. Its action upon the blood has frequently been illustrated clinically. In one case there were bloody blebs upon the skin and in the mouth, besides hæmaturia and bloody stools (Isham, *Med. News*, xl. 454); in another there was profuse hæmorrhage from the nose, eyes, fauces, and bowels (Lucas, *Med News*, xl. 587); and in the third instance inhalations of the fumes of the salt seem to have occasioned hæmorrhage from the pharynx (Fuller, *Med. Record*, xix. 474).

Chloride of ammonium is sometimes used with a view of promoting the cutaneous efflorescence in *eruptive fevers*; but it is of more value in the cure of obstinate *intermittent fevers*, doubtless through its influence upon the function of nutrition. This value is, however, very uncertain and restricted. In *bronchitis* that has passed its inflammatory stage few medicines are more efficient than this; and in all the chronic forms of the

affection occurring in persons of a feeble and relaxed habit of body it is a most valuable remedy when given alone or associated with stimulant expectorants. *Whooping cough* is benefited by its use when the sputa are tenacious and excessive. Its wholesome stimulation is manifested in cases of *chronic pharyngitis* accompanied with a flaccid state of the mucous membrane and a glairy secretion. Inhalation of the fumes or vapors of the salt has been recommended in these diseases by Franks (*Lancet*, Jan. 1887, p. 167). A similar secretion from other mucous membranes, constituting *gleet*, *leucorrhœa*, etc., is often modified favorably by it. The alterative action of the medicine—*i. e.* its slow but steady modification of the nutrition of tissues—is exhibited by its beneficial action in *amenorrhœa* and *dysmenorrhœa* when the former depends upon torpor of the uterine system, and the latter upon chronic engorgement of the uterus, with or without catarrh. This action is doubtless exerted by it in those cases of cure which it brings about in the various general disorders that arise from sympathy with the uterine system at the *menopause*. It is also in this manner that it appears to be useful in certain cases of fibrous *tumors of the uterus*. To a similar mode of action may be referred its utility in chronic *glandular enlargements*, as in those of the *thyroid body* (*goitre*), the *prostate*, the *liver*, etc. In regard to its utility in *goitre* there can be little doubt. Among many illustrations may be mentioned six cases in which the disease began at puberty, and which were cured after about three months of treatment (Stevens, *Med. Record*, xvii. 429). In the case of the liver its administration has been alleged to diminish the tendency to *hepatic abscess*, but such an assertion must be difficult to substantiate. According to the first and the only physician who has attributed this virtue to the medicine, and whose field of observation was in the East Indies, it should be prescribed in the dose of Gm. 1.30 (gr. xx) as soon as pain in the hepatic region gives warning of the danger of suppuration (Stewart, *Lancet*, May, 1870, p. 726; *ibid.*, Oct. 1887).

The forms of *neuralgia* in which chloride of ammonium is beneficial are not easily defined. According to certain statements, it is equally useful in rheumatic and idiopathic neuralgias, in those depending upon local congestions, and those associated with anæmia, as well as those of less easy definition which are connected with uterine, gastric, and other functional disorders. We have no doubt that it is chiefly serviceable in neuralgia depending upon cold, in which, indeed, especially in neuralgia of the fifth pair, the intercostal nerves, and the sciatic nerve, it sometimes exerts a very prompt and salutary action. In those cases of diffused neuralgic headache known as hemicrania, and often associated with gastric acidity, this medicine is sometimes beneficial, but less so than the carbonate or the liquid preparations of ammonia. In the muscular aches which are produced by the prolonged and repeated use of the same set of muscles, and which have been styled *myalgia*, this medicine is of service if the tired organs are allowed repose. A somewhat analogous condition obtains in chronic *muscular rheumatism*, for which also this salt may be advantageously prescribed. Like other ammoniacal preparations, it has been used with alleged benefit for *snake-bites*, but associated with such other active remedies that a judgment of its share in the result is impossible (*Practitioner*, xl. 291). It has also been recommended in the treatment of *hæmorrhage* from the stomach, the uterus, and the lungs; but except in the case of the uterus the tendency of bleeding to cease spontaneously is so well known that the influence of a medicine in controlling it demands a clearer demonstration than is offered in this case. This salt is alleged to reduce the proportion of sugar voided in *saccharine diabetes*, but clinical observation does not favor its use in that disease (Guttmann, *Zeitsch. f. klin. Med.*, i. 610; ii. 473; Adamkiewicz, *ibid.*, ii. 195).

The stimulant action of this salt has been employed to stay the progress of *gangrene*, especially of the senile variety. It should be applied in cataplasms or in local baths, according to the situation of the disease. The same action is very usefully resorted to in the treatment of *contusions* and lacerated and contused *wounds*. In local *inflammations* the cold produced by it while dissolving may sometimes be taken advantage of. A mixture of 5 parts of it with as many of nitrate of potassium and 16 parts of water will lower the thermometer from 50° to 10° F. Such a mixture, contained in a bladder, has been used to promote the reduction of *hernial tumors* and in various cutting operations of minor surgery. Chloride of ammonium forms a useful ingredient of *errhine* powders, *gargles*, *dentifrices* for whitening the teeth, *cosmetic* preparations for removing the pimples of *acne* from the face, plasters for the treatment of enlarged *bursæ* and *joints*, and atomized solutions for the cure of *pharyngeal* and *laryngeal* affections requiring direct stimulation. Among the last are nervous *aphonia* and *chronic bronchitis*.

The dose of chloride of ammonium varies from Gm. 0.30–2.00 (gr. v–xxx), but a

larger dose than Gm. 0.60 (gr. x) is seldom necessary. It is best administered in solution, and its taste may be disguised by the addition of extract of liquorice or the syrup of liquorice-root. In bronchial diseases its virtues are increased by this association. In neuralgia it may be necessary to repeat hourly the dose of Gm. 0.30–0.60 (gr. v–x) for three or four consecutive hours. In affections of the air-passages it may be given by the stomach, and also by the inhalation of an atomized saturated solution of the salt in water. The *ammonio-chloride of iron* is credited by some German therapeutists with special virtues due to its non-metallic constituent, in scrofula, anæmia, and other states involving general debility. There is no sufficient ground for this opinion, and the taste of the preparation is so disagreeable that the use of it may well be dispensed with. Its dose is said to be from Gm. 0.20–0.60 (gr. iij–x). It may be given in a solution of extract of liquorice.

AMMONII IODIDUM, *U. S.*—Ammonium Iodide.

Ammonium jodatum, *Ioduretum ammonicum.*—*Iodure d'ammonium*, Fr.; *Jodammonium*, *Ammonium jodid*, G.; *Yodhidrato de amoniaco*, Sp.

Formula NH_4I or AmI. Molecular weight 144.54.

Preparation.—This salt is most advantageously prepared by the process recommended by Jacobsen in 1863, and which, with some modifications, was adopted by the U. S. Pharmacopœia of 1870. After correcting the errors in the latter this process is as follows: Mix potassium iodide in coarse powder 2½ troyounces, and ammonium sulphate in coarse powder 1 troyounce; add to the mixture 2 fluidounces of boiling water; stir well, allow to cool slowly, add 2 fluidounces of alcohol, and place the mixture in a bath of iced water, stirring occasionally; throw the mixture into a glass funnel stopped with moistened cotton, collect the clear liquid, and wash the crystalline salt with diluted alcohol; lastly evaporate the filtrate rapidly to dryness, stirring constantly. Contact with iron or other metals is to be avoided.

1 molecule of ammonium sulphate (132 parts) and 2 molecules of potassium iodide (331.2 parts) decompose each other when mixed in solution, with the formation of ammonium iodide and potassium sulphate; $2KI + (NH_4)_2SO_4$ forms $2NH_4I + K_2SO_4$. The latter salt, being insoluble in alcohol, will separate from the solution as a crystalline powder on adding alcohol and cooling the mixture, after which the filtrate may be evaporated to dryness, yielding rather more than 2⅛ troyounces of the iodide. The minute quantity of potassium sulphate contained in it does not interfere with its medical properties. If a still purer salt is desired, the product may be dissolved in alcohol, filtered from the insoluble potassium sulphate, and evaporated as before.

Other processes have been proposed, of which the following may be mentioned: Hydriodic acid is neutralized with ammonia or ammonium carbonate. Ferrous iodide is decomposed by ammonium carbonate, and the filtrate evaporated (Ch. Ellis, 1835). Potassium iodide and ammonium bitartrate are made to react upon each other in hot solutions; on cooling, potassium bitartrate crystallizes, and the evaporated filtrate, still containing a little of this salt, is treated with 70 per cent. alcohol, which dissolves only the ammonium iodide (W. H. Pile, 1862). Iodine is treated with ammonium sulphide until the brown color has completely disappeared, when the solution is boiled, filtered from the liberated sulphur, and evaporated (Spencer, 1852.)

When iodine is added to ammonia-water, ammonium iodide is produced, but at the same time the extremely explosive compound nitrogen iodide results. Mixtures of the two substances named should therefore be made with great caution.

"Ammonium iodide should be preserved in small, well-stopped vials, protected from light. When deeply colored it should not be dispensed, but it may be deprived of free iodine by adding to its concentrated aqueous solution sufficient ammonium sulphide test-solution to render it colorless, then filtering, and evaporating on a water-bath to dryness."—*U. S.*

Properties.—Ammonium iodide is in white granular crystals, and on the slow evaporation of its solution, which should be kept slightly alkaline by ammonia, is obtained in colorless and inodorous cubes having the specific gravity 2.498. If the air is excluded, the salt sublimes undecomposed; in contact with the atmosphere it acquires a yellowish-brown color and a slight odor of iodine. The salt is very deliquescent, and dissolves freely in water and alcohol, requiring 1 part of water and 9 parts of alcohol at 15° C. (59° F.), .5 part of boiling water, and 3.7 parts of boiling alcohol for solution (*U. S.*); the solutions have a slight acid reaction and become yellow on exposure. Iodine is

liberated on the addition of nitric acid and ammonia by potassa or lime. On the addition of a little chlorine-water to the aqueous solution of the salt, iodine is set free, which will dissolve in chloroform or in carbon disulphide with a violet color, and will impart a blue color to mucilage of starch; excess of chlorine will prevent these color-reactions through the formation of colorless compounds.

Tests.—The purity of the salt is recognized by its complete volatility, and by its solution yielding not any, or only a slight, turbidity with barium chloride (sulphate). Ammonium bromide and chloride are recognized by precipitating the solution with silver nitrate and adding ammonia in excess, in which silver iodide is very sparingly soluble, so that the ammoniacal liquid will yield merely a slight turbidity on the addition of nitric acid. If a precipitate occurs, this is agitated with chlorine-water gradually added in the presence of chloroform, which will be colored red if bromine be present; if the chloroform is not colored, the impurity is a chloride. The limits of impurities are thus ascertained: "On adding to 1 Gm. of the salt, dissolved in 20 Cc. of water (with a few drops of dilute hydrochloric acid), 5 or 6 drops of test-solution of barium nitrate, no immediate cloudiness or precipitate should make its appearance (limit of sulphate). If 0.25 Gm. of the salt be dissolved in 10 Cc. of ammonia-water, then shaken with 7.6 Cc. of decinormal silver nitrate solution, and the filtrate be supersaturated with 5 Cc. of nitric acid, no cloudiness should make its appearance within ten minutes (absence of more than about 0.5 per cent. of chloride or bromide). A 1 per cent. aqueous solution should not at once be colored blue by test-solution of potassium ferrocyanide (limit of iron), nor, after being mixed with gelatinized starch, should it assume a deep-blue color (limit of free iodine)."—*U. S.* The solution of 10 grains of ammonium iodide, treated with sufficient silver nitrate, yields a precipitate of silver iodide, which, after washing and drying, weighs about 162 grains (or 1.618 Gm. from 1 Gm. AmI).

Action and Uses.—Iodide of ammonium resembles the other alkaline iodides, but is more active as well as more transient in its effects. It is said that Gm. 0.50 (gr. viij) (Böcker), and even Gm. 1.30 (gr. xx) (Gamberini), may be taken at a dose without other effect than some warmth and irritation of the throat and stomach. It was first used in an ointment for *psoriasis*, *tinea capitis*, and other scaly affections of the skin, particularly those due to a syphilitic infection, and it was afterward administered internally for the same class of affections and for rheumatism with success. As a topical application in ointments and poultices it reduces *enlarged glands*, and, being more irritating than iodide of potassium, is probably superior to the latter salt for this purpose, but it is inferior to the iodide of lead. A solution of Gm. 2.00–2.60 (gr. xxx–xl) of the salt in a fluidounce of glycerin has been used with the same object, and also as an application to enlarged and indurated *tonsils*. It is sometimes added to volatile, camphorated, and other liniments used for the relief of *rheumatic* and other local pains. The *dose* of this iodide is from Gm. 0.06–0.30 (gr. j–v) and upward. It should be dissolved in water with syrup, and dispensed in bottles of blue glass to prevent its decomposition by the light. An ointment containing from Gm. 2–4 (gr. xxx–lx) of the salt in an ounce of lard should be freshly prepared when required.

AMMONII NITRAS, *U. S., Br.*—Ammonium Nitrate.

Ammoniæ nitras, Br.; *Ammonium nitricum*, *Nitrum flammans*.—*Nitrate of ammonia*, E.; *Azotate d'ammoniaque*, *Nitre inflammable*, *Nitre ammoniacal*, *Sel ammoniacal Nitreux*, Fr.; *Salpetersaures Ammon* (*Ammonium*, *Ammoniak*), *Ammoniumnitrat*, G. *Nitrato de amoniaco*, Sp.

Formula NH_4NO_3 or $AmNO_3$. Molecular weight 79.9.

Preparation.—Ammonium nitrate exists in small quantity in the atmosphere and in rain-water, particularly after thunder-storms; likewise in the water of several springs. On dissolving iron in nitric acid the same salt is formed through the action of nascent hydrogen upon a portion of the acid; many other metals have the same effect.

For preparing ammonium nitrate, nitric acid is neutralized with ammonia or ammonium carbonate, or, in place of the latter, the pulverulent bicarbonate which accumulates in the shops may be advantageously employed; the solution is concentrated by evaporation and crystallized, or until it congeals on cooling. On the large scale it is manufactured from ammonium sulphate and potassium nitrate, the mixed solutions of which yield, first, crystals of the less freely soluble potassium sulphate, afterward crystals of ammonium nitrate, which require to be purified by recrystallization.

Properties.—Ammonium nitrate crystallizes in colorless hexagonal prisms, or on the

rapid refrigeration of the concentrated solution in long, flexible, thread-like needles; after fusion it forms colorless crystalline, inodorous masses. It has the specific gravity 1.70, and possesses a sharp bitterish taste. It deliquesces in contact with moist air, and dissolves at ordinary temperatures in about half its weight, and in much less of boiling water. It dissolves in 2.20 parts of alcohol, specific gravity 0.880, at 25° C. (77° F.) (Pohl); in 1.1 parts of boiling alcohol (Wenzel); in 20 parts of alcohol at 15° C. (59° F.), and in 3 parts of boiling alcohol (*U. S. P.*). The solutions on exposure or on heating lose ammonia and acquire an acid reaction. The salt deliquesces in ammonia gas, forming a solution in liquefied ammonia, as observed by Divers (1872); at 23° C. (73.4° F.) and the pressure of the atmosphere the liquid consists of 4 parts, and at 0° C. (32° F.) of 2 parts, by weight, of the nitrate to 1 part of ammonia; but under greater pressure or at lower temperatures much more ammonia can be condensed by the nitrate. Like an aqueous solution, the liquid boils when heated, and may crystallize on cooling or become supersaturated with the salt without crystallizing; at 80° C. (176° F.) the whole of the ammonia is expelled. Ammonium nitrate softens on the application of heat, and fuses at 165°–166° C. (329°–330.8° F.) (U. S.), 160° C. (320° F.) (Br.) 108° C. (226.4° F.) (Pleischl), at 152° C. (305.6° F.) (Berthelot,1872), at 165° to 166° C. (329°–330.8° F.) (Pickering, 1878), the difference in these observations being doubtless due to the presence of moisture and other impurities. The same causes affect also the temperature at which the salt is decomposed, and which has been determined at 185° C. (365° F.) by Pickering, at 190°–200° C.(374°–392° F.), by Legrand, at 210° C. (410° F.) by Berthelot, and at near 240° C. (464° F.) by Pleischl, the U. S. P. requiring a salt which decomposes between 230° and 250° C. (446° and 482° F.), (*U. S.*), 176.7° C. to 232.2° C. (350° to 450° F.) (*Br.*). A portion of the salt is volatilized unaltered. When rapidly heated it is decomposed into water, nitrogen trioxide, and nitrogen, or into nitrous and nitric oxides, ammonium nitrite, and ammonia; but if gradually heated it is decomposed into water and nitrous oxide, or *laughing gas*, N_2O. This decomposition is effected according to the following equation: $NH_4NO_3 = N_2O + 2H_2O$. It is evident from this that in the preparation of nitrous oxide gas to be used for inhalation the heat should be carefully regulated and the gas pass through solutions of potassa (or lime-water) and ferrous sulphate, whereby all the gaseous impurities, except the nitrogen which may be present, are completely removed, even if chlorine should have been evolved in consequence of the presence of ammonium chloride in the nitrate.

The salt detonates when thrown upon red-hot charcoal or when mixed with powdered charcoal and heated to 170° C. (338° F.). When mixed with sulphuric acid, nitric acid vapors are given off, and potassa or lime evolves ammonia when heated with the aqueous solution.

Tests.—The salt should be completely volatilized without charring when heated upon platinum-foil, and a 10 per cent. aqueous solution acidulated with nitric acid should not be precipitated either by silver nitrate or barium chloride (absence of chloride and sulphate).

Action and Uses.—Nitrate of ammonium is seldom used, but its dose is stated at Gm. 0.05–1.5 (gr. j–xx). It is generally regarded as having properties analogous to those of potassium nitrate. It is made officinal chiefly as the source from which nitrous oxide gas is derived by means of heat. It is also used to prepare freezing mixtures and artificial cold applications.

AMMONII PHOSPHAS, *Br.*—Ammonium Phosphate.

Ammoniæ phosphas, Ammonium phosphoricum, Phosphas ammonicus.—Phosphate of ammonia, Diammonium orthophosphate, E.; *Phosphate d'ammoniaque*, Fr.; *Ammoniumphosphat, Phosphorsaures Ammon (Ammonium, Ammoniak)*, G.

Formula $(NH_4)_2HPO_4$. Molecular weight 131.82.

Preparation.—Take of Diluted Phosphoric Acid 20 fluidounces; Strong Solution of Ammonia a sufficiency. Add the ammonia to the phosphoric acid until the solution is slightly alkaline, then evaporate the liquid, adding ammonia from time to time, so as to keep it in slight excess, and when the crystals are formed on the cooling of the solution, dry them quickly on filtering-paper placed on a porous tile, and preserve them in a stoppered bottle.—*Br.*

This process yields the salt by the direct union of tribasic phosphoric acid and ammonia. Since the salt has a distinct alkaline reaction and heat expels a portion of the ammonia, it becomes necessary to add ammonia-water from time to time, and particularly when the solution is set aside to crystallize, in order to preserve the alkaline reaction,

otherwise this so-called neutral salt will be mixed in variable proportions with the acid phosphate, having the composition $NH_4H_2PO_4$. The salt may also be obtained from bones calcined to whiteness by the process for SODIUM PHOSPHATE (which see), if the sodium carbonate there directed is replaced by ammonium carbonate, and the resulting liquid, after suitable concentration, is rendered alkaline by the addition of some ammonia. If necessary, the salt obtained is to be purified by recrystallization from distilled water, with the addition of a little ammonia, until the crystals are free from sulphate. If the crystallizing liquid should have been rendered strongly alkaline by ammonia, the salt would consist of or contain triammonium (the so-called basic) orthophosphate of the formula $(NH_4)_3PO_4$.

Properties.—Ammonium phosphate crystallizes in transparent, colorless, monoclinic prisms having the specific gravity 1.678 (Buignet, 1861). It has a cooling and sharply saline taste, effloresces superficially in a damp atmosphere through loss of ammonia, is insoluble in alcohol, but dissolves in 4 parts of water at 15° C. (59° F.) and in .5 part of boiling water, yielding a solution which is at first slightly alkaline, but on exposure becomes neutral through loss of ammonia, and by continued boiling loses one-half of it. The solution yields a yellow precipitate with silver nitrate, soluble in nitric acid and ammonia, and evolves ammonia when heated with potassa. The salt, when heated, fuses and is gradually decomposed into metaphosphoric acid, ammonia, and water, and at a bright red heat is finally completely volatilized.

Tests.—20 grains of the salt, dissolved in water and precipitated by a solution of ammonio-magnesium sulphate, yield a crystalline precipitate, which, when well washed with diluted ammonia-water, dried, and ignited, weighs 16.8 grains. The solution should not be affected by ammonium sulphide, or, after being acidulated with nitric acid, by hydrogen sulphide (absence of metals), and should yield no precipitate with barium chloride (sulphate) or silver nitrate (chloride). 10 grains of the salt, gradually heated upon platinum-foil to redness, should leave a residue weighing 6.1 grains.

Action and Uses.—Ammonium phosphate was proposed as a remedy for *gout*, upon the theoretical ground that it would produce, with the uric acid in the system, more soluble salts than those of soda and lime, which form the bases of gouty concretions. By a singular perversion of logic the same condition was assumed to exist in *rheumatism*, which is a totally different disease, essentially as well as clinically. It was indeed pointed out that, even from a chemical point of view, the administration of the medicine would be apt to favor the formation of ammoniaco-magnesian calculi. However, it was alleged that during the use of the medicine uric acid rapidly disappeared from the urine, and that the pains and other local phenomena in the joints during acute gout and rheumatism subsided, just as they do in the latter disease under the use of the carbonates of the alkalies. No general concurrence in the results of observation has confirmed the special if not specific advantages ascribed to this medicine at its introduction, and which are neither greater than those of the other alkalies nor different from them. Like them, phosphate of ammonium has been found very serviceable in many cases of *diabetes* by maintaining a highly alkaline condition of the blood, and thereby diminishing the amount of sugar eliminated with the urine. The *dose* is from Gm. 0.60–1.30 (gr. x–xx) three times a day, dissolved in water or in some mild liquid, such as barley- or rice-water.

AMMONII SULPHAS.—AMMONIUM SULPHATE.

Ammonium sulphuricum, *Sulphas ammonicus*, *Sal ammonium secretum Glauberi.*—*Sulfate d'ammoniaque*, *Sel secret de Glauber*, Fr.; *Schwefelsaures Ammon* (*Ammonium*, *Ammoniak*), *Ammoniumsulfat*, G.

Formula $(NH_4)_2SO_4$ or Am_2SO_4. Molecular weight 131.84.

Origin.—Ammonium sulphate was observed by Libavius (1595), and first prepared from oil of vitriol and volatile alkali by Glauber (1667), after which time it was much employed as a purgative. The salt is a constituent of a few minerals, and is sometimes found in the neighborhood of volcanoes.

Preparation.—Ammonium sulphate is largely obtained from coal-gas liquor (see AMMONII CHLORIDUM) by neutralizing it with sulphuric acid or by digesting it with calcium sulphate. A convenient process is to percolate the gas-liquor through powdered gypsum, whereby calcium carbonate is left in the percolator and ammonium sulphate is found in the filtrate $CaSO_4 + (NH_4)_2CO_3$ yields $CaCO_3 + (NH_4)_2SO_4$. The solution is evaporated; the resulting crystals are gradually heated to about 240° C. (464° F.) to

expel tarry compounds, and then recrystallized from water. Nearly all that is consumed in the United States is manufactured here.

Properties.—It forms colorless rhombic prisms isomorphous with potassium sulphate, free from odor, and of a sharp saline and bitterish taste. It has the specific gravity 1.76, fuses at 140° C. (284° F.), and is decomposed at a heat exceeding 260° C. (500° F.), yielding ammonia, water, nitrogen, and a sublimate of ammonium sulphite with a little ammonium sulphate. 100 parts of water dissolve, according to Alluard (1864),

71.00	73.65	76.30	78.95	81.60	84.25	86.90	89.55	92.20	94.85	97.50 parts of Am_2SO_4
at 0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100° C.

The solution in cold water has a neutral reaction to test-paper, but on exposure or on boiling evolves a little ammonia and acquires a faint acid reaction (Debbits, 1872). It is insoluble in absolute alcohol, requires for solution about 500 parts of alcohol (spec. grav. .88), but dissolves more freely in weaker alcohol. Its solution evolves ammonia when heated with potassa or lime, and chloride of barium produces in it a white precipitate insoluble in diluted nitric acid.

Tests.—When gradually heated to redness the salt should not be blackened, and should finally leave no residue upon platinum-foil. Metals, chlorides, and other impurities are detected in the same manner as in other ammonium salts.

Action and Uses.—Ammonium sulphate is used in the manufacture of ammonia-water, chloride of ammonium, and ammonia alum; also for sulphate of iron and ammonium. It is not used as a medicine.

AMMONII VALERIANAS, *U. S.*—Ammonium Valerianate.

Valerianas ammonicus.—Ammonium Valerate, E.; *Valérianate d'ammoniaque*, Fr.; *Ammoniumvalerianat, Baldriansaures Ammonium*, G.; *Valerianato de amoniaco*, Sp.

Formula $NH_4C_5H_9O_2$. Molecular weight 118.78.

Preparation.—The practical details of the process recognized by the U. S. Pharmacopœia of 1870 were published by B. J. Crew (1860), and are based upon Chevreul's observations that concentrated valerianic acid, placed in an atmosphere of ammonia, yields this salt in crystals. A convenient quantity of valerianic acid (spec. grav. .935) is placed in a tall, narrow glass vessel and saturated with dry ammonia gas, which is generated from a mixture of equal weights of ammonium chloride and slaked lime, the gas being dried by passing it through a bottle filled with pieces of burned lime. On the combination of the dry ammonia gas with the acid much heat is produced, and after neutralization has been attained the salt crystallizes readily on cooling; after several hours it is broken into pieces, drained, if necessary, in a glass funnel, dried on bibulous paper, and preserved in a well-stopped bottle. Valerianic acid, which is weaker than the above and of higher specific gravity, yields few or no crystals by this process.

Properties.—Ammonium valerianate, thus prepared, forms colorless or white quadrangular plates having the odor of valerianic acid and possessing a sharp and sweet taste. It effloresces when placed in a dry atmosphere, and deliquesces in moist air. On the application of heat it fuses, giving off ammoniacal and acid vapors, and is finally dissipated without leaving any residue. It dissolves freely in water and alcohol, the solutions being neutral, and on evaporation acquiring an acid reaction from the loss of ammonia. Alkalies decompose it with the evolution of ammonia, and the stronger acids with the separation of oily valerianic acid, floating upon the aqueous solution. Should the salt have an acid reaction, its solution, when dispensed, should be neutralized by the careful addition of ammonia, whereby the disagreeable odor and taste of valerianic acid are masked to a considerable extent.

Tests.—Heated to redness upon platinum-foil, the salt should leave no residue (potassium, etc. salts). A 5 per cent. aqueous solution, after having been acidulated with nitric acid, should not be precipitated by barium chloride (sulphate) or silver nitrate (chloride), or, after having been rendered alkaline by ammonia, by magnesium sulphate (phosphate). When the aqueous solution is treated with an excess of sulphuric acid, and the clear watery liquid is nearly neutralized with ammonia, a deep-red coloration should not be produced on the addition of ferric sulphate or chloride (absence of acetate).

Action and Uses.—The experiments of Parke on the frog (*Therap. Gaz.*, xi. 167) led him to conclude that valerianate of ammonium in small doses probably stimulates the

spinal cord, and in large doses depresses it. Like several other medicines, including valerian itself, its influence is exhibited chiefly in certain morbid conditions due to exhaustion of the nervous system. It was first employed successfully for the relief of *neuralgia* of this description, and it continues to be used as a convenient palliative for that affection, for *nervous headache*, *nervousness*, *insomnia*, *hysterical disorders*, *palpitation of the heart*, etc. It would be a waste of time to prescribe it in cases of epilepsy, chorea, and fully-formed hysterical convulsions. *Dose*, from Gm. 0.10–0.60 (gr. ij–x) dissolved in water, with the addition of a flavoring tincture, which also preserves the salt from decomposition.

AMPELOPSIS.—Virginia Creeper.

American ivy, E.; *Vigne vierge*, Fr.; *Wilder Wein*, *Amerikanischer Epheu*, G.

The young branches and bark of Ampelopsis (Cissus, *Persoon*, Vitis, *Mœnch*) quinquefolia, *Michaux*, s. Vitis (Cissus, *Barton*) hederacea, *Willdenow*.

Nat. Ord.—Vitaceæ.

Description.—The Virginia creeper is a woody vine, climbing extensively by adventitious roots and by tendrils; it has digitate leaves composed of five oblong lanceolate somewhat dentate leaflets, and cymose clusters of greenish flowers with five unconnected deciduous petals, and produces two-celled and two- or four-seeded acidulous blue-black berries of the size of a pea. The young branches and bark are employed, and collected in autumn. The plant is indigenous to North America, and is often cultivated here and in Europe as a covering for walls.

Constituents.—The leaves were analyzed by Wittstein (1845) and by Gorup-Besanez (1872 and 1874). Collected in June, they contain albumen, sugar, pyrocatechin, free tartaric acid, potassium bitartrate, and calcium tartrate; when collected in September no potassium bitartrate or free tartaric acid was found, and in addition to the other constituents pectin and glycolate of calcium were obtained. The berries contained the same principles except glycolic acid.

The root of Amp. Botrya, *De Candolle*, of South-eastern Africa, is reputed to possess diuretic properties.

Action and Uses.—There appears to be nothing recently added to the scanty statements long ago made regarding this plant. A decoction or infusion of the bark was said to be useful in dropsy, and "to act rather by stimulating absorption than as a diuretic." The therapeusis of this statement is as crude as its physiology.

AMYGDALA.—Almond.

Amandes, Fr.; *Mandeln*, G.; *Almendras*, Sp.; *Mandorle*, F. It.

The seed of the almond tree, Amygdalus communis, *Linné*, s. Prunus Amygdalus, *Stokes*. Bentley and Trimen, *Med. Plants*, 99.

Nat. Ord.—Rosaceæ, Amygdaleæ.

Officinal Varieties.—1. Amygdala amara, U. S., Br.; *Amygdalæ amaræ*, P. G.; *Semen Amygdali amarum.—Bitter Almond*, E.; *Amandes amères*, Fr.; *Bittere Mandeln*, G.; *Almendras amargas*, Sp.

The seed of Amygdalus communis, *Linné*, var. amara, *De Candolle*.

2. Amygdala dulcis, U. S., Br.; *Amygdalæ dulces*, P. G.; *Semen amygdali dulce.—Sweet Almond*, E.; *Amandes douces*, Fr.; *Süsse Mandeln*, G.; *Almendras dulces*, Sp.

The seed of Amygdalus communis, *Linné*, var. dulcis, *De Candolle*.

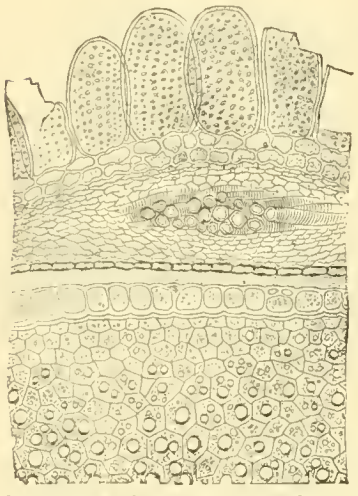
Origin.—The almond tree is probably indigenous to Western Asia, but at an early period was introduced into Northern Africa and southern Europe, where by long cultivation numerous varieties have been produced, differing mainly in the size and shape of the fruit and in the hardness of the shell (endocarp). It has also been introduced in the warmer parts of the United States and in other countries of the warmer temperate and subtropical regions; in California, according to M. J. Murphy, about 100 trees are planted to the acre, and begin to yield fruit when three years old of an average value of $50, increasing to $2000 in the eighth year. The tree attains a height of 5 to 6 M. (15 to 20 feet,) and with its bright green foliage and large rose-colored or white flowers presents a handsome appearance. The fruit is a short-stalked, ovate drupe about 38 Mm. (2¼ inches long), 25 Mm. (1 inch broad), somewhat flattened, with a groove on one side, covered with a greenish leathery sarcocarp, which is whitish, velvety, hairy, splits at maturity, and falls away from the putamen; this constitutes the *commercial* almond, which, at least in California, is bleached and rendered of uniform appearance by exposure

to the vapors of burning sulphur, whereby insects present are also destroyed. The putamen, deprived of its hard shell, the thick or papery endocarp, furnishes the *officinal* almond. The bitter and sweet almond trees do not differ from each other botanically, and even the fruits and seeds of the two varieties resemble each other closely.

Description.—The sweet and bitter almonds cannot be distinguished from each other except by one of their constituents and their taste. Bitter almonds are usually thinner, broader, and shorter than the larger variety of the sweet almond, which is ordered by the British Pharmacopœia, and which is known in our commerce by the name of *Jordan almonds.* They are cultivated in Spain; the best are exported from Malaga, and are a hard-shelled variety, but are frequently seen in commerce deprived of the shell. The soft-shelled sweet almonds (variety fragilis, *De Candolle*) are cultivated largely in the Balearic Isles (Majorca), and are exported from Valencia and the Mediterranean ports of France and Italy. The cheapest variety are the Barbary almonds, which are small and unsightly in appearance.

Jordan or Malaga almonds are about 25 Mm. (an inch) in length and 15 Mm. ($\frac{3}{5}$ inch) broad, flattened, and ovate-lanceolate in shape. The testa is of a cinnamon-brown color and scurfy upon its surface from detached cells; it adheres to the whitish tegmen, and the two integuments are easily detached from the white embryo or kernel (blanched) after the seed has been soaked in lukewarm water for a short time. The hilum is just below the pointed end and upon one edge of the almond, the raphe running along this edge to the broad end, where it forms the broad chalaza, and divides into about sixteen branches, which pass in plainly visible lines toward the pointed end. The embryo consists of two plano-convex white and oily cotyledons of the size and shape of the seed, between which, near the pointed end, the flat plumule is placed, with the short thick radicle somewhat projecting. The tissue of the embryo is made up, besides a small number of delicate fibro-vascular bundles, of thin-walled, irregularly angular parenchyma-cells filled with fixed oil and granules of different size. Almonds are inodorous, and have a sweetish bland, nutty taste, that of the bitter variety being decidedly bitter and aromatic.

FIG. 12.



Almond: section through seed-coats and portion of cotyledon. Magnified 190 diameters.

FIG. 13.

Almond.

The embryo of both varieties of almonds yields, on being triturated with water, a milk-white emulsion, which is either inodorous and sweet or aromatic and bitter, according to the variety used.

Constituents.—Both varieties of almonds have qualitatively the same composition, except that amygdalin is found in bitter but not in sweet almonds. The fixed oil (see OLEUM AMYGDALÆ EXPRESSUM) is present to the amount of 45 to 56 per cent., the sweet almonds yielding usually from 5 to 10 per cent. more than the bitter. About 3 per cent. of mucilaginous matter, 6 per cent. of sugar, and 24 to 30 per cent. of protein compounds, besides water and cellular tissue, are found in almonds. On keeping almonds for several days in absolute alcohol they become covered with minute crystals, which Portes (1876) recognized as asparagin. Ludwig and Scheitz (1872) found in unblanched almonds tannin, giving a green reaction with ferric salt, green resin, and a bitterish acrid yellow substance, which is possibly a glucoside; the three compounds seem to be contained only in the integuments; the last two yield with caustic soda a cherry-red color, which, with more alkali, turns dingy-green. The sugar of almonds is mostly glucose, but Pelouze obtained (1855) also cane-sugar. The two protein compounds are, according to Ritthausen (1872), modifications of vegetable casein. Both are soluble in cold water; one, the *conglutin* of Ritthausen and *amandin* of Comaille (1866), being precipitated by acetic acid, while the second compound, known as *emulsin* or *synaptase*, may afterward be precipitated by alcohol, together with some inorganic salts. Both protein compounds act as emulsionizing agents in suspending the fixed oil when the almonds are triturated with water; but it appears to be the emulsin only which is capable of decomposing the amygdalin of bitter almonds into hydrocyanic acid and benzaldehyd. (See OLEUM AMYGDALÆ AMARÆ.)

Amygdalin, $C_{20}H_{27}NO_{11}$, was discovered by Robiquet and Boutron-Charlard (1830) by

exhausting bitter almonds, deprived of their fixed oil, by alcohol; they also observed that the residue would not yield oil of bitter almonds in contact with water. Liebig and Wöhler found (1837) that amygdalin, on being decomposed by emulsin, yields, besides oil of bitter almonds and hydrocyanic acid, also grape-sugar; it was the first glucoside discovered. Amygdalin is obtained from bitter almonds to the amount of from 1 to 3 per cent., and is also contained in the bark, leaves, flowers, and seeds of many trees and shrubs of the sub-orders Amygdaleæ and Pomeæ; according to Henschen (1872), also in minute quantity in sweet almonds, and, according to Ritthausen and Kreussler (1870), in the vetch. It occurs sometimes in an amorphous condition, but as obtained by alcohol from bitter almonds, peach-kernels, etc. it crystallizes with $2H_2O$, the water being expelled at 120° C. (248° F.). It is soluble in about 15 parts of water, has no odor, but a bitter taste, and is not poisonous unless decomposed by emulsin. Henschen found that this decomposition is also effected by rye-, wheat-, and pea-flour, but it is uncertain whether by the agency of emulsin or another proteid. 17 grains of anhydrous amygdalin yield 1 grain of hydrocyanic acid. On boiling amygdalin with an alkali it is decomposed into ammonia and *amygdalic acid*, $C_{20}H_{28}O_{13}$, the latter, on being boiled with dilute acids, yielding glucose and *mandelic* or *phenylglycolic acid*, $C_8H_8O_3$ or $C_6H_5.CHOH.COOH$.

Almonds yield from 3 to 5 per cent. of ash, consisting mainly of potassium, calcium, and magnesium phosphates.

Preservation.—Bitter almonds should be kept unbroken and in a dry atmosphere, to prevent the decomposition of amygdalin and of the fixed oil. Almonds the embryo of which has become discolored or acquired a rancid odor and taste, or has been partly converted into gum (bassorin), as described by Vulpius (1878), are unfit for medicinal purposes.

Pharmaceutical Uses.—Both varieties are employed for obtaining Oleum amygdalæ and in preparing Syrupus amygdalæ. Sweet almonds enter into the composition of Mistura amygdalæ, Syrupus amygdalæ, *U. S.*, and Pulv. amygdalæ comp., *Br.*

Action and Uses.—Sweet almond is used to prepare an emulsion, and also an oil, which are treated of elsewhere. With it a kind of bread is made which is a tolerable substitute for wheaten bread in the treatment of *diabetes*. Bitter almonds and their essential oil are excessively poisonous in large doses, owing to the quantity of hydrocyanic acid developed in the former by admixture with water and by the presence of the same acid in the latter. A drachm of bitter-almond pulp will kill a pigeon or a kitten. The symptoms produced in man by an overdose of this substance are great debility and depression, cyanosis, collapse, convulsions or muscular rigidity (see Acid Hydrocyanicum), and, if the dose is fatal, insensibility occurs suddenly, with frothing at the nose and mouth, and after death the eyes remain fixed and glistening. Non-poisonous doses are apt to produce an eruption of urticaria—an effect which sometimes follows the ingestion of sweet almonds.

In preparing the almond for food in cases of *diabetes*, it is first blanched, then subjected to a strong pressure to expel a portion of the oil, treated with boiling water slightly acidulated with tartaric acid to remove the sugar, and then ground to a fine powder, which can be made into cakes and puddings with eggs and cream. These products have a pleasant taste and are said to be quite digestible.

The proper treatment of poisoning by bitter almonds consists in evacuating the stomach by means of the finger in the throat or the administration of a mechanical emetic, such as sulphate of zinc. If the patient is unable to swallow, the stomach-pump should be used. If respiration fails, the galvanic battery should be resorted to without delay. Reaction may be promoted by small but repeated doses of brandy or whiskey and the application of ammonia to the nostrils.

AMYL NITRIS, *U. S., Br.*—Amyl Nitrite.

Amylium nitrosum, P. G.; *Amylæther nitrosus.—Amylo-nitrous ether*, E.; *Azotite d'amyl, Ether amylazoteux*, Fr.; *Amylnitrit*, G.; *Etere isoamil nitroso*, F. It.; *Nitrito de amilo*, Sp.

Formula $C_5H_{11}NO_2$. Molecular weight 116.78.

A liquid containing about 80 per cent. of amyl (chiefly isoamyl) nitrite, together with variable quantities of undetermined compounds.—*U. S.*

A liquid produced by the action of nitric or nitrous acid on amylic alcohol, which volatilizes between 128° and 132° C. (262° and 270° F.). It consists chiefly of amyl nitrite.—*Br.*

Preparation.—Purified amylic alcohol is introduced into a capacious glass retort

with about an equal bulk of nitric acid; a gradually increasing heat is applied until the mixture approaches boiling, when the reaction will proceed spontaneously. The distillate is collected until the temperature in the retort rises above 100° C. (212° F.), the portion distilling at a higher temperature containing much amyl nitrate and ethyl amylic ether. The distillate obtained below 100° is agitated with water and an alkali (potassa, lime, or their carbonates) to remove hydrocyanic, nitric, and nitrous acids; and the oily layer, which separates, is rectified from a clean retort by a gradually-increased heat, amylic aldehyde coming over in the first portion; that distilling between 95° and 100° C. is collected separately. (See *Amer. Jour. of Pharmacy*, 1871, p. 147.) If not carefully rectified it requires to be purified by fractional distillation. This is Balard's process (1844), with some modifications.

The process now generally followed is identical with the one prescribed in the Pharmacopœia for the manufacture of ethyl nitrite in the preparation of spirit of nitrous ether, except that amylic alcohol is substituted for common or ethylic alcohol. A mixture of sodium nitrite, amylic alcohol, and diluted sulphuric acid is subjected to distillation in a retort, that portion being collected which vaporizes between 95° and 100° C.; the distillate is well washed with a solution of sodium carbonate, dehydrated with pure potassium carbonate, and redistilled below 100° C. (212° F.). The reaction occurring is explained by the following equation: $2C_5H_{11}OH + 2NaNO_2 + H_2SO_4 = 2C_5H_{11}NO_2 + Na_2SO_4 + 2H_2O$; theoretically, 138 parts of sodium nitrite are capable of producing 234 parts of amyl nitrite; this yield, however, is never obtained, owing to impurities in the amylic alcohol and sodium salt, as well as possible carelessness during the process.

Properties.—Amyl nitrite is an ethereal liquid of a yellowish color, a neutral reaction, a peculiar not disagreeable fruit-like odor, and a pungent aromatic taste. The U. S. Pharmacopœia requires its spec. grav. to be 0.870–0.880, while Rieckher has determined it to be .877 and Bunge .905 at 14.5° C. (58° F.). Amyl nitrite boils constantly and without being decomposed at 96° C. (205° F.) (W. H. Greene, 1879), or, according to Chapman (1867), between 98° and 99° C.; the vapor is orange-colored and has the density 4.03. Amyl nitrite burns with a bright fawn-colored and sooty flame. It is insoluble in water, but dissolves in all proportions in rectified spirit and other alcohols, in ethers, carbon disulphide, benzene, benzin, and other hydrocarbons. It dissolves fixed oils, fatty acids, phosphorus, and a small proportion of sulphur, caoutchouc, and gutta-percha. On exposure to air and light it acquires an acid reaction, and should therefore be preserved in small glass-stoppered vials kept in a cool and dark place—according to *P. G.* with a few crystals of potassium tartrate, whereby an undue amount of free acid will be prevented. In contact with potassa solution it is gradually decomposed, with the formation of amyl alcohol and potassium nitrite, the decomposition being accelerated by warming and in the presence of alcohol; the presence of nitrite is shown by adding to the alkaline liquid a little potassium iodide, then acetic acid to an acid reaction; an immediate separation of iodine will take place, and on the addition of gelatinized starch a deep-blue color will appear (distinction from nitrate). If it be added drop by drop to caustic potassa heated to fusion, potassium valerianate will be formed, frequently with the production of flame.

The commercial product is frequently very impure. Sixteen samples, European and American products, examined by Curtmann (1892), contained, respectively, 27.14, 33.9, 37.68, 39.6, 59.33, 65.35, 66.36, 67.83, 71.32, 73.81, 76.24, 81.37, 83.03, 84.23, 86.13, and 93.71 per cent. of true amyl nitrite.

Tests.—Amyl nitrite should remain transparent or nearly so when exposed to the temperature of melting ice (absence of water).—*U. S.* and *P. G.* On shaking 10 Cc. of amyl nitrite with 2 Cc. of a mixture of 1 part of water of ammonia and 9 parts of water, the liquid should not redden blue litmus-paper (limit of free acid).—*U. S.* and *P. G.* If equal volumes of amyl nitrite and test-solution of potassa be shaken together, the aqueous layer should not acquire a deeper tint than pale yellow (limit of aldehyde).—*U. S.* The Br. Ph. requires at least 70 per cent. of distillate between 90° and 100° C. (194° and 212° F.). The amount of amyl nitrite present is directed by the U. S. Ph. to be estimated gasometrically as follows: "If 0.26 Gm. of amyl nitrite, diluted with 5 Cc. of alcohol, be introduced into a nitrometer, followed by 10 Cc. of potassium iodide test-solution, and afterward by 10 Cc. of normal sulphuric acid, the volume of nitric oxide generated, measured at the ordinary indoor temperature (assumed to be at or near 25° C. or 77° F.), should be about 40 Cc." The pharmacopœial requirement is no doubt sufficiently accurate for general purposes, but the equation, $C_5H_{11}NO_2 + KI + H_2SO_4 = C_5H_{11}OH + NO + I + KHSO_4$, shows that 116.78 Gm. of amyl nitrite, upon oxidation, yield 29.97 Gm. of nitric oxide; 1 Cc. of nitric oxide, therefore, at 25° C. (77° F.),

weighing 0.0012297 Gm. must be equal to 0.0047923 Gm of amyl nitrite, and nearly 43.5 Cc. of NO gas should be generated at 25° C. (77° F.) instead of 40, as stated in the Pharmacopœia to indicate 80 per cent. of amyl nitrite in the official test; 80 per cent. of 0.26 Gm. is 0.208, and $0.0047923 \times 43.5 = 0.208465$.

Allied Compounds.—Amyl Nitras, amyl nitrate, $C_5H_{11}NO_3$.—It was discovered by W. Hofmann (1848), and is most advantageously prepared, according to Chapman and Smith (1867), by dropping through a long tube, and *with constant stirring*, 50 Cc. of amylic alcohol into 150 Cc. of a mixture made of 1 volume of nitric and 2 volumes of sulphuric acid, and kept cool by ice and table-salt. Without any visible reaction an oily layer of amyl nitrate separates on the surface, which is obtained pure by washing with dilute potassa solution and water, drying with calcium chloride, and rectifying. It is a colorless oily liquid of a peculiar odor and sweet and burning taste. Its density at 15° C. is 0.902, and it boils at 147° C. (296.6° F.). It dissolves in glacial acetic acid, benzene, and in ethylic, methylic, and amylic alcohol, but not in water.

Action and Uses.—When 5 or 6 drops of nitrite of amyl are inhaled the heart becomes excited, the pulse rising from 70 to 160; its force, as measured by the sphygmograph, diminishes, but practically is increased, for all clinical observation proves that it directly or indirectly enables the heart to overcome embarrassment; the skin, especially of the face, turns crimson; some vertigo is experienced, and the breathing is hurried as it is after rapid walking. If the dose is large the sight may be dimmed, and in the field of vision sometimes a yellow circle appears, surrounded by a violet border. It neither increases nor lessens general sensibility. In full doses it depresses the normal temperature by from 1° to 3° F. Sanders has recorded cases in which sudden collapse followed upon its administration, and Samelsohn one in which the usual flush was succeeded by deadly pallor, the pulse becoming thread-like and slow, the skin cold and clammy, and respiration difficult and gasping, although consciousness was retained. Others are referred to by Jastrowitz. Dugau (1879) relates that after continuing to breathe the vapor for a considerable time he suffered from distressing and irregular palpitation of the heart, with pallor, debility, vertigo, and loss of appetite. During the inhalation the patient is generally conscious of giddiness, a feeling of the head being inordinately large, a diffused glow, and throbbing of the heart and large arteries. It is alleged that the action of this medicine is exceedingly capricious—that while some persons can without injury inhale 30 or 40 drops, others are sensibly affected even by a fraction of a drop. It does not appear, as has been alleged, to increase the acidity of the urine, but it does augment its amount.

Dr. Senter has reported the case of a lady who swallowed a dessertspoonful (f℥ij) of nitrite of amyl. Twenty-five minutes later she was vomiting, her face grayish white, the pupils widely dilated, and the eyes glassy and rolling. The mouth was open, the breathing alternately rapid and slow, and then was almost suspended. The pulse, irregular and jerking at first, become very slow and hardly perceptible. The muscles were all relaxed; the skin, cold and sweating, exhaled an odor of amyl. The patient recovered under the use of coffee, laudanum, heat, friction, and flagellation (*Amer. Jour. of Phar.*, Mar. 1881, p. 137). In the case of a man affected with pulmonary phthisis death followed the inhalation of 7 drachms of nitrite of amyl (*Boston Med. and Surg. Jour.*, May, 1883, p. 526.) Ringer has related several cases in which very small and even minute doses produced unconsciousness, and Strahan one in which the hypodermic administration of 10 minims of a 10 per cent. solution of the compound occasioned pallor, and then epileptiform convulsions (*Practitioner*, xxxiii. 452).

The power of nitrite of amyl to dilate the capillaries is said to have suggested its use in *angina pectoris*, *epilepsy*, and other spasmodic diseases. It is certain that in many cases of the first-named disease the inhalation of 2 or 3 drops suffices to arrest the paroxysm of pain or materially to mitigate it. The various lesions which may give rise to angina render these differences of effect intelligible. In some cases, probably those which are either purely functional or connected with the less serious organic lesions of the heart and aorta, the habit of using the medicine appears to render the attacks both less frequent and less severe. This result may ensue even when organic softening of the heart exists, with atheroma of its arteries; for the medicine dilates the blood-vessels, and therefore relieves them from the tension of the blood within them. But in course of time, like other nervines, its influence declines. The mode of action of the medicine in this disease appears to be anodyne, and at the same time antispasmodic. It should be very cautiously used, and most of all when there is reason to suspect degeneration of the arteries of the brain. In pure *neuralgia*, especially of the fifth nerve, it sometimes relieves the pain promptly; and the same may be said of *neu-*

ralgic headache and of *gastralgia*. In *spasmodic asthma* also it frequently brings prompt relief in proportion as the character of the attack is nervous. In several cases it appears to have suspended dyspnœa produced by fatty degeneration and other debilitating lesions of the heart. It has also been used in *whooping cough*. In 1877 ten cases of the disease were reported by D. Bayles, who claimed for the nitrite a positive value "in allaying the violence and limiting the duration of the cough." (*Trans. N. Y. State Med. Soc.*, 1877, p. 181). A striking case is reported by Dr. T. M. Lewis (*Thérap. Gaz.*, x. 231). In persistent *hiccup* occuring without known cause nitrite of amyl has arrested the attack after the failure of cautery, atropine, and chloroform (*Med. Record*, xxii. 231). It has relieved infantile *spasm of the glottis* (Williams) and the *vomiting* of *pregnancy*. In *syncope* from post-partum hæmorrhage it has restored consciousness and saved life (Köhler; Kerr), and dissipated the dizziness and *faintness* caused by anæmia or by such severe pain as *hepatic* and *renal colic* produce (Kurz). It may be believed that these effects are due to the power which the nitrite has of dilating the blood-vessels, for they are observed in other affections to which this explanation applies. One is *sea-sickness*, in which the subjective symptoms seem due to cerebral anæmia, and are promptly relieved by this medicine (Clapham, *Lancet*, June, 1879); another is the *vertigo* and *syncope* which accompany various obstructive or asystolic lesions, such as mitral insufficiency, dilatation, and softening of the heart. It may be added that this preparation has been used to distinguish anæmia from congestion of the brain—conditions which are often very much alike in their phenomena. The nitrite palliates the former, but aggravates the latter state. In *pneumonia* involving a large portion of both lungs, and therefore producing a relative debility of the heart and imperfect supply of blood to the brain, it has been given by the stomach with marked advantage (Keating). It is said that the chill of *intermittent fever* has been abruptly arrested by the inhalation of this vapor, while the febrile stage was correspondingly shortened; and also that a like effect has been produced in the paroxysm of *dysmenorrhœa* (*Boston Med. and Surg. Jour.*, Dec. 1881, p. 597). The medicine has been used to combat the *night-sweats* of phthisis, but in the reported cases (Murrell, *Practitioner*, xxiii. 97) the dose employed was too insignificant to be efficient and the results were mainly negative. There appears to be good reason for believing that it sometimes cures *chorea*, but for this purpose it must be administered two or three times daily for several days. Several cases of traumatic *tetanus* have recovered under its use; and since, in experiments upon frogs tetanized by strychnine, death was prevented by the use of nitrite of amyl until the elimination of the poison, it is probable that the same effect might ensue, and even more promptly, in man. In the cases of tetanus successfully treated by the nitrite it was administered two or three times a day, and in doses of only 5 drops. In *trismus nascentium* it has also been found to control the spasms. The same statement is true of *puerperal eclampsia*. In one such case the use of the medicine was followed by relaxation of the uterus and profuse hæmorrhage. In *infantile convulsions* its utility has been shown, even when the child was brought to death's door by a farrago of medicines, including chloral, chloroform, and morphine; and in *hydrophobia*, although incapable of staying the advance of death, it has enabled the patient to take food and drink and lessened the horror of impending dissolution. In *hysterical convulsions* it has also arrested the paroxysm, but in no degree modified the general course of the disease or lessened the frequency of the attacks. If we may trust the published reports, its influence upon *epilepsy* is more permanent and radical: it would seem not only to prevent the development of the paroxysms when applied early, but also to render their occurrence less frequent. This is particularly true of cases in which several successive convulsions make up the paroxysm. Necessarily, it must be most useful when the fit is preceded by an aura or other warning symptom; but even in those cases in which the fits are subintrant the remedy usually produces a very sensible amelioration. It is to be noted that when it it is employed during the fit, and when the face is very livid, this color is gradually replaced by a vivid flush as consciousness returns, Epilepsy cannot be cured by this medicine. It has been employed to relieve *pain* of a more or less *spasmodic nature* occurring in the œsophagus, diaphragm, stomach, bowels, bladder, urethra, uterus, vagina, etc., including pains during and after *labor*, *dysmenorrhœa*, etc. A case of *blepharospasm* is recorded in which the patient is said to have been cured by its inhalation in very unusual doses—viz. from f℥ss to f℥j from one to three times a day for four successive days. A case of *strychnine-poisoning* in which the tetanic phenomena were very severe was cured by the repeated inhalation of nitrite of amyl, which effectually averted or greatly modified the fits as often as it was administered (Barnes, *British Med. Jour.*, Apr. 1, 1882).

Dr. H. A. Hare has shown, by experiments on rabbits that the fleeting influence of amyl-nitrite inhalations cannot be relied upon to counteract the continuous operation of strychnine (*Boston Med. and Surg. Jour.*, Nov. 1884, p. 481). It may be supplemented by administering amyl nitrite by the mouth. Nitrite-of-amyl inhalation has relieved *chordee*. It has arrested the paroxysm of *intermittent fever* when inhaled during the cold stage in the dose of 4 drops. In a case of *exophthalmic goitre* 2 drops were found to be an excessive dose, and "one-tenth of a drop" was directed to be taken half an hour before eating, with complete relief of all the subjective symptoms (Blake). The patient was a nervous female.

One of the most important qualities of nitrite of amyl consists in the antagonism of its primary action to *chloroform syncope*. It is certain that chloroform contracts, and that nitrite of amyl dilates, the capillaries of the brain and of the skin of the face; under the former the patient grows pale, under the latter he is flushed. In experiments upon animals, if the nitrite be used in an excessive dose, cyanosis arises in consequence of venous engorgement. Experiments have also shown that if it is given in full doses to an animal already narcotized by chloroform, it deepens instead of relieving the narcotism, while if it be administered in moderate quantities, either by inhalation or hypodermically, it revives the heart's action and removes the pallor caused by the chloroform. These effects have been happily illustrated in at least eight cases of chloroform-poisoning. In all of them the patients were rescued from imminent death. The salutary or pernicious effects of the nitrite being due to the amount of it administered, we may explain why Testa should have fallen into the error of declaring that it intensifies the dangers which chloroform creates. Besides the cases just mentioned of its remedial power in chloroform syncope, others might be cited to show that it is equally efficacious when injected hypodermically in the dose of 3 minims (*Med. Record*, xxi. 335). The nitrite has also been used with advantage in poisoning by *chloral* (*British Med. Jour.*, June, 1879). Like alcohol and other excitants of the heart and nervous system, it has been found of service in various states of *exhaustion* and *typhoid depression*. As its action is fugitive, its adminstration must in such cases be frequently repeated. It has been successfully employed in several cases of *carbonic-acid* poisoning and to relieve insomnia produced by the *opium habit*. A case of prompt restoration from *opium coma* by means of this agent is recorded (*Med. Record*, xxvi. 13), and also one of threatening death from the hypodermic use of a very small dose of *cocaïne* (*Centralbl. f. d. g. Therap.*, iv. 88). Imperfect vision due to insufficient blood-supply to the retina (*amblyopia*), and which strychnine has failed or ceased to profit, has sometimes improved under this medicine; and in many cases of subjective *noises in the ear* the repeated use of it has afforded great relief when the tinnitus has not been due to a mechanical cause. Applied locally, it is anodyne, relieving the pain of *headache, toothache, earache, neuralgia, dysmenorrhœa*, etc. Fetor from gangrene, the decomposition of morbid growths, the putrefaction of secretions and exudations, etc., may be corrected by solutions of this preparation.

Nitrite of amyl may be given in the dose of from Gm. 0.12–0.30 (3 to 5 drops) by the mouth, dissolved in a little aromatic spirit. Dr. Richardson recommends the following: Amyl nitrite (pure) ♏xxv; Ethylic alcohol (sp. gr. 830) ʒv; Pure glycerin to ℥iss. To make a mixture of twelve doses. One fluidrachm to be taken in a wineglassful of warm water (*Asclepiad*, July, 1884). Like most other medicines which act directly upon the nervous system, it rapidly becomes tolerated in increased doses. Dugan relates that in experiments on himself he could at first inhale no more than 5 drops, but he gradually became able to inspire the vapor largely without occasioning symptoms which in the beginning seemed alarming. Bourneville frequently gave it in doses of 20 drops. We have found but one case recorded of its fatal use, and that was from an excessive dose. It has sometimes been injected hypodermically in cases of chloroform-poisoning, and without occasioning any local irritation. Usually, nitrite of amyl is administered by inhalation, about 5 drops being poured upon the palm of the hand, a piece of sponge, or a folded napkin; or else it is carried in a well-stopped bottle (especially by epileptics), to be used when the fit threatens. Tubes and (still better) "tears" of glass containing about Gm. 0.30 (♏v) each are also employed by the same class of patients, the glass being crushed in a handkerchief and its contents inhaled. It should rarely be used when syncope is produced by profuse hæmorrhage or when there is organic disease of the heart or brain.

AMYLENUM HYDRATUM, *P. G.*—Amylene Hydrate.

Dimethyl-ethylcarbinol, Tertiary amylic alcohol, E.; *Hydrate d'amylène*, Fr.; *Amylenhydrat*, G.

Formula $2CH_3.C_2H_5.C.OH. = C_5H_{12}O$. Molecular weight 87.81.

Origin.—Of the alcohols corresponding to the general formula $C_5H_{11}OH$ no less than eight are theoretically possible, and of this number seven have been actually prepared. The best known of the amylic alcohols is that produced in the fermentation of grain, potatoes, etc. (see page 156), and designated as isobutyl carbinol. Tertiary amylic alcohol was first prepared by Wurtz.

Preparation.—A mixture of 100 measures each of sulphuric acid, water, and commercial amylene is exposed to a low temperature with frequent agitation; the amyl-sulphuric acid formed is separated after a lapse of thirty minutes, and added to twice its volume of ice-cold water, filtered, and neutralized with milk of lime or solution of soda, after which it is distilled. The distillate is dehydrated with potassium carbonate, and subjected to fractional distillation, that portion being collected which comes over between 100° and 102.5° C. (212° and 216.5° F.).

Properties.—Amylene hydrate is a limpid, colorless, volatile, neutral liquid of peculiar penetrating odor which reminds of camphor and peppermint, and a burning taste; its specific gravity is 0.815 to 0.820, and its boiling-point when pure at 102.5° C. (216.5° F.). It is soluble in 8 parts of water, and miscible in all proportions with alcohol, chloroform, benzin, glycerin, and fixed oils.

Tests.—Besides solubility in 8 parts of water, the Germ. Ph. requires of amylene hydrate that 20 Cc. of a 5 per cent. aqueous solution, after addition of 2 drops of potassium permanganate test-solution, shall not become decolorized within ten minutes (absence of amylic alcohol, etc.); also, that, if ammonium silver nitrate be added to the aqueous solution and the mixture heated for ten minutes in a water-bath, no reduction to metallic silver shall take place (absence of aldehyde).

Allied Compounds.—*Amylenum*, Amylene, Valerene, Pentene, C_5H_{10}.—This hydrocarbon was obtained by Balard (1844) by distilling amylic alcohol with a concentrated solution of zinc chloride. It is a thin volatile, inflammable liquid with disagreeable cabbage-like odor, and consists of varying proportions of two or three isomeric compounds boiling between 32° and 40° C. (89.6° and 104° F.). *Amyl hydride*, C_5H_{12}, which is contained among the most volatile products of petroleum and in the light tar-oil of cannel coal, resembles amylene, but has a more agreeable, ethereal odor, resembling chloroform, and boils at 30° C. (86° F.).

Pental, tri-methyl ethylene, beta-isoamylene. This is a somewhat purer form of amylene, and like it is prepared from amylic alcohol by digestion with zinc chloride for twenty-four hours and subsequent fractional distillation. It is a colorless liquid, very volatile and inflammable, insoluble in water, and with a mustard-like odor. Its specific gravity is 0.620, and its boiling point at 38° C. (100.4° F.). It is administered like chloroform, and requires only 20 Cc. (about 5½ fluidrachms) to produce in two or three minutes an anæsthesia which, though not deep, is complete enough for minor operations. It has been found perfectly free from danger and safer than ethyl bromide.

Action and Uses.—Amylene hydrate is a relatively safe anæsthetic, because it does not depress the heart. The effects of an overdose of this compound are prolonged sleep, muscular relaxation, loss of tactile and reflex sensibility, dilatation of the pupils with feeble reaction to the light, shallow and irregular respiration, a slow and small pulse, and reduced temperature. It has been employed chiefly for promoting sleep. V. Mering and others used it in doses of from Gm. 3–5 (grs. xlv–lxxv) for *insomnia* arising from many different causes, but chiefly for those independent of pain and due to general nervousness, (neurasthenia), mental strain, old age, convalescence from acute affections, anæmia, phthisis, dyspnœa from emphysema and cardiac disease, acute bronchitis, alcoholic excitement, itching from jaundice, rheumatism, typhoid fever, etc., etc. (*Centralbl. Therap.*, vi. 205; *Boston Med. and Surg. Jour.*, Feb. 1888, p. 176; *Med. News*, lii. 549). It is of little use in spasmodic affections. Its soporific action is generally manifested within half an hour, and often in five or ten minutes, and the sleep is nearly always natural, and not like stupor from a narcotic. The awakening is usually prompt and complete. In general, the pulse-rate, rhythm, and force are unaffected. It occasions neither loss of appetite nor nausea, seldom vomiting, and no disorder of the bowels, nor headache. In exceptional cases it has seemed to excite some hysterical phenomena. Even where it fails to bring on sleep, it induces a certain calm and restful condition, which renders it serviceable in nervous forms of *insanity* (*Med. News*, lii. 99). It appears to occupy a position between

chloral and paraldehyde. "It has," says Laves (*Centralbl. f. Therap.*, vi. 531), "neither the unpleasant and persistent taste and smell of the latter nor the same uncertainty of action. It seems to have about half the strength of chloral; and, although its hypnotic action is perhaps less certain, the sleep it causes is more refreshing and the mind remains clearer after its use." It acts in smaller doses than paraldehyde. Scharschmidt (*ibid.*, v. 695), indeed, estimates it as four or five times stronger. It is said by Avelli that the habitual use of opiates does not lessen its operation (*ibid*, vi. 94).

Amylene hydrate is generally prescribed in water or red wine, thickened and flavored with extract (or syrup) of liquorice or some fruit syrup. Before each dose the mixture should be shaken. The dose is from Gm. 2–4 (gr. xxx–lx); for an enema, Gm. 3–5 (grs. xlv–lxxv) suspended in mucilage. It has been given hypodermically (amylene hydrate 8 parts, alcohol 4 parts), about Gm. 0.06 (gr. j) under the skin of the back. The injection is said not to occasion an abscess. If the stomach is diseased (by simple or cancerous ulcers), the medicine should be administered by enema.

Pental, from it first introduction (1892), was, on the one hand, said to be exceedingly safe and prompt, although transient in its action, but on the other hand, it was described as being tedious and depressing in its operation, and several deaths were charged to it. It was advocated as being readily inhaled, gradual in its action, as not wholly destroying consciousness, and as leaving no unpleasant effects behind it; and condemned as giving rise to albuminous and even bloody urine, as becoming congealed by its own rapid evaporation, as causing a very transient anæsthesia, and a depression of the heart's power "more dangerous than the chloride of ethyl, and much more dangerous than chloroform." It seems less adapted to inhalation than to the production of local anæsthesia.

Trimethycarbinol and *dimethycarbinol* have been studied by Boris Chapiroff. They are said to be identical in action, but the latter is the more powerful of the two. It is stated that doses of 2 to 15 drops of the former, repeated several times a day, lessened greatly nervous excitability without first increasing it, and produced a deep, calm, and dreamless sleep. It is recommended in all cases of hyperexcitability of the nervous system, such as is found in *hysteria*, *delirium tremens*, etc. Only the purest preparation can be relied upon (*Bull. et Mém. Soc. thérap.*, 1887, p. 175).

Amylene, which was introduced by Snow in 1856, was shown by him to produce unconsciousness and anæsthesia in animals very rapidly, but not in proportion to the amount inhaled, since a very large part of it was expelled without having been absorbed. It produced death suddenly by causing arrest of the heart. In the *surgical operations* in which it was used anæsthesia was observed to be complete in many instances before consciousness was lost, while under ether or chloroform unconsciousness precedes complete anæsthesia. Its action occurs more promptly than even that of either of the substances just named, but its effects pass off with like rapidity. It does not cause sickness of the stomach as readily as they do. But, whatever its advantage may have been, the occurrence of several cases of sudden death during its use caused it to be laid aside (*e. g. St. George's Hosp. Rep.*, iii. 230).

AMYLUM, *U. S., Br.*—Starch.

Corn Starch, E.; *Fécule* (*Amidon*) *de maize*, Fr.; *Stärke*, *Kraftmehl*, *Maisstärke*, G.; *Almidon*, Sp.; *Amido*, It.

Composition $C_6H_{10}O_5$. Molecular weight 161.62.

The fecula of the seed of Zea Mays, *Linné*, s. Z. cryptosperma, *Bonafous*. Bentley and Trimen, *Med. Plants*, 296

Nat. Ord.—Graminaceæ.

Origin.—Starch is found in most vegetables at some period of their growth, and exists in different plants in very different proportions. It is nearly always deposited in the cellular tissue, but is found suspended in the milk-juice of some plants. In many plants a considerable amount of starch is deposited in the root, rhizome, or tuber, or in the seed; in some cases, as in certain palms, it is largely found in the trunk previous to flowering. The mode of preparation must necessarily vary to a certain extent, but always consists in the comminution of the part of the plant by grinding or rasping, and in removing the coarse particles of tissue by sieves, and by subsidence from water, in which the starch remains suspended for some time. (For remarks on the origin and composition of wheat see Farina Tritici.)

Description.—From whatever source obtained, starch appears to the naked eye in the form of a fine white powder, the particles of which frequently adhere together super-

ficially, so as to form irregular columnar masses. Under the microscope the powder is observed to consist of distinct grains of a peculiar shape and size, which vary with the plant from which the starch has been obtained. The smallest starch-granules observable with the aid of a microscope are globular in appearance, but the form of the larger granules, such as potato starch, arrow-root, etc., is quite characteristic, so that the origin of starch may by this means be detected with tolerable certainty.

Schleiden classified the starches thus:

1. Without distinct shape (non-mealy sarsaparilla, Carex arenaria).

2. Mostly single grains: *a*, roundish, and without or oftener with a small nucleus; layers indistinct (maize, rice); layers distinct and grains ovate (potato, arrow-root), conchoidal (lily) or subconical (bletia); nucleus elongated (pea, bean) or cup-shaped (orris); *b*, lenticular, layers more or less distinct (wheat, rye, barley); *c*, very flat, layers distinct (Zingiberaceæ); *d*, stick-like, and layers distinct or nucleus elongated, or shape irregular (euphorbia).

3. Compound grains: *a*, without nucleus (bryony, sarsaparilla); *b*, with nucleus, and this small (manihot), large and radiate (colchicum), or cup-shaped (anatherum), forming irregular groups (arum), or several small grains united with a large one (sago).

The granules are evidently made up of layers, apparently differing somewhat in density, and more or less concentrically arranged around a nucleus or hilum, which in many cases is not in the centre, but near the margin or one end of the granule. With respect to the relative age of the different layers, the fact that the innermost ones are softer or less dense is regarded by Schleiden, Payen, Nägeli, and others as conclusive evidence that the outer ones were first deposited, and that those near and around the hilum originated later; while Fritzsche, Berg, and others, on the contrary, find that this condition is a proof of the external growth of the granules by deposits of fresh and denser layers around the more or less gelatinous nucleus. All these layers are considered by many investigators to be of the same composition, and to differ from each other mainly in the amount of moisture retained by them. Opinions, however, in relation to the existence of an enveloping membrane differing in composition are considerably at variance with one another. Those investigators who explain the formation of the starch-granules by external additions reject its existence, and, according to Schleiden, the denser outer layer of the granule which is first deposited is uniform and of precisely the same chemical behavior as the remainder. Payen, Persoz, and Nägeli, on the other hand, find that the starch proper has been deposited within a very thin membrane which has some of the characteristics of cellulose. If starch is acted upon by being digested with saliva, pepsin, or bile, it is dissolved, according to Nägeli, with the exception of a minute residue which does not swell on being boiled with water and requires to be treated with sulphuric acid before it is colored blue by iodine, but dissolves in ammoniacal solution of cupric oxide. For this outer membrane the name *amylin* has been proposed, while the portion soluble in hot water has been named *granulose* and *amidin*. The chlorides of zinc and calcium dissolve starch completely without leaving any residue.

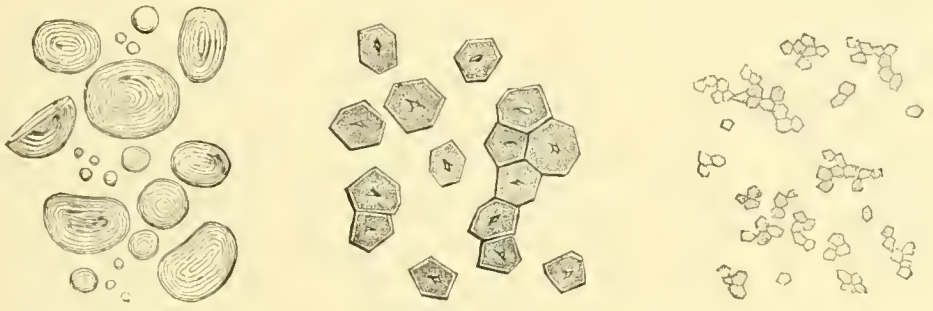
Wheat starch, when viewed under the microscope, is found to consist of nearly circular and flat or lenticular granules, the largest of which are about $\frac{1}{1000}$ inch in diameter, and are mixed with many minute granules, but with a few of an intermediate size. The hilum, if observable, is near the centre of the circle, the indistinct layers forming nearly uniformly concentric rings.

Rye starch, from Secale cereale *Linné* (Seigle (fruit), *F. Cod.;* Roggen, *G.;* Centeno, *Sp.;* Segala, *It.*), consists of small and large granules, the latter varying between oblong-ovate and lenticular in shape. The layers are concentric and rather indistinct; the hilum is near the centre, and mostly with three to five or six rays.

Preparation.—Wheat or other grain is soaked in warm water, to which sometimes an alkali is added, until the outer coating has become soft; it is then ground under water, and washed upon suitable sieves with pure water, with which the starch passes through and is collected by subsidence in suitable tanks, the alkaline water retaining the gluten; or the latter is removed by allowing it to undergo decomposition, when acetic, butyric, or lactic and other acids are produced. The gluten need not be destroyed, but may be obtained as a by-product; for this purpose wheat flour is made with water into a stiff dough; this is set aside for 2 hours, and then placed upon a fine wire sieve, where it is kneaded under a thin stream of water until the latter no longer becomes milky; nearly the whole of the gluten will remain upon the sieve. After sufficient washing with pure water the starch is drained in boxes, cut into cubical blocks, and dried in properly constructed drying-chambers.

Properties.—Starch forms a white, inodorous, and tasteless powder, with a peculiar slippery feel between the fingers. Exposed to the atmosphere, it contains from 10 to 13 per cent. of moisture, which is given off at 100° C. (212° F.), and is reabsorbed on exposure. The spec. grav. of starch is about 1.5, but after complete drying is increased to 1.56. It is insoluble in ether, alcohol, and cold water; the last-mentioned liquid, however, when triturated with starch, so that some of the granules are ruptured, evidently dissolves a little, since it acquires, after filtration, a blue color on the addition of iodine. *Soluble starch* is obtained, according to Maschke, by the prolonged heating of starch to 100° C. (212° F.). When heated to between 160° and 200° C. (320° and 392° F.) it is gradually converted into *dextrin* (see below). Starch becomes soluble in cold water in the presence of the chlorides of zinc and of calcium and of other deliquescent or freely soluble salts. Its solution in hot water gelatinizes on cooling, the jelly of wheat starch being milk-white—that of potato starch, particularly when made with much water, being more translucent. On heating starch with glycerin a solution is obtained which, according to Zulkowski (1875, 1880), contains soluble starch, obtainable by diluting with water and precipitating the clear filtrate with alcohol. Potato starch is easily converted into the soluble form, but wheat starch requires a prolonged heating, and rice starch is thus changed with still greater difficulty.

Fig. 14. Fig. 15. Fig. 16.



Wheat Starch. Corn Starch. Rice Starch.

Each magnified 250 diameters.

Mucilage of starch, when heated to about 160° C. (320° F.), or when boiled with very dilute sulphuric acid, or when digested with diastase at about 70° C. (158° F.), is converted, according to Musculus (1860), first into *maltose*, $C_{12}H_{22}O_{11}$, which is probably a compound of *dextrin*, $C_6H_{10}O_5$, and *dextrose*, $C_6H_{12}O_6$, the former passing finally likewise into glucose. Iodine imparts to starch in the presence of water, and to starch-mucilage, a blue color which disappears on the application of heat, but reappears on cooling. Bromine colors the starch brown-yellow. Fuming nitric acid transforms starch into *xyloïdin*, $C_6H_9(NO_2)O_5$, which is a white, tasteless powder, insoluble in alcohol, but softening in boiling water. A filtered solution of starch in water yields with tannin a flocculent precipitate which is soluble in boiling water. When incinerated, starch should leave not over 1 per cent. of ash.

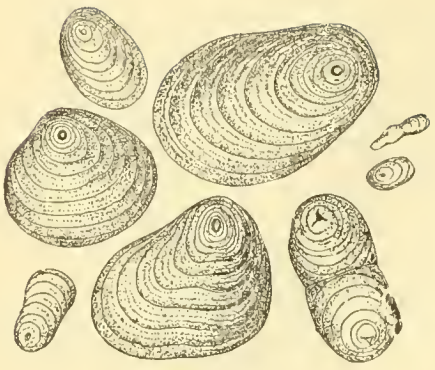
Preservation.—All starches and farinaceous substances should be kept in a dry place. When confined in a damp atmosphere they acquire a musty odor, which may be removed by repeated washing with pure water and rapid drying.

Other Starches.—1. Amylum Maydis.—Corn starch, *E.*; Fécule de maïs, *Fr.*; Maisstärke, *G.* From the seed of Zea Mays, *Linné.* Bentley and Trimen, *Med. Pl.*, 296. Nat. Ord. Graminaceæ.—The plant known as *maize* and *Indian corn* was found in extensive cultivation at the time of the discovery of America, and was from here introduced into Europe; it is said to have been introduced into China from Central Asia. The starch-granules are more uniform in size, but only about two-thirds as large as those of wheat starch; they are irregularly angular, rounded on the edges, and occasionally oblong muller-shaped, with a usually slit hilum and indistinct layers.

2. Amylum Oryzæ.—Rice starch, Rice flour, *E.*; Farine de riz, *Fr.*; Reisstärke, *G.* From the seed of Oryza sativa, *Linné.* Bentley and Trimen, *Med. Pl.*, 291. Nat. Ord. Graminaceæ.—The rice-plant is a native of India, has been cultivated from a very early period, and has been introduced into the most tropical and subtropical countries. *Rice* (Riz, *F. Cod.*; Aroz, *Sp.*) of commerce consists of the seeds deprived of the persistent paleæ and of the integuments; it is oblong or subcylindrical in shape, about 3 Mm. (⅛ inch) or more in length, translucent, and furrowed on one side. Rice starch consists of polygonal granules less than one-fifth the diameter of wheat starch, and smaller than all other commercial starches, but mostly united to larger grains.

3. Amylum Solani.—Potato starch, *E.*; Fécule de pomme de terre, *F. Cod.*; Kartoffelstärke, *G.*; Fecula de patata, *Sp.*—From the tubers of Solanum tuberosum, *Linné.* Nat. Ord. Solanaceæ.

Fig. 17.



Potato Starch.

The potato plant grows wild in the mountainous districts of Peru and Chili, and several tuber-bearing species of Solanum are indigenous to the mountains of New Mexico and Arizona. The potato was brought to England from Virginia in 1586, and is at present extensively cultivated in many varieties in most countries of the temperate zones; its starch is largely manufactured and used in Europe, and is sometimes substituted for arrow-root or used for adulterating it. The granules are of two sizes, a portion being small and subspherical, another portion larger than maranta starch, of an ovate or irregular oval shape, marked with rather coarse concentric lines, and with an inconspicuous hilum at the narrow end.

4. Amylum Marantæ.—Arrow-root, *E.*, *F. Cod.*, *G.*, *Sp.*; Salep des Indes occidentales, *Fr.*; Marantastärke, *G.*; Arroru, *Sp.* From the rhizome of Maranta arundinacea, *Linné*. Bentley and Trimen, *Med. Pl.*, 265. Nat. Ord. Marantaceæ.—The plant is indigenous to the West Indies and tropical America, and is largely cultivated in the Bermudas, in Georgia, Jamaica, St. Vincent, and in Brazil. It is a perennial herb, with a branching, fleshy, cylindrical rhizome covered with whitish scales or annulate with their scars. The slender branching stem is 5 to 6 feet high, has thickened nodes, ovate lanceolate leaves with long sheaths, and small whitish flowers, usually in pairs at the ends of the branches. M. indica, *Tussac*, is now regarded by botanists as being a smooth and narrower-leaved variety of the preceding; it is found in Bengal, Java, and the Philippines, and has been introduced into tropical Africa; the *Natal* and *East-India arrow-root* is obtained from it, but the latter sometimes consists of the starch of Curcuma leucorrhiza and C. angustifolia, *Roxburgh*, which is in flattened elliptic or elongated ovate granules marked with numerous fine lines and at the narrow end with a hilum. When about a year old the rhizomes of maranta are dug up, carefully cleaned from the scales, well mashed, and either ground in a mill or rasped until reduced to a pulp, which is suspended in water, the fibrous portion being either separated by hand or by sieves. The starch which settles from the water is repeatedly stirred with fresh portions of clean water, finally allowed to setttle, and dried with a gentle heat. The rhizomes yield from 13 to 20 per cent. of fecula. (See papers by Robert Battey in *Proceedings of the Amer. Pharm. Assoc.*, 1858, p. 332, and by W. Eberhard in *Archiv d. Pharm.*, 1868, vol. clxxxiv. p. 257.) The importation of arrow-root into the United States amounted to over 1,500,000 pounds in 1876, and decreased to 69,206 pounds in 1881 and 77,192 pounds in 1882.

Fig. 18.

Maranta Starch.

Fig. 19.

Curcuma Starch.

Arrow-root is pulverulent or in small irregular lumps, less than ¼ inch thick, white, opaque, tasteless, and inodorous. Under the microscope it is seen to consist of ovate or somewhat oval granules, the layers of which are marked by fine but distinct lines, and have usually upon the broader end a small nucleus or a transverse fissure; the granules are nearly uniform in size.

Tests.—According to the German Pharmacopœia of 1872, 1 part of arrow-root gives with 96 parts of boiling water a moderately thin, pellucid mucilage; and when it is agitated for 10 minutes with a mixture of 2 parts of hydrochloric acid and 1 part of water, nearly the whole of the starch should separate unchanged and without the formation of a mucilage or the production of an herbaceous odor. Schaer (1875) showed that some samples of maranta starch yield in a short time a turbid jelly which gradually becomes limpid, while in most cases it separates unchanged, but is partly dissolved within twenty-four hours. This difference is probably due to climatic influences. The starches of manihot and curcuma have a similar behavior; wheat starch yields no jelly, but after several hours a strongly opalescent solution. Potato starch, however, is readily transformed into a thick, almost clear jelly, forming a complete solution in a few hours, and having a strong herbaceous or bean-like odor.

Fig. 20.

Canna Starch.

5. Amylum Cannæ, Canna, *U. S.* 1870.—Canna starch, Tous-les-mois, Toulema, *E.*; Amidon de canne, Fécule de Tolomane, *Fr.*; Cannastärke, *G.* From the rhizome of (probably) Canna edulis, *Ker*. Bentley and Trimen, *Med. Pl.*, 266. Nat. Ord. Marantaceæ, Canneæ.—This showy plant is indigenous to Peru and Brazil, and is cultivated in St. Kitts and other West Indian Islands. Canna starch is a white powder having a satiny lustre: its granules are the largest among the commercial starches, flattish, usually

oblong or ovate, but variable in outline, with the inconspicuous nucleus or hilum mostly near the narrowed end, and with numerous concentric rings. Canna starch contains about one-sixth of its weight of hygroscopic water, and yields with 20 parts of boiling water a jelly which is considerably more tenacious, but less clear and transparent, than that of arrow-root.

6. Amylum Manihot.—Brazilian arrow-root, Tapioca meal, *E.;* Cassava, *E., Fr., G.* From the root of Manihot utilissima, *Pohl*, s. Janipha (Jatropha, *Linné*) Manihot, *Kunth.* Bentley and Trimen, *Med. Pl.*, 235. Nat. Ord. Euphorbiaceæ.—The plant also known as *mandioc* and *manioc*, is probably indigenous to Brazil, where it has been cultivated from a remote period. It has been introduced into other parts of tropical America, into Florida, Africa, and the East Indies. Its fleshy, tuberous roots attain a length of 1 M. (40 inches) and contain a milky juice which is poisonous from the presence of hydrocyanic acid. E. Francis (1882) found cassava-root to yield on an average .0275 per cent., and the sweet cassava .0168 per cent., HCy. The sweet cassava is Manihot palmata, *J. Mueller*, s. M. Aipi, *Pohl*, s. Jatropha dulcis, *Gmelin.* This and another species, Manihot carthaginensis, *J. Mueller*, s. Jatropha Janipha, *Linné*, are used like the preceding. On grating the roots, expressing the poisonous juice, drying the residue and grinding it, *cassava meal* is obtained, which, when baked in thin cakes, furnishes *cassava bread.* From the expressed juice, and by washing the meal with water, on standing the *starch* is deposited. On drying this starch while still moist on heated plates *tapioca* is obtained.

Fig. 21.

Cassava Starch.

Cassava starch forms a white powder, which under the microscope is seen to consist of muller-shaped granules; these, viewed from one end, have the appearance of spherical grains. The nucleus is small, circular, or often elongated, sometimes radiate, and the different layers are indistinctly marked. The grains were originally united in groups of two to four, but in the commercial articles are mostly separate. Their size is usually less than half that of potato starch. Tapioca, Tapioka, *F. Cod.;* is in irregular opaque or somewhat translucent pieces, which consist of the same starch granules partly distended, ruptured, and agglutinated. It is inodorous, has an insipid taste, and agrees in chemical behavior and composition with other starches.

Fig. 22.

Altered Starch-granules from Tapioca.

7. Sago, *U. S.* 1870.—Sago, *E., G.;* Sagou, *F. Cod.;* Sagú, *Sp.* From the pith of Metroxylon Sagu, *Rottboell* (s. M. Sago, *Koenig*, M. læve, *Martius*, Sagus lævis, *Blume*), Metr. Rumphii, *Martius*, (s. Sagus Rumphii, *Wildenow*, S. genuina, *Blume*), Sagus farinifera, *Lamarck*, Arenga saccharifera, *Labillardière* (s. Saguerus Rumphii, *Roxburgh*), and of other palms. Bentley and Trimen, *Med. Pl.*, 278. Nat. Ord. Palmæ.—The sago-palms inhabit the East Indian and Polynesian islands, and are extensively cultivated. They are mostly trees of medium height, but with a thick stem, containing a large amount of parenchyma-tissue, the cells of which are filled with starch. When of sufficient size the tree is cut down, split lengthwise, and the pith removed, powdered, and washed with water to remove woody tissue and other impurities. The dry starch is known as *sago meal.* This is granulated by passing the sufficiently damp meal through a sieve, the globular pieces dropping into a shallow pot suspended over a fire, where they are dried with constant stirring. While flowering the Arenga furnishes a juice rich in sugar.

Fig. 23.

Sago Starch.

Sago is occasionally seen in the form of whitish glistening powder or irregular grains, varying somewhat in tint, and being distinguished as *white* and *brown sago.* More frequently it is seen as *pearl sago*, in the form of globular grains, pearl-like in appearance, with a smooth surface, and occasionally two or three grains adhering together. From the heat employed in its preparation it is somewhat diaphanous, and when examined under the microscope some of the starch-granules are seen to be distended and partly ruptured. Sago starch consists of irregularly ovate, oval, or elliptical grains, often with a roughish surface; the hilum is located near one end, and is naturally small and circular, but in sago is often slit in one or more directions from the effect of heat. The end opposite the hilum is always more or less truncate or flat and muller-shaped. *Factitious sago*, which is made in Europe of potato starch, is best recognized by means of the microscope.

The granules of *Tahiti arrow-root*, which is obtained from Tacca pinnatifida and oceanica, *Forster*, and which is now rarely seen in commerce, are of about the same size as those of cassava starch, but are flattened and angular.

Derivative of Starch.—Dextrinum, *Dextrin*, $C_6H_{10}O_5$.—Heat in a steam-bath, with frequent stirring, a mixture of 150 parts of starch, 750 parts of distilled water, and 4 parts of oxalic acid, until starch can no longer be detected by solution of iodine; then neutralize the acid with pure calcium carbonate, and after two days filter, evaporate, and dry at a gentle heat.—*P. G.*, 1872. On a large scale dextrin is prepared by heating starch in a cylinder or flat vessel to a temperature between 225° and 260° C. (437° and 500° F.): the yellowish product thus obtained is known in commerce as *British gum.* White dextrin, resembling starch in appearance, is manufactured

by Heuzé's process: 1000 parts of starch are mixed with diluted nitric acid, made from 2 parts of nitric acid sp. gr. 1.4 and 150 parts of water; the mixture is formed into cakes; these are dried in the air, then slowly heated to about 80° C. (176° F.) until the acid has been expelled, and powdered; on exposing the powder for from sixty to ninety minutes to a temperature between 100° and 110° C. (212° and 230° F.) the conversion into dextrin will be completed. It may be purified and freed from sugar, according to Hager (1870), by dissolving 10 parts of it in 18 parts of distilled water by agitation, straining if necessary, and mixing the solution with about 2 volumes of alcohol; the doughy precipitate is redissolved in a little distilled water and the solution dried upon glass. Dextrin is granular or a whitish or pale-yellowish amorphous gummy mass, readily soluble in water, but insoluble in alcohol and ether; its solution is dextrogyre and does not reduce an alkaline solution of copper.

Amylum Iodatum, Iodized starch, *E.*; Iodure d'amidon, *Fr.*; Iodstärke, *G.*—The U. S. Ph., 1880, directed this preparation to be made by triturating 5 parts of iodine with a little distilled water, adding 95 parts of starch gradually, and continuing the trituration until the compound assumes a uniform blue color, approaching black. It must be dried at a temperature not exceeding 40° C. (104° F.), rubbed to a fine powder, and preserved in glass-stoppered vials.

That starch produces a blue or violet-blue color with iodine was observed by Colin and Gaultier de Claubry in 1814, and that the color of starches of different origin and age may vary to some extent was subsequently shown by Nägeli and others. Liebig regarded iodized starch as a mere mixture of starch with finely-divided iodine, and this view is now generally adopted. Payen and Fritzsche, however, believed it to be a definite compound, $(C_6H_{10}O_5)_{10}I$, and Bondonneau gives it the formula $(C_6H_{10}O_5)_5I$, equal to 13 per cent. of iodine, the latter being dissolved by alcohol, but not by potassium iodide, benzin, carbon sulphide, or other solvents. According to the process adopted the amount of iodine varies, and, though generally about 7.5 per cent., may be as low as 3.2 per cent. (Sonstadt), or, as obtained by Lassaigne, as high as 41.75 per cent. Fritzsche obtained his supposed definite compound by adding tincture of iodine to a filtered solution of starch in concentrated hydrochloric acid. Bondonneau (1878) dissolved the starch first in caustic soda, and precipitated the slightly acidulated solution with tincture of iodine. According to Quesneville (1868), it may be obtained both in a soluble and an insoluble state as follows: 1050 parts of starch and 100 parts of iodine, both in fine powder, are well mixed, and then triturated with a mixture of 400 parts of water and 100 of alcohol, the liquid to be added gradually; the whole is left in contact for fifteen or twenty days, and afterward carefully dried. Thus prepared, it is a dark blackish-blue powder, has no odor of iodine, and contains 10 per cent. of this element. To obtain it soluble it is heated in a porcelain or enamelled dish over a slow fire and with continued agitation until a pungent odor commences to be given off. It may be still further purified by making a concentrated solution in warm water, precipitating the clear liquid by alcohol, drying, and powdering the precipitate.

Properties.—Iodized starch is a dark-blue powder having the odor of iodine in a mild degree. Exposed to the sunlight, it is decolorized; when heated with water to 65° C. (149° F.) it becomes colorless, and blue again on cooling; but when heated to boiling, iodine is given off, and may be completely expelled by continuing the heat for a sufficient length of time.

The production of iodized starch is one of the most delicate tests for the recognition of starch as well as of iodine, the limits of the reaction being influenced by the temperature. Fresenius (1857) ascertained that 1 part of iodine may thus be detected at 0° C. (32° F.) in 660,000 parts of water, at 13° C. (55.4° F.) in 330,000 parts, at 20° C. (68° F.) in 264,000 parts, and at 30° C. (86° F.) in 132,000 parts of water. For detecting minute quantities of starch or iodine the test should obviously be applied at as low a temperature as possible.

Action and Uses.—Starch is applied in dilute decoction as a demulcent to protect irritated surfaces upon the skin and in the digestive canal. As a powder it is extensively employed to shield the skin from the action of the air, to diminish the friction of contiguous surfaces, and to promote the healing of excoriations. Thus it may be used to allay the itching and burning of the skin in *erythema*, *uticaria*, *erysipelas*, and *small-pox*. In the form of a thick mucilage it has been employed to prevent pitting in the last-named disease. Bandages saturated with starch mucilage made with hot water are used in dressing *fractures* and other injuries and diseases of the bones in which absolute rest of the injured part is required; or the mucilage is smeared on the outer surface of the bandage as it is applied to the affected part. This dressing dries slowly, and should be kept at perfect rest for nearly twenty-four hours. Starch-mucilage is constantly employed as a lenitive injection in inflammation of the *rectum* and the *bladder* and as a vehicle for applying narcotic and other substances to those parts. Mixed with water, starch is the best antidote to the caustic action of *iodine* upon the stomach, as it forms with this substance a bland compound. It also forms the surest test of the presence of iodine in the urine and other secretions by striking with it a characteristic blue color. Starchy food is to be avoided in fermentative *dyspepsia*, in consequence of its liability to undergo fermentation.

The fecula of *canna* has the nutritious and demulcent qualities of starch in general. As the purest natural form of starch, *arrow-root* is nutritious and demulcent, and does not, like potato starch, irritate the bowels. Hence it is extensively used in *febrile affections*,

especially in those involving the stomach and bowels, and is also a favorite food for infants at weaning-time. It is prepared by mixing a tablespoonful of arrow-root with sufficient cold water to reduce it to a paste, and then gradually adding a pint of boiling water or milk, or a due proportion of each, stirring the mixture the while. It may then be sweetened. Cream is sometimes mixed with the watery mucilage when the stomach or bowels are irritable. In exhausting diseases a little wine may be added, with cinnamon or nutmeg. *Sago* is demulcent and nutritious, and forms an excellent food for the sick when the digestive organs are feeble or fever contraindicates the use of a stimulant diet. It is more generally acceptable to the palate than arrow-root or tapioca, and is more digestible than rice. The demulcent and nutritive properties of *tapioca*, as well as the poisonous properties of the juices of the plant that yields it, were known in the seventeenth century. The qualities of the juice are due to the prussic acid it contains. The symptoms it produces are identical with those of prussic acid, as spasmodic constriction of the throat, convulsions, coma, and death with dilated pupils. Tapioca is chiefly used for making puddings and as a simple mucilaginous food for the sick and for infants. A palatable form of it is prepared as follows: Take a tablespoonful of tapioca; macerate it in a pint of warm water for an hour, and then boil it for ten minutes, stirring all the time. Sugar, lemon-juice, or some fruit syrup, nutmeg, wine, etc., may be added for flavoring and to neutralize the pasty and mawkish taste of the starch.

Amylum Iodatum.—Iodized starch serves as a means of introducing a large amount of iodine into the system without irritating the stomach. Buchanan, who proposed it, gave as much as an ounce of it three times a day without any unpleasant symptoms. In In 1879, Bellini recommended it as an antidote for *poisons* generally, stating that it formed insoluble compounds with many of them, and that in cases of poisoning by salts of lead or mercury it aids in their elimination (*Boston M. and S. Jour.*, Aug. 1879, p. 267). McCall Anderson used it with advantage in *lupus erythematodes*, giving a heaped-up teaspoonful several times a day.

ANACARDIUM.—Cashew-nut.

Acajou à pommes, Fr.; *Caschunuss*, G.; *Anacardo*, Sp.

The fruit of Anacardium occidentale, *Linné*, s. Cassuvium pomiferum, *Lamarck*.

Nat. Ord.—Terebinthaceæ.

Origin.—This is the fruit of a small tree with coriaceous, shining, oval, entire, and very obtuse leaves, and loose racemes of small whitish or purplish flowers. After fructification the pedicels of the pistillate flowers become large, fleshy, pear-shaped, and edible, having an acidulous taste, and bear upon their summits the nut-like fruit. The plant is indigenous to tropical America, and has been naturalized in some portions of Africa and the East Indies.

Description.—The fruit is about an inch (25 Mm.) long, somewhat less broad, and about one-third of an inch (8 Mm.) thick. It is kidney-shaped, convex on the back, with a scar on one of the rounded ends, of a gray-brown color, and inodorous. The shell is hard and brittle, and contains in the mesocarp a very acrid oily liquid which in contact with air turns black. The single white seed has the shape of the fruit and a mild oily taste.

Constituents.—The cotyledons contain some bland fixed oil. Vieira de Mattos (1831) found in the pericarp tannin, gallic acid, soft acrid resin, etc. The brown oil was found by A. Basiner (1881) to be soluble in potassa, with a red color, darkening on exposure, and its alcoholic solution to yield a red precipitate with basic lead acetate. Staedeler (1847, 1848) separated the vesicating principle, *cardol*, $C_{21}H_{30}O_2$, as a yellowish or reddish oil, evolving, when heated, a faint aromatic odor, and readily soluble in alcohol and ether. It is obtained from the ethereal extract, which is washed with water to remove tannin, dissolved in alcohol, and digested, and afterward boiled with hydrate of lead to remove *anacardic acid* and ammonia salt. The remaining color is removed by a little basic lead acetate. Cardol may be separated from mixtures by extraction with glacial acetic acid and subsequent agitation of the latter with benzol (Basiner). Anacardic acid, when pure, is white and crystalline, has an aromatic afterward burning taste, but is not vesicating. Cazeneuve and Latour (1875) found *catechin* in the wood of the cashew tree.

The *Oriental cashew-nut*, known as Anacardium orientale, is the fruit of Semecarpus Anacardium, *Linné filius*, s. Anacardium latifolium, *Lamarck*, a tall tree of India. The nut is about an inch (25 Mm.) long, nearly heart-shaped, flattish, obtuse, smooth, glossy, and black. The pericarp and cotyledons have the same properties and probably the same

constituents as the preceding; but Basiner (1881) ascertained that the brown oil of the mesocarp dissolves in potassa with a green color, and its alcoholic solution turns black with basic lead acetate.

Action and Uses.—The kernel of anacardium when roasted, and even when raw, is edible, but the juice furnished by the rind of the cashew-nut is acrid and almost caustic, and has been used for destroying *corns*, *warts*, and *vegetations* and as an epispastic. But the latter application of it is very objectionable, not only because it is slow in its operation, but because the juice is apt to be carried by the patient's fingers to the genitals and other parts and give rise to a very painful and persistent eczematous eruption. The liquid contained in the blisters has a similar property. A like effect is produced by the fumes arising from the nuts while roasting. The remedies for it are such as are employed in poisoning by toxicodendron. A weak solution of tincture of iodine may also be applied with advantage. A case in which this topical remedy was successfully employed was caused by using heat to reduce a liquid extract of the drug to a solid consistence (*Am. Jour. Phar.*, June, 1881, p. 281). It is stated (Buchheim) that the oil has a very faint and hardly acrid taste, and that 3 or 4 drops of it may be swallowed without marked effects. This contrast with its action upon the skin is attributed to its total insolubility in the fluids of the digestive canal, while upon the dry skin nothing interferes with its irritant action. It has been used as a *vermifuge*. According to Basiner, the subcutaneous injection of small doses of cardol produces on cold-blooded animals paresis, increasing to paralysis, of the extremities, stupor, arrest of respiration, and tetanic spasms. In warm-blooded animals large doses are not lethal, but stupor, paralysis of the extremities, and diarrhœa occur, and after death congestion of the intestinal membrane is found. Cardol seems to be excreted chiefly with the urine, but partially also with the feces. Applied on a small piece of lint to the skin of the breast, it raised a watery blister in fourteen hours. The brown-black oil of the Oriental cashew-nut occasioned within twelve hours a black blister, and on the following day eczematous vesicles appeared in the neighborhood, and afterward extended to the arms, hands, face, abdomen, and penis, the poison no doubt being carried thither by the fingers. On the sixth day scales began to form on the breast and forehead; micturition was painful, the urine red-brown; the stools bloody and very painful. More than two weeks elapsed before the sores were healed (Basiner, *Am. Jour. Phar.*, Mar. 1882, p. 131). This oil has been used with advantage in distroying the cutaneous tubercles of *leprosy*, which it causes to soften and disappear (Peters, *Edinb. Med. Jour.*, xxviii. 814).

ANDIRA.—Cabbage Tree Bark.

Ecorce de geoffrée, Fr.; *Kohlbaumrinde*, *Wurmrinde*, G.

The bark of Andira (Geoffroya, *Swartz*) inermis, *Kunth*, and of Andira (Geoffroya, *Lamarck*) retusa, *Kunth*.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—Both species are medium-sized trees, with impari-pinnate leaves, terminal racemes of red flowers, and roundish hard one-seeded pods. The first-named species is a native of Jamaica and other West Indian islands, the second is found in Surinam and Cayenne.

Description.—*Jamaica* cabbage tree bark occurs in long pieces about one-eighth of an inch (3 Mm.) thick, gray or whitish, and fissured externally, upon the inner surface brownish and striate, internally brown or brownish, radially striate, and with yellowish bast-fibres in tangential rows, which cause the laminated fibrous appearance of the bark when broken transversely. It yields a grayish powder, and has a feeble but disagreeable odor and a mucilaginous bitter taste.

Surinam cabbage tree bark resembles the preceding, but is internally dark red-brown, has a checkered and glossy appearance on transverse section, yields a cinnamon-colored powder, is nearly inodorous, and has a bitterish acrid taste.

Constituents.—Hüttenschmid (1824) discovered in each of the cabbage tree barks an alkaloid, which he named *jamaicine* and *surinamine*, the former of which was proved by Gastell (1866) to be identical with berberine. The latter is described as being in fine white needles, scarcely soluble in cold water, alcohol, and ether, but readily soluble in boiling water. The other constituents are those commonly occurring in plants; the bark from Surinam contains also notable quantities of tannin.

Allied Species.—And. anthelmintica, *Bentham*, s. Geof. vermifuga, *St. Hilaire*, is a tall forest tree of Brazil. The seeds, known there as *angelim amargosa*, are of the size of a nutmeg, oblong,

somewhat horny, yellowish, usually in transverse or longitudinal sections, whitish internally, inodorous, and almost tasteless. They are regarded as anthelmintic. According to Peckolt (1858), the wood contains *andirin*, a brown-yellow coloring principle, soluble in water and fixed and volatile oils, but insoluble in alcohol and ether. The drastic and anthelmintic principle is an acrid resin soluble in ether and alcohol. (See also ARAROBA.)

Action and Uses.—In medium doses andira is said to occasion nausea, vomiting, diarrhœa, fever, and delirium, especially when given in cold infusion. Sometimes it augments the urinary secretion. It was used in the West Indies as a remedy for *lumbricoid worms*. The dose is stated to be from Gm. 0.30–0.60 (gr. v–x) for children, and from Gm. 0.60–2.00 (gr. x–xxx) for adults. An infusion or decoction was made with Gm. 30 in Gm. 250 (an ounce of the bark in 8 fluidounces of water), and was given in tablespoonful doses until nausea began to be felt.

ANETHI FRUCTUS, *Br.*—DILL-FRUIT.

Aneth, *Fenouil puant*, Fr.; *Dill*, G.; *Eneldo*, Sp.

The fruit of Anethum (Peucedanum, *Hiern*) graveolens, *Linné*. Bentley and Trimen, *Med. Pl.*, 132.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—The plant is indigenous to Southern Europe and Asia Minor, and is cultivated in other parts of Europe and in this country. It is an annual, with finely-divided glaucous leaves, growing to the height of about 2 feet (60 Cm.) and bearing yellow flowers.

FIG. 24.

Anethum: fruit, 3 diameters; transverse section, 5 diameters.

Description.—The fruit is oval, about one-eighth to one-fifth of an inch (3 to 5 Mm.) long, dorsally compressed, of a brown color, and separates when ripe into two mericarps, which are flat upon their face and somewhat convex upon the back. The three dorsal ribs are filiform and rather sharply keeled, while the two lateral ones are extended into a light-colored broad membranous margin. The fruit cultivated in India is narrower, more convex on the back, and is less winged than the European fruit. Of the six dark-colored vittæ, two are found on the commissure, the remaining four in the furrows of the back. The odor and taste of dill are aromatic.

Constituents and Uses.—The fruit contains a fixed and 3 to 4 per cent. of an oxygenated volatile oil (see OLEUM ANETHI), to which its medicinal properties are due. It is used for preparing dill-water.

Action and Uses.—Dill is not much used in this country. It has the properties of the aromatic stimulants generally, and is employed to relieve *flatulent colic* and *hiccup* occasioned by gastric indigestion and flatulence. Dill-water, the usual form of exhibiting it, may be given in doses of Gm. 4 (ʒj) or more. The essential oil may likewise be used in the dose of from Gm. 0.10–0.30 (♏ij–v) with sugar or incorporated with magnesia.

ANGELICA, *F. It.*—ANGELICA-ROOT.

Racine d'angélique, Fr.; *Engelwurzel*, G.; *Angelica*, Sp.

The root of (1) Archangelica officinalis, *Hoffmann*, s. Angelica Archangelica, *Linné*, s. Ang. officinalis, *Moench*, and of (2) Arch. (Angelica, *Linné*) atropurpurea, *Hoffmann*, s. Ang. triquinata, *Michaux*.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—These plants attain a height of 6 feet (1.8 M.). The former is indigenous to Northern Europe, and the latter to North America, from Pennsylvania northward. The European angelica-root is solely obtained from plants cultivated in Germany, which differ in some respects from the wild species named, of which they are regarded by some botanists as a variety merely, and by others as a distinct species, Archan. (Angelica, *Miller*) sativa, *Fries*.

Description.—European or garden angelica-root consists of a short, thick root-stock, which is closely annulated above, and below abruptly divided into a large number of nearly simple branches, which are about ¼ inch (6 Mm.) thick and 6 inches (15 Cm.) long, longitudinally wrinkled, of a grayish-brown color externally, yellowish inside, with a spongy, radiated meditullium and numerous shining resin-cells in the thick bark. It has a strong aromatic odor and a sweetish, pungently aromatic, and bitter taste, and breaks with a smooth somewhat waxy fracture.

American angelica-root is similar, but smaller, has a longer main root, few branches, a

lighter color, fewer resin-dots in the bark, and is less strongly aromatic. The very similar but rather smaller root of Arehan. (Angelica, *Michaux*) hirsuta, *Torrey and Gray*, which grows southward to Florida, is not unfrequently collected with it.

The root of the European Ang. sylvestris, *Linné*, is light gray-yellow, internally white, and more woody.

All the above roots are readily attacked by insects.

Constituents.—Garden angelica contains about ½ per cent. of yellowish volatile oil, a white waxy matter crystallizing from hot alcohol in wart-like masses; *angelicin*, which is a somewhat acrid acid resin, soluble in alkalies and crystallizing from alcohol in colorless needles; volatile angelic acid; an amorphous bitter principle; some tannin, pectin, and other common principles (Buchner, 1842). The volatile oil was examined by F. Beilstein and E. Wiegand (1882), who, by fractional distillation and rectification over sodium, obtained three terpenes, of which one distilled at 158° C. (316.4° F.), the second near 175° C. (347° F.), and the third near 250° C. (482° F.). The first one is present in largest quantity; the second yields a crystallizable hydrochloride having the properties of the so-called artificial camphor, and melting at 127° C. (260.6° F.). Naudin (1883) showed that by distillation *in vacuo* a hydrocarbon of a peppery odor and the boiling-point 166° C. is obtained, and that at 160° C. (320° F.) it becomes thick and polymerized; the volatile oil of the fruit, examined in 1881, boils at 175° C. (347° F.), but becomes thick already at 100° C. (212° F.); these hydrocarbons have been named *terebangelene*. The composition of the American roots is probably similar.

Angelic acid, $C_5H_8O_2$, crystallizes in colorless prisms, melts at 45° C. (113° F.), boils at 190° C. (374° F.), has a peculiar aromatic odor and a strongly acid taste, and when melted with potassa yields propionic and acetic acids.

Action and Uses.—Angelica is tonic, stimulant, and diaphoretic, and in large doses and in warm infusion may act as an emetic or a diaphoretic. It was formerly employed in the treatment of *typhoid* conditions to meet the same indications for which serpentaria and valerian are now generally administered. It appears to have been beneficial in *chronic bronchitis* under conditions similar to those in which senega is recommended. It has also been used in chronic *rheumatism* and *gout* and in *intermittent fever*. Angelica-root may be given in powder in doses of from Gm. 0.60–2.00 (gr. x–xxx), or an infusion made with Gm. 32 (℥j) of the root to Gm. 500 (Oj) of water or white wine may be used in the dose of 1 or 2 teaspoonfuls. Externally it is sometimes applied in a decoction to foment painful parts.

ANGUSTURA.—Angustura-Bark.

Cusparix cortex, Br.; *Cortex angusturæ*.—*Angusture*, Fr.; *Angustura-Rinde*, G.

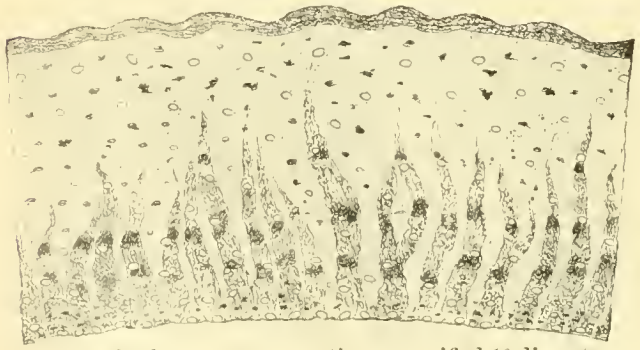
The bark of Galipea Cusparia, *St. Hilaire*, s. Gal. officinalis, *Hancock*, s. Gal. febrifuga, *Baillon*, s. Cusparia febrifuga, *Humboldt*, s. Bonplandia trifoliata, *Willdenow*. Bentley and Trimen, *Med. Plants*, 43.

Nat. Ord.—Rutaceæ, Cuspariеæ.

Origin.—The tree attains a height of 20 feet (6 M.), and is found abundantly in the mountains near the Orinoko River.

Description.—The bark is met with in commerce in flat or curved pieces, usually between 1 and 3 inches (about 5 Cm.) in length, rarely longer, about 1 to 1½ inches (25–38 Mm.) wide, and $\frac{1}{16}$ to ⅛ inch (1.5–3 Mm.) thick. Its color is reddish-brown, the inner surface smooth and lighter than the outer surface, which is uneven, and, if carefully preserved, covered with an ochrey-gray, scurfy, and friable cork. It breaks readily with a smooth, somewhat granular fracture, which is of a reddish-brown color, resinous in appearance, and displays to the naked eye numerous white, glistening striæ of crystals of calcium oxalate. The latter are more plainly visible with a lens, whereby also the radiating medullary rays and bast-wedges are revealed. The odor of the bark is aromatic, not agreeable; its taste is aromatic and bitter.

Fig. 25.



Angustura-bark: transverse section, magnified 10 diameters.

Substitutions.—The so-called false angustura-bark obtained from Strychnos Nux vomica, *Linné*, was found in Europe, early in the present century, mixed with the former, to which it bears no resemblance. The trunk-bark is of an irregular shape, rather thick and hard, externally gray, with bright rust-colored patches of cork, and white warts; the inner surface brown; the fracture smooth and destitute of white striæ; the branch-bark is more or less quilled, externally gray, with whitish warts. It has a bitter taste, and contains strychnine and brucine.

Another substitution appears to be frequently met with in France, and has also been noticed in this country (*Amer. Jour. Pharm.*, 1874, pp. 50, 414). This bark, now sometimes called *Brazilian angustura*, comes from Brazil, from Esenbeckia (Evodia, *St. Hilaire*) febrifuga, *Martius*, and consists of dark-brown inner layers, covered with patches of a soft, brownish-gray cork, which is of a pale-orange rust-brown within; it breaks with a short fibrous fracture, is without the white striæ, and has a purely bitter not aromatic taste. Copalchi, guaiacum, and other more or less bitter barks have likewise been observed as adulterations.

Constituents.—The latest analysis of angustura-bark is by Oberlin and Schlagdenhauffen (1878), who found 9.2 per cent. moisture, .27 fat, wax, and stearic acid, soluble in benzin, .47 fat soluble in alcohol and yellow bitter matter, 3.86 resin, .19 volatile oil, 7.8 ash. The bitter matter contained an alkaloid, *angosturine*, $C_{10}H_{40}NO_{14}$, which melts at 85° C. (185° F.), is crystallizable, and is turned red by pure sulphuric acid and green by the same acid containing nitric acid or other oxidizing agent. The volatile oil, according to Herzog (1858), has the composition $C_{13}H_{24}O$, and boils at 266° C. (511° F.). *Cusparin* was obtained by Saladin (1833) by spontaneously evaporating the tincture prepared with strong alcohol. It crystallizes in the cold in needles and tetrahedrons, fuses at a moderate heat, is inflammable, insoluble in ether and volatile oils, soluble in 100 parts of boiling water, but readily soluble in alcohol; it is neutral in behavior and has a bitter taste. Herzog was unable to obtain it. Tannin is not present, but the infusion yields a red-brown precipitate with ferric chloride and several other metallic salts.

The Brazilian angustura-bark contains the alkaloid *evodine* or *esenbeckine*, $C_6H_{18}NO_6$, which is colored yellowish-green by sulphuric acid (Oberlin and Schlagdenhauffen).

Action and Uses.—Angustura has a tonic operation without astringency, and a slightly stimulating action. It was at one time supposed to be a valuable antiperiodic, but experience has proved it to have no more claim to this virtue than the simple bitters. It is probably of more use in the *typhoid state* of fevers and inflammations, and especially in that of tropical *dysentery*, in which its highest reputation has been gained. In ordinary cases of atonic *dyspepsia*, and especially in those in which flatulence predominates, it has been found of service. But it has no special superiority over numerous other tonic and aromatic stimulants which can be more readily procured. The dose of angustura in powder is from Gm. 0.60–2.00 (gr. x–xxx). An infusion may be made by percolation, containing Gm. 16 in Gm. 500 (℥ss in Oj) of water. *Dose*, Gm. 32–64 (f℥j–ij).

ANILINA, *F. It.*—Aniline.

Amidobenzene, *Phenylamine*, E.; *Aniline*, Fr.; *Anilin*, G.

Formula C_6H_7N or $C_6H_5NH_2$. Molecular weight 92.83.

Origin.—Aniline was discovered by Unverdorben (1826) among the products of the dry distillation of indigo, and was found by Runge (1833) in the heavy oil of coal-tar. Zinin (1842) introduced the method of preparing it from nitrobenzene by the action of hydrogen sulphide in the presence of alcohol and ammonia, and A. W. Hofmann (1845) by nascent hydrogen from the action of dilute sulphuric acid upon zinc. The name *aniline* (from *anil*, the Portuguese name for indigo) was proposed by Fritzsche (1841). Unverdorben had called it *crystalline*, and Runge *kyanol* on account of the deep violet-blue color which it gives with chlorinated lime. The identity of these bodies was proven by Erdmann and Hofmann. Aniline has also been named *benzidam* and *phenamid*.

Preparation.—Aniline is prepared from nitrobenzene by the reducing action of nascent hydrogen, by digesting with a mixture of iron filings and acetic acid, as suggested by Béchamp, in which case the deoxidizing action of ferrous acetate, $Fe(C_2H_3O_2)_2$, first produced, materially assists the change. Nitrobenzene is thereby converted into aniline and water; $C_6H_5(NO_2) + 3H_2$ yields $C_6H_7N + 2H_2O$. The acetic acid has been replaced, by Brimmeyr, by hydrochloric acid. When, after several days, the reaction

is completed, milk of lime is added and the aniline is distilled off, the receiver being changed toward the close of the distillation; the temperature then rises, and a red oil, *azobenzid*, $C_{12}H_{10}O_2$, passes over, which congeals to a crystalline mass. The separation of aniline from the heavy oil of coal-tar is effected by a complicated process depending upon its solubility in hydrochloric acid, the insolubility of this compound in ether, the liberation of the bases by an alkali, and their separation from each other by fractional distillation.

Properties.—Aniline is a colorless, limpid, oily, inflammable liquid of a peculiar wine-like odor and burning aromatic taste. It has the spec. grav. 1.0245 at 15° C.(59° F.), congeals at a low temperature, melts at —8° C. (17.6° F.), boils at 184.5° C. (364.1° F.), acquires in contact with air a yellow and brown color, is sparingly soluble in cold water and in all proportions of wood-spirit, alcohol, ether, aldehyde, acetone, and fixed and volatile oils. It dissolves phosphorus, camphor, several resins, and by the aid of heat much sulphur; coagulates albumen; precipitates the salts of iron, zinc, and aluminum; and unites with acids to form salts, which are mostly crystallizable, readily soluble in water, inodorous and colorless, but acquire a red color in contact with the air; alkalies decompose them, with the separation of aniline. Commercial pure aniline usually contains about 1 per cent. of toluidine: other grades contain more of this base.

Toluidine or *amidotoluene*, C_7H_9N or $C_7H_7NH_2$, exists in three modifications, of which two are present in the product of the above process. *Paratoluidine* forms colorless tabular crystals, melts at 45° C. (113° F.), and boils at 198° C. (288.4° F.). *Orthotoluidine* or *pseudotoluidine* is a colorless liquid of the same density as water at 15° C. (59° F.), boiling at 199.5° C. (390.2° F.), and not solidifying at — 20° C. (— 4° F.).

Toluidine gives a reddish color with chlorinated lime, but aniline is characterized by the production of a violet color with the same reagent—a reaction which has led to its application in the production of *coal-tar dyes*, the more important of which are the following:

Aniline-purple, or *mauve*, is obtained by acting upon aniline with sulphuric acid and potassium dichromate or other oxidizing agents, whereby the alkaloid *mauveine*, $C_{26}H_{24}N_4$, is produced.

Safranine, $C_{21}H_{20}N_4$, is a red compound obtained from aniline containing toluidine by treatment with nitrous and arsenic acid.

Aniline-red, or *magenta*, is formed by heating a mixture of aniline and toluidine with corrosive sublimate or arsenic acid, and is a salt of *rosaniline*, $C_{20}H_{19}N_3$, or of *pararosaniline*, $C_{19}H_{17}N_3$, the alkaloids being colorless. *Roseine*, *fuchsine*, and *azaleine* are the acetate, hydrochloride, and nitrate of the same base. If obtained by the action of arsenic acid the dyes usually contain arsenic. To obtain the dyes free from arsenic the oxidation is now often effected by nitrobenzene or nitrotoluene.

Aniline-yellow, or *chrysaniline*, $C_{20}H_{17}N_3$, is a yellow secondary product of the preceding process; its hydrochloride has a scarlet color, and its nitrate is ruby-red and very sparingly soluble in water.

Aniline-blue is a salt of *triphenyl-rosaniline*, $C_{20}H_{16}(C_6H_5)_3N_3$, obtained by boiling a salt of rosaniline with aniline, and by treatment with iodide of methyl, ethyl, and similar compounds a large variety of blue, violet, and green (*iodine-green*, *methyl-green*, etc.) dyes are obtained.

Aniline-black, or *jetoline*, a salt of $C_{12}H_{10}N_2$, is very dark-green, and is obtained by the slow oxidation of aniline. *Nigrosine*, $C_{30}H_{29}O_3HCl$, is a similar compound of a dark-blue tint.

The aniline colors are largely employed in dyeing, and are used in the preparation of *colored inks*, which consist of aqueous solutions of the dyes, to which a small quantity of gum-arabic may be added. *Ink for stamping* is made by dissolving 5 parts of the dye in 75 parts of hot water, and adding 1 part of syrup and 2 parts of glycerin. On exposure to light all aniline dyes fade more or less rapidly.

Most of the aniline dyes used in the United States are imported from Europe, the importation having increased from 210,500 pounds in 1877 to 1,103,864 pounds in 1882.

During the last few years several of the aniline dyes have been proposed for medical use, both internally and externally, on account of their reputed antiseptic and analgesic qualities; they are also employed as valuable staining agents in histological and bacteriological work. The following are deserving of special notice:

Fuchsine, or rosaniline hydrochloride, $C_{20}H_{19}N_3HCl$, occurs in bright iridescent crystals, which are soluble in 10 parts of alcohol, but require 300 parts of water for solution; in pure essential oils fuchsine is insoluble, and can therefore be used to detect the

presence of alcohol in oils. Although commercial fuchsine is frequently contaminated with arsenic, it is possible to obtain it entirely free from this impurity if prepared by Jegel's process, which consists in heating together aniline nitrate and hydrochloride in proper proportions; the resulting mass is treated with water, which removes the fuchsine, leaving a peculiar blue compound behind (*Proc. A. P. A.*, 1875). Fuchsine has been used in albuminuria, and externally (in form of a 1 per cent. alcoholic solution) with success in traumatic erysipelas. It has also been employed with marked benefit in throat affections. The maximum adult dose according to Fischer is 4 grains.

Methylene blue, or Tetramethyl thionin-chloride, $C_{16}H_{18}N_3SCl$, is prepared by treating dimethylparaphenylenediamine ($NH_2C_6H_4N2CH_3$) in acid solution with hydrogen sulphide and ferric chloride; formerly the commercial form only was to be had, which consisted of a double chloride of zinc and tetramethylthionin, but the zinc was removed by purification, and the pure article alone should be employed. It occurs in small blue scaly crystals with a copper-bronze tinge, and is readily soluble in water. Methylene blue has been used with more or less success in neuralgic and rheumatic affections, and also in intermittent fevers, the average adult dose being 1½ grains five or six times a day. It has proved the best stain for the plasmodia found in the blood-corpuscles of malarial patients. In the form of a 10 per cent. solution it has been used successfully as a local application in diphtheria and chronic cystitis. It must not be confounded with *methyl blue*, the sodium salt of triphenylpararosaniline-trisulphonic acid, $C_{37}H_{26}N_3S_3O_9Na_3$, which is made by treating pararosaniline with aniline, and the resulting product with sulphuric acid. Sodium hydroxide, added to a solution of methylene blue, causes the blue color to change to violet, while in the case of methyl blue it changes to reddish-brown.

Pyoktanin—Two varieties, blue and yellow pyoktanin, have been brought to notice, the former intended for general surgery, the latter more especially for ophthalmic practice. Only the blue pyoktanin, methyl violet, appears to have been employed to any extent; it is probably of variable composition, tetra–, penta–, or hexamethyl pararosaniline, while yellow pyoktanin is one of the group of dyes known as *auramines*. Pyoktanin has been used with varying results by oculists and laryngologists, but the reports are often confusing and conflicting.

Apyonin was brought forward as a rival to pyoktanin, and has been claimed to be identical with the yellow variety of that substance, but it has failed to attract much attention.

Benzo-phenonoid is said to be equal to pyoktanin in germicidal properties; it is soluble in 100 parts of water, and is neither caustic nor irritant. The discoverers of it claim that it is a definite compound produced by the decomposition of an aniline dye.

Action and Uses.—Workmen exposed to the vapors evolved in the manufacture of aniline acquire a cyanotic hue of the face, lips, and mouth, and suffer from giddiness, headache, chilliness, weakness of the lower limbs, and sometimes epileptiform convulsions. They are subject also to bronchial irritation, nausea, constipation, diarrhœa, and cutaneous eruptions. A carboy of aniline oil breaking, the man engaged in moving it fell into a stertorous sleep of many hours' duration, with complete insensibility of the skin. For three days he suffered pain in the bladder and had hæmaturia (*Med. News*, xlvii. 464). A woman who swallowed f℥iiss of aniline oil fell into coma, with cyanosis, collapse, and jaundice with ecchymoses (*Med. News*, lii. 409). An infant has been poisoned by wearing a diaper marked with aniline ink (*Boston Med. and Surg. Jour.*, Nov. 1886, p. 473), and a man by using the point of an aniline pencil to dislodge the fang of a broken tooth from his gum (*Med. Record*, Nov. 1886, p. 571). Stockings, cravats, gloves, etc. dyed with aniline have occasioned eczematous eruptions upon the skin in contact with them, and patients affected with psoriasis have been poisoned by the application of bandages wet with a solution of muriate of aniline. In the case of a woman who had attempted suicide by swallowing about six fluidrachms of aniline oil, and who died in a few hours, there were found many hæmorrhagic nodules or effusions in the heart-muscles, the lungs, and kidneys, and aniline was detected in the urine (*Archives gén.*, Juin, 1885, p. 735).

Aniline has been used in *chorea*. Six inveterate cases are reported to have been speedily cured by this agent in doses of 1 or 2 grains three times a day (Turnbull); while in another group of five cases, in which aniline was given persistently until the doses reached Gm. 0.40–0.45 (gr. vj–vij) three times a day, not the slightest impression was made upon the symptoms (Fraser, etc.). It has also been administered in *epilepsy* without apparent advantage. The use of fuchsine (a derivative of aniline) to color wines was claimed to be innocuous, and when employed as a medicine it caused the disappearance of

albumen from the urine while increasing the proportion of phosphates in this secretion (*Gaz. hebdomadaire*, June 23, 1876). Divet observed that it removed albuminuria without regard to its cause (*Bull. de Thérap.*, xcviii. 89). Bouchut found it an efficient remedy for scarlatinous dropsy, and not productive of injury (*Practitioner*, xxiii. 203). Similar results were obtained by Sawyer in England (*Practitioner*, xxvi. 41) and De Renzi in Genoa (*Virchow's Archiv*, lxxx. 510). It seems, however, that it has only been conspicuously useful in tubular nephritis, and Dieulafoy denies that it diminishes renal dropsy or its attendant thoracic and pulmonary symptoms (*Bull. de Thérap.*, xcvii. 478). It has been claimed, on very insufficient grounds, to be a remedy for phthisis (*Med. News*, l. 346). It appears, therefore, that neither the conditions nor the nature of its influence is at present understood. Moreover, a longer clinical experience has rendered it probable that the aniline colors are of no value in therapeutics (*Centralbl. f. Therap.*, viii. 495; *Therap. Gaz.*, xiv. 533). The daily portion of fuchsine has varied between Gm. 0.10–0.20 (gr. iss–iij), given in divided doses, and it is said that it may be prescribed to the extent of from gr. iij–v without causing nausea.

Pyoctanin (methyl violet) was stated in 1890 (*Therap. Monatsh.*, iv. 294) to be a valuable remedy in certain diseases of the eye by arresting inflammation, suppuration, and ulceration, and that it was superior to other antibacillar agents when applied in a solution of 1 : 2000–1 : 5000, or in powder, pencil, or ointment, or was administered in pastilles. These claims, were, in the main, supported by Bresgen (*ibid.*, p. 479), who concluded that the preparation allayed pain, inflammation, and suppuration, but were rather discredited by other reporters, as Liebreich made manifest (*ibid.*, p. 344). Indeed, it seemed that its application to the eye and nostrils often aggravated the existing inflammation of those parts. Braunschweig reached a similar conclusion (*Centralbl. f. Therap.*, viii. 496). As the preparation consists of various, and perhaps varying, ingredients, an accurate estimate of its virtues is at present impracticable.

ANISUM, *U. S.*—Anise.

Anisi fructus, Br.; *Fructus Anisi*, P. G.; *Fructus* (*Semen*) *Anisi vulgaris.*—*Aniseed*, E.; *Anis*, *Anis vert*, Fr.; *Anis*, G.

The fruit of Pimpinella Anisum, *Linné*, s. Anisum vulgare, *Moench.* Bentley and Trimen, *Med. Plants*, 122.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—The plant is an annual which is indigenous to the eastern portion of the basin of the Mediterranean, and extensively cultivated in Southern and Central Europe, and occasionally in this country. It grows to about 1 foot (30 Cm.) in height, has the radical leaves roundish-cordate, lobed, and serrate, the stem leaves pinnate with lanceolate lobes, and the upper ones trifid or undivided and linear. The flowers are small and white, in numerous small and long-stalked umbels.

Fig. 26.

Anisum: Fruit and longitudinal section, magnified 3 diameters; transverse section, magnified 8 diameters.

Description.—The fruit is about $\frac{1}{6}$ to $\frac{1}{5}$ inch (4–5 Mm.) long, ovate, tapering above toward the thick stylopode, somewhat compressed at the sides, of a grayish or greenish-gray color, and covered with short appressed hairs. The two mericarps are usually united. Each has five light-brownish filiform ridges, and from 12 to 20 oil-tubes situated on the flat commissure and in the furrows. The fruit has an agreeable aromatic odor and a sweet spicy taste. The importation of anise and star-anise in 1877 was 93,485 pounds, and 367,186 pounds in 1881.

Impurities.—Anise of commerce is not unfrequently mixed with earthy matters resembling the fruit in color. This adulteration is readily detected and the amount thereof determined, according to Hager, by agitating a known weight of anise for a short time with a saturated solution of table-salt; the anise will rise to the surface of the liquid, and after rapidly washing with water and drying is again weighed; earthy matter and sand will subside. Accidental admixtures of *conium-fruit* have been repeatedly reported. This is easily distinguished from anise by the mericarps, when ripe, being separate, smooth, grooved upon the face, with the ribs prominent and crenate, and by being destitute of oil-cells.

Constituents.—The fruit contains, according to Brandes and Reimann, 3 per cent. of volatile oil, 3.38 per cent. of fixed oil, some gum, sugar, resin, malates, phosphates, and other salts. The volatile oil represents the medical properties of the fruit. (See Oleum Anisi.)

Pharmaceutical Uses.—Anise is used for preparing Oleum anisi and Aqua anisi.

Off. Prep.—Tinct. Rhei dulcis, U. S.

Action and Uses.—Although it imparts a peculiar taste to the milk of nurses, it probably does not augment the secretion (Dolan). Anise is an aromatic stimulant and carminative; its oil and infusion are habitually employed to relieve *flatulent colic*, and the seeds enter into the composition of many culinary products as a condiment which tends to render them less indigestible. It has been imagined to have some special influence upon the *bronchial tubes*, modifying their secretions and promoting expectoration. But all volatile oils and resins are exhaled by the bronchia, and all have more or less repute as stimulant expectorants. In *infantile catarrh*, when the acute stage has passed, infusion of anise may be given with advantage. It may be made with Gm. 8–12 (ʒij–iij) of the bruised seeds in half a pint of boiling water, and given in teaspoonful doses to infants at the breast. The dose of bruised anise is from Gm. 0.60–1.20 (gr. x–xx). According to Curci, the anisates of the alkalies are closely analogous in their action to the salicylates (*Bull. de Thérap.*, cviii. 140).

ANTHEMIS, *U. S.*—Anthemis.

Anthemidis flores, Br.; *Flores Chamomillæ romanæ.—Chamomile-flowers, Roman or English chamomile*, E.; *Camomille romaine*, F. Cod.; *Römische Kamille*, G.; *Manzanilla romana*, Sp.; *Camomilla romana*, F. It.

The flower-heads of Anthemis (Chamomilla, *Godr.*) nobilis, *Linné*, collected from cultivated plants. Bentley and Trimen, *Med. Plants*, 154.

Nat. Ord.—Compositæ, Senecionideæ.

Origin.—A low perennial plant indigenous to Southern and Western Europe as far north as England, and cultivated in Germany, Great Britain, France, and Belgium. The small oblique rhizome produces numerous prostrate or ascending and radiating stems, with alternate sessile grayish-green leaves, which are hairy and twice or thrice pinnately divided into acute linear segments. The flower-heads terminate the branches, and appear from June to September. Anthemis-flowers have been dismissed from the German Pharmacopœia.

Fig. 27.

Anthemis nobilis, *Linné*.
Ray- and disk-floret, mag. 4 diam. Section through single flower-head, nat. size.

Description.—The flower-heads of the wild plant, which have a single row of white ligulate ray-florets and numerous yellow tubular disk-florets, are not met with in commerce. In the cultivated plant the tubular florets are more or less changed into white ligulate florets, and therefore the heads have either a smaller yellow centre or are entirely white. The heads are about ¾ inch (2 Cm.) broad, and consist of an involucre composed of numerous imbricated oblong ovate scales with a scarious margin, of a solid convex finally conical receptacle with narrow concave chaff, and of numerous white strap-shaped and three-toothed florets, which are pistillate. The yellow disk-florets, if present, are tubular, five-toothed, and hermaphrodite, with the two branches of the style projecting. The tapering achene is destitute of a pappus. Since the oil-glands are found mainly on the tubular portion of the florets, the so-called *single chamomile*, with one or a few rows of ray-florets, appears to be better adapted for medicinal use, and has a stronger and more agreeable odor.

Adulterations.—The flower-heads of several Compositæ, like Anthemis arvensis, *Linné*, Maruta Cotula, *De Candolle*, Matricaria Chamomilla, *Linné*, Pyrethrum Parthenium, *Linné*, and Achillea Ptarmica, *Linné*, have been named as occasional adulterations, but they are much smaller than Roman chamomile. The first-named three species, not being cultivated, have the heads always with a single row of ray-florets, while the last two are frequently double in cultivation. Of these, the feverfew (Pyrethrum) has a flat or merely convex and nearly naked receptacle, and the Achillea flowers have shorter and rounded rays, are inodorous, and of an acrid taste.

Constituents.—According to J. P. Wyss (1833), chamomile-flowers contain volatile

oil (see OLEUM ANTHEMIDIS), traces of tannin, 5.25 per cent. resin, 1.50 per cent. wax, albumen, gum, bitter principle, fixed oil, chlorophyll, extractive, and salts. From the investigations of Cambonlises (1871) it seems probable that the bitter taste is due to anthemic acid (see MATRICARIA); fat, grape-sugar, and 6 per cent. of ash were found in the flowers. The bitter principle is soluble in water and alcohol.

Pharmaceutical Uses.—For preparing Oleum anthemidis, Extract. anthemidis, and Infusum anthemidis, *Br.*

OLEUM ANTHEMIDIS INFUSUM, Oleol of chamomile, *E.;* Huile de camomille, *Fr.;* Gekochtes Römisch-Kamillenöl, *G.*—Digest for 2 hours chamomile-flowers 10 parts in olive oil 100 parts; express and filter.—*F. Cod.*

Action and Uses.—Chamomile is stimulant and tonic. The former property is due to its essential oil, the latter to its bitter principle. In substance or strong infusion it occasions a sense of warmth in the stomach; it expels flatus, improves digestion, does not constipate, and, like other aromatic stimulants, is reputed to possess emmenagogue virtues. In large doses it occasions nausea, vomiting, diarrhœa, pain and fulness of the head, and sometimes a degree of somnolent intoxication. In medicinal doses the infusion is tonic if cold, but emetic if warm.

Chamomile is commonly used as a mild stimulant tonic to improve the *digestion* during convalescence from acute diseases and in many states of general debility. It is particularly indicated when the gastric digestion is laborious and accompanied with flatulence, and also when the latter stage of the process is attended with colic. Hence its use, like calumba, in various *diarrhœal* conditions. It is an excellent preventive remedy for periodical sick headache, and its warm infusion is a salutary emetic during the attack. It is reputed also to be *emmenagogue*, to cure *neuralgia*, and to diminish chronic *suppuration*. Evidently, it exerts these powers indirectly and only by its power of improving the nutrition of the whole system. In the same way, probably, it sometimes cures *intermittent fever*. Many bitter tonics have a similar operation, but cinchona alone exhibits a direct curative control over periodical fevers. These remarks apply only to their use as tonics; camomile and its associate bitters often cure mild intermittents when administered in the form of a hot infusion immediately before the paroxysm. This is a physiological mode of cure, and may be practised with the aid of whatever will equally well excite copious diaphoresis. In forms of malarial fever distinguished by *biliary derangement* warm chamomile tea is often used to produce both vomiting and diaphoresis, and thereby not only to moderate the general severity of the paroxysm, but also to lessen hepatic congestion and the evils which ensue thereon. As an emetic chamomile is peculiarly appropriate whenever it is desired to empty the stomach without depressing the system, and hence in those numerous cases of crapulous *indigestion* occurring in coarse feeders and in drunkards. It often will put an end to an attack of *delirium tremens* in the forming stage. Subsequently, nothing excels a cold infusion of chamomile in repairing the exhausted condition of the digestive organs.

Externally, fomentations made with chamomile-flowers saturated with hot water or with hot vinegar and water form a most soothing application for *local pains*, whether neuralgic or congestive, in intestinal and uterine *colic*, *toothache*, *earache*, *abscess*, *sprains*, etc. It is believed by high authorities that the odor of chamomile is destructive of the *itch-insect*, the *gnat*, etc. Oil of chamomile has been applied to painful *rheumatic* parts and to the abdomen in *flatulent colic*.

Chamomile is never prescribed in substance except as a masticatory, and in this manner it is often useful in slight dyspeptic disorders. The extract (*Br. Ph.*) is a good simple bitter tonic in the dose of from Gm. 0.20–0.60 (gr. iij–x). A fluid extract is prepared, a fluidrachm of which represents 30 grains of chamomile. The oil is sometimes prescribed internally in doses of 5 or 6 drops upon sugar, in ether, in Hoffmann's anodyne, or in pills made with crumb of bread. An infusion is made with half a troy-ounce of chamomile to a pint of boiling water. When cold it is used as a tonic in doses of Gm. 30–60 (f℥j–ij). When warm it acts as an emetic if freely drunken.

ANTIARIS.—UPAS ANTIAR.

Upas antiar, Fr., G.

A gum-resinous exudation of Antiaris toxicaria, *Leschenault.*

Nat. Ord.—Urticaceæ, Artocarpeæ.

Origin.—The upas tree is one of the largest trees of the forests of Java and of some of the neighboring islands. When wounded it yields a milk-white or yellowish exudation,

which on exposure turns brownish, and constitutes the principal ingredient of the Upas antiar, or Javanese arrow-poison.

Description.—Upas antiar is reddish-brown, of a waxy consistence, and has an extremely bitter and at the same time acrid taste. Triturated with water, it yields an emulsion. It is partly soluble in alcohol and ether.

Constituents.—It contains gum, sugar, albumen, wax, resin, and *antiarin*, the poisonous principle discovered by Pelletier and Caventou (1824). The latter is obtained by exhausting the alcoholic extract with boiling water. Mulder obtained from the dry juice 3.5 per cent. of antiarin, the composition of which is $C_{14}H_{20}O_5$. It crystallizes from water in silvery scales containing 11.86 per cent. ($2H_2O$) of water, and is soluble in 70 parts of alcohol, very slightly in ether, more freely in dilute acids and alkalies. The resin is readily soluble in ether, sparingly in cold alcohol, and is not poisonous.

Action and Uses.—Under the name "upas," which in the Malay language signifies poison, or, specifically, arrow-poison, several quite different products are included. Upas Tieuté contains strychnine, and the symptoms it occasions are more or less distinctly tetanic, but Upas antiaris, as well as its active principle, antiarin, produces very different effects. However introduced into the system, it impairs or suspends voluntary movements without causing convulsions. It is a paralyzing poison to the heart as well as to the voluntary muscles, and appears to act directly upon these organs and upon the great nervous trunks, but not upon the brain or spinal marrow. A specimen of arrow-poison has been found to contain both a convulsing and a paralyzing agent, which could be separated and both made to display their peculiar effects.

We are unacquainted with any instances of the therapeutical use of this product, but the remarkable analogy of its operation with that of physostigma would seem to indicate its application to similar conditions.

ANTIMONII ET POTASSII TARTRAS, *U. S.*—Antimony and Potassium Tartrate.

Antimonium tartaratum, *Antimonii potassio-tartras*, *Antimonium tartarisatum*, Br.; *Tartarus stibiatus*, P. G.—*Tartarated antimony*, *Tartar emetic*, E.; *Tartrate de potasse et d'antimoine*, *Emétique*, *Tartre stibié*, Fr.; *Brechweinstein*, G.; *Tartrato di antimonio e di potassio*, F. It.; *Tartrato de potassa y antimonio*, Sp.

Formula $2KSbOC_4H_4O_6 + H_2O$. Molecular weight 662.42.

Origin.—A process for the preparation of tartar emetic from cream of tartar and crocus of antimony was first published in 1631 by Adrian van Mynsicht. Glauber (1648) used flowers of antimony or antimonial glass. At present the salt is generally prepared with oxychloride or with pure oxide of antimony. The British Pharmacopœia recognizes two synonyms besides the official title.

Preparation.—Take of Oxide of Antimony 5 ounces; Acid Potassium Tartrate in fine powder 6 ounces; Distilled Water 2 pints. Mix the oxide of antimony and acid potassium tartrate with sufficient water to form a paste, and set aside for twenty-four hours. Then add the remainder of the water and boil for a quarter of an hour, stirring frequently. Filter and set aside the clear filtrate to crystallize. Pour off the mother-liquor, evaporate to one-third, and set aside, that more crystals may form. Dry the crystals on filtering-paper at the temperature of the air.—*Br.*

The process formerly recognized by the U. S. Pharmacopœia consisted in boiling for one hour 18 fluidounces of water containing a mixture of 2 troyounces of oxide of antimony and 2½ troyounces of acid potassium tartrate, water being added from time to time to supply the loss by evaporation. This long-continued application of heat is apt to produce a change whereby the liquid becomes colored and a portion of the salt is converted into an uncrystallizable compound; the mother-liquor from the first crystallization yields, on further evaporation, crystals which are colored and require to be recrystallized. By the British process heat is avoided, except for a much shorter time, the combination being effected at the ordinary temperature; or digestion at a gentle heat may be resorted to with little danger of inducing the changes alluded to. The compounds are made to react upon each other in the presence of a little water, a slight excess of antimonous oxide being used; and the subsequent boiling with a larger quantity of water mainly aims at bringing the tartar emetic already formed into solution, so that it may be freed by filtration from the excess of the oxide used, and obtained in crystals. It is of importance that the antimonous oxide should be free from oxychloride, otherwise the mother-liquor will become acid, and more or less of the salt will be lost by refusing to

crystallize. The acid potassium tartrate should be free from calcium tartrate which would contaminate the crystals of tartar emetic, necessitating their recrystallization, and thus occasioning loss.

The reaction between the antimony trioxide and acid potassium tartrate is a very simple one, the univalent radical (SbO), antimonyl, displacing hydrogen, with the formation of water, as follows: $Sb_2O_3 + 2KHC_4H_4O_6 = 2(KSbOC_4H_4O_6) + H_2O$.

Other processes have been recommended, and are perhaps followed by some manufacturers: they agree in this, that an impure oxide of antimony, which may be obtained in various ways, is used. While the trouble of its purification is thus avoided, a subsequent loss cannot be prevented, as explained above. Operating on a large scale, such a course is probably the cheapest, but for the pharmacist the use of pure materials is by far more advantageous, since with proper and careful manipulation the entire solution may be made to crystallize.

Properties.—Antimony and potassium tartrate produces colorless transparent crystals, which have the form of a rhombic octahedron, become white and opaque on exposure to the air, and have a sweetish afterward disagreeable strongly metallic taste. In commerce it is usually seen in the form of a white finely-granular powder. Heated to 110° C. (230° F.), the salt loses its water of crystallization, 2.71 per cent.; at 200° C. (392° F.) parts with more water, and is converted into metatartrate; at a higher heat it decomposes, becomes brown and black, giving off empyreumatic products having the odor of burning sugar, and finally leaves a black or gray residue having an alkaline reaction. Tartar emetic is soluble in 17 parts of water at 15° C. (59° F.) and 3 parts of boiling water (*U. S.* and *P. G.*); in 15 parts of water at 60° F. (*Br.*).

According to Brandes, 1 part of the salt

Dissolves in	19.0,	12.6,	8.2,	7.1,	5.5,	4.8,	3.2,	3.0,	2.8 parts of water
at	8.7°,	21°,	31°,	37.5°	50°,	62.5°,	75°,	87.5°,	100° C.

The aqueous solution is precipitated on the addition of alcohol in the form of a crystalline powder; in this manner a pure powder of tartar emetic is readily and most advantageously obtained for pharmaceutical purposes. The solution yields with hydrochloric and other mineral acids a white precipitate of an oxy-salt of antimony, which is soluble in hydrochloric acid, and does not occur if tartaric acid has been previously added to the solution. The aqueous solution, even if largely diluted, at once becomes turbid on the addition of a little potassium carbonate. Hydrogen sulphide causes an orange-red precipitate, which, when obtained from 20 grains of the salt after washing and drying at 100° C. (212° F.), weighs 10.12 grains. A solution of tartar emetic which is not too dilute produces a flocculent precipitate on the addition of infusion of galls; an excess of the latter redissolves the precipitate. The salts of most metals and earths, being precipitated by normal tartrates, are incompatible with tartar emetic; also the alkalies, tannin, and tinctures containing tannin.

Tests.—Chlorides and sulphates, if present, are detected in the solution, previously acidulated with acetic acid, by silver nitrate and barium chloride, calcium by ammonium oxalate, and copper, iron, and other metals by potassium ferrocyanide. "A 1 per cent. solution of the salt should not be clouded by the addition of a few drops of the reagents named."—*U. S.* Arsenic may be detected by carefully heating 20 or 30 grains of the salt until a black residue remains; on gradually increasing the temperature to redness a garlic-like odor will be evolved. More delicate tests are the following: "If 1 Gm. of the salt be dissolved, with the aid of heat, in hydrochloric acid, and to this solution 1 Cc. of test-solution of stannous chloride be added, together with a small piece of pure tin-foil, no turbidity or coloration should ensue within one hour (limit of arsenic)."—*U. S.* "If 1 Gm. of tartar emetic, in powder, be shaken with 3 Cc. of solution of stannous chloride, no coloration should ensue within one hour."—*P. G.* The impurity which is likely to be met with in consequence of faulty preparation is cream of tartar, the presence of which cannot be detected by its behavior to test-paper, since the solution of tartar emetic has an acid reaction; but a permanent precipitate will not appear with potassium carbonate until after this impurity has been neutralized. By dissolving 24 grains of the salt in a fluid-ounce of warm water and cooling the solution to 10° C. (50° F.) it should remain clear. A crystalline deposit will occur if more than 8 per cent. of cream of tartar is present. The U. S. Ph. demands that if sodium carbonate solution be added to crushed crystals of tartar emetic, no effervescence should take place, to show absence of this impurity. A more delicate test, which, however, does not indicate the nature of the impurity, consists

in preparing antimony sulphide from a given weight of the salt, as stated above. As the U. S. Ph. demands absolute purity for tartar emetic, the salt should respond to the following volumetric test: "If 0.331 Gm. of the crystallized salt, or 0.322 Gm. of the salt dried at 110° C. (230° F.), be dissolved in 10 Cc. of water, and about 20 Cc. of a cold saturated solution of sodium bicarbonate, and a little test-solution of starch added, it should require not less than 20 Cc. of decinormal iodine solution to produce a permanent blue color (corresponding to 100 per cent. of the pure salt)."—*U. S.* The following equation will explain the reaction taking place in the test: $2(KSbOC_4H_4O_6)H_2O + 6NaOH + I_4 = 2NaSbO_3$ (meta-antimonate) $+ 4NaI + 2(KHC_4H_4O_6) + 6CO_2 + 3H_2O$. Now, since 506.12 ($126.53 \times 4$) parts of iodine are necessary to completely oxidize the antimony contained in 662.42 parts of crystallized tartar emetic, it follows that 20 Cc. of $\frac{N}{10}$ iodine solution, representing 0.25306 Gm. of iodine, are required for 0.331 Gm. of the salt, for 662.42 : 506.12 : : 0.331 : 0.25306.

Pharmaceutical Uses and Preparations.—Tartar emetic is a convenient test for distinguishing different kinds of tannin, some of which yield no precipitate with it.

Emplastrum Antimonii, *U. S.* 1870; Emplastrum stibiatum *s.* antimoniale.—Antimonial plaster, *E.;* Emplâtre (Poix) émétisée, Emplâtre antimonial, *Fr.;* Brechweinstein-Pflaster, *G.*—Take of Antimony and Potassium Tartrate in fine powder a troyounce; Burgundy Pitch 4 troyounces. Melt the pitch by means of a water-bath and strain; then add the powder, and stir them well together until the mixture thickens on cooling. The finely-powdered tartar emetic should not be added until the fused mass almost begins to thicken; the addition of 2 or 4 drachms of wax would improve the adhesive qualities of the plaster.

Action and Uses.—When tartar emetic in strong solution or in ointment is applied to the skin it produces a pustular eruption almost identical in appearance with that of small-pox, forming scabs and leaving indelible scars. If the skin is very delicate, it may ulcerate or slough. The pustulation is less apt to occur in persons of a naturally tough integument and also during high febrile action. Occasionally the constitutional operation of the medicine has been developed by its endermic employment. A solution of tartar emetic has been injected into the veins for the purpose of dislodging foreign bodies from the stomach by vomiting. This effect has also followed its administration by enema.

Taken internally, even in such doses as the $\frac{1}{100}$th of a grain frequently repeated, it occasions malaise and nausea, with colic and looseness of the bowels, loss of appetite, a pasty state of the mouth, debility and depression, and sometimes a pustular eruption on the skin. When the dose is large enough to excite vomiting it produces a sense of sinking, nausea, copious salivation, violent and prolonged retching, and often liquid stools, coldness of the hands and feet, and a cool perspiration. The matters vomited usually contain bile before the end of the operation. If the salt is given with but little fluid, the evacuations may be confined to vomiting: if the liquid is abundant, there may be copious purging without emesis. The more depressing the operation of the medicine, as indicated by the preceding symptoms, the more frequent and feeble does the pulse become. In the case of a boy whose brain membranes were exposed, Dr. Mary Putnam Jacobi observed that in two and a half hours after the administration of a quarter of a grain of tartar emetic, which did not occasion vomiting, the intracranial blood-pressure was diminished and the walls of the arteries relaxed. This peculiarity was not noticed under the action of sedative doses of quinine, and was produced only by nauseating doses of tartar emetic.

In poisoning by this substance the symptoms mentioned are greatly intensified. The patient is attacked with pain in the stomach, followed by incessant retching, præcordial cramps and burning heat, distension of the epigastrium, severe colic, watery and frequent stools, dryness of the throat, difficult deglutition, and salivation. The muscles are sometimes rigid, but generally relaxed; the skin pale, cool, and clammy; the pulse feeble and at first infrequent, but subsequently rapid and thready; respiration is slow. The dose required to produce such symptoms cannot be precisely stated. It may be but the fraction of a grain which occasions them, and that with a fatal result. In other instances several drachms of the salt have been taken without fatal consequences. In one case, followed by prompt recovery, the estimated quantity of the salt swallowed was 170 grains (*Med. Record*, xxiv. 401). Its continued use generally establishes a tolerance of its operation, as was formerly shown by its employment in the treatment of pneumonia—a method which is now forgotten except as a monument of rashness and folly. The use of this method illustrated the local action of the salt by the inflammation and ulcers which it

sometimes produced in the mouth, fauces, œsophagus, and stomach. It is to be noted that after fatal acute poisoning by tartar emetic gastric lesions are not always found—a fact which further illustrates the previous proposition, that it causes death by its action upon the heart and lungs through the nervous system, and not merely by its local operation on the stomach.

The idea that fever must be combated by means of agents which directly tend to lessen the frequency and lower the force of the pulse, and which was formerly carried out by venesection and purgation, and more recently by veratrum viride, aconite, and digitalis, was at one period sought to be realized by means of tartar emetic. The mischief wrought by the last-named agent was one of the medical scandals of the sixteenth century, when it was employed as an emeto-cathartic; but it reached its extreme development when Rasori, an Italian theorist, demonstrated that it was possible to administer 24 grains of this salt in as many hours to a pneumonic patient, and as much as 2 ounces in the course of an attack of *pneumonia*, without occasioning such a mortality as might reasonably have been expected. Indeed, many of the most distinguished clinical observers recorded their eulogies of this treatment, and if it were to be compared with those alone which approach it in their perturbative effects, it might still maintain the claims which once were made in its behalf. But since it has been demonstrated that the most successful by far of all methods of treating pneumonia is simply to place the patient in the most favorable conditions for the exertion of his natural powers of cure, a discussion of the relative values of different active medications has greatly declined in interest as well as utility. Even in 1882, and again in 1887–88. some indications existed of a desire to return to this obsolete method, which seemed to have been finally condemned and abandoned by the physicians of all countries. But we trust that the number of those who are acquainted with its martyrology will prove sufficient to check this dangerous tendency. The proposed revival did not, indeed, contemplate the use of the original sedative doses, but only the administration of divided doses until vomiting and purging had occurred three or four times. That such a method may be useful in exceptionally robust persons and in the early stages of the disease may be admitted, but its dangers, as well as its needlessness, in all other cases we cannot for a moment doubt. Even less than this degree of action has been deemed sufficient by some advocates of the revival of the use of tartar emetic who employed it like one of the antipyretics that happened to be in vogue, and sought, not an emetic or cathartic, but a sudorific and sedative effect. In this manner it is less harmful, yet quite superfluous.

A confusion produced by ignorance of the essential differences between pseudo-membranous *laryngitis* and spasmodic laryngitis led to the use of tartar emetic in the former disease, although clinical observation and analogy are strong against it, for it tends to produce a sudden and extreme prostration, and thereby to lessen the chances of the removal of the false membrane by coughing. On the other hand, the *spasmodic* affection, which involves also a superficial inflammatory element, is beneficially treated by nauseants and emetics, which relieve at once the congestion and the spasm of the larynx and terminate the attack. It is not generally necessary to excite vomiting with this object; nauseant doses of the medicine are usually sufficient. This statement is indirectly illustrated by the usually prompt effect of opiates and revulsives in the same affection. Among inflammatory diseases *acute bronchitis* is most decidedly modified by nauseant doses of this medicine, and even by smaller ones than produce any sensible effect besides an increase of the bronchial secretion and a greater facility of expectoration. Acute articular *rheumatism* was at one time treated by sedative doses of tartar emetic, but the evidence in its favor, which was originally small, is less than nothing at the present day. It has been said that nauseating and depressing doses of it will sometimes cut short various local inflammations in their forming stage, such as *tonsillitis*, *mammary abscess*, *hernia humoralis*, acute *ophthalmia*, *mumps*, etc. There is very little doubt of the fact, but the uncertainty of action of the medicine and its distressing operation have, for the present at least, rendered its use in these affections quite exceptional. Undoubtedly such minute doses as will, without nauseating, tend to bring on diaphoresis are often serviceable in the forming stage of such affections. And it is possible that those which neither nauseate nor depress may, under particular conditions, favorably modify inflammations which, although more or less chronic as to duration, have something of the symptomatic activity of an acute disease. Cases often occur of *erythema*, *urticaria*, *eczema*, and *psoriasis* which present these characters, and which may be benefited, and even cured, by the persistent use of small and repeated doses of tartar emetic, associated with a diet of milk and vegetables and abstinence from alcoholic and

other stimulants. (Compare Morris, *Brit. Med. Jour.*, Sept. 22, 1883, and Spender, *Practitioner*, xxxiv. 160.) It has been employed in *dropsy* produced by cold (renal dropsy); to arrest mercurial *salivation;* in acute *meningitis;* in *epilepsy, chorea, mania, convulsions, mania-à-potu*, etc.; but in none of these diseases does the good it effects outweigh the inconveniences arising from its depressing and exhausting operation. Its power of overcoming *rigidity of the os uteri* during labor has been attested by the highest authorities, but owing to the superior advantages of anæsthetics it is now seldom resorted to. The same remark applies to its use for producing relaxation in *strangulated hernia* and *dislocations*. Locally, it has been applied to excite inflammation and thereby destroy *nævi*, and also to produce the constriction and closure of *varicose veins*. The plaster and the ointment of tartar emetic, which are no longer officinal, were used to pustulate the skin. But the severity of their action and the scars they frequently left behind them have led to their disuse.

Tartar emetic should seldom be administered to the very young or very old, or to those who from any cause are feeble. If it produces *poisoning* by being swallowed, the stomach should be emptied as soon as possible by large draughts of tepid water containing or followed by vegetable astringents, such as green tea, galls, tannic acid, etc. Its sedative effects may be moderated by strong coffee, by wine, alcohol, ether, or opium.

The average emetic *dose* of tartar emetic is Gm. 0.06, (gr. j), or Gm. 0.20 (gr. iij) may be dissolved in Gm. 32 (f℥j.) of water, of which one-half may be administered; if this have no effect, half of the remainder may be given in fifteen minutes, and in fifteen minutes more the rest. Warm water should be freely administered. As a nauseant sudorific the dose is from to Gm. 0.01–0.03 (gr. $\frac{1}{6}$–$\frac{1}{2}$) every hour or more. As a diaphoretic and expectorant from Gm. 0.005–0.01 (gr. $\frac{1}{12}$–$\frac{1}{6}$) may be given at intervals of from one to three hours. Pustulation may be produced by means of tartar-emetic ointment, by a strong watery solution applied on a compress, or by inoculation of a paste made with the salt and by means of a fine lancet, or by the antimonial plaster (U. S. P. 1870). The last is a painful and unmanageable preparation.

ANTIMONII OXIDUM, *U. S., Br.*—Antimony Oxide.

Stibium oxydatum, Oxydum antimonicum s. stibicum.—Antimony Trioxide, Antimonous oxide, E.; *Oxyde d' antimoine*, Fr.; *Antimonoxyd*, G.; *Oxido de antimonio*, Sp.

Formula Sb_2O_3. Molecular weight 287.08.

Origin.—Oxide of antimony in an impure form was known to the alchemists of the Middle Ages. The term *flores antimonii* was at first chiefly applied to the product obtained by the burning of the black sulphide, but subsequently to the purer white powder resulting from the burning of metallic antimony in air. The mineral *valentinite* or *white antimony* consists of this oxide; *antimony ochre* or *cervantite* is antimonous-antimonic oxide.

Preparation.—Take of Solution of Chloride of Antimony 16 fluidounces; Sodium carbonate 6 ounces; Water 2 gallons; Distilled Water a sufficiency. Pour the antimonial solution into the water, mix thoroughly, let the precipitate settle, remove the supernatant liquid by a siphon, add 1 gallon of distilled water, agitate well, let the precipitate subside, again withdraw the fluid, and repeat the process of affusion of distilled water, agitation, and subsidence. Add now the sodium carbonate, previously dissolved in 2 pints of distilled water, leave them in contact for half an hour, stirring frequently, collect the deposit on a calico filter, and wash with boiling distilled water until the washings cease to give a precipitate with a solution of silver nitrate acidulated by nitric acid. Lastly, dry the product at a heat not exceeding 100° C. (212° F.)—*Br.*

The process of the U. S. Pharmacopœia (1870) was essentially the same as the above, except that directions were also given for preparing a solution of antimonous chloride by digesting black antimony sulphide 4 parts with hydrochloric acid 18 parts. By this treatment $Sb_2S_3 + 6HCl$ yields $2SbCl_3$, which remains dissolved in an excess of the acid, and $3H_2S$, which escapes; the solution contains also ferrous chloride, resulting from the iron usually contained in the black antimony. The subsequent step of adding nitric acid was an unnecessary complication; it will oxidize any hydrogen sulphide that may have remained in solution to sulphuric acid, and convert the ferrous into ferric chloride; but the former can be expelled more expeditiously and with less cost by boiling the solution, and the ferrous chloride will not be precipitated on the addition of water, which will also retain in solution the chlorides of the other metals occasionally present. On

adding the solution to water, antimonous oxychloride, or *powder of Algaroth*, is precipitated and obtained of the composition $2SbCl_3.5Sb_2O_3$. By washing this with water the chlorine is gradually but not completely removed as hydrochloric acid, a more basic oxychloride remaining. The conversion into the oxide is more readily effected by an alkali or alkali carbonate, for which purpose ammonia may be used or sodium carbonate, as directed above. In the one case ammonium chloride, in the other case sodium chloride and carbon dioxide, are formed, antimonous oxide remaining behind in both instances; $2SbCl_35Sb_2O_3 + 3Na_2CO_3$ yields $6Sb_2O_3 + 6NaCl + 3CO_2$. The resulting antimonous oxide must be dried at a not too elevated temperature, to avoid the formation of higher oxides of antimony. A contamination with arsenous acid, resulting from the arsenic sulphide frequently present in the black antimony, need not be apprehended; the greater part of it will be expelled during the first part of the operation as arsenic chloride, and what little may be left in the liquid will remain in solution on precipitating with water. The large quantity of noxious gases given off renders it necessary to operate under a hood or to dispose of the gases by consuming them in a furnace.

On heating metallic antimony in a loosely-covered crucible the metal burns at a red heat when in contact with air to antimonous oxide, and this sublimes in glossy, transparent, or white needles, intermixed with octahedrons; this product was formerly distinguished as *flores antimonii* (*flowers of antimony*).

Properties.—Antimonous oxide is a dense white or grayish-white powder, which is very sparingly soluble in water, insoluble in alcohol, ether, and nitric acid, but dissolves readily in hydrochloric acid; it is also soluble in a warm solution of tartaric acid or in a boiling solution of acid potassium tartrate. It is without odor and taste, and when heated in closed vessels turns yellow, and on cooling becomes white again; melts at a dull red heat to a yellowish liquid, which on cooling congeals to a crystalline mass of a pearly color, and at a full red heat sublimes in crystals, as stated above; slow sublimation gives mainly octahedrons, while rhombic prisms are obtained by rapid heating. But when the oxide is slowly heated in contact with air it is converted into grayish, infusible, and non-volatile tetroxide, or *antimonous-antimonic oxide*, Sb_2O_4 or $Sb_2O_3.Sb_2O_5$. When heated with soda upon charcoal by means of the blowpipe, very brittle metallic globules are obtained. Its solution in hydrochloric acid dropped into water yields a white precipitate, and this is at once changed to orange-red by hydrogen sulphide.

Tests.—A solution of antimony oxide in hydrochloric acid, diluted with water to incipient permanent turbidity, will yield with hydrogen sulphide a precipitate which when thoroughly washed must be perfectly soluble in ammonium sulphide solution, to indicate the absence of lead and copper. In a dilute (1 per cent.) aqueous solution made with aid of tartaric acid, sulphates would be detected by barium chloride solution, chlorides by silver nitrate, and iron and other metals by potassium ferrocyanide. The allowable limit of arsenic may be detected by adding 1 Cc. of stannous chloride test-solution and a piece of pure tin-foil to a solution of 1 Gm. of the oxide in hydrochloric acid; no turbidity or coloration should ensue within one hour.—*U. S.*

Pharmceutical Uses.—Oxide of antimony is employed in preparing tartar emetic, and is a constituent of Pulv. antimonialis, *U. S.*, *Br.*

Other oxides of antimony, more or less pure or combined with antimony sulphide, were formerly employed in medicine, and are occasionally, though very rarely, called for. When black antimony sulphide is gradually heated to redness in contact with the air, it is partly oxidized to antimonous antimonate, $Sb_2O_3\ Sb_2O_5$, and constitutes then an ash-gray powder known as *cinis antimonii* (*antimony ash*). When this is fused with a little black antimony, a transparent garnet-red mass known as *vitrum antimonii* (*antimonial glass*) is obtained. When a mixture of equal parts of black antimony and potassium nitrate is deflagrated by igniting it in small quantities, it yields *hepar antimonii* (*liver of antimony*), and when this is exhausted with water to remove potassium sulphate and sulphantimonate *crocus of antimony* is left behind, which is mainly a mixture of antimony oxide and sulphide. *Antimonium diaphoreticum* (*diaphoretic antimony*) is prepared like liver of antimony, except that more (2 parts) of potassium nitrate is used, so that the preparation contains, besides antimony oxide, antimonate, sulphate, nitrate, and nitrite of potassium in varying proportions. By washing this with water the residue consists mainly of *potassium antimonate*, which is recognized by the French Codex. The other preparations described were formerly employed in medicine.

Action and Uses.—The oxide of antimony is rarely used in medicine. It is stated to possess the general properties of antimonial preparations, with a less tendency to excite nausea and vomiting, owing to its inferior solubility. Its *dose* is from Gm. 0.10–0.20 (gr. ij–iv).

ANTIMONII SULPHIDUM, *U. S.*—Antimony Sulphide.

Antimonii sulphuretum, U. S. 1870; *Antimonium nigrum*, Br. 1867; *Stibium sulfuratum nigrum*, P. G.; *Antimonium crudum*, *Sulfuretum stibicum.*—*Black (crude) antimony*, *Antimony trisulphide*, *Antimonous sulphide*, E.; *Sulfure d'antimoine*, *Antimoine cru*, *A. sulfuré*, Fr.; *Schwefelspiessglanz*, *Spiessglanz*, *Schwefelantimon*, G.; *Trisulfuro di antimonio*, F. It.; *Sulfuro de antimonio*, Sp.

Formula Sb_2S_3. Molecular weight 335.14.

Origin.—It is found native as *stibnite*, gray antimony ore, or black antimony, and associated with galena, iron pyrites, quartz, and heavy spar, in various parts of Europe, Borneo, New Brunswick, Nevada, and in Sevier co., Ark. It was known to the ancients as "stimmi," and was early employed as an external remedy in cutaneous diseases and for darkening the eyebrows and eyelashes. From the infusible ores with which it is associated it is freed by fusion in pots arranged in such a manner that the fused sulphide runs off into earthen vessels, where it cools. It is afterward powdered.

Properties.—Thus purified, it is known in commerce as crude antimony, and contains variable small quantities of iron, and often traces of arsenic, lead, and copper, all in the state of sulphides. From the shape of the pots in which it has cooled it usually is in the form of blunt cones, which are of a blackish color externally, and when broken steel-gray, of a metallic lustre and a radiated crystalline texture, friable, soft, and leaving a black mark upon harder bodies. Its specific gravity varies between 4.6 and 4.7, it being but little lighter than black oxide of manganese, from which it is readily distinguished by the ready fusibility of splinters of antimony sulphide when held in the flame of a candle. It is inodorous and tasteless, and insoluble in simple solvents. At a temperature below a red heat it fuses to a dark brown liquid. It is frequently seen as a heavy black or grayish-black and somewhat shining powder. This, "when boiled with 10 parts of hydrochloric acid, dissolves without leaving more than 1 per cent. of residue. The solution, completely deprived of hydrogen sulphide by boiling, when added to water gives a white precipitate which is soluble in a solution of tartaric acid. After separation of the precipitate by filtration the filtrate gives an orange-red precipitate with hydrogen sulphide test-solution."—*U. S.*

Purification.—Antimonii sulphidum purificatum, *U. S.*; Antimonium nigrum purificatum, *Br.*; Purified antimony trisulphide, Purified black antimony, *E.*—Sulfure d'antimoine depuré, *Fr.*; Gereinigtes Schwefelantimon, *G.*—Antimony sulphide 100 Gm.; Ammonia Water 50 Cc.; Water a sufficient quantity. Reduce the antimony sulphide to a very fine powder. Separate the coarser particles by elutriation, and, when the finely-divided sulphide has been deposited, pour off the water, add the ammonia-water, and macerate for five days, agitating the mixture frequently. Then let the powder settle, pour off the ammonia water, and wash the residue by repeated affusion and decantation of water. Finally, dry the product by the aid of heat.—*U. S.* The Br. P. process is identical with this.

Similar processes have been long in use with the object of freeing antimonous sulphide from arsenic; but it has long since been proven that antimonous sulphide is likewise dissolved to a large extent; and Garot has shown that the ammoniacal liquid, when evaporated, leaves a red residue which contains very little arsenic. Arsenous sulphide is, however, freely soluble in *ammonium carbonate*, which dissolves but little antimonous sulphide. The process devised by Hager is as follows: Mix in a high vessel 1000 parts of levigated antimony sulphide with 100 parts of ammonia-water, sp. gr. .960, and sufficient warm water to permit the mixture being readily stirred; digest for a day at between 30° and 40° C. (86° and 104° F.), add 50 parts of official ammonium carbonate, again digest with frequent agitation for forty-eight hours, then dilute with water, and wash thoroughly. It forms a dark-gray or grayish-black lustreless powder having the properties mentioned above.

Tests.—Commercial antimony sulphide is sometimes adulterated with coal-dust, or mixtures of powdered coal and chalk are sold in place of it. The latter effervesce briskly with dilute hydrochloric acid, forming a solution containing calcium chloride. "If 2 Gm. of the salt be mixed and cautiously ignited in a porcelain crucible with 8 Gm. of pure sodium nitrate, and the fused mass boiled with 25 Cc. of water, there will remain a residue which should be white or nearly so, and not yellowish nor brownish (absence of other metallic sulphides). On boiling the filtrate with an excess of nitric acid until no more nitrous vapors are evolved, then dissolving in it 0.1 Gm. of silver nitrate, filtering again if neces-

sary, and cautiously pouring a few drops of water of ammonia on top, not more than a white cloud, but no red nor reddish precipitate, should appear at the line of contact of the two liquids (absence of more than about 0.1 per cent. of arsenic)."—*U. S.*

Pharmaceutical Uses.—Antimony trisulphide, being the commonest and cheapest antimony ore, is employed for preparing the metal and as the source of all compounds of antimony.

Action and Uses.—Sulphide of antimony is seldom employed in medicine. It was formerly prescribed along with drastic cathartics in the *dose* of Gm. 6.30–1.00 (gr. v–xv).

ANTIMONIUM SULPHURATUM, *U. S., Br.*—Sulphurated Antimony.

Antimonii oxysulphuretum (Lond.); *Antimonii sulphuretum aureum* (Edinb.); *Antimonii sulphuretum præcipitatum* (Dubl.), Br.—*Kermes mineral*, E.; *Sulfure d'antimoine précipité*, Fr.; *Gefälltes Schwefelantimon*, G.; *Sulfuro de antimonio hidratado*, Sp.

Chiefly antimonous sulphide (Sb_2S_3; 335.14), with a very small amount of antimonous oxide.—*U. S.*

Origin.—Both antimonial kermes and golden sulphur appear to have been first obtained by Basilius Valentinus in the fifteenth century. The latter was called *sulphur auratum* by Quercetanus (1603). The former was prepared by Glauber by dissolving black antimony in potash and cooling, and was lauded by Simon (1719) under the name of *alkermes minerale*. Numerous processes for obtaining these preparations have been published, nearly all of them resulting in mixtures of one or both sulphides of antimony with more or less antimonous oxide. The U. S. and Br. Pharmacopœias now recognize a nearly pure Sb_2S_3, which, from the synonyms given by the Br. Phar. of 1867, may also be dispensed as golden sulphur. The German Pharmacopœia recognizes only pure Sb_2S_5.

Preparation.—Purified Antimony Sulphide in very fine powder 100 Gm.; Solution of Soda 1200 Cc.; Distilled Water, Diluted Sulphuric Acid, each a sufficient quantity. Mix the antimony sulphide with the solution of soda and 3000 Cc. of distilled water, and boil the mixture over a gentle fire for two hours, constantly stirring, and occasionally adding distilled water, so as to preserve the same measure. Strain the liquid immediately through a double muslin strainer, and drop into it, while yet hot, diluted sulphuric acid so long as it produces a precipitate. Wash the precipitate with hot distilled water until the washings are at most but very slightly clouded by test-solution of barium chloride, then dry the precipitate and rub it to a fine powder.—*U. S.* If avoirdupois weight be used, 3⅓ oz. of antimony sulphide will require 40½ fluidounces of solution of soda and 6½ pints of distilled water.

The British Pharmacopœia follows a similar process, but employs a weaker soda solution and a larger amount of antimony sulphide, the proportion being 4½ Imperial pints of the former to 10 ounces of the latter, mixed with 10 ounces of sublimed sulphur.

Amorphous antimony sulphide dissolves readily in cold alkaline liquids, but for effecting the solution of the crystalline sulphide the application of heat is required. The solution contains both sulphantimonite and antimonite of the alkali, the formation of which is seen from the following equation: $Sb_2S_3 + 4NaOH = NaSbO_2$ (meta-antimonite) $+ Na_3SbS_3$ (ortho-sulphantimonite). On adding sulphuric acid both the compounds named are decomposed and, antimonous sulphide is precipitated without the evolution of hydrogen sulphide: $NaSbO_2 + Na_3SbS_3 + 2H_2SO_4 = Sb_2S_3 + 2Na_2SO_4 + 2H_2O$. The precipitate, however, is likely to retain a portion of undecomposed antimonite, which, if remaining in the hot acidulated liquid, is gradually decomposed; to ensure this decomposition, Liebig suggested to pour the hot alkaline solution into an excess of diluted sulphuric acid and to boil the moist precipitate with a fresh portion of such acid.

1 part of sodium hydroxide is theoretically able to form sodium antimonite and sulphantimonite with 4.2 parts of Sb_2S_3. In practice, however, a much smaller amount of the sulphide should be used, the pharmacopœias ordering 1.66 (*U. S.*) and 2.55 (*Br.*) parts. Using larger proportions would result in the formation of sodium sulphantimonate and antimonate, and finally of antimonic sulphide, Sb_2S_5. The reaction is likewise influenced by the concentration of the alkaline liquid and by its exposure to air. The adopted processes should therefore be strictly followed in order to obtain as nearly as possible uniform results.

Properties and Tests.—Sulphurated antimony is a reddish-brown (orange-red,

Br.) powder, without odor and taste, and insoluble in water and other simple solvents. Heated in a dry test-tube, it emits moisture and leaves a black residue. When heated with ten times its weight of official hydrochloric acid it is nearly all dissolved, with evolution of hydrogen sulphide. The residue, after having been washed and dried, burns with the characters of sulphur and leaves a scanty ash. The solution in hydrochloric acid, when added to water, deposits a white powder. The liquid filtered from this powder yields an orange-red precipitate with hydrogen sulphide. Water in which the preparation has been boiled should not yield a white precipitate with ammonium oxalate. A mixture of 1 part of sulphurated antimony and 20 parts of hot water, well shaken, should yield a filtrate which is neutral to test-paper, and which should not be rendered more than slightly opalescent by barium chloride test-solution (limit of sulphate) or silver nitrate test-solution (limit of chloride) (*U. S.*). The limit allowed by the Pharmacopœia for arsenic is the same as prescribed in the case of purified black antimony. (See page 223.) The precipitate which falls when a solution of 60 grains of sulphurated antimony in sufficient hydrochloric acid is dropped into water should, after washing and drying, weigh not less than 51 grains, or 85 per cent. (*U. S.*). Boiled in water with acid potassium tartrate, the resulting solution is precipitated orange-red with hydrogen sulphide, thus showing the presence of antimonous oxide. Oxidized with nitric acid, 60 grains give a white residue of 40 grains (*Br.*).

Allied Compounds.—1. ANTIMONII OXYSULPHURETUM, *U. S.* 1870.—Stibium sulfuratum rubeum, *P. G.* 1872; Sulphur stibiatum rubeum, Kermes minerale, Alkermes aurificum minerale.—Oxysulphuret of antimony, Kermes mineral, *E.;* Sulfure d'antimoine hydraté, Kermés minéral, Poudre des Chartreux, *Fr.;* Mineralkermes, *G.*

The name "Kermes mineral" is now applied by the U. S. Ph. to the official sulphurated antimony. (See above.)

Composition, a mixture of Sb_2S_3 and Sb_2O_3.

This was prepared by boiling for one hour 1 part of black antimony with 250 parts of water containing 23 parts of sodium carbonate, filtering and cooling; after twenty-four hours the precipitate was collected, washed with cold water previously boiled, and dried. The process was proposed by Cluzel, and received the prize of the Paris Pharmaceutical Society in 1806. The reaction is similar to that described above, except that carbon dioxide is given off. On cooling, a mixture of Sb_2S_3 and Sb_2O_3 is deposited, varying with the relative proportion of the sulphide and carbonate, and with the concentration of the liquid. The solution decanted from the precipitate, on being boiled with a fresh portion of antimonous sulphide, yields again a precipitate of similar appearance, but containing a much larger amount of oxide. Sonnenberg obtained by four successive boilings kermes containing 8, 33, 43, and 67 per cent. of antimonous oxide.

Oxysulphuret of antimony is a purplish-brown, tasteless powder, soft and velvety to the touch, wholly and readily soluble in hot hydrochloric acid, with evolution of hydrogen sulphide, and partly soluble in a hot solution of potassa, leaving a residue soluble in tartaric acid. On examination with the microscope it is found to be a mixture of amorphous globules of the sulphide with minute transparent prisms of antimony oxide, which latter is dissolved by solution of tartaric acid.

2. ANTIMONII PENTASULPHIDUM.—Antimonii sulphuretum aureum s. præcipitatum, Stibium sulfuratum aurantiacum, *P. G.;* Sulphur stibiatum aurantiacum, Sulphur auratum antimonii.—Antimonic sulphide, Golden sulphuret of antimony, Golden sulphur, *E.;* Soufre doré d'antimoine, *F.;* Goldschwefel, Sulfaurat, *G.*

This was originally prepared by precipitating an aqueous solution of liver of antimony (see ANTIMONII OXIDUM) with an acid, and contained, besides Sb_2S_5, also variable amounts of Sb_2S_3 and Sb_2O_3. Instead of such mixtures the German and other pharmacopœias now recognize the pure antimonial sulphide, which is prepared as follows:

A solution of 70 parts of crystallized sodium carbonate in 250 parts of water is boiled, and mixed with milk of lime containing 26 parts of lime and 80 parts of water. 36 parts of levigated antimony sulphide and 7 parts of sublimed sulphur are added, and the whole boiled until the gray color has disappeared, when the liquid is filtered and crystallized. 24 parts of these crystals, which, from the discoverer Schlippe (1821), are known as *Schlippe's salt*, and have the composition $Na_3SbS_4 + 9H_2O$, are dissolved in 700 parts of water, and added to a mixture of 9 parts of sulphuric acid and 200 parts of water. The precipitate, having the composition Sb_2S_5, is washed and dried. The reactions involved in this process may be illustrated by the following equations: (1) $4Sb_2S_3 + 9(Na_2CO_3 10H_2O) + S_8 + 9CaO = 5(Na_3SbS_4 9H_2O) + 3(NaSbO_3) + 9CaCO_3 + 45H_2O$. (2) $2(Na_3SbS_4 9H_2O) + 3H_2SO_4 = Sb_2S_5 + 3(Na_2SO_4) + 3H_2S + 18H_2O$.

It is an orange-colored, inodorous, and tasteless powder, which on being slowly heated in a test-tube, gives a sublimate of sulphur, leaving a residue of black antimonous sulphide; at a red heat it is completely volatilized.

The absence of arsenic is indicated if 1 part of the powder be boiled with 100 parts of water to 10 parts, when cool filtered and evaporated to 1 part, the addition of 3 parts of stannous chloride solution not causing any coloration within one hour. The limits of sulphate and

chloride are tested for by adding silver nitrate and barium nitrate solutions respectively to water which has been shaken with the powder; no turbidity should occur immediately.—*P. G.*

Action and Uses.—Sulphurated antimony and the oxysulphuret have essentially the same medicinal properties, and may be prescribed in the same doses. The former is very rarely employed, and kermes mineral, although it does not differ essentially from other antimonials in its action, is generally described as being "alterative, diaphoretic, and emetic." Its dose as an alterative may be stated to be Gm. 0.05–0.10 (gr. j–ij) twice a day, and as an emetic from Gm. 0.30–1.20 (gr. v–xx).

ANTIPYRINUM, *P. G.*—Antipyrine.

Phenazonum, Br. Add.; *Phenazone*, *Methozine*, *Analgesine*, *Dimethyl-phenylpyrazolon*, *Dehydrodimethyl-phenylpyrazine*, E.; *Antipyrine*, *Anodynine*, *Parodyne*, Fr.; *Antipyrin*, G.; *Antipirina*, F. It.

Formula $C_6H_5N.CO.CH.NCH_3.CCH_3 = C_{11}H_{12}N_2O$. Molecular weight 187.65.

Origin and Preparation.—Antipyrine was first prepared by L. Knorr (1883), and afterward introduced to the medical profession by Filehne. When aniline hydrochloride or sulphate is treated with sodium nitrite, diazobenzene hydrochloride or sulphate will be formed, and if this salt be further treated with reducing reagents (alkali sulphite and stannous chloride), the corresponding salt of phenylhydrazine will be obtained; from this the base phenylhydrazine, $C_6H_5HN.NH_2$, is set free by means of caustic soda. By acting on phenylhydrazine in the cold with di-acetic ether, Knorr obtained phenylhydrazine di-acetic ether, with elimination of water, the former an oily liquid, which when heated to 100° C. parts with the elements of alcohol and is converted into phenylmethylpyrazolon (formerly called methyloxychinizin). Its formula is $C_{10}H_{10}N_2O$, containing still 1 atom of displaceable hydrogen; it possesses both acid and basic properties, but loses the former when heated with methyl iodide in the presence of methylic alcohol, and is converted into phenyldimethyl pyrazolon iodide. The mass is next decolorized by boiling with sulphurous acid solution, the alcohol is distilled off, and on the addition of strong solution of soda the base is separated as a heavy oil, and recrystallized from toluene or ether.

Recently (1891) a new process has been patented for manufacturing antipyrine under the name of dehydrodimethylphenylpyrazine. It consists of three successive operations, as follows: 1st. Equivalent quantities of a compound ether, containing beta-bromo or chlorobutyric acid, and of phenylhydrazine, are dissolved, the solution being rendered slightly alkaline, and then gently heated on a steam-bath until the odor of the compound ether has disappeared. On pouring the product into water methylphenylpyrazine separates. 2d. The dried product is dissolved in benzene, and then shaken with some slow oxidizing agent, such as mercuric oxide. The result is dehydromethylphenylpyrazine. 3d. This product is finally dissolved in methylic alcohol, and heated with methyl iodide to 100° C., which results in the formation of dehydrodimethylphenylpyrazine or antipyrine. (Compare above.) Still more recently (1892), Knorr and Duden have announced that antipyrine may also be produced by heating a mixture of equal molecules of crotonic acid and phenylhydrazine in an oil-bath to 115° C.; as the reaction slackens the heat is gradually increased to 160° C., where it is kept until a sample of the mass when rubbed with a glass rod solidifies. The new body, phenylmethylpyrazolidone, is then further treated with oxidizing agents to convert it into phenylmethylpyrazolon, from which antipyrine is prepared as stated above.

Properties.—Antipyrine crystallizes readily in laminæ, or from water in rhombic prisms. The commercial article is a voluminous crystalline white or whitish powder; it is almost inodorous, and has a mild bitter taste. At 15° C. (59° F.) it dissolves in about two-thirds its weight of water, in about 1 part of alcohol or chloroform, and in about 50 parts of ether, and is freely soluble in benzene, but slightly soluble in benzin. The aqueous solution yields precipitates with basic lead acetate, mercuric chloride, and most reagents for alkaloids, and reduces Fehling's solution. 2 Cc. of a 1 per cent. solution acquire with 2 drops of fuming nitric acid a green color, changing to red on the addition of another drop of the acid to the previously boiled liquid. One drop of ferric chloride solution, added to 2 Cc. of a $\frac{1}{10}$th per cent. solution of antipyrine, causes a deep-red color, changing to pale yellow on the addition of 10 drops of sulphuric acid. The solution of antipyrine in water should have a neutral reaction, should be colorless, should not have an acrid taste, and should not be affected by hydrogen sulphide. It should volatilize completely when heated—*P. G.* On the addition of nitrous acid or nitroso-nitric acid to

a cold concentrated aqueous solution of antipyrine, green crystals are separated. Antipyrine melts at 113° C. (235.4° F.), and when further heated turns red, then brown, and acquires an empyreumatic odor resembling oil of amber, the residue being soluble in alcohol, and with a red color in chloroform. Antipyrine dissolved in wine causes the gradual precipitation of the coloring-matter from the latter. Syrup, or a fruit syrup with an aromatic spirit, has been found to be a suitable adjuvant for the solution. The powder as well as the solution should be carefully protected from contact with iron compounds.

Acetanilid has been found mixed with antipyrine; its detection is easy, for although both compounds have approximate melting-points (113° C.) a mixture of equal parts melts at 45° C. (113° F.) (Helbing). Antipyrine is a well-characterized base, and forms salts with the acids by direct addition. Many drugs have been found incompatible with it, among which may be mentioned sodium bicarbonate and salicylate in solid form, chloral hydrate and croton chloral hydrate, hydrocyanic acid, spirit of nitrous ether, and all acid nitrites in solution, tinctures containing tannin, etc.

Composition.—Antipyrine is phenyldimethylpyrazolon, and has the formula $C_{11}H_{12}N_2O$. It is isomeric with methyl derivatives of tolylhydrazines, which, however, have an acid character. These compounds were discovered by Knorr (*Berichte d. Chem. Ges.*, 1884, pp. 546, 2032).

Allied Compounds.—*Agathin* (salicylaldehyde-alpha methylphenylhydrazone). It is prepared by direct union of salicyl-aldehyde with alpha-methylphenylhydrazine, and occurs in small faintly green plate-like crystals, without odor and taste and insoluble in water.

Antithermin.—This name was given by Nicot (1887) to a compound which he obtained as a white precipitate upon mixing an acetic-acid solution of 108 parts of phenylhydrazine with an aqueous solution of 116 parts of levulinic acid. The precipitate is dissolved in boiling water, decolorized with animal charcoal, and crystallized. Antithermin occurs in shining, colorless crystals, with a very faint taste and sparingly soluble in cold water or alcohol. Its aqueous solution is neutral. It melts at 108°C. (226.4° F.), and if heated to 170° C. (338° F.) is converted into phenylhydrazine levulinic anhydride ($C_{11}H_{12}N_2O$). Little is known regarding its effects and proper dosage.

Derivatives of Antipyrine.—*Benzopyrine* or antipyrine benzoate. According to S. Cressati, this compound is obtained when antipyrine is added to a boiling solution of benzoic acid; it melts below the boiling-point of water, forming a yellow liquid which solidifies to an opaque crystalline mass. It is almost insoluble in hot or cold water, but quite soluble in alcohol or ether.

Iodopyrine.—When a hot solution of 1 equivalent of iodine in 12 parts of alcohol is mixed with a solution of 1 equivalent of antipyrine in 4 parts of alcohol, the mixture after several days will separate crystals of iodopyrine (Duroy's patent), which consist of colorless silky needles, only slightly soluble in water and practically free from odor and taste. Antipyrine di-iodide is obtained if 2 equivalents of iodine be used instead of 1. Iodopyrine melts at 160° C. (320° F.), and is readily soluble in hot water.

Phenopyrine, an oily, colorless, inodorous liquid, crystallizing after a time; it is insoluble in cold water. It is obtained by triturating together equal parts of pure and well-dried phenol (carbolic acid) and antipyrine.

Picropyrine occurs in fine yellow needles, and may be obtained by adding a concentrated solution of antipyrine drop by drop to a concentrated aqueous solution of picric acid, and recrystallizing the precipitate from boiling water.

Naphtopyrine and *Pyrogallopyrine* are obtained when antipyrine is triturated with twice its weight of beta-naphtol and pyrogallol respectively; both are insoluble in cold water, but soluble in alcohol and ether, and to some extent in boiling water. By mixing solutions of antipyrine and pyrogallol beautiful prismatic crystals may be obtained after four or five hours.

Salipyrine, or antipyrine salicylate, has been more extensively employed than any other salt of the base. It may be prepared by heating antipyrine and salicylic acid together in molecular proportions, with or without water, on a steam-bath; the mixture melts to an oily liquid, which upon cooling solidifies, and is recrystallized from alcohol. Another method is to shake together an aqueous solution of antipyrine and an ethereal solution of salicylic acid; the compound will separate slowly in the form of handsome crystals, being practically insoluble in water and only with difficulty in ether. Salipyrine melts at 91.5° C. (196.7° F.), and is readily soluble in alcohol and in benzene. The solutions manifest a faintly acid reaction and a sweet taste, which is bitter afterward. It has been used with good results in sciatica, epidemic influenza, and acute and chronic rheumatism; its advantages over antipyrine are claimed to be freedom from cardiac influence and unpleasant after-effects. The usual dose is 15 grains at intervals of one-quarter to one hour until 2 drachms have been taken in cases of articular rheumatism; 8 grains is often sufficient to arrest neuralgia; it is administered either in powder form or mixtures. (The reaction between sodium salicylate and antipyrine, thought to be due to chemical change, is simply due to deliquescence.)

Action and Uses.—Neudörfer asserts that antipyrin is antiseptic, preventing

putrefaction and destroying bacteria; also that it not only is anodyne, but that it neither irritates the skin nor corrodes steel instruments. When antipyrin was first introduced little allusion was made to the vomiting it is apt to occasion. But afterward depression verging on collapse, with coldness, profuse sweating, irregular pulse, feeble voice, and vomiting, especially in females, were found to be ordinary consequences of what were then held to be efficient doses. To counteract them, cordial and nervine stimulants were administered. It often happened that the pulse and temperature did not fall in an equal ratio, and sometimes, indeed, the pulse-rate was increased instead of being slightly lowered, as it usually is. In healthy persons the temperature is but little if at all reduced by antipyrin; but in fever it begins to decline soon after the medicine is administered, and its subsidence is most marked within from four to six hours after the administration of Gm. 1 (15 grains), and by a repetition of the dose or the administration of a smaller one may be prevented from rising again. It appears that in children the sedative action on the pulse is insignificant. In all cases sweating is apt to be provoked by an excessive dose. Antipyrin is eliminated slightly with the milk and largely with the urine, but it does not irritate the urinary tract. According to Jacubowitsch, the quantity of urea, sodium chloride, and acids is notably diminished in children, and sometimes the urine itself is so to the extent of one-half. These conclusions were confirmed by Robin and by Elvey. In many cases antipyrin produces an erythematous, measly eruption upon the trunk and limbs. It has been described as consisting of "irregularly rounded pimples lying close together and forming patches," and followed by a slight desquamation. It is symmetrical, lasts about five days, abounds most on the extensor surface, and may present a few vesicles, and occasion itching. In some cases blebs and bloody vesicles have occurred. Its contact with the teeth discolors them. Among the occasional effects of antipyrin the following may be noted: Laache (*Centralbl. f. d. g. Ther.*, iv. 453) observed, along with the exanthem, a burning sensation in the mouth and throat, and coryza; Umbach saw analogous effects in healthy persons (*Arch. f. exp. Pathol.*, xxi. 1886); and Sturge likewise, with the addition of a sense of suffocation, violent cough, ringing in the ears, and a copperish taste in the mouth (*Brit. Med. Jour.*, Feb. 4, 1888). Bernouilli relates an analogous case (*Deutsche Med. Zeit.*, Nov. 24, 1887). According to Jaksch, antipyrin tends to render eruptions hæmorrhagic (*Boston Med. and Surg. Jour.*, Oct. 1888, p. 357). Sometimes the skin becomes cyanotic, and in one case 75 grains are said to have occasioned gastro-enteritis and mental hebetude. In typhoid fever, epistaxis, purpura, and death have been charged to it, and in presumed kidney disease fatal eclampsia. In the case of a woman who took an ounce of antipyrin at one dose, insensibility of fourteen hours' duration ensued. Sometimes poisoning has been caused by doses of 7 and even 3½ grains (*Med. News*, li. 166. (See also *Med. Record*, xxxi. 95; xxxiii. 14; *Med. News*, lii. 32; *Therap. Gaz.*, xii. 283; *Gaz. Hebdom.*, Mar. 23, 1888; *Bull. de Thérap.*, cxv. 134; *Practitioner*, xl. 375; *Brit. Med. Jour.*, June 15, 1889). Henderson (*Med. Record*, xxxi. 95) has reported two cases of poisoning by antipyrin, one of which was fatal, and it is stated (*Lancet*, Jan. 1890, p. 35) that in Vienna seventeen deaths from arrest of the heart were attributed to this medicine. Whitehouse (*ibid.*, xxxii. 706) mentions one which, besides the usual symptoms, was attended with excruciating gastric pains; and Huchard (*Centralb. f. d. g. Ther.*, v. 695) a case of hyperpyrexial typhoid fever in which the temperature was not lowered, but raised. Among the less frequent untoward effects may be enumerated diarrhœa, dysury, vomiting, sopor, convulsions, paralysis, dyspnœa, swelling of the mouth and fauces and diphtherial exudation, and severe and general neuralgia. (Compare *Lancet*, Feb. 1888, p. 364; *Jour. Amer. Med. Assoc.*, xiii. 922; *Med. News*, liv. 461; *Therap. Monatsh.*, iii. 385; *Lancet*, Aug. 1889, p. 813; *ibid.*, Jan. 1890, p. 35; *British Med. Jour.*, June 15, 1889; *Med. Record*, xxxvii. 409. See also Drasche, *Centralb. f. Therap.*, vii. 19; Schwabe, *ibid.*, viii. 552; Falk, *Therap. Monatsh.*, iv. 97, 151.) On the other hand, excessive doses have sometimes been taken without serious injury, as in the case of a woman suffering from osteoscopic pains, who in five days consumed 1½ ounces of the preparation. She became cyanotic and her legs were swollen (*Therap. Gaz.*, xii. 684). Also the case of a man who recovered after taking Gm. 8 (℥ij) of antipyrin (*Centralb. f. Therap.*, viii. 134).

We have on many occasions protested against the use of merely antithermic medicines in the treatment of fevers. The study of antipyrin offers an occasion for renewing the protest, and declaring that the reduction of temperature in healthy animals by poisons affords no warrant for employing such poisons in treating the fevers of human beings. The conditions in the two cases are neither identical nor analogous. All anti-

thermic agents agree in demonstrating that behind its high temperature each febrile disease presents a specific element, be it a definite morbid poison, an alteration of the constitution of the blood, or some change in the solid tissues. The fever of phthisis, for instance, has a different nature from that of malarial fever, and the fevers of both these from that of an acute exanthem. To lower the temperature merely, even if it were possible at will to reduce it to the normal degree, is therefore a very different thing from removing the cause upon which the fever depends. But a true cure involves the latter. Huchard, and after him Arduin, have insisted that a high temperature alone does not call for antipyretic interference, and that a temperature which is essentially normal in one disease is excessive in another, but only to such an extent as it exceeds the ordinary temperature in that disease. The tendency to heart-failure in all protracted febrile diseases, and the special liability to this accident in tender age, are additional and special reasons against the use of this class of medicines. The worst mischiefs of antipyretics are due to a disregard of such laws and precepts. These views and conclusions both experiment and clinical observation have increasingly supported. They have shown that antipyrin and its congeners retain in the blood the very morbid agents which the febrile process in the course of nature tends to eliminate, and that the extent of their advantage consists in palliating the functional disturbances, such as insomnia and delirium, and lowering the temperature in many cases. They neither reduce the mortality nor abridge the course nor lessen the complications of acute frebrile diseases, and they offer no advantages which are not attainable by remedies more naturally adapted to fevers, among which cold water by ablution or in baths is the most powerful as well as the most efficient when skilfully applied in suitable cases; that is, when a high febrile temperature involves danger to the life of persons of average robustness, and that not, as we have elsewhere insisted, merely by extracting caloric from the body, but by powerfully stimulating all the functions, including those of the heart and eliminating glands. In this connection it should not be overlooked that antipyrin and its congeners, by lowering the animal temperature in persons exposed to atmospheric influences, may render them more liable to be chilled. Antipyrin has been compared with other agents of the same class. Huchard has pointed out the following contrasts: Quinine is transient in its action; salicylic acid and its salts are uncertain, and, if hæmorrhage already exists, are apt to increase it; carbolic acid causes sweating, pulmonary congestion, and collapse; resorcin does not moderate hectic fever; it causes vertigo and auditory disorder, and but slightly modifies the temperature in typhoid fever; while kairin, although inducing a transient subsidence of fever, also occasions profuse sweat and chills, and, indeed, acts only after having brought about serious blood-lesions (*Bull. de Thérap.*, cvii. 511). This is a succinct and emphatic condemnation of the antithermic agents enumerated, but it is nearly as applicable in degree, and quite as much so in kind, to antipyrin. (See W. H. Porter, *Med. Record*, xxxiv. 87.) If, too, kairin is to be rejected because it induces sweating, then antipyrin is quite as open to the same objection, for Frankenberg relates a case in which the loss of weight in this way amounted to a pound and a quarter in two hours; and yet it is in the hectic fever of phthisis that antipyrin is emphatically recommended, even while the advice is given that its tendency to promote sweating should be combated with atropine or agaricine!

Typhoid fever has been extensively treated by means of antipyrin. It moderates delirium and dryness of tongue in proportion as it reduces the temperature, whether the pulse-rate fall or not. It also palliates the restlessness, wakefulness, and excitement. But it does not shorten the course or lessen the mortality of the disease. Indeed, relapses seem to increase under its use. The main indication for it in this as in other febrile diseases is hyperpyrexia, and hence the necessity for it cannot be very frequent. It has been noted that in these affections the urea and the sulphates and the water diminish in the urine under its use, and for this reason some leading clinicians reject antipyrin absolutely. The best clinicians do not employ it. Dujardin-Beaumetz declared that it in no way modifies the gravity of the disease or lessens the nervous symptoms (*Bull. de Thérap.*, cxiii. 496); Robin found that by reducing elimination and depressing the nervous system it is unsafe in typhoid fever (*Archives gén.*, Jan. 1888, p. 21); Guitéras concluded that it has no power to control the disease (*Therap. Gaz.*, xi. 462); and its use in typhoid fever is generally abandoned. In *intermittent fever* antipyrin is valueless, notwithstanding the plausible reasons assigned for its use. It has been used with alleged advantage in the treatment of *puerperal metro-peritonitis*, but the cases published to illustrate its virtues did not sustain the claim, and it is now abandoned. In *pneumonia* it seems to have been less injurious than its action upon the heart would lead one to appre-

hend. It reduces the pulse-rate and temperature, and has been thought sometimes to bring about a critical sweat. But on the duration and mortality of pneumonia it exerts no favorable influence. Indeed, Posadski, who treated two series of cases, the one with antipyrin and the other with calomel, concluded that the latter was the superior remedy, in that it was followed by an earlier recovery. Moreover, of the 25 patients treated with antipyrin, no less than 5 suffered collapse, and 4 vomiting; 2 presented the specific eruption, and 11 the characteristic dark-red urine. These patients lost weight more than those of the parallel series, and their convalescence was slower (*Centralblatt f. Therapie*, iv. 495). Its virtues in the hectic fever of *phthisis* have been highly lauded; but experience has shown that only moderate doses of it should be used, such as Gm. 0.25–0.50 (gr. v–10) every hour or two. Sometimes, when the proper dose has been learned, the medicine renders more tolerable the sweats that beset the *consumptive* in the advanced stages of his disease. Beyond this it has no good influence. Longer experience has shown that whatever slight gain may attend its use in lessening fever and cough is more than counterbalanced by its tendency to cause prostration, nausea and vomiting, and profuse sweating. In acute articular *rheumatism* antipyrin has appeared to reduce the pain and swelling in the joints. Neumann inclined to admit it almost to an equality with salicylic acid and the salicylates (*Centralblatt f. d. g. Med.*, iii. 542), and even claimed efficiency for it in the treatment of chronic rheumatism and rheumatic neuralgia. Bamberger, whose authority is very high, expressly excludes antipyrin from the treatment of rheumatism (*Therapeut. Gaz.*, x. 277). But later on (1886) Eich found it equal to salicylic acid, as did also Golebiewski, Clément of Lyons, Bernheim (who, however, noted that it was more efficient in diffused than in fixed articular *rheumatism*, and held it to be a palliative only, and not specific), and Hirsch (*Centralbl. f. Med.*, vi. 724), who vaunted it chiefly in muscular rheumatism. Sarda extolled it in every variety of rheumatism for its relief of pain (*Bull. de Thérap.*, cxiv. 433), when given hypodermically, yet Tullio (*ibid.*, cxv. 236) accused the medicine of favoring complications by the sweating and debility it occasions. In *diphtheria* the natural tendency of the disease to syncope is increased by antipyrin. Demme reports the case of a boy in which its administration was followed by fluttering of the heart, dilated and fixed pupils, and spasms of the limbs. Some recorded cases seem to indicate that antipyrin may be found useful in *sunstroke* or "thermic fever," but not in heat-exhaustion. But it should be used cautiously, and by the hypodermic method. Even then it has been found inoperative (*Med. Record*, xxx. 344). Huchard, Henocque, and others ascribe *hæmostatic* virtues to antipyrin, which are also claimed for its internal as well as its topical use by Casati, who employed 5- and 6-per-cent. solutions. But the porous dressing on which it was applied suffices to explain its action locally; and of its hæmostatic virtues internally there is no sufficient proof.

The estimate we have expressed of the medicinal value of antipyrin in febrile diseases received stronger confirmation the longer the medicine was submitted to clinical tests. Reihlen's (*Deutches Archiv für klinische Medicin*, April, 1886) conclusion was that, except in reducing temperature, it exerted no favorable influence on any fever. Its analgesic or anodyne virtue is its most valuable quality.

Functional disorders of the nervous system afford the most profitable field for the use of antipyrin, especially those in which spasm or pain is present. It has been used, like potassium bromide, to counteract *insomnia* and acute *mania*, but with inferior results. Its use by Legroux in 1888, according to his reports, proved it to be one of the surest, safest, and quickest remedies for *chorea*. He began by giving 15 grs. daily in divided doses, and gradually raised the dose to 45 grains a day (*Annuaire de Thérap.*, 1888, p. 48). Dr. H. C. Wood, and also Simon, Grim, and Lilienfeld, have reported similar results, but with much smaller doses. In *epilepsy* it appears to have been useful when the paroxysm occurred about the menstrual period. Bokenham favored its use when there was a marked aura, and McLane Hamilton when the disease was purely functional. J. Leidy, Jr., found it beneficial in only 3 out of 36 cases. On the whole, therefore, it cannot inspire confidence. According to Mendel, it is more injurious than useful in *hysteria* (*Centralb. f. d. g. Ther.*, v. 515). In *spasmodic laryngitis* it appears to have resolved the spasm. Wendelband, and also Sonnenberger, among the first, found that it palliated the paroxysms of *whooping cough* and abridged the duration of the disease. For infants and children they prescribed doses from a fraction of a grain to 3 or 4 grains several times a day. Such results were also obtained by Griffith (*Therap. Gaz.*, xii. 84; *Med. News*, lvii. 624), Genser, (*Med. News*, lii. 576; liv. 241), and Dubousquet Laborderie (*Bull. de Thérap.*, cxiv. 385; *Bull. et Mém. Soc. Ther.*, 1889, p. 37; 1890, p. 91),

who gave from Gm. 0.30–1 (5 to 15 grs.) a day for infants under two years of age, and from Gm. 1–4 (15 to 60 grs.) for older persons, in divided doses. These results have in the main been confirmed, among others by Leubuscher and by Windelschmidt, who treated about 350 cases of the disease (*Centralb. f. Therap.*, viii. 49); but some have held it to be only a palliative, while still others (Loewe, *Therap. Monats.*, iii. 169; Schnirer, *ibid.*, iii. 377; Tuczeck, *Ann. de Ther.*, 1889, p. 298; Buisson, *Ther. Gaz.*, xiv. 288) have asserted that it acted poisonously, or, again, was quite inert. Beyond all doubt it lessens pain and reflex irritability or spasm, for it has been found efficient in mitigating the pains of *labor* and of *gravel*, of *dysmenorrhœa*, *migraine*, *otalgia*, *sciatica*, *tetanus*, and *locomotor ataxia*. Bruen used it advantageously in various forms of spasmodic *cough* (*University Med. Mag.*, i. 223). A case of *spasmodic asthma* cured by antipyrin has been reported by Dodge (*Therap. Gaz.*, xii. 262), and its efficacy in *hay fever* is claimed by Cheatham (*Med. Record.*, xxxii. 485). Analogy has suggested the use of antipyrin in *strychnine-poisoning*, and it is said to have been found useful in epidemic *cerebro-spinal meningitis* (*Jour. Amer. Med. Assoc.*, xi. 17). Doubtless by a similar sedative action it has been used with advantage in certain cases of *hallucination* of sight and hearing, and in *sun-stroke* of the congestive form; in *sea-sickness* when administered in advance in doses of about Gm. 0.65 (10 grs.) three times a day (*Med. News*, li. 711; *Med. Record*, xxxiv. 633); to suppress *the secretion of milk* (*Bull. de Thérap.*, cxiv. 554); to diminish *polyuria* of cerebral origin (*Bull. de la Soc. de Thérap.*, 1888, pp. 46, 62), though it does not control saccharine diabetes with equal certainty. It has been found to check nocturnal *seminal emissions* when given at bed-time in the dose of from Gm. 0.50–1 (gr. viij–xv) (*Med. Record*, xxxiii. 708). Sée ascribed partly to its sedative action on the heart the benefit he believed it to confer in cases of *aortic aneurism;* but it also assuaged the pains that often exist in such cases. He gave it along with potassium iodide (*Practitioner*, xli. 376).

Although early experimenters on animals perceived an anæsthetic virtue in antipyrin, no clinical use was made of this observation until the antipyretic uses of the medicine had been established. Then it was employed for the relief it gave in *migraine*, but its efficacy was attributed to its sedative, and not to its anodyne, virtues. One of the first to call attention to its use in *headache* was Dr. J. B. White (*Med. Record*, xxx. 293), and about the same time Ungar made similar observations (*Centralb. f. Therap.*, v. 18), which were confirmed by Mendel, (*ibid.*, v. 514), Sprimer (*Lond. Med. Gaz.*, Jan. 5, 1887), Robertson (*Med. Record*, xxxi. 517), Lyman (*Med. News*, l. 535), and many others. These or similar results were speedily generalized by Sée, who, with Gley, determined experimentally the analgesic virtues of the preparation, and showed clinically that it was an anodyne for nearly every form of pain, although it was most efficient in neuralgic pain (*Union Méd.*, Avr. 26, 1886). The series of cases noted include *gout*, *rheumatism* (articular and muscular), *rheumatoid arthritis*, *locomotor ataxia*, *angina pectoris*, *cancer*, *syphilitic pains* (*University Med. Mag.*, i. 106), *biliary and renal colic*, the *neuralgia of zona*, *dysmenorrhœa*, etc. (*Med. Record*, xxxiv. 477; *Med. News*, liii. 420; *Boston Med. and. Sury. Jour.*, Dec. 1887, p. 558; *Archives gén.*, Oct. 1887, p. 497); and the itching, burning, etc. of various *skin diseases* (*Practitioner*, xlii. 371; *Med. News*, lvii. 220). In general terms, neuralgia, and especially neuralgic headache, was most amenable to its influence, which in both its hypnotic and depressing powers seemed distinct (*Jour. Amer. Med. Assoc.*, xi. 196), even with very small doses such as 3 or 4 grains (Bokenham, *Practitioner*, xl. 99, 266). Its action is by no means uniform, however, and not a few observers seem to have missed it altogether (*Boston Med. and Surg. Jour.*, Dec. 1887, p. 560). In 1887, Sée suggested that the efficacy of the medicine depended wholly on its analgesic power (*Med. Record*, xxxii. 31), while others claimed its antipyretic action as a factor in the result (Davis, *Jour. Amer. Med. Asso.*, ix. 13; Bernheim and Simon, *Centralb. f. d. g. Med.*, v. 687), and Hamilton maintained its especial virtues in "angiospastic migraine" and other cases of cerebral excitement (*Therap. Gaz.*, xi. 485; Wright, *Med. Record.* xxxii. 814). But, as Ungar pointed out in 1886, its success or failure cannot be counted upon. In two successive attacks the same person may be greatly relieved or not at all benefited. Antipyrin, like other anæsthetics, relieves neuralgia without very definite regard to the cause producing it; yet it palliates the severe lancinating pains of locomotor ataxia and others of organic origin with more certainty than the pains of hysterical or nervous neuralgia (Sée; Suckling; Mendel). So, too, in *diseases of the eye* Kacovnrow, Post. Dujardin and others have observed that the pains most readily controlled by the medicine were due to material lesions (*Annuaire de Thérap.*, 1887, p. 88). On the other hand, Fischer met with the best results in functional neuralgia (*Med. News*, liii. 420).

Windelschmidt found that enemas containing antipyrin relieved *dysmenorrhœa*, and his observations have been confirmed (Dellenbaugh, *Med. Record*, xxxi. 379). Queirel relieved the pain of *parturition* by injections of 5 grains, repeated, if necessary, in two hours (*Archives gén.*, Avr. 1888, p. 489), while Laight, Chouppe (*British Med. Jour.*, Dec. 17, 1887), and others agree that it does not lessen the vigor of the expulsive action. Auvard and Lefébre, however, declare that in the majority of cases the medicine displays no such powers, and that it is not to be compared to chloral or chloroform in this respect. According to Milne, it relieves *after-pains* in the dose of 15 to 20 grains (*Med. Record*, xxxiii. 39). Miraschi (*Annuaire de Ther.*, 1890, p. 246) also found that it allayed *after-pains* (especially when caused by ergot), as well as the pains occuring during dilatation of the os uteri, but not the expulsive pains of labor. It palliates the pain of *dysmenorrhœa*, but without lessening the menstrual flow. Phillips has confirmed these and similar conclusions (*Lancet*, Sept. 1890, p. 605).

Applied locally, antipyrin in fine powder has been used to relieve the pain and promote the healing of *ulcers* (Bosse; Neudörfer), and the *hæmostatic* properties ascribed to it by Hénoque (*Annuaire de Thérap.*, 1888, p. 75), which were not confirmed by Glinsky (*Med. News*, lii. 695), are stated by Hinkel to be equal to those of cocaine when a solution of it is sprayed into the nostrils to control epistaxis (*ibid.*, liii. 473). Sée, Berdach, and others have found a 50 per cent. solution an efficient hypodermic analgesic.

Although nearly identical with antifebrin in the nature of its action, antipyrin is generally regarded as less eligible on account of the larger dose of it required and the untoward effects it is more liable to produce; nevertheless, the two agents are different in the degree rather than the nature of their operation, and even moderate doses of antifebrin have occasioned alarming symptoms. Dujardin-Beaumetz has pronounced it the most dangerous preparation of its class (*Bull. et Mém. Soc. Thérap.*, 1888, p. 204). Thallin, according to Johnson, has a less prolonged action than antipyrin, and is less apt to produce toxical effects (*Lancet*, Aug. 1886, p. 388). A discussion by the Association of American Physicians in 1888 showed that at that meeting the preponderance of opinion was distinctly on the side of antifebrin.

Doses of antipyrin of Gm. 5–6 (gr lxxv–xc) a day, advised by some, or of Gm. 1–5 (gr. xv–lxxv), by later authorities, are seldom given at the present time. In articular rheumatism Gm. 1–1.30 (gr. 15–20) every 4 or 6 hours need not be exceeded. Mendel gave Gm. 2 (gr. xxx) four times a day in a severe case of articular rheumatism, but it caused great depression and gastric disturbance. For infants the dose should not exceed 2 or 3 grains. Smaller doses than the above should be used to procure the anodyne or hypnotic action of the medicine—*e. g.* Gm. 0.30–0.60 (gr. v–x) every hour or half hour. It may be given in an aromatic water, or in coffee with milk and sugar, or in a wafer. By enema it is thought by some to act as well as by the mouth, but others condemn the method as inefficient. Suppositories containing from Gm. 0.50–1 (gr. viii–xv) have been employed. For hypodermic administration a solution containing equal parts, by weight, of water and antipyrin (of each about 5 grs. (Gm. 0.30)) has generally been used for a single dose. Hirsch advises the addition of a small proportion of glycerin. According to him, the hypodermic is the most eligible method (*Centrabl. f. d. g. Ther.*, vi. 724), but a number of reporters relate that it causes excessive pain and hæmorrhagic infarctions, abscesses, or sloughing (Bach, *Therap. Gaz.*, Nov. 1889, p. 747; Hess, *Centrabl. f. Ther.*, vii. 85; Dujardin-Beaumetz, *Bull. de Ther.*, cxvii. 343). These effects are said to be diminished when the puncture is made deeply, and also by mixing with the injection a solution of cocaine or using the latter in advance. In case of threatening collapse alcoholic stimuli and hypodermic injections of atropine may be employed.

AGATHIN is reported to be useful in *neuralgia* and *rheumatism* when it is given in doses of Gm. 0.50 (gr. viii) three times a day, and to occasion no bad symptoms.

ANTITHERMIN, as its name implies, is used as an antipyretic, and in the dose of about Gm. 0.30 (gr. v).

IODOPYRIN, like most of its congeners, reduces febrile heat without modifying the course of any febrile disease. It sometimes occasions profuse sweating. Dose, Gm. 0.06–0.30 (gr. i–v).

APOCYNUM, *U. S.*—Apocynum.

Canadian Hemp, E.; *Chanvre du Canada*, Fr.; *Canadische Hanfwurzel*, G.

The root of Apocynum cannabinum, *Linné.*

Nat. Ord.—Apocynaceæ. Echitideæ.

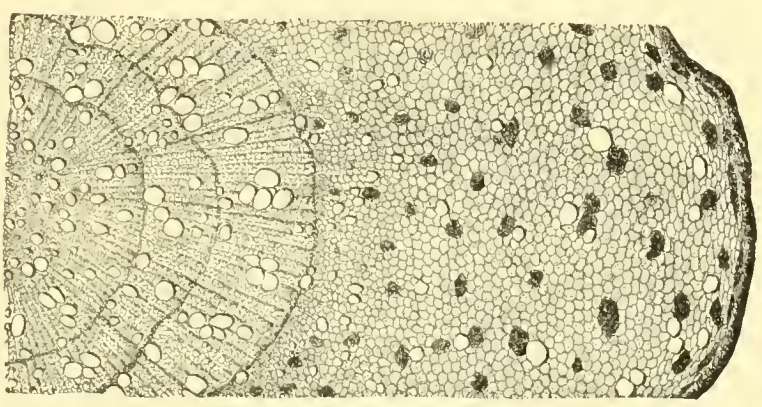
Origin.—This perennial herb grows in fields and grassy places and on the border of woods throughout a large portion of the North American continent from Florida northward. The smooth often purplish stem is about 1 M. (40 inches) high, has rather erect branches, opposite oblong or linear-oblong acute and mucronate leaves and many-flowered cymes, the corolla being greenish-white or reddish, having five erect lobes and a tube of the length of the calyx; the fruit consists of a pair of slender follicles containing numerous narrow silky-tufted seeds. All parts of the plant, which flowers in July and August, contain a white adhesive milk-juice. Its popular name of *Indian hemp* refers to the strong fibres of the stem-bark, which somewhat resemble the bast-fibres of hemp.

Description.—The root is horizontal, several feet long, 6 to 12 Mm. ($\frac{1}{4}$ to $\frac{1}{2}$ inch) thick, slightly branched and beset with a very few fibres; when dry, longitudinally wrinkled, and the thinner portions somewhat annulated by deep transverse fissures. It has a brownish-gray or pale-brown color externally, and under the thin corky layer a fleshy whitish bark, which is about as thick as the woody layer, contains laticiferous vessels, and encloses a yellowish or whitish porous wood composed of several rings and finely radiate by medullary rays; in the centre is a thin pith. The root breaks with a short fracture, is inodorous, and the wood tasteless, but the bark, which constitutes about 60 per cent. of the drug, develops gradually a very persistent bitter and rather disagreeable taste; its parenchyma-cells are filled with starch. It is usually mixed with the lower portion of the stem, which has a smoother and tougher bark and harder wood, the latter enclosing a larger pith.

Constituents.—The earlier analyses of Dr. Knapp and Dr. Griscom (1833) proved the presence of tannin, gallic acid, gum, starch, resin, and wax. J. U. Lloyd (1879) obtained from a fluid extract of this root, on standing, crystals of cane-sugar and a precipitate of white, tasteless, waxy matter. Schmiedeberg (1883) has isolated two principles resembling digitalin in their properties. *Apocynin* is resin-like, amorphous, easily soluble in alcohol and ether, nearly insoluble in water, and becomes inert on being boiled with hydrochloric acid. *Apocynein* is a yellowish glucoside, easily soluble in water and alcohol, insoluble in chloroform, ether, and benzin, and, like apocynin, gives no characteristic reaction with sulphuric acid and bromine. The glucoside recognized by Poppenhusen (1888) in the ether extract was probably apocynin; the ash amounts to about 11 per cent.

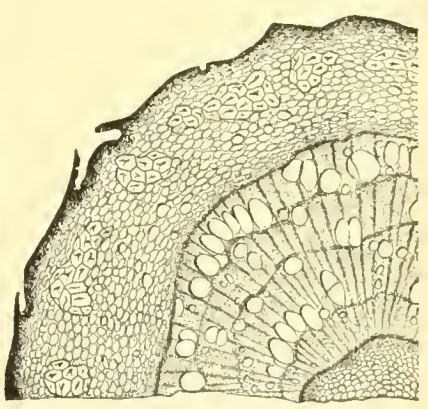
Allied Plant.—Apocynum androsæmifolium, *Linné*, known as *dog'sbane*, grows in similar localities as the preceding northward from North Carolina, and appears to be more frequent in

Fig. 28.



Apocynum cannabinum: transverse section; magnified 25 diameters.

Fig. 29.



Apocynum androsæmifolium: transverse section; magnified 25 diameters.

the northern section of the continent. It differs from Canadian hemp chiefly by the spreading stem and branches, the relatively broader leaves, and the bell-shaped, rose-colored corolla with reflexed lobes and a tube longer than the calyx. The long rhizome and roots are from 3 to 6 Mm. ($\frac{1}{8}$–$\frac{1}{4}$ inch) thick, and have a pale-brownish, wrinkled, transversely fissured, thickish bark, which is about half the thickness of the woody layer, contains groups of stone-cells in the mid-

dle part, is of an unpleasantly bitter taste, and separates easily from the tough, white, finely-porous, and delicately rayed wood, enclosing a rather large pith. The starch of this species is much smaller than that of the preceding. Canadian hemp-root has been frequently sold in place of dog'sbane-root. (For microscopical descriptions of both drugs see E. B. Stuart in *Proceedings Amer. Phar. Assoc.*, 1881, p. 468, and E. A. Manheimer, in *Amer. Jour. Phar.*, 1881, p. 554.) Bigelow found in dog'sbane a red coloring matter soluble in water and insoluble in alcohol, a trace of volatile oil, and a caoutchouc-like body. The bitter principle was obtained as an extract-like mass. The active constituents are probably identical with those of the preceding drug.

Action and Uses.—Apocynum is a powerful emetic and cathartic, and when it produces vomiting is diaphoretic also. It also promotes expectoration, causes a tendency to drowsiness, increases the urinary secretion, and diminishes the frequency and force of the pulse. Its evacuant properties have sometimes been made available in *dropsy*, but it does not always appear in what forms of dropsy its efficacy has been chiefly shown. Probably it is, in large doses, a mere evacuant of dropsical effusions. But the observations of Murray appear to prove that, even in small doses, it acts as a tonic of the heart and directly or indirectly as a diuretic. There can be little doubt of its possessing the latter value in common with jalap and other hydragogue cathartics. The experiments made by Skoboloff appear to show that an aqueous infusion of apocynum-root acts as a depressant of the heart (*Amer. Jour. Phar.*, lx. 581)—an observation confirmed and defined by Murray (*Therap. Gaz.*, xiii. 585), who compares the drug with digitalis, and contends that, without acting purgatively, it causes diuresis in dropsy depending upon cardiac obstruction. Possibly it has the advantage of exciting diaphoresis and diuresis while it purges and vomits. In the crudely-reported cases intended to demonstrate its efficacy it is seldom clear whether it acted as a diuretic or as a cathartic, or with what associated phenomena (e. g. *Therap. Gaz.*, xi. 29). It is said to destroy *intestinal worms*. An infusion and a tincture of the root have both been regarded as tonic and alterative in *dyspeptic* derangements, and as curative of mild cases of *intermittent fever*. These properties are doubtless owing to the bitter principle which it contains. The dose of the powdered root is about Gm. 0.30 (gr. v) as an antiperiodic, and Gm. 1.30 (gr. xx) as an emetic. The decoction is usually made with Gm. 32 (℥j) of the root in Gm. 750 (Oiss) boiled down one-third, and may be given in doses of a wine-glassful three times a day. Some physicians recommend as a diuretic in dropsy an infusion made with Gm. 4 (℥j) of the bark of the root in Gm. 250 (℥viij) of water, of which Gm. 16 (f℥ss) may be given once in six hours. A fluid extract is in use and is administered in doses of from 5 to 10 drops.

Dog'sbane is said to be diaphoretic and emetic, without causing much nausea, and to operate more gently and certainly than ipecacuanha; but it deteriorates by keeping. It is also reputed to be tonic, cathartic, and alterative, and to possess antisyphilitic powers. In reality, its virtues, if it have any that entitle it to a place in the materia medica, are not well defined. The powder of the recently-dried root is emetic in the dose of Gm. 2 (gr. xxx). From Gm. 0.60–1.20 (gr. x–xx) may be given as a tonic or alterative in substance, infusion, decoction, or tincture.

APOMORPHINÆ HYDROCHLORAS, *U. S., Br.*—Apomorphine Hydrochlorate.

Apomorphinum hydrochloricum, P. G.—*Chlorhydrate d'apomorphine*, Fr.; *Apomorphin-Hydrochlorat*, G.; *Chloridrato di apomorfina*, F. It.

The hydrochlorate of an artificial alkaloid prepared from morphine.—*U. S.*

Formula $C_{17}H_{17}NO_2.HCl$. Molecular weight 302.79.

Preparation.—1 part of pure morphine and 20 parts of pure hydrochloric acid are introduced into a strong glass tube having at least fifteen times the capacity of the mixture; the open end is securely sealed, the glass tube introduced into a strong metallic tube closed by a screw-cap, and the whole immersed for 3 hours in an oil-bath heated to between 140° and 150° C. (284° and 302° F.). After cooling, the tube is opened, the liquid diluted with water, and sodium bicarbonate added in excess. The liquid is decanted from the precipitate, and this is agitated with ether. To the ethereal solution a few drops of hydrochloric acid are added, whereby amorphine hydrochlorate is separated; this is recrystallized from boiling water and rapidly dried over concentrated sulphuric acid. In this process chloroform may be used in the place of ether.

This process is the one devised by Matthiessen and Wright (1869). The hydrochloric acid, acting upon the morphine at the temperature stated above, merely abstracts 1 mole-

cule of water from the molecule of morphine, and on opening the cooled tube no pressure is observed in it and no gas escapes. During the heating, however, there is considerable pressure in the sealed tube from the volatile acid, and to guard against accidents its enclosure in a strong metallic tube, as directed above, is advisable. A portion of morphine may possibly not undergo the change, and will be precipitated with the apomorphine by the bicarbonate. Morphine being insoluble in ether, it is left behind when the precipitate is treated with this solvent, which readily dissolves apomorphine. On the addition of a little hydrochloric acid apomorphine hydrochlorate is produced, and, being insoluble in ether, separated in a crystalline condition. The recrystallization of the salt from boiling water renders it perfectly pure. Since apomorphine is soluble in aqueous liquids, the mother-liquor decanted from the precipitate contains notable quantities of the alkaloid, which may be recovered by agitation with ether or chloroform and by treating these solutions with a little hydrochloric acid. The salt as well as the alkaloid should be rapidly dried upon bibulous paper or over sulphuric acid under a bell-glass, and kept in small well-stopped bottles protected from moisture and light.

Matthiessen and Wright have obtained the same compound from codeine and hydrochloric acid, which yield at first *chlorocodid*, $C_{18}H_{20}ClNO_2$, and on continuing to heat in a sealed tube this compound is split into methyl chloride, CH_3Cl, and apomorphine, $C_{17}H_{17}NO_2$.

Mayer (1871) noticed that morphine hydrochlorate is more rapidly and at a lower temperature converted into apomorphine by heating it to 120° C. (248 F.) with a solution of zinc chloride of such strength that its boiling-point is at 200 (392° F.); the change is then effected in 90 minutes, and the apomorphine or its salt may be obtained pure by the above process, the zinc carbonate, which is precipitated at the same time, being insoluble in ether.

In 1845, Arppe had obtained *sulphomorphid*, by heating morphine sulphate with an excess of sulphuric acid and water to 150° C.) 302 F.). This is white, nearly insoluble in water, and was proved by Matthiessen and Wright to be apomorphine sulphate. Arppe had given it the formula $C_{17}H_{18}NSO_4$. Nadler (1873) separated from it the alkaloid and converted it into hydrochlorate.

Properties.—Apomorphine hydrochlorate is in "minute, colorless, or grayish-white, shining crystals, turning greenish on exposure to light and air, odorless, having a bitter taste and a neutral or faintly acid reaction; soluble in 6.8 parts of water and in 50 parts of alcohol at 15° C. (59° F.); slowly decomposed by boiling water or boiling alcohol; almost insoluble in ether or chloroform, and should it impart color to either of these liquids it should be rejected, or it may be purified by thoroughly agitating it with either liquid, filtering, and then rapidly drying the salt on bibulous paper in a dark place. The aqueous solution on gentle warming rapidly turns green, but retains a neutral reaction. Solution of sodium bicarbonate, added to an aqueous solution of the salt, throws down the white, amorphous alkaloid, which soon turns green on exposure to air, and forms a bluish-green solution with alcohol, a purple one with ether or pure benzene, and a violet or blue one with chloroform. Addition of test-solution of silver nitrate to an aqueous solution of the salt produces a white precipitate insoluble in nitric acid, but instantly reduced to metallic silver by water of ammonia."—*U. S.* "It turns blood-red with nitric acid, dissolves in an excess of solution of soda, the liquid kept in an open vessel becoming in a short time purple, and finally black."—*P. G.* Its concentrated solution yields with potassium permanganate a dingy-green precipitate, soluble brown-yellow in potassa, and brick-red in nitric acid; potassium iodide yields a white gelatinous precipitate insoluble in excess, but soluble in ammonia (Annecssens, 1882).

The pure alkaloid is a white, or more generally a grayish, amorphous powder, rather freely soluble in water, ether, benzene, and chloroform. On exposure to the air while still moist it rapidly turns green, and then dissolves in chloroform with a blue color. Nadler observed that on being precipitated from its solution in sulphuric acid by ammonia it speedily acquires a reddish-brown color, and yields with chloroform a rose-colored solution. Apomorphine is colored red by nitric acid, brown by iodic acid, and rose-red or amethyst-red by ferric chloride, this last reaction being quite distinct from the blue color produced by the same reagent with morphine.

The salts of apomorphine appear to be slightly soluble in cold water, but more freely so in warm and in acidulated water. The aqueous and alcoholic solutions of the alkaloid and its salts acquire an emerald-green color on exposure to air, at the same time losing their medical properties; apomorphine should therefore not be kept in solution. In order

to preserve it for a week or two, Hager recommends the addition of a drop of ether to 2 Gm. (half a drachm) of the solution.

Action and Uses.—Some persons appear to be readily poisoned by apomorphine, which then produces, usually, a degree of sedation which may reach full collapse. This has happened even in robust subjects. In one nausea occurred at the end of ten minutes; in three minutes more the patient grew very giddy and pale, and fell to the ground; he then broke into a cold sweat and appeared to be dying, but he vomited copiously and recovered. One-thirty-second of a grain was very unwisely injected in the case of a child affected with capillary bronchitis. Violent and repeated vomiting took place, the the patient grew deadly pale and had a tracheal rattle, but it survived. A drunkard affected with albuminuria had injected one-sixth of a grain of muriate of apomorphine. Vomiting presently took place, and then sudden syncope; the pulse was extinct and respiration hardly perceptible; the skin was pale and livid and covered with a cold sweat; there was complete extinction of consciousness and sensibility. Under electrical stimulus the man was saved (Dujardin-Beaumetz). Very similar effects occurred in the following case: A middle-aged woman, suffering from sore throat, received a hypodermic injection of one-sixteenth of a grain of muriate of apomorphine. Besides the symptoms last mentioned there occurred convulsive twitchings of the corners of the mouth. For some hours after the return of consciousness she was inclined to faint. In a case of quinsy one-sixth of a grain was injected subcutaneously. In ten minutes the patient suddenly threw himself backward and flexed his arms rigidly; the pulse was very small, the skin cool, and the heart-sounds feeble. Opisthotonos followed, the man supporting himself on the neck and heels. In a few minutes the rigidity disappeared and the patient sank into a deep sleep. A man fifty-two years old, suffering from bronchitis, received a subcutaneous injection of one-fifteenth of a grain of muriate of apomorphine. He did not vomit, but in seven minutes he became collapsed and died. The autopsy threw no light upon the immediate cause of his death (Ungar).

Pecholier, a professor of Montpellier, has published a detailed history of the poisonous effects produced in himself by the hypodermic injection of about one-sixth of a grain of this substance. He lay with his limbs extended, inert, and unconscious, his face livid, his tongue protuding, and his breathing suspended. Strange to say, however, the pulse was full and firm and the temperature natural. Another injection like the first was administered! It brought on copious vomiting, immediately followed by complete collapse, in which, besides the phenomena just mentioned, the pulse grew feeble and irregular and the limbs cold. From this state of imminent death the patient was rescued by hypodermic injections of sulphuric ether and sinapisms, after which reaction took place rapidly (*Bull. de Thérap.*, cii. 353).

The sedative, or rather the depressing, action of apomorphine has been occasionally invoked. Thus in the case of a boy in *maniacal delirium*, with dilated and insensible pupils, one-tenth of a grain given hypodermically produced in a few minutes calmness, and then vomiting, after which he slept, and the next morning was well. Several cases of *hystero-epilepsy* are recorded in which the same method was successfully employed (*Times and Gaz.*, Dec. 1883, p. 655; *Therap. Gaz.*, ix. 255). In *chorea* it has produced subsidence of the agitation and arrested persistent *hiccup*. In India *sunstroke* has been treated in the same way, one-sixteenth of a grain producing emesis, followed by a speedy reduction of temperature and return of consciousness (*Practitioner*, xxiv. 456). It is said to have produced relaxation of a *rigid os uteri*, and it has been given hypodermically with negative or only palliative results in true *epilepsy*. In a case of attempted suicide by a man who took the estimated quantity of 6 grains of *strychnine*, one-third of a grain of apomorphine was injected hypodermically within half an hour. Immediately the spasms subsided, vomiting took place, and the patient recovered (Glisan). It has also been given hypodermically in the *convulsions* of children, with the effect of arresting them (*Med. News*, 1882, p. 391). It has been administered similarly in cases of *opium-poisoning* and alcoholic *intoxication*, and dissipated their effects rapidly after free vomiting had taken place (*Practitioner*, xxx. 211). In a case of poisoning with *oil of bitter almond* it acted as a prompt and sufficient emetic in the dose of one-eighth of a grain hypodermically. Half a grain administered in the same manner in three minutes produced copious emesis in a case of poisoning with *carbolic acid*, and the patient recovered. Further illustrative cases have been furnished by Dr. Tait (*Therap. Gaz.*, xiii. 242). A similar result occurred when a man had been poisoned by swallowing 1½ pints of *kerosene*. The like expedient has been used to cause the expulsion of a *foreign body* from the œsophagus. In *quinsy*, when swallowing is very difficult, this medicine may be used

hypodermically to excite vomiting with the intention of breaking the abscess. It is generally thought to be contraindicated in affections of the air-passages, on account of its tendency to produce a profuse watery secretion in the bronchia; yet it has sometimes been given in emetic doses, and with advantage, in cases of *suffocative catarrh*, *bronchorrhœa*, and *foreign bodies* in the larynx or trachea, and has been recommended in *membranous croup*. Smidowitsch used it in the latter disease and in *spasmodic croup* with alleged advantage, giving large doses, such as 1 grain in the course of a day for several successive days (*Med. Record*, xvii. 346). In minute doses it appears to be applicable to the conditions which antimony is used to remove, especially when, in *laryngitis* or *bronchitis*, the mucous membrane is dry and irritable. Kormann, Kushel, and others have found it serviceable in *bronchitis* and catarrhal *pneumonia*. It was given in minute doses of from $\frac{1}{120}$ to $\frac{1}{60}$ of a grain, and, without causing vomiting or interfering with digestion, it converted the dry into moist râles, facilitated expectoration, and reduced the fever (*Med. Record*, xx. 290).

The use of this product is very limited. Fortunately, the cases for which it is adapted hypodermically are few indeed. The difficulty of preserving it forms another obstacle to its employment, although it is alleged not to lose its special mode of action when its color changes to a green or olive tint. Even this change is said to be preventible by adding glycerin or glucose to its solution, while the former renders muriate of apomorphine more soluble. The dose of this compound is variously stated. By the German Pharmacopœia the maximum is Gm. 0.02 (gr. $\frac{1}{3}$), and the minimum daily quantity Gm. 0.10 (gr. $1\frac{1}{2}$). In the British Pharmacopœia (extra), gr. $\frac{1}{32}$ to $\frac{1}{16}$ as an expectorant; gr. $\frac{1}{12}$ to $\frac{1}{4}$ as an emetic by the mouth; $\frac{1}{25}$ to $\frac{1}{6}$ gr. hypodermically are the doses recommended. For young children the dose by the mouth or subcutaneously should not exceed Gm. 0.002 (gr. $\frac{1}{24}$).

AQUA, *U. S.*, *Br.*—Water.

Eau, Fr.; *Wasser*, G.; *Agua*, Sp.; *Acqua*, It.

Natural water in its purest attainable state (*U. S.*), cleared, if necessary, by filtration (*Br.*).

Composition H_2O. Molecular weight 17.96.

Properties.—Water is often combined in nature, as in many crystalline compounds, and is very abundant in the free state. Natural water is an excellent solvent for most gases and many salts, but it is rarely found pure; B. M. Brackenridge and Dr. E. Stieren observed (1860) chemically pure water in the spring of a ravine known as "the Dark Hollow" in Allegheny county, Pa. With few exceptions *spring-water* contains carbon dioxide in solution, and by its agency dissolves some calcium carbonate and sulphate and magnesium carbonate from the soil. Such water precipitates an insoluble lime-soap from solution of ordinary soap, and is called hard. This hardness may be removed by expelling the excess of carbonic acid by heat; the carbonate and a portion of the calcium sulphate, also magnesium carbonate if present, are thus precipitated. A similar precipitation takes place in rivers, from the water of which, owing to its extended surface, the carbon dioxide is mostly given off; hence *river-water* is usually soft. Both spring- and river-waters contain variable quantities of salts of alkalies in solution, of which they cannot be deprived except by distillation.

Rain- and snow-water are free from such saline compounds, except the portions falling first; these contain particles of dust and various organic and inorganic matters which had been suspended or dissolved in the air. Among them, ammonia, iodine, chlorine, and nitric acid have been found, the latter more particularly during a thunder-storm, the former two elements occasionally, while ammonia or allied compounds are always present in inhabited regions. It is advisable, therefore, to collect rain-water only some time after the rain has commenced falling, and as far removed from dwellings as possible; it will then contain a little carbonic acid, which has been dissolved from the air.

The purity of running and well-water is affected by the nature of the surrounding soil and the proximity of decaying animal or vegetable matter, the decomposition-products of which may find an outlet into the former by natural drainage, sometimes from a considerable distance, and render such water unwholesome and unfit for many purposes. The refreshing taste of spring-water is mainly due to the carbonic acid dissolved therein. Of secondary importance is the small quantity of saline compounds contained in it. When the latter is permanently increased beyond a certain quantity the spring is called a *mineral spring*. (See Aquæ Minerales.)

Most spring waters are unfit for chemical and pharmaceutical uses, but may often become adapted therefor after boiling and filtering. River-water, if not naturally bright and transparent, is improved by filtration through sand and charcoal, and may then be employed if nearly free from organic matter, the amount of which may be approximately ascertained by a dilute solution of potassium permanganate, which will permanently impart its color to the water as soon as the organic matter and other deoxidizing agents accidentally present have been destroyed or oxidized. But distilled water is best for all the purposes indicated. It taste is insipid, owing to the absence of carbonic acid or to the minute quantity of this gas absorbed by contact with air.

At the temperature of 0° C. (32° F.) water freezes, forming transparent crystals of ice; if entirely undisturbed, it may be cooled to several degrees below this point without freezing, and if now slightly agitated will at once congeal, the temperature rising to the freezing-point in consequence of the liberation of latent heat. Water impregnated with salts, particularly such as are readily soluble in it, freezes at a lower temperature, the ice being free from the compounds which were dissolved in the water. Hence, water equal in purity to distilled water may be obtained by melting perfectly clear and transparent ice under conditions which preclude the admixture of dust and other impurities. *Sea-water*, which has the specific gravity 1.027 and contains about 3½ per cent. of salts, yields ice of as great purity as river-water.

The boiling-point of water is 100° C. (212° F.), and rises beyond this temperature if notable quantities of salts, etc. are dissolved in it or if the pressure is increased; on the reduction of pressure water boils at a lower temperature.

The density of distilled water at 15° C. (59° F.) or at 15.5° C. (60° F.) is by general consent regarded as the unit by which the density of liquid and solid bodies is measured. In Europe, however, this unit is sometimes taken from water at its greatest density, and several of the tables published in the U. S. Pharmacopœia (1880) are based upon this unit. The specific gravity of water decreases with the rise of temperature, and increases gradually as the temperature is lowered until + 4° C. (39° F.) is reached, when it has its maximum density, becomes lighter again toward the freezing-point, and expands very considerably when passing into the solid state, ice having the specific gravity 0.916. When converted into vapor, water expands to nearly seventeen hundred times its bulk, and forms a transparent and colorless gas having the specific gravity 0.455 at 100° C. (212° F.); it has therefore less than one-half the density of atmospheric air. When mixed with air it condenses into minute drops, to which the opaqueness of steam is due; the over-saturation of air with aqueous vapor causes a similar condensation in the atmosphere, hence the appearance of clouds.

Tests of Purity.—Water is "a colorless limpid liquid, without odor and taste at ordinary temperatures, and of a perfectly neutral reaction, remaining odorless while being heated to boiling. The transparency or color of water should not be affected by hydrogen sulphide or ammonium sulphide test-solutions (absence of metallic impurities). The limits of impurities are prescribed as follows: It should remain unaffected by mercuric chloride test-solution (limit of ammonia). On evaporating 1000 Cc. of water on a water-bath, it should not leave a residue weighing more than 0.5 Gm. (limit of soluble salts), and this residue, when ignited, should not carbonize nor evolve ammoniacal or acid vapors. If 200 Cc. of water be acidulated with hydrochloric acid and heated to boiling, and 0.5 Cc. of barium chloride test-solution added, the liquid, cooled and filtered, should give no further precipitate on the addition of a few drops of barium chloride test-solution, even on standing (limit of sulphates). If 100 Cc. of water be acidulated with nitric acid, and 0.5 Cc. of decinormal silver nitrate solution be added, the filtered liquid should not be affected by the subsequent addition of a few drops of silver nitrate test solution (limit of chlorides). If 5 Cc. of water mixed with a few drops of diphenylamine test-solution, be carefully poured upon about 5 Cc. of sulphuric acid contained in a test-tube, so as to form a separate layer, no blue color should be formed at the line of contact of the two liquids (limit of nitrates). If 100 Cc. of water be acidulated with diluted sulphuric acid, and a few drops of zinc-iodide starch test-solution subsequently added, the liquid should not at once assume a blue or violet color (absence of nitrites). On heating 100 Cc. of water, acidulated with 10 Cc. of diluted sulphuric acid, to boiling, and subsequently adding 0.5 Cc. of decinormal potassium permanganate solution, the color of the liquid should not be completely destroyed by boiling it for ten minutes (limit of organic or other oxidizable matters).—*U. S.*

Pharmaceutical Uses.—The utility of water as a solvent and vehicle is well known; it is employed in preparing most chemicals, constitutes the solvent of the medi-

cated waters, decoctions, and infusions, and most solutions and syrups, and as an addition to alcohol is present in many of the fluid extracts, tinctures, etc.

Action and Uses of Cold Water.—Water constitues by far the larger portion of the bulk of all organized beings, and is essential to their organic constitution as well as to the molecular actions and movements by which life is manifested. It is important, therefore, as an article of food which directly supplies one constituent of the body; it is not less so as a means of promoting the solution of solid food in the digestive organs and facilitating its absorption; it is equally the solvent of all the secretions and excretions, and the chief vehicle by which the latter are carried out of the body. But all natural water is not adapted for food. The greater part of the water in the world is contained in the ocean; another large portion consists of spring- and river-waters which are so mineralized as to be unfit for ordinary drinking, or of other waters in certain sluggish rivers and in marshes which contain too large a portion of animal or vegetable matter to be wholesome. The purest natural waters are rain-water, which is, however, insipid and contains but little air, and certain springs which are remarkable for their purity as well as the vivacity of their taste. For pharmaceutical, and indirectly for medicinal, purposes water must be deprived, as far as possible, of its foreign constituents—an object which is most perfectly attained by distillation. But for many of such purposes water that has been boiled or filtered rain- or snow-water has been found sufficiently pure.

In a general way, water acts chiefly as a direct means of modifying the temperature of the body. But the mechanism by which the temperature is raised or lowered is identical with that which quickens or retards organic processes, for it is chiefly upon the degree of activity of the latter that the animal temperature depends. Water at a temperature higher than that of the body is a direct stimulant of the circulation, and therefore of all the functions; cold water, on the other hand, robs the body of a portion of its caloric, and therefore is a direct sedative of the circulatory and the other functions. But cold may indirectly become a physiological stimulant, since it is a property of living organisms to react against whatever powerfully tends to depress them, and this the more vigorously and abruptly the depressing influence has been exerted. Therefore, cold applied to the body in a certain measure and for a given time produces a diminished activity of the function, which is followed by a degree of activity greater than which originally existed. In this manner the primary effect of heat and the secondary effect of cold resemble one another, and the same purpose may be accomplished by either or by both successively. But cold and heat are conventional terms; they do not designate definite temperatures. The normal animal temperature being about 98° F., whatever is higher than this may be described as heat, whatever is lower as cold. Hence different degrees of heat may be expected to produce different grades of effect, from a mild to a powerful stimulation, and even to the destruction of vitality; and in like manner coolness, cold, congelation, etc. are terms applied to the different degrees in which caloric has been abstracted. It is evident, therefore, that the action of water, and consequently its use in medicine, will vary between very remote extremes—that it may stimulate moderately or violently, and soothe gently or depress more or less profoundly, according to the conditions which have been pointed out. The effects of cold water upon the living body are complex: they comprise the direct abstraction of caloric, the diminished production of it, and a multitude of reflex effects due to the relations between the skin and the internal organs. The loss of caloric by the contact of cold water with the skin is more or less completely balanced by the generation of caloric through the organic changes which are incessantly active in every tissue. Hence the interior of the body in health maintains a certain average temperature, or within two or three degrees of it, whatever may be the temperature of the surrounding medium. With the abstraction of caloric all the vital processes are depressed, the skin grows pale and shrivelled, and the internal organs are overloaded with blood; the pulse beats slowly, the secretions are diminished, and the muscles torpid. Taken internally, cold water occasions a sense of coolness in the throat and stomach, and afterward in the rest of the body; but if the water be very cold and taken in large quantity, it may produce in the stomach severe pains which radiate to the chest and abdomen and give a violent shock to the whole nervous system—effects which are accompanied by spasm or by collapse, or by both in succession. If these effects are not fatal, reaction with fever is apt to occur. The transient application of cold to the skin is so quickly followed by reaction that the effects seem to be those of direct stimulation; the cutaneous circulation becomes more active, a sense of warmth with gentle perspiration ensues, and through this reflux and flux of the blood and the excitation of the nervous system all the functions are quickened. Indeed, the chief

value of cold water applied to the entire skin in disease consists less in its direct action as cold than in its indirect action as a functional stimulant. Yet the abstraction of calorie may in certain exceptional cases be useful. The topical effects of cold water as distinguished from those of cold applied in other ways are diminished local circulation and calorification, followed by a more or less distinct reaction whenever the action of the cold is suspended.

According, then, to the circumstances under which it acts, cold water may be refrigerant, excitant, sedative, astringent, tonic, debilitating, or perturbating. It may be used to check febrile and inflammatory processes, to stimulate a torpid and oppressed nervous system, to arrest spasm, to relieve congestion and pain, to abate excessive secretions, hæmorrhage, etc. Among the diseases in which it has proved most useful are *continued fevers* in which the temperature is extremely high, and provided no intercurrent inflammation complicates them. Cold water in the form of douche, baths, sponging, and wet wrappings has been employed with decided benefit in many cases of *typhus fever*, *typhoid fever*, *scarlet fever*, *variola*, etc.; and the douche or other similar shock with cold water has proved curative in various forms of *intermittent fever*. It may be used in either of several conditions: (1) To reduce hyperpyrexia; (2) to provoke a reaction in the rapidly adynamic forms of these diseases; and (3) to lessen the delirium, stupor, spasm, and other cerebral and spinal symptoms at the height of the attack. Of these stupor is by far the most important in relation to the use of cold water. But apart from quite exceptional cases, we believe that all the benefits derivable from cold immersion or the douche bath may be obtained by simply sponging the skin repeatedly with cold water and giving cool water to drink as much as the patient desires or tolerates, for the use of cold water as a drink in fevers is prescribed by instinct as well as reason. Much attention has been given to this subject. Naunyn, after lengthened observation of its use, had his confidence strengthened in the hydriatic treatment of *typhoid fever* (*Archiv f. exper. Pathol.*, etc., xviii. 116). In cases adapted to it—*i. e.* where the axillary temperature exceeded 103° F.—he applied the cold bath (72° to 82° F.) as often as eight times, and occasionally even twelve times, in twenty-four hours, and each bath lasted from five to ten minutes. But only such temperature and duration of the bath were permitted when the patient's condition plainly warranted them. In other cases baths at 90° to 95° F. were preferred, and in others, again, at a temperature intermediate between these extremes. The frequent repetition of the bath just mentioned does not harmonize with the explanation given by this author of the utility of lukewarm and warm baths, for he attributes it to their increasing the activity of the skin, by which the brain and other internal organs are relieved and cutaneous and renal elimination is quickened. But the method now described is less vigorous than that of Brand, its chief apostle, which requires that the patient should every three hours be bathed for fifteen minutes in water at 60° F.; and this rule is not allowed on any account to be relaxed (*Med. Record*, xxxv. 436). V. Ziemssen's views are more in harmony with those of Naunyn, for he recommends that the sudden shock of very cold water should be avoided; that the bath at first should have a temperature of 86° to 90° and be gradually reduced by the addition of cool water to 71° or 72°; that the immersion should not last longer than fifteen minutes, and the repetition be from two to six times a day; and that after the bath the patient should be allowed to rest for a quarter of an hour wrapped in a warm blanket, then rubbed dry, clothed in clean linen, and allowed to sleep (*Jour. Amer. Med. Assoc.*, viii. 533). The use of cold baths in typhoid fever has, however, been amply discussed at home and abroad, and the weight of testimony is opposed to it as an ordinary treatment. Even in the cases most favorable to its use no adequate comparison has been made of its results with those of warm baths; and its alleged superiority to ordinary measures cannot be admitted unless a comparison be also made with cases treated expectantly—a method which has hitherto afforded the lowest mortality-rate. This, it is true, has been done by Brand (*Centralbl. f. Ther.*, v. 510), who (incorrectly) alleges that the mortality under the expectant treatment varies between 13 and 32 per cent., while under the hydriatic method it is between 0 and 5 per cent. Baruch, in this country, adopted similar conclusions (*Med. Record*, xxxi. 34; xxxv. 176, 434, etc.), and so did Vogl in Munich (*Therap. Monatscheft.*, 1889, p. 129), and Josias in Paris (*Amer. Med. Jour. Sci.*, Jan. 1890, p. 73). But, as we have said, the fever is not the whole of any febrile disease, nor is an artificial reduction of temperature a cure of the affection in which fever occurs. As Dujardin-Beaumetz insists, the treatment by cold water "is and must continue to be suited only to exceptional cases. To abstract animal heat by physical means does not hinder the generation of calorie." Still less can good be expected from the

barbarous expedient that has been proposed of controlling the febrile action of the heart by applying over it a bag of pounded ice or of cold water. The shower-bath or spray-bath, which has been suggested as a more powerful antipyretic than the immersion bath (Placzek, *Therap. Monatsch.*, 1887, p. 133), may be ranked as only a shade less cruel than the expedient just dismissed. Many years ago (1867) Skoda used ice-poultices in the treatment of *pneumonia*, but they were soon discarded. The application of ice-bags to the chest in this disease has been lately advocated by Lees (*Lancet*, Nov. 1889, p. 890), but does not appear to have commanded the confidence of physicians. Among its dangers is the occurrence of syncope.

Cool drinks are essential in *inflammation of the stomach*. Pounded ice mixed with bran forms a most efficient poultice for *sore throat*, including *tonsillitis* and *diphtheria*, and its efficacy is increased by ice melting in the mouth. The same or any other convenient mode of applying cold has often been successful in preventing the formation of *abscesses*, mammary, inguinal, and others. Some physicians have been bold enough to treat *pneumonia* by cold baths at 68°, and even at 59° F., repeated several times a day, and to claim for the method an exceptionally low rate of mortality. They have at least demonstrated the marvellous power of the animal economy to resist the injurious assaults of those who prefer heroic measures to the spontaneous evolutions of nature. The application of wet compresses around the inflamed joints in acute articular *rheumatism* has not produced the bad consequences which it was supposed would follow from a repercussion of the morbid fluxion, and such applications, when made with an alkaline liquid, have often proved extremely salutary. The general cold bath has been used in this disease with hyperpyrexia, but sometimes with the result of inducing inflammatory complications of the heart and lungs, and sometimes of causing death (*Practitioner*, x. 79; xi. 263). But in a certain number of cases of hyperpyrexia with symptoms of cerebral rheumatism—a complication of the gravest description—cold baths have appeared to mitigate the gravity of the attack and bring about a cure (Woillez, *Bull. de Thér.*, xcix. 344; Raynaud, *Arch. gén.*, Jan. 1881, p. 105). The average temperature of the baths used in these cases may be stated as 68° F., and the extremes as 60° and 75° F. On reviewing the cases the relation between the cerebral symptoms and the hyperpyrexia is far from being apparent, and the benefit derived from cold baths appears to have been due far more to the calming influence of the low temperature upon the nervous system than upon the mere abstraction of caloric. (Compare Carrington, *British Med. Jour.*, Mar. 5, 1887.) Cold water is one of the best applications for a variety of local inflammations, such as *burns*, *scalds*, *intertrigo*, and the *stings* of insects. Its use in a foot-bath or in a douche is familiar as a means of preventing *cold feet* and *chilblains*. Cold is one of the most potent means of arresting *hæmorrhage*, whether from the nose, lungs, stomach, bowels, or uterus, or from wounds. In such cases it should be applied as nearly as possible to the source of bleeding. In uterine hæmorrhage ice and iced water have been introduced into the uterus with complete success and without injury. But it is less generally efficient than hot water. *Scrofula*, *chlorosis*, and *anæmia* are diseases which have some elements in common, chief among which is impoverishment of the blood. Whether this condition be primary or secondary, the use of cold water internally and externally improves nutrition, and thereby tends more or less to moderate or to remove the defects of nutrition upon which the diseases depend. It is in this way—that is, by its direct stimulant and indirectly corroborant action—that cold water in the forms of baths, and especially salt and surf baths, tends to remedy *nervous exhaustion* produced by mental or physical excesses. A state of debility, here as elsewhere, requires that so powerful an agent as this should be cautiously applied. In most of the diseases last referred to cold water is used as a stimulant or as an indirect agent for promoting perspiration, but in some others its aid is sought for its direct and continuous agency in repressing vascular action and its consequences. Thus in all cases of *hyperæmia of the brain*, whether arterial or venous, the excitement of the one and the stupor of the other condition may be mitigated by cold water duly applied to the head. No medicinal remedy for *insomnia* is so certain and, at the same time, so harmless as cold water poured upon the scalp and back of the neck. Irrigation with cold water, or the constant application of an ice-poultice to the scalp, with the hair closely clipped, and, still more powerful, the cold douche, will often succeed in securing sleep, allaying violent delirium, or restoring consciousness in deep coma. *Insanity*, when acute and accompanied with heat of head, yields to the same method, especially if the body be at the same time immersed in a bath at 95° F. and the treatment be continued daily for several hours at a time. In these various affections a water-proof pillow containing ice or iced water is very convenient. The same method is entirely applicable to the treat-

ment of *mania-à-potu* in violent patients and for the relief of narcotism in *poisoning by opium*. In congestive *sunstroke* the brain symptoms are due not only to an excess of blood within the cranium, but also to the excessive heat of the blood itself, which is denoted by a surface temperature of 109° to 111° F. Cold water and ice frictions appear to be the most successful, as they are plainly the most natural, remedies for this fatal affection, but their efficacy depends greatly upon their prompt application. (Compare Packard, *Am. Jour. Med. Sci.*, June, 1888, p. 554.) Cold affusions have also been used to restore a person struck by *lightning* (*Therap. Gaz.*, xi. 707).

Most of the spasmodic affections may be treated by cold water. *Hysteria* is favorably modified by cold bathing, as by all influences that strengthen the system generally and the nervous functions in particular. *Convulsions* of whatever sort, attended with fulness of the cerebral blood-vessels, should be treated by cold applications to the head and the nape of the neck; *coma* with stertor, and also spasms induced by anæsthetics in very nervous women, have been relieved by applying ice over the side of the neck. *Epilepsy* has been favorably affected by the use of ice-bags to the cervical spine, and *tetanus* of the idiopathic form has been repeatedly cured in ancient and in modern times by cold affusions. Even traumatic tetanus has got well under the direct application of ice to the spine. A number of cases of anomalous *paralytic* and *spasmodic* affections, caused by fatigue, fright, and other mental impressions, have been cured by a course of hydropathic regimen after the failure of other remedies (Friedmann, *Monthly Abst.*, vi. 540). *Chorea* was formerly treated with cold affusions on the spine and by the ice-bag, but the former was apt to affright the timid children who are often the subjects of the disease, and the latter was difficult of application. Sulphuric ether applied to the spine in spray is perhaps more efficient, but is only palliative. Cold bathing, and especially sea-bathing, is of great value in this disease. *Chronic* nervous affections, whether *neuralgic* or purely functional, are so generally associated with anæmia, a state that implies debility, and imperfect calorification and mental depression, that the subjects of them are rarely tolerant of a treatment by cold water. This is emphatically true of nervous disorders that involve a chronic and substantial lesion of the brain or spinal cord. It is, however, true that to distinguish a substantial from a functional disease, of the nervous system especially, is extremely difficult, and the treatment by cold, as by other remedies, must be tentatively employed. Cold ablutions, and also ice-poultices, have been found efficient in arresting *spasmodic croup*. Among diseases of the digestive organs amenable to treatment by cold water is *constipation*, as the oldest and most recent records demonstrate. It has often been employed successfully by causing the patient to walk upon a cold stone pavement, by dashing cold water over the limbs, or by applying it to the abdomen by means of wet compresses, while copious draughts of the same liquid were taken. Friction of the abdomen with lumps of ice has been particularly recommended in such cases (*Centralbl. f. Therap.*, vi. 19). These methods have been successfully employed to overcome the obstinate constipation of *lead colic*. Apparently hopeless *intussusception* of the bowel appears to have been overcome by large enemata of ice-water (Kormann, *Practitioner*, xxv. 212).

In surgery the applications of cold water are important and numerous. It is the most convenient as well as the most efficient remedy for *sprains* and *contusions*, including those to which a joint has been subjected by its *dislocation* or the soft parts by *fractures* of bones, etc. The full benefit of the treatment is best secured by its earliest possible application after the injury, for then it prevents the excessive exudations which embarrass and retard the cure. The utility and the mode of action of the remedy are just the same in the treatment of *wounds* which are not likely to unite directly or by the first intention; and, indeed, even these heal more readily under its use, provided that the several surfaces are maintained in close apposition; while contused and lacerated wounds, whose union is usually hindered by inflammation, close all the more readily when this process is abated by cold water. The repressive action of cold water is well illustrated by its power of preventing the development of local non-traumatic inflammations, such as *boils*, *carbuncles*, *whitlow*, *acute orchitis*, etc. In all of these affections, if steadily maintained, it arrests their development, but its intermittent application is useless or worse. *Ulcers*, especially of an indolent and ill-conditioned sort, are often cured by cold and moisture combined, by which the nutrition of the part is rendered more active and normal. The water may be applied on compresses, by washing, and, above all, by the douche. The two former are the most appropriate for irritable, and the last for indolent, ulcers. The repressive power of cold water is well exhibited in the treatment of *burns* and *scalds;* provided that it be applied immediately after the injury and steadily kept in

operation, it will tend to prevent ulterior changes of tissue dependent upon inflammation. The more extensive the injury the less appropriate does this method become. The strangulation of *hernia* is often due to a distension of the blood-vessels of the tumor, and in so far the reduction may be facilitated by whatever tends to disgorge the swelling of its blood; cold water has proved efficient for this purpose in many cases. Even ice and freezing mixtures have been applied with the same object, but they are not free from the danger of producing mortification. In like manner, certain *venous dilatations* have been diminished, particularly those of the *rectum*, the *uterus*, and the *penis*. No better palliative for *hæmorrhoids* exists than frequent ablution with cold water, especially after stool. It is most efficiently applied with a sponge. Acting in a similar manner, pellets of ice have been administered to produce contraction of the *œsophagus* above and around a *foreign body* impacted in it, and render the use of the probang more efficient (*Bull. de Thérap.*, cii. 374). Ice has been extensively and efficiently employed to produce anæsthesia and local congelation, and facilitate the performance of many minor surgical operations, such as *opening abscesses*, *removing tumors*, *evulsion of toe-nails*, and even the destructions of *cancers* by chloride of zinc and their obliteration by systematic pressure (Arnott, *Times and Gazette*, 1879, i. 347, 396, 533). The hypodermic injection of cold water has been used as an anodyne in *neuralgia*, *toothache*, and *articular rheumatism*, and as a substitute for *morphine injections* where it was desired to cure the habit of using the latter. That the mitigation or the suspension of pain by this operation is real in many cases cannot be doubted, but it is almost certain that such relief is due, chiefly if not entirely, to expectant attention. (See *Med. News*, xii. 258, 361). This opinion is strengthened by the fact than the effect has been obtained by the injection of warm as well as if cold water. Cold water or ice may be used to relieve various local pains, whether inflammatory or neuralgic. Abscesses are examples of the first, and neuralgia of the face is an instance of the second. *Sciatica* has been cured by congealing the integuments over the ischiatic notch by means of a freezing mixture, or by the spray of chloride of methyl (Jacoby, *Med. Record*, xxxii. 473). But two hundred years ago snow was applied by Bartholini for the relief of neuralgia, and nearly forty years ago freezing mixtures were employed by Arnott (Stillé, *Therapeutics*, 4th ed., ii. 237).

The internal use of cold water requires to be cautiously guarded; the risk of drinking it too freely when the system is exhausted by heat has been pointed out. It is not readily absorbed from the stomach in other atonic states of this organ, and if largely taken during or too near a meal it is very apt to interfere with digestion. It should not be used freely during pulmonary, and especially bronchial inflammations, nor in diarrhœa. It is better tolerated and is often salutary in acute *dysentery*. Baths at a lower temperature than 50° F. are unsafe for children and old persons at all seasons, and when serious disease exists of any organ essential to life the temperature should not be lower than 75°. In any case cold baths should be of very short duration, and active or passive exercise used during and after them. If local applications of cold water occasion chilliness, they ought not to be continued. Cold baths should not be taken immediately after a meal, nor when the air is chilly, nor when the mind is distressed. Early morning baths are invigorating, but cold baths before bedtime are of great utility in summer by rendering sleep sounder and more refreshing. In cold bathing the head should always be wetted before the rest of the body, and after the bath the skin should be stimulated by rubbing it with coarse cloths.

Local cold baths, applied to the head, the pelvis, and the feet, are employed to relieve congestion and stimulate the circulation in these parts, and thus prevent or remove the effects of vascular stagnation. Their sedative or their stimulant operation will be determined by their duration, the temperature of the water, the manipulations employed at the same time, etc. Silva found (*Centralb. f. Ther.*, v. 183) that ice applied over the heart increased the tone of that organ and of the arteries and lowered the temperature of the blood. He used it efficiently in low fevers and functional *heart disorders*, in the collapse of *alcoholic* intoxication, in *congestion of the lungs*, and in *venous congestions* generally, but found it contraindicated by *muscular degeneration* of the heart, in advanced stages of *valvular disease* with imperfect compensation, and in *diabetes* and *nephritis*. Walter, who confirmed these statements (*Bull. de Thérap.*, cxiv. 28) applied the ice-bag with great advantage in cases of hyperpyræmia in *typhoid fever*. Cold water is often employed by *irrigation*—that is, by directing a stream of it over some portion of the body; in an *epithem* or mass of lint, sponge, or other porous material kept saturated with the liquid, or by means of pounded ice, which is sometimes mixed with flaxseed or Indian meal or bran, and enclosed between woollen cloths, and sometimes also with nitrate of potas-

sium and chloride of ammonium in order to form a freezing mixture; by *ablution*, which consists in applying cold water, with more or less friction, to the surface of the body in order to allay the heat of the skin and promote diaphoresis in febrile states, etc.; by *affusion*, in which large quantities of cold water are poured over the body, previously washed or not with hot water and soap, by which means the functions of the skin are quickened and sometimes a salutary crisis is brought about. The *douche* is a form of affusion in which a continuous stream of water falls from a height upon the body, adding a mechanical stimulus to that produced by the cold water; the *shower-bath* is a modification of the same method, in which the stimulus is very gentle, and therefore adapted to persons who are comparatively feeble. The so-called *hydropathic* measures, which consist essentially in enveloping the body in wet wrappings, which are in turn surrounded by dry ones, while the patient drinks abundantly of cold water, have for their chief effect the production of profuse perspiration, by means of which the blood is purged of deleterious matters circulating with it. The purification may become general or be made local by restricting the application of wet compresses to the ailing parts. This last-named method is of very general application, and is useful in all injuries of joints and other local injuries, as well as in almost all internal inflammations, including those of the brain, lungs, and abdominal and pelvic viscera. The sweats produced by topical as well as by general wet applications have sometimes an offensive smell, which probably shows that effete, and therefore deleterious, substances are eliminated by means of them. Potter's clay, instead of wet compresses, has been employed in the treatment of *burns*, *sprains*, *insect bites*, and *swelled testicle*.

Action and Uses of Warm Water.—Water of a higher temperature than that of the body may be applied in the form of vapor or of liquid. A vapor-bath at 120° F. may increase the pulse-rate to 145 or more, rendering the respiration difficult, causing hæmoptysis, producing fulness of the head, congestion of the brain, and even apoplexy. The more fully the atmosphere is charged with moisture, the greater is the suffering of the system in proportion to the elevation of the temperature, because less caloric is lost by radiation; under the same circumstances, however, the body rapidly loses weight by perspiration. The internal secretions, and the urine particularly, are notably diminished. These conditions are carried to an extreme limit in the Russian vapor-bath, and are intensified by other methods of stimulating the skin, such as violent frictions and flagellation with softened rods. It has been found that a person unaccustomed to such baths may lose nearly a pound in weight by the operation of a single one. For domestic and medical purposes a vapor-bath may be constructed by merely surrounding the patient, seated in a chair, with a tent of blanket or other impermeable stuff and introducing steam within the enclosure. The head should not be included in the covering. Very soon active diaphoresis will commence. The vapor of warm water may also be diffused throughout an apartment by boiling a kettle or other convenient vessel or by slaking lime in the neighborhood of the patient. The latter expedient is to be recommended in cases of *membranous croup;* the others are usually employed in the treatment of acute and chronic muscular *rheumatism*, in chronic articular rheumatism and *gout*, and in cases of *paralysis* that require muscular stimulation. This vapor-bath is also beneficial in *dropsy*, especially when it is produced by cold or as a scarlatinous sequela; in *eruptive fevers* when the eruption is tardy and imperfect; in all chronic *diseases of the skin* in which the integument is torpid, dry, and hard; and in cases of profuse *sweating* due to a relaxed state of the skin.

As the capacity of water for caloric is three thousand times greater than that of air, the former is capable of producing the phenomena of heat much more energetically than the latter. When water warmer than the body (99° to 113° F.) is swallowed, it excites a local and diffusive warmth, quickens the pulse, and increases the perspiration and urine. The hotter the water the more decided are these effects. The *warm bath* (100° to 105°) tends to check exhalation from the parts of the body immersed, but increases it from the surface exposed to the air; but before this effect takes place the exposed parts become congested and a sense of fulness and discomfort is experienced in the head and face. The skin grows red, the pulse and respiration are quickened, but the tension of the pulse is diminished, and syncope may occur if the heart is weak. Sweating follows the bath, especially if encouraged by warm bed-clothing, and there is a general sense of relaxation, and usually an inclination to sleep. Diaphoresis by means of warm baths is useful in relieving general *dropsy*, but less so than when it is incited by hot-air baths. The same remark applies to *rheumatism*. The local action of water of the temperature mentioned is to relax the tissues and allow the blood to accumulate in them, thereby tending

to withdraw it from remoter parts. Hence the utility of this measure in lessening *congestions* of the brain and other internal organs, and relieving *pain*, *muscular spasm*, and *fever*. The greater the surface exposed to the action of the bath the more efficient is its operation, particularly in relaxing spasm and allaying internal pain, as is familiarly exhibited by the efficacy of this agent in cases of *dislocations of joints*, in *spasm* of the *gall-ducts*, *ureters*, *intestines*, *uterus*, etc. If the body, after the action of a hot-bath, is subjected to the sudden contact of cold water, a reaction occurs which is usually accompanied with profuse perspiration.

The internal administration of warm and hot water has long been employed at the thermal springs of Europe as a means of quickening tissue-change and promoting diaphoresis and diuresis. It is most efficient when the water has a temperature of about 110° F. and the patient remains well covered in bed. In this manner it benefits *rheumatic* and *gouty* dyscrasiæ. Water at about this temperature is sometimes beneficial in *constipation*, *chronic diarrhœa*, and *gastralgia*. The general warm bath is an important hygienic instrument, by means of which the skin is cleansed of its accumulation of effete secretions and its functional activity is augmented. It is also an almost indispensable agent in modifying the nutrition of the skin, and thereby promoting the cure of many *cutaneous diseases* in their chronic forms. Warm baths have long been used in the treatment of fevers, whether in the *eruptive fevers* in which the exanthem appears tardily or imperfectly, or in these and also in *typhus* and *typhoid fevers* for the purpose of moderating delirium, diminishing stupor, or calming nervous symptoms, such as spasm, twitching, etc. It has even been claimed that when the last named of these fevers is treated by "permanent" warm baths the temperature is rapidly lowered, the course of the attack is shorter and milder, and the mortality diminished (Reiss, *Zeitsch. f. klin. Med.*, iii. 389). If even these statements were accepted literally, the difficulties of employing the method, especially in diarrhœal cases, are sufficient to render it practically unavailable in them. (Compare Riess, *Centralbl. f. Therap.*, vi. 622; Anuschat, *ibid.*, viii. 603.) In *pneumonia* baths of from 86° to 90° F., and prolonged for several hours, have been asserted by Bozzolo to be superior to any other treatment (*Centralbl. f. d. g. Ther.*, i. 368), but the method is impracticable as a general one, and the evidence in its favor is inadequate. Benevolsky has claimed a like success for hot half-baths (from the feet to the waist) at 108°–111 F. of a half-hour's duration, which he regards as efficiently revulsive during the first stage of the disease (*Bull. de Thérap.* cxi. 278). The warm bath is one of the most efficient agents in the treatment of chronic *rheumatism*, especially in the form of sulphurous mineral waters. It is an important adjuvant in all the varieties of *albuminuria* and of *diabetes*. Prolonged warm baths are most efficient auxiliaries in all excito-motor derangements, but especially in *convulsion* and muscular *spasm*, and also in *insanity* of nearly every type. Among these diseases *albuminuria* and convulsions due to renal obstruction are most conspicuously benefited, as they also are by purgation or whatever else relieves the circulatory tension without impoverishing the blood. In certain cases of *paralysis*, and particularly in rheumatic paraplegia, the efficiency of the warm bath is sometimes remarkable. Its stimulant and revulsive operation is valuable in various intestinal disorders, and notably in *cholera infantum* and *acute dysentery*. Its depurative action is frequently sought in *scrofula*, *chlorosis*, and constitutional *syphilis*. According to Mosler, enemata of hot water stimulate the discharge of bile in catarrhal *jaundice*. The hot bath tends to relieve extreme muscular exhaustion, and is available in cases of apparent death from *apnœa*, *asphyxia*, *strangulation*, and *intoxication*, and when the new-born child fails to breathe, or does so imperfectly, owing to debility and not to cerebral congestion.

Partial warm baths are applied to the feet, the hips, and sometimes to the hands. Warm foot-baths or hand-baths, if much above the temperature of the blood, are powerful stimulants, exciting the heart and brain, preventing sleep, etc., but at about 98° to 100° F. draw the blood away from the brain, and thereby promote sleep and relieve pain and congestion of the head and trunk. They are very efficient in arresting the formation of *coryza*, *sore throat*, *pulmonary catarrh*, *laryngitis*, especially of the spasmodic form, and muscular *rheumatism*, and in promoting the *menstrual flow*. If the water is hot enough to produce a painful impression on the skin, it stimulates the whole system, and is more apt to occasion a sense of fulness than relief, and to prevent sleep instead of promoting it. The warm hip-bath is used at about the same temperature (98° to 101° F.), and is especially adapted to allay painful *abdominal* and *pelvic disorders*, such as *biliary*, *renal*, and *uterine colic* and *strangury*, to relieve *retention of urine*, and bring on retarded *menses* and the *hæmorrhoidal flow*. Fomentations with warm water by means of cloths, sponges,

spongio-piline, poultices, etc. may be regarded as partial warm baths, and are used to relieve the tension of the skin in local phlegmonous inflammations, and at the same time, by increasing the amount of blood in the part, to promote suppuration. Such fomentations of the mammæ favor the *secretion of milk*, and, through the sympathy of these glands with the uterine system, sometimes excite the *menstrual flow*. This last effect has been secured by prolonged douches of warm water in the vagina, which are also useful in recalling suppressed *lochia* and allaying pain in the pelvis. Enemas of warm water are habitually used to evacuate the bowels. It is alleged that irrigation of the rectum with water at from 100° to 110° F., and repeated every two hours during the active stage of *dysentery*, has a marked influence, not only in palliating the tenesmus, but in shortening the attack (Reid, *New York Jour. of Med.*, xxiv. 603). Enemas of about two pints of water at 110° F. have been used advantageously for congestions and infarctions of the *uterus*, *bladder*, *prostate gland*, and other organs of the pelvis. Höfler states that enemas (varying from 104° to 113° F.), if thrown into the empty bowel through a long tube, directly increase the flow of urine (*Centralbl. f. Therap.*, vi. 478). Warm sand- or mud-baths are often employed at thermal springs in the treatment of chronic *rheumatism*, *gout*, general *dropsy*, etc. Water so hot that its contact can just be borne without scalding acts as a stimulant, and is sometimes used to arrest certain inflammations in debilitated parts, such as *panaris*, *frost-bite*, the effects of *local contusions*, etc.; to check local *perspirations* and general *colliquative sweats*, *epistaxis*, and *capillary hæmorrhage;* and to relieve various pains, such as *earache*, *toothache*, *neuralgia*, *colic*, *uterine pain*, etc. Its power is familiar in arresting the bleeding from *leech-bites* and similar small wounds. Following a German method, Dr. F. H. Hamilton applied successfully, in the treatment of lacerated and contused *wounds*, local baths of warm water, and also fomentations of cotton batting soaked in water at 95° to 110° F. and renewed every half hour. Subsequently, he employed the same method successfully in arresting *traumatic gangrene* (*Trans. Med. Soc. of State of New York*, 1875 and 1879). Water at 160° F. has been used to check the capillary *hæmorrhage* which is apt to follow the removal of Esmarch's tourniquet. But Dr. C. T. Hunter found that similar hæmorrhages are efficiently checked by water at 125° or 130° F. (*Phila. Med. Times*, x. 89). Hot-water injections have been used with prompt effect to arrest *uterine* hæmorrhage (Emmett, Barker), and that variety of it produced by laceration of the cervix or hæmorrhage from a like injury of the vulva has been controlled by means of water at 110° to 115° F. A stream of such water directed upon the undilated cervix uteri at term will bring on *labor*, or thrown into the cavity of a relaxed and bleeding uterus will induce its contraction (A. H. Smith). The hot bath prolonged for a half hour or more has repeatedly been used to bring on labor delayed by inertia of the uterus. In various inflammatory and congested states of the *eye* the stimulant action of hot water is at once the simplest and most efficient remedy. It should be as hot as the patient can comfortably bear with the hand, and should be applied by drenching or by being thrown against the eye with the hand while the face is bent over a basin containing the water. This operation should be repeated every hour or two or only two or three times a day, as may be required (Connor, *Am. Jour. of Med. Sci.*, Oct. 1881, p. 466). Still better, the face may be immersed in the water while the eye is kept open. According to Pétrequin, warm water is a better solvent for *cerumen* than oil, glycerin, etc. Boiling water may be employed to produce a powerful stimulant or revulsive action, as in cases of *asphyxia* and prolonged *syncope*. Its use requires great caution, and is not as safe as the application of a hammer or similar metallic instrument previously immersed in boiling water.

AQUÆ MEDICATÆ.—Medicated Waters.

Aquæ destillatæ, P. G.; *Aquæ stillatitiæ.—Distilled waters*, E.; *Eaux distillées, Hydrolats*, Fr.; *Destillirte Wässer*, G.; *Acquæ distillate*, F. It.

Preparation and Properties.—The above names are applied to waters which have been impregnated with volatile substances. All odorous plants and parts of plants impart their odor, and to a certain extent also their taste, to water which is distilled therefrom. This is due to a considerable extent to the volatile oils passing over with the vapor of water; but in many instances the flavor of such distilled waters differs more or less from that of the aqueous solutions of the corresponding volatile oils, and we must therefore assume that besides the volatile oils other volatile compounds, acids, and probably ethers, pass over and remain dissolved in the water, whereby the flavor is modified and

nearly always becomes more agreeable. In preparing medicated waters distillation should be resorted to whenever practicable.

The drugs are preferably used in the fresh state if they can be thus obtained, since during the drying process more or less of the volatile constituents are lost by evaporation, and, in common with the others, often modified in composition. In some cases where the oil-cells are well protected, as in cinnamon-bark, or the oil is produced only by contact with water, as in bitter almonds, the material may be preserved in the dry state for a long time without deterioration. In all cases where the oil-cells are not situated on the surface, as they are in many leaves, the drug should be suitably comminuted, so that it may be easily penetrated by the hot water and the oil-cells ruptured.

In distilling medicated waters over a naked fire great care should be taken to prevent the material from being burned, otherwise an empyreumatic odor and taste will be imparted to the distillate; this is obviated by placing the drug upon a diaphragm, or setting within the still another vessel perforated on the sides and bottom, so that the vapors will pass through it without unnecessary obstruction. If steam is used the danger of burning is avoided; in this case a jet of steam may be conducted to the bottom of the still, the contents of which are thereby heated to the boiling-point. If dry material is used, allowance must be made for its swelling on becoming thoroughly permeated by the water, as it might otherwise fill the still and pass into the condenser. Some materials when boiled in water foam considerably, and portions of the decoction are then apt to be carried over mechanically, rendering the distillate colored and otherwise impure. This tendency to foam over will be lessened by adding to the contents of the retort a small quantity of a fixed oil.

The rapidity with which medicated waters are distilled is of importance, since it has a considerable influence on their flavor and stability. In all cases the waters should be rapidly and thoroughly cooled in the condenser, to prevent the action of the hot water and of the acids which are frequently present upon the tin, and to avoid changes in the volatile oil, which, in its finely-divided condition, are apt to occur. Waters which have been insufficiently cooled very frequently become ropy in keeping. It is advisable, therefore, to distill them slowly and cool the condenser well with a sufficient supply of water.

A peculiar odor is observed in some waters immediately after they have been distilled from tin vessels or condensed in tin worms, but not when glass vessels have been used. If the waters are exposed to the air in loosely-closed vessels for a few days, this still-odor disappears and the natural odor of the water becomes apparent.

Distilled waters which, like orange-flower and rose-water, are not completely saturated with volatile oil, are advantageously prepared of double or triple strength, either by distilling off only one-half or one-third of the necessary quantity of water, or by having recourse to the process of cohobation, in which case the proper quantity of water is distilled off and a second or third time distilled from fresh portions of the same material. When wanted for use they are diluted with distilled water in the proper proportions. The German Pharmacopœia (1872) directed *concentrated medicated waters* to be prepared of German chamomile, melissa, sage, elderflowers, and linden-flowers, by distilling from 10 parts of the drugs 100 parts of water, adding to the distillate 2 parts of alcohol, and again distilling 10 parts. For use 1 part of these waters was diluted with 9 parts of distilled water.

Distilled waters are best preserved in well-corked bottles, which should be completely filled and protected from the light. Exposed to air and light, they gradually turn sour and lose their agreeable odor.

The U. S. Pharmacopœia allows most medicated waters to be prepared by dissolving the volatile oil in distilled water. To facilitate the solution the oils are now directed to be triturated with twice their weight of precipitated calcium phosphate, after which the distilled water is gradually added under constant trituration; the mixture is finally filtered through paper. Thorough trituration with an insoluble powder causes the division of the oils into very minute particles, in which condition they are more readily dissolved by water. The method of distributing the oil over purified cotton, and then bringing it into aqueous solution by slow percolation with distilled water, as advocated in the Pharmacopœia of 1880, did not meet with much approbation, on account of the possible bad effects arising from the continued contact of the oils with the fingers of the operator. The division of the volatile oils was formerly accomplished by triturating them with magnesium carbonate; but a minute quantity of this salt is always dissolved and the acids which may be naturally contained in the oils are neutralized. In some cases, as in cinnamon-water, a yellow or brownish color is also produced. One of the most import-

ant objections to the use of magnesia or magnesium carbonate is found in the action upon the salts of poisonous alkaloids and metals, which are decomposed thereby, with the precipitation of the alkaloids or metallic oxides, unless some acid be added to neutralize the magnesia (T. H. Powers, 1833). Other substances which are completely insoluble in water have been recommended for this purpose, such as powdered silica, kaolin, glass, pumice-stone, paper-pulp, and purified animal charcoal. G. G. Percival recommends the dissolving of the volatile oils directly in hot distilled water, filtering after cooling, whereby a strong and otherwise pure medicated water is obtained.

Tests for Purity.—Medicated waters should evaporate in a clean porcelain capsule without leaving any appreciable residue. The water should not acquire a brown or black color by ammonium sulphide or hydrogen sulphide (metals), or yield with the former a white sediment after having been previously rendered alkaline by the addition of ammonia (zinc).

AQUA AMMONIÆ, *U. S.*—Ammonia water.

Liquor ammoniæ, Br.; *Liquor ammonii caustici*, P. G.; *Spiritus salis ammoniaci causticus*, *Ammonia aqua soluta.*—*Ammoniaque liquide*, *Eau* (*Solution Liqueur*) *d'ammoniaque*, Fr.; *Salmiakgeist*, *Aetzammoniak*, *Ammoniak-Flüssigkeit*, G.; *Ammoniaca*, F. It.; *Amoniaco liquido*, Sp.

An aqueous solution of ammonia having the specific gravity 0.959 (*Br.*),0.960 (*U. S.*, *P. G.*), and containing 10 per cent. by weight of the gas.

Stronger water of ammonia has the specific gravity 0.891 (*Br.*), 0.901 (*U. S.*), and contains 32.5 (*Br.*), 28 (*U. S.*) per cent. by weight of the gas.

Formula of ammonia gas NH_3. Molecular weight 17.01.

Production.—Ammonia is produced during the putrefaction of all organisms and of many organic compounds containing nitrogen; it exists in the air and in the soil in the free state, mostly in combination with acids in the air, as carbonate and nitrite. Ammoniacal salts are met with in most plants and animals. The products of the dry distillation of many nitrogenated compounds contain ammonia, and it is from such a source—namely, from the so-called gas-liquor, a by-product of the manufacture of illuminating gas—that ammoniacal salts are principally obtained. (See Ammonii Chloridum and Ammonii Sulphas.)

Preparation.—1. Ammonia-water. The U. S. Pharmacopœia of 1890, like its predecessor, not stating an official method for preparing ammonia-water, the method of 1870 is here published; it will be found to yield an excellent product on a small scale: Take of Ammonium Chloride in small pieces, Lime, each 12 troyounces; Water 6 pints; Distilled Water a sufficient quantity. Pour a pint of the water upon the lime in a convenient vessel, and after it has slaked stir the mixture so as to bring it to the consistence of a smooth paste. Then add the remainder of the water and mix the whole thoroughly together. Decant the milky liquid from the gritty sediment into a glass retort of the capacity of 16 pints, and add the ammonium chloride. Place the retort on a sand-bath, and adapt to it a washing-bottle, previously connected with a two-pint bottle, by means of a glass tube reaching nearly to the bottom of the bottle, containing a pint of distilled water. Surround the bottle with ice-cold water and apply heat, gradually increased until ammonia ceases to come over. Remove the liquid from the bottle, and add to it sufficient distilled water to raise its specific gravity to 0.960. Lastly, keep the liquid in small bottles, well stopped.

According to the British Pharmacopœia, 1 pint of strong solution of ammonia is mixed with 2 pints of distilled water.

2. Aqua Ammoniæ Fortior, *U. S.*; Liquor ammoniæ fortior, *Br.*—Stronger water (Strong solution) of ammonia, *E.*; Eau d'ammoniaque forte, *Fr.*; Starker Salmiakgeist, *G.*—Take of Ammonium Chloride in coarse powder 3 pounds; Slaked Lime 4 pounds: and Distilled Water 32 fluidounces. Mix the lime with the ammonium chloride, and introduce the mixture into an iron bottle placed in a metal pot surrounded by sand. Connect the iron tube, which screws air-tight into the bottle in the usual manner, by corks, glass tubes, and caoutchouc collars, with a Woulf's bottle capable of holding a pint; connect this with a second Woulf's bottle of the same size; the second bottle with a flask or other vessel of the capacity of 3 pints, in which 22 ounces of the distilled water are placed, and connect the vessel, by means of a tube bent twice at right angles, with an ordinary bottle containing the remaining 10 ounces of distilled water. Bottles Nos. 1 and 2 are empty, and the latter and the vessel which contains the 22 ounces of distilled water are

furnished each with a siphon safety-tube charged with a very short column of mercury. The heat of a fire, which should be very gradually raised, is now to be applied to the metal pot, and continued until bubbles of condensable gas escape from the extremity of the glass tube which dips into the water of the vessel. The process being terminated, the vessel will contain about 43 fluidounces of strong solution of ammonia.

Bottles 1 and 2 will now include, the first about 16, the second about 10, fluidounces of a colored ammoniacal liquid. Place this in a flask closed by a cork, which should be perforated by a siphon safety-tube containing a little mercury, and also by a second tube bent twice at right angles and made to pass to the bottom of the terminal bottle used in the preceding process. Apply heat to the flask until the colored liquid it contains is reduced to three-fourths of its original bulk. The product now contained in the terminal bottle will be nearly of the strength of solution of ammonia, and may be made exactly so by the addition of the proper quantity of distilled water or of strong solution of ammonia.—*Br.*

When ammonium salts are treated with the hydroxide of a metal of the alkalies or alkaline earths, the corresponding salts of the metals are formed and ammonia and water are set free. In both of the above processes ammonium chloride and calcium hydroxide are used, the reaction resulting in the production of calcium chloride, ammonia, and water, as follows: $2NH_4Cl + CaOH_2$ yields $CaCl_2 + 2NH_3 + 2H_2O$. But, while the two processes are identical as far as the chemical reaction is concerned, they differ very considerably in the manipulation. In the first process the materials react upon each other in the presence of much water, resulting, even at the ordinary temperature, in the liberation of much ammonia, and permitting the completion of the process, including the disengagement of the ammonia, at the boiling temperature and in glass retorts. It is important to heat the mixture gradually, so that much of the gas may be given off before the boiling temperature is reached. A rapid heating is apt to cause the extrication of the gas with such violence that the contents of the retort will boil over.

In the British process the materials act upon each other in the dry state, requiring a higher heat, and, in consequence thereof, the employment of an iron retort. This process is mostly followed in the preparation of ammonia on the large scale, when ammonium sulphate is often substituted for the chloride on account of the cheapness of the former salt. The dry process necessitates greater care in the purification of the gas, which is indicated already by the dark color acquired by the liquid in the wash-bottle. The impurities in the gas are chiefly decomposition-products, resulting from the impurities contained in the ammonia salt and lime. Although the latter is used in excess, ammonium carbonate may form either from calcium carbonate possibly present or from the decomposition of organic matter. If the wash-bottle is charged with milk of lime, the organic decomposition-products are better retained, and any ammonium carbonate contained in the gas will be decomposed, yielding ammonia and calcium carbonate. In preparing ammonia on the large scale it is advantageous to connect the wash-bottle with a series of stoneware receivers shaped like Woulf's bottles, so that the gas which is not absorbed in the first will pass into the second receiver, and so on.

The employment of a considerable excess of calcium hydroxide has been found advantageous to ensure the complete decomposition of the ammonium salt. On account of this excess the residue in the retort will contain a basic calcium chloride having the composition $CaCl_2.3CaO$, which, after having been filtered from the lime, may be neutralized by hydrochloric acid and evaporated to dryness, to be utilized as calcium chloride.

On the large scale ammonia-water is usually made with common water, the natural impurities of which it contains, together, frequently, with notable quantities of iron derived from the iron delivery-tubes employed. Chemically pure ammonia-water may be obtained from this by heating it, or, preferably, the commercial stronger ammonia-water, in a glass flask or retort, and conducting the gas, a considerable amount of which is evolved below the boiling-point of water, by means of glass tubes, into distilled water.

Gaseous ammonia is obtained by passing the gaseous products in the above processes over dry potassa or calcium chloride.

Properties.—1. Gaseous Ammonia.—Ammonia is a colorless gas having a strong penetrating odor and an acrid alkaline taste. In pure oxygen it burns, forming water and free nitrogen. It has the specific gravity 0.593. By a pressure of seven atmospheres at 15° C. (59° F.), or when cooled to —40° at the ordinary atmospheric pressure, it condenses into a colorless liquid much lighter than water, which boils a few degrees above this temperature and crystallizes when placed in a mixture of solid carbon

dioxide and ether at about — 75° C. (— 102° F.). Water dissolves about 700 times its volume of ammonia gas.

2. Ammonia-water.—The aqueous solutions of ammonia constitute colorless, transparent liquids possessing the odor and taste of the gas, being lighter than distilled water and having a lower freezing-point than this liquid. They impart a brown color to turmeric-paper, a blue color to red litmus-paper, and a green color to the juice of violet-flowers, and evolve dense white fumes when a glass rod moistened with hydrochloric or acetic acid is held over the liquid. Ammonia neutralizes all acids, forming salts which are mostly colorless and crystallizable, possess a sharp saline taste, and when heated to redness are entirely volatilized, without leaving any residue unless the acid be non-volatile; even the solutions of most ammonium salts, when evaporated or heated to boiling, lose a portion of the ammonia. For the neutralization of 3.4 Gm. of ammonia-water 20 Cc. of normal sulphuric acid should be required (*U. S.*), or 85 grains by weight require 500 grain-measures of the volumetric solution of oxalic acid (*Br.*), or 28 to 28.5 Cc. of volumetric hydrochloric acid for 5 Cc. of ammonia-water (*P. G.*).

3. Stronger Ammonia-water.—It has the properties of ammonia-water, from which it differs chiefly in specific gravity and greater strength. To neutralize 3.4 Gm. of it should require 56 Cc. of normal sulphuric acid (*U. S.*). 5.23 Gm. require 100 Cc. (*Br.*), corresponding, the former to 28 per cent., the latter to 32.3 per cent. NH_3.

The following table gives the specific gravities of ammonia-waters of different strengths at 14° C. (57.2° F.), as ascertained by Carius, 1856:

Per cent. NH_3.	Specific gravity.	Per cent. NH_3.	Specific gravity.	Per cent. NH_3.	Specific gravity.	Per cent. NH_3.	Specific gravity.
36	0.8844	27	0.9052	18	0.9314	9	0.9631
35	0.8864	26	0.9078	17	0.9347	8	0.9670
34	0.8885	25	0.9106	16	0.9380	7	0.9709
33	0.8907	24	0.9133	15	0.9414	6	0.9749
32	0.8929	23	0.9162	14	0.9449	5	0.9790
31	0.8953	22	0.9191	13	0.9484	4	0.9831
30	0.8976	21	0.9221	12	0.9520	3	0.9873
29	0.9001	20	0.9251	11	0.9556	2	0.9915
28	0.9026	19	0.9283	10	0.9593	1	0.9959

Tests.—The solutions of ammonium salts yield orange-colored crystalline precipitates with platinum chloride and sodium cobaltic nitrate, and, if not too dilute, white ones with tartaric acid or acid sodium tartrate. The most delicate tests for ammonia are those of Einbrodt (1852) and of Nessler (1856). *Einbrodt's reagent* is an aqueous solution of corrosive sublimate, rendered slightly alkaline by the addition of a minute quantity of potassium carbonate. The test is applied to an alkaline solution, or if the solution has an acid reaction it should be rendered faintly alkaline by the addition of potassa or soda, when the test-liquid will produce a white cloudiness if only $\frac{1}{500000}$ of ammonia is contained in the solution.

Nessler's reagent is a solution of potassium iodo-hydrargyrate, made either by saturating a solution of potassium iodide with mercuric iodide, and rendering this alkaline by potassa, or it is prepared from potassium iodide and mercuric chloride. (See Hydrarg. Iodidum Rubrum.) With solutions of ammonia or ammoniacal salts it gives a brown-red precipitate, or if very dilute an orange color. It may be used for the quantitative determination of minute quantities of ammonia by diluting the liquid so far that with Nessler's solution only an orange tint is produced, which is compared with that obtained from a solution of ammonium chloride of known strength by diluting the latter until the same coloration is produced with the test liquid.

Test of Purity.—Water of ammonia should evaporate at the temperature of boiling water without leaving any residue (salts). "On slightly supersaturating 10 Cc. of Ammonia Water with diluted sulphuric acid, no empyreumatic odor or red color should be developed, and if to this liquid 1 Cc. of centinormal potassium permanganate solution be added, the pink color should not be completely destroyed within ten minutes (absence of readily oxidizable matters). "If Ammonia Water be mixed with 4 times its volume of lime-water, it should not afford an immediate turbidity (only minute traces of carbonic acid); and if it be diluted with twice its volume of water, it should not be affected by ammonium oxalate test-solution (absence of calcium), nor should it be affected by hydrogen sulphide test-solution either before or after neutralization with hydrochloric

acid (absence of metallic impurities). "If Ammonia Water be slightly supersaturated with nitric acid, it should not be affected by barium chloride test-solution (absence of sulphates), nor by silver nitrate test-solution (chloride); and if a third portion of the acidulated liquid be evaporated on a water-bath to dryness, it should afford a colorless residue, which, on ignition, should be completely volatilized (absence of coal-tar bases and of fixed impurities)."—*U. S.*

Pharmaceutical Uses and Preparation.—Ammonia-water is extensively employed as a precipitant in the manufacture of most alkaloids, of calcium phosphate, iron hydroxide, and purified ammonium chloride; it is used for nearly neutralizing solutions in preparing digitalin and bismuth subcarbonate and subnitrate, and as a solvent for impurities in the process for santonin. Combined with citric acid as ammonium citrate, it acts as a solvent for certain salts of iron and bismuth which are insoluble in water; it is employed in the preparation of ammonium benzoate, phosphate, and citrate, and of hydrargyrum ammoniatum.

Action and Uses.—The vapor of ammonia causes plants to fade and shrivel and asphyxiates animals immersed in it. Water of ammonia given to animals occasions distress, frequent pulse and respiration, prostration, and rigid spasm before death, after which the gastro-intestinal mucous membrane is injected, softened, and covered with bloody mucus, while the blood in the vessels coagulates imperfectly and its corpuscles are disintegrated. It does not appear to increase the alkalinity of the blood or of the secretions, and it is found in the urine oxidized. When ammonia-water is injected into the veins of an animal exhausted by loss of blood and exposure of the viscera, and the congested heart has almost ceased to beat, immediately the heart resumes its action and normal color and the aorta is filled with bright-colored blood (Griswold, *Med. Record*, xv. 532; compare Talma and v. d. Weyde, *Zeitsch. f. k. Med.*, ix. 311). Applied to the human skin, caustic ammonia excites a sense of warmth, followed by burning pain and more or less vesication, or, if the application be excessive and prolonged, by gangrene of the part. Blisters caused by ammonia are very painful and slow to heal. Ammoniacal vapors in contact with the eye occasion severe pain and inflammation. Inhaled through the nose, they produce sneezing, lachrymation, and burning. In the air-passages they excite violent irritation unless greatly diluted, and if inhaled during a state of insensibility fatal asphyxia may result. The passage of the vapor through the mouth under such circumstances may produce severe inflammation of its lining membrane. Internally, its action upon the healthy system is slight and transient, but in states of nervous exhaustion it is very prompt and distinct. A sense of tension in the temples, exhilaration of the feelings, a consciousness of increased strength, greater warmth of the skin, and an augmented secretion of sweat, urine, and bronchial mucus, are among its most sensible effects, which are not, as in the case of alcohol, followed by a corresponding depression. The action of large doses is not uniform. Sometimes death follows in a few minutes, with symptoms of cauterization of the fauces and larynx, sometimes later with those of gastro-enteritis, accompanied or not with delirium, stupor, and spasm. A drunkard, having swallowed nearly 2 fluidounces of "aqua ammoniæ," survived four and a quarter days (*Boston Med. and Surg. Jour.*, Aug. 1880, p. 166). After death may be found inflammation and œdema of the fauces and larynx, sometimes of the bronchia also, and generally of the œsophagus, stomach, and small intestine. The mucous membrane may even look charred. In other cases, in spite of large doses of the poison and violent symptoms denoting local irritation and nervous exhaustion, the patients recover, although it may be after a long time. A man who inhaled the fumes of strong water of ammonia suffered from dyspnœa, the inside of his mouth and the tongue were covered with white patches, he had burning at the epigastrium and frontal headache, lost his appetite, and suffered from pulmonary œdema. He recovered within six weeks, (*ibid.*, May, 1884, p, 497).

Externally, ammonia is commonly employed both as an ingredient of stimulating liniments and as a caustic. In the former it is a very popular palliative for the pains of muscular *rheumatism*, *neuralgia*, *muscular spasm*, etc., and for relieving *congestion*, particularly of the *larynx*, lungs, *throat*, and bowels. As the latter its greatest utility is limited to the first period of the attack. In neuralgia its caustic is more important than its stimulant action, and is best secured by vesicating the skin wherever the affected nerve is found to be tender, either at its point of emergence from bones, muscles, etc. or where it is ultimately distributed to the skin. The vesication must be superficial for superficial nerves, and deeper for profound ones. It is best effected by saturating a disk of cloth with ammonia, applying it accurately to the skin, and holding it there, covered

with some solid substance, until vesication has been accomplished. A salt of morphine dissolved in the ammonia used renders the relief more certain. *Amenorrhœa* has been successfully treated by vaginal injections of a weak solution of ammonia, and the same is true of vaginal *leucorrhœa*. Other cases in which the local substitutive irritation of ammonia is available are—a tendency to *amaurosis* from exhaustion of the retina, in which case the vapor may be cautiously allowed to come in contact with the conjunctiva; superficial *burns* and *frost-bite;* and a general exhaustion or depression of the nervous system in *low fevers*, when a weak solution of ammonia in hot water may be applied by sponging to the whole skin. Ammonia enters into most of the liniments and washes that are used to prevent the *hair* from falling out or to stimulate its growth. *Vulvar pruritus* is said to be benefited by vaginal injections consisting of half a fluidrachm or more of stronger water of ammonia in half a pint of common water. This may possibly be true of pruritus connected with amennorrhœa, but the remedy is useless in most of the other forms, except as a very transient palliative.

By inhalation the vapor of ammonia has been used to arrest the development of catarrhal affections of the throat and air-passages (*bronchitis*, *coryza*, and *pharyngitis*). It is recommended to employ a weak solution. The most successful application of this method is, perhaps, to chronic dryness of the *pharynx* and to chronic *hoarseness*. Ammonia has been used as an antidote to *chlorine* and to *bromine*. *Acidity* of the stomach from feeble digestion is benefited by this medicine, and so is the *tympanites* which is often associated with it. In two affections in which spasm of the larynx is a more or less prominent symptom, *whooping cough* and *epilepsy*, the inhalation of ammoniacal fumes has been known to delay or prevent the paroxysm. The same means are popularly employed to relieve *syncope* from all causes, and the various conditions which lead to it and to which nervous women are subject. Hence it is the basis of most of the "smelling-salts." It may be cautiously used in all cases of suspended animation, whether from syncope or *asphyxia*. In these and various analogous conditions the utility of ammonia is due to its indirect stimulation of the heart. It has been manifested in the advanced stage of many exhausting diseases. Its power is strongly exhibited when *disordered action* of the heart depends upon either its positive or its relative debility—*i. e.* in muscular wasting or valvular obstruction. It has been proposed to employ it in *cholera* conjointly with large aqueous or saline intravenous injections. Ammonia is, if promptly employed, an antidote to *hydrocyanic acid* and to *alcoholic intoxication*. The best mode of administering it in the former case is by intravenous injection. For this purpose the officinal ammonia-water, which is a 10 per cent. by weight solution, is diluted with an equal quantity of pure water, and about a fluidrachm at a time is cautiously injected. The revival of the insensible and apparently lifeless patient is sometimes very prompt. (Compare *Glasgow Med. Jour.*, iv. 493; *Lancet*, 1879, p. 158; *Med. Record*, xv. 532.) This expedient has been employed successfully in poisoning by privy-gas (*Boston Med. and Surg. Jour.*, Sept. 1882, p. 309). Trusewitz has reported a case of attempted suicide by muriatic acid in which, after its apparent extinction, life was restored by the hypodermic injection of solution of ammonia. The caustic produced a circumscribed slough (*Centralbl. f. Ther.*, iii. 163). Locally applied, ammonia-water relieves the pain of the stings and bites of *bees*, *wasps*, *spiders*, *mosquitoes*, etc., and a large amount of evidence exists to prove its antidotal power against the bites of *serpents*, both when administered by the stomach and when injected into veins. The latter method is alleged to be by far the most efficient. The median cephalic vein is the one generally selected for the operation, and from 5 to 20 drops of a strong solution of ammonia in a fluidrachm of water is thrown into the vein with a hypodermic syringe. The clinical facts relied upon for establishing the efficacy of the method are numerous, but the experiments on animals by Fontana in the last century and by some recent observers gave only negative or doubtful results (*Times and Gaz.*, Dec. 1873, p. 712; *Lancet*, Sept. 19, 1874; *Practitioner*, xl. 292). Ammonia has been administered in large doses for the purpose of causing *resolution of fibrin* in the right side of the heart and in the great vessels. In three out of four cases the treatment was apparently successful. It is found experimentally that ammonia mixed with blood preserves it fresh and fluid for a long time. Richardson, who proposed this treatment, insists on the perfect repose of the patient during its progress (*Med. News*, xlix. 630). Van Wyck recommends the use of ammonia to hasten the removal of cerebral clots after *apoplexy*, with the caution that it should not be given until ten days or a fortnight after the attack (*Med. News*, xlvi. 673; compare Munoz, *Bull. de Thérap.*, cxiv. 184).

The dose of water of ammonia is from Gm. 60–2.00 (♏x–xxx), largely diluted. The

stronger prepartion is for external use. It may be applied to the skin on some porous tissue saturated with it and covered with an impermeable substance. In from three to ten minutes the desired effect may be expected. Gondret's paste is formed by adding concentrated water of ammonia to a mixture of melted lard and tallow. It may be applied in a disk-shaped layer an inch or two in diameter. It is apt to cauterize the skin too deeply. As a rubefacient ammonia is generally associated with oil or some unctuous substance, and should be applied with gentle friction to the skin.

As an *antidote* any mild vegetable acid (vinegar, lemon-juice) may be employed to neutralize the uncombined ammonia in the stomach. The local irritant effects require demulcent and protective remedies.

AQUA AMYGDALÆ AMARÆ, *U. S.*—Bitter-Almond Water.

Aqua amygdalarum amararum, P. G.—*Eau d'amandes amères*, Fr.; *Bittermandelwasser*, G.; *Acqua distillata di mandorle amare*, F. It.

Preparation.—Oil of Bitter Almonds 1 Cc.; Distilled Water 999 Cc. Dissolve the oil in the distilled water by agitation and filter through a well-wetted filter.—*U. S.* (16 minims of oil of bitter almonds, dissolved in 2 pints of distilled water, will yield a preparation of official strength.)

Made by this process, bitter-almond water is a very unreliable preparation, owing to the variable amount of hydrocyanic acid contained in the oil of bitter almonds. The following will yield a water of definite strength in hydrocyanic acid; and, since in this form the latter is scarcely prone to decomposition, such or a similar preparation deserves to take the place of the officinal hydrocyanic acid and of the present bitter-almond water (see *Amer. Jour. of Pharmacy*, 1874, p. 217):

Bruise Bitter Almonds 12 parts, and express as much fixed oil as possible without the aid of heat. Powder the press-cake, mix it thoroughly with water 20 parts and distil off 9 parts into a receiver containing alcohol 3 parts, determine the amount of hydrocyanic acid in the distillate, and then dilute with a mixture of alcohol 1 part and distilled water 3 parts, so that 1000 parts of the mixture contain 1 part of hydrocyanic acid.

Thus prepared, bitter-almond water is nearly clear, and has a strong odor of hydrocyanic acid and oil of bitter-almonds, the latter remaining after the hydrocyanic acid has been removed by means of silver nitrate.—*P. G.*

In making bitter-almond water by the latter process the fixed oil is removed, because it hinders the reaction between the amygdalin and emulsin, to complete which maceration of the expressed almonds with water for about ten or twelve hours is advisable at a temperature of about 30° or 35° C. (86° or 95° F.). The almond mixture is then placed upon a perforated diaphragm and heat applied to the still. Pettenkofer's process, which has been adopted by the Austrian Pharmacopœia, differs in this: that 11 parts of the powdered bitter almonds are twice mixed with hot water and boiled to dissolve the amygdalin; the expressed decoctions, when cold, are mixed with 1 part of powdered bitter almonds, macerated and distilled as before; the emulsin contained in 1 part of the almond is sufficient to decompose the whole of the amygdalin, and, there being only a small amount of insoluble matter in the still, the distillation proceeds without difficulty even over a naked fire.

When the requisite quantity of water has distilled over, 27 Gm. of the distillate are diluted with 54 Gm. of distilled water, mixed with sufficient magnesia, previously rubbed with water to render it milky, and with a few drops of solution of potassium chromate; decinormal (volumetric) solution of silver nitrate is then added until the red color produced by the latter ceases to disappear on stirring; each Cc. of the silver solution represents .01 per cent. of HCy. A bitter-almond water containing .1 per cent. of hydrocyanic acid will require 10 Cc. of the silver solution. The strength may also be determined gravimetrically by adding to 1000 grains of the water first a little ammonia, then a slight excess of nitric acid, and finally solution of silver nitrate until a precipitate ceases to appear; this, when washed and dried, should weigh exactly 5 grains; if it weighs more the distillate must be diluted; should it weigh less, which may happen if the almond-powder has not been macerated with water or if the bitter almonds have been mixed with sweet almonds, it is best to redistil the water, adding, if necessary, some common water to the retort, and recovering a quantity calculated beforehand from the weight of the precipitate.

This bitter-almond water has exactly one-twentieth the strength of the diluted hydrocyanic acid, but is much stronger than that of the U. S. Pharmacopœia, the latter corre-

sponding perhaps better with the *Aqua amygdalarum amararum diluta* (vel *Aqua cerasorum*) which the German Pharmacopœia (1872) prepared by mixing 1 part of the above almond-water with 19 parts of distilled water. If the oil of bitter almonds has been previously deprived of its hydrocyanic acid, the bitter-almond water prepared from it will possess no virtues except for imparting flavor.

Action and Uses.—This uncertain—and unsafe as well as uncertain—preparation, as directed by U. S. P., is not officinal in the British Pharmacopœia. If hydrocyanic acid must be given internally, it may be administered with less risk in the form of potassium cyanide. The dose of the concentrated German preparation is Gm. 1–2 (♏ x–xxx), and of the American Gm. 10–15 (3 or 4 teaspoonfuls).

AQUA ANETHI, *Br.*—Dill-Water.

Eau d'aneth, Fr.; *Dillwasser*, G.

Preparation.—Take of Dill-Fruit bruised 1 pound; Water 2 gallons. Distil 1 Imperial gallon (= 10 pounds).—*Br.*

The water, which is at first slightly milky if prepared by this process, possesses the odor and taste of dill-fruit.

Action and Uses.—It does not increase the lacteal secretion, but imparts to it an aromatic flavor, which renders its administration to the nursing mother convenient in cases of infantile *colic*. It, however, has no advantage in taste or action over anise-water, which it in all respects resembles. It is seldom used in this country.

AQUA ANISI, *U. S.*, *Br.*—Anise-water.

Eau d'anis, Fr.; *Aniswasser*, G.; *Acqua distillata di anice*, F. It.

Preparation.—Oil of Anise 2 Cc.; Precipitated Calcium Phosphate 4 Gm.; Distilled Water a sufficient quantity; to make 1000 Cc. Triturate the oil with the calcium phosphate, add the water gradually under constant trituration, and filter.—*U. S.*

(32 minims of oil of anise may be triturated with 60 grains of calcium phosphate, and will require 2 pints of distilled water.)

Anise-fruit bruised 1 pound; water 2 gallons. Distil 1 Imperial gallon (= 10 pounds).—*Br.* Distilled from the fruit, anise-water has a more pleasant odor and taste than that made from the oil.

Action and Uses.—Anise-water is an agreeable and useful vehicle for medicines intended to expel *flatus* and to allay *colic* and the pain of laborious digestion. It is often used to mitigate the *griping* of senna, rhubarb, jalap, and other purgatives, and as a suitable vehicle for magnesia. It is thought also to be an appropriate excipient for expectorant medicines. *Dose*, Gm. 16–32 (f℥ss–i) and upward.

AQUA AURANTII FLORUM, *U. S.*—Orange-flower Water.

Aqua aurantii floris, Br.; *Aqua florum naphæ.—Eau (Hydrolat) de fleur d'oranger, Eau de naphe*, Fr.; *Orangenblüthenwasser*, G.; *Acqua distillata di arancio*, F. It.; *Agua de azahar*, Sp.

Preparation.—Stronger Orange-flower Water, Distilled Water, of each 1 volume. Mix them immediately before use.—*U. S.*

Action and Uses.—Orange-flower water is more remarkable for its delicate and refreshing perfume than for active medicinal properties. It forms a pleasant flavoring ingredient of many potions, and may be prescribed for nervous persons during attacks of neuralgic *headache*, *palpitation* of the heart, and a variety of minor *hysteroidal* disorders, the offspring of indolence and self-indulgence.

AQUA AURANTII FLORUM FORTIOR, *U. S.*—Stronger Orange-flower Water; Triple Orange-flower Water.

Water saturated with the volatile oil of fresh Orange-flowers, obtained as a by-product in the distillation of the oil of orange-flowers. It should be kept in loosely-stoppered bottles in a dark place.—*U. S.*

The French Codex directs the distillation, by means of steam, of twice the weight of the fresh orange-flowers used. Thus prepared, it is called in commerce *double orange-flower water*, and if it is diluted with its own weight of distilled water it is known as

simple orange-flower water. The so-called *triple* and *quadruple orange-flower waters* are also met with in commerce, the former being obtained by distilling 3 parts, the latter by distilling 2 parts, of water from 2 parts of fresh orange-flowers.

Distilled orange-flower water is a clear and colorless or slightly opalescent liquid of a very agreeable odor and aromatic taste, which cannot be imitated by preparing the water from the oil of orange-flowers (neroli). As distilled from the flowers, it possibly contains some volatile ethers, which are freely soluble in water and not contained in the volatile oil. Occasionally, commercial orange-flower water has separated mucilaginous flocks, which may be removed by agitation with powdered kaolin and filtration. If it has acquired an acid reaction, it is advisable to distil it over magnesia. The total absence of metallic salts, resulting from the use of a metallic condenser or from keeping the water in metallic vessels, is proved by its remaining unaffected by hydrogen sulphide and by ammonium sulphide. Occasionally distilled orange-flower water has been met with which acquires a red color on the addition of an acid; the cause of this abnormal behavior has not been ascertained, but may perhaps be due to some accidental impurity.

Action and Uses.—Stronger orange flower-water is only used for the preparation of aqua aurantii florum.

AQUA CAMPHORÆ, *U. S.*, *Br.*—Camphor-water.

Aqua camphorata.—Eau camphrée, Fr.; *Kampherwasser*, G.; *Agua alcanforada*, Sp.

Preparation.—Camphor 8 Gm.; Alcohol 5 Cc.; Precipitated Calcium Phosphate 5 Gm.; Distilled Water a sufficient quantity; to make 1000 Cc. Triturate the camphor with the alcohol, afterward with the calcium phosphate, and with the water gradually added. Finally, filter.—*U. S.*

(120 grains of camphor, 80 minims of alcohol, and 80 grains of calcium phosphate may be used in making 2 pints of camphor-water.)

Take of camphor broken in pieces half an ounce; distilled water 1 gallon. Enclose the camphor in a muslin bag, and attach this to one end of a glass rod, by means of which it may be kept at the bottom of a bottle containing the distilled water. Close mouth of the bottle, macerate for at least two days, and then pour off the solution when it is required.—*Br.*

This is intended to be a saturated solution of camphor in water. R. Rother (1871) has shown that very cold water dissolves more camphor than can be retained in solution at the ordinary temperature, the excess crystallizing out, leaving, after filtration, such a saturated solution as is intended by the pharmacopœias. In preparing camphor-water by the above processes cold water should therefore be used. Prepared with the aid of magnesium carbonate by the process of the U. S. P. 1870, camphor-water contained, according to G. F. H. Markoe (1865), 2 grains of camphor in the fluidounce; that of the British Pharmacopœia, only ½ grain.

Action and Uses.—The proportion of 1 grain of camphor which is contained in each ½ fluidounce of this preparation is not sufficient to develop the more potent effects of the drug, yet quite enough to sustain the nervous system in the minor grades of exhaustion and prostration into which it is apt to fall in *low fevers* on the one hand, and in states of *nervous debility* and disorder on the other. Its anodyne and antispasmodic influence is shown in mild attacks of *neuralgia*, of nervous *headache*, of *colic*, of *dysmenorrhœa* depending upon an irritable state of the uterus, in *after-pains*, in *hiccup*, and in nervous *palpitation of the heart*. The average dose is about Gm. 16 (f℥ss), which may be repeated at intervals of an hour or two.

AQUA CARUI, *Br.*—Caraway-water.

Aqua carui.—Eau distillée de carvi, Fr.; *Kümmelwasser*, G.

Preparation.—Take of Caraway Fruit bruised 1 pound (avoirdupois); Water 20 pounds. Distil 10 pounds (avoirdupois) (1 gallon Imperial).—*Br.*

This water has the flavor of the fruit in a marked degree.

Action and Uses.—The properties of caraway-water are almost identical with those of anise-water; it may be given in the dose of a fluidrachm (Gm. 4) or more.

AQUA CHLORI, *U. S.*—Chlorine-water.

Liquor chlori, Br.; *Aqua chlorata*, P. G.; *Aqua chlorinii*, U. S. 1870; *Chlorum solutum*, *Aqua oxymuriatica.—Solution of chlorine*, E.; *Eau chlorée, Chlore liquide*, Fr.; *Chlorwasser*, G.; *Acqua di cloro*, F. It.

An aqueous solution of chlorine containing at least .4 per cent. (*U. S.*, *P. G.*), not less than .6 (*Br.*), of the gas.

Symbol of chlorine Cl. Atomicity univalent. Atomic weight 35.37.

Origin.—Chlorine was discovered by Scheele (1774), and was at first called dephlogisticated muriatic acid, afterward *oxymuriatic acid*, under the supposition that it was a compound of muriatic acid with oxygen. Gay-Lussac and Thénard (1809) showed that from its behavior it might be regarded as an element, a view which was strengthened by the researches of Humphry Davy (1810), who called it chlorie gas, which name was changed to chlorine by Gay-Lussac (1813). Chlorine is widely distributed in nature, but owing to its affinity for other elements it is never found in the isolated state. It exists in many minerals, in most spring-waters, in sea-water, in plants, and in animals, and is liberated from the chlorides by the combined action of sulphuric action and an oxidizing agent.

Preparation.—Take of Manganese Dioxide 10 Gm.; Hydrochloric Acid 35 Cc.; Water, 75 Cc.; Distilled Water 400 Cc. Place the oxide in a flask connected by a suitable tube with a small wash-bottle containing 50 Cc. of water, and connect this with a bottle having a capacity of 1000 Cc., and containing 400 Cc. of distilled water which has previously been boiled and allowed to cool. Add to the oxide in the generating flask the hydrochloric acid, previously diluted with 25 Cc. of water, and by means of a sand-bath apply a gentle heat. Conduct the generated chlorine through the water contained in the wash-bottle to the bottom of the bottle containing distilled water, which should be loosely stopped with cotton and kept during the operation at a temperature of about 10° C. (50° F.). When the air has been entirely displaced by the gas, disconnect the bottle from the apparatus, and, having inserted the stopper, shake the bottle, loosening the stopper from time to time, until the gas ceases to be absorbed. If necessary, reconnect the bottle with the apparatus, and continue passing the gas and agitating, until the distilled water is saturated. Finally, pour the chlorine-water into small, dark amber-colored, glass-stoppered bottles, which should be completely filled therewith, and keep them in a dark and cool place. Chlorine-water, even when kept from light and air, is apt to deteriorate. When it is required of full strength it should be freshly prepared.—*U. S.*

(When it is desired to make chlorine-water by the pharmacopœial method, 150 grains of manganese dioxide, 1¼ fluidounces of hydrochloric acid, 2½ fluidounces of water, and 13½ fluidounces of distilled water may be used, and the official directions then followed.)

This process is identical with that of the British Pharmacopœia, except as to weights and measures, but both aim at a saturated solution of chlorine in water with the simplest manipulation. In following the Pharmacopœia the best corks should be used for the generating-flask and wash-bottle, since porous corks are readily penetrated and destroyed by chlorine gas. This gas is generated by the action of hydrochloric acid upon manganese dioxide, manganese chloride, chlorine, and water being produced; $MnO_2 + 4HCl$ yields $MnCl_2 + Cl_2 + 2H_2O$. If the undiluted acid of the Pharmacopœia is employed, the evolution of chlorine gas will commence without heat being applied, and will continue for some time. Diluted as directed, the application of heat is necessary from the beginning. A strong heat should not be used at first, since hydrochloric acid gas would be carried over into the wash-bottle. The loss of acid may be entirely avoided if the manganese oxide is used in small lumps instead of in powder, and in sufficient quantity so as not to be covered by the acid. Although chlorine is soluble in water to a considerable extent, it does not dissolve very readily; hence gas-bubbles will soon pass through the water without being much diminished in size. The pharmacopœias direct the use of receiving-bottles which are but partially filled with water. The atmosphere in the upper part of the bottle will gradually be displaced by the heavier chlorine, and when the latter begins to escape from the mouth of the bottle, this is disconnected from the apparatus, loosely corked, and agitated, when the gas will be absorbed. The bottle, which should be protected from the light, is then replaced, and the operation repeated until no further diminution of the pressure is observed in the bottle on being gently agitated when filled with chlorine. The British Pharmacopœia directs the agitation of the bottle only

after the evolution of chlorine gas has ceased; much of the gas may be lost by not repeating the agitation several times.

The temperature best suited for dissolving the chlorine in water is 10° C. (50° F.). Near the freezing-point of water a solid chlorine hydrate, $Cl.5H_2O$, is formed, which is less soluble in water than the gas. At the temperature indicated water dissolves, according to Schönfeld, 2.585 times its volume of gas, the solubility being gradually lessened as the temperature rises. When the operation is finished it is well to pour the chlorine-water at once into small glass-stoppered vials, which should be completely filled and kept in a cool and dark place. The stoppers should be secured by twine, or, as suggested by Hager, by bladder which has been previously coated with a mixture of collodion and paraffin.

For the preparation of chlorine on the large scale, as in the manufacture of chlorinated lime, sulphuric acid is sometimes used in addition to the manganese dioxide and hydrochloric acid, when all the chlorine contained in the latter is obtained and manganous sulphate is left in solution. Or the generation of hydrochloric acid and of chlorine is effected in one operation by the use of sulphuric acid, sodium chloride, and manganese dioxide, in which case the sulphates of sodium and of manganese remain behind.

For special purposes chlorine may be prepared by the action of hydrochloric acid upon potassium dichromate; $14HCl + K_2Cr_2O_7$ yield $3Cl_2 + 2KCl + Cr_2Cl_6 + 7H_2O$, the result being chlorine, potassium chloride, chromium chloride, and water. Or potassium chlorate may be decomposed by hydrochloric acid, with the formation of chlorine, potassium chloride, and water; $6HCl + KClO_3$ yields $3Cl_2 + KCl + 3H_2O$, but the gas is in this case apt to be contaminated with hypochlorous acid.

During the preparation and handling of chlorine-water the operator should be careful not to inhale the gas, on account of its irritating and poisonous properties. Should its effects be perceived, it is advisable to carefully inhale a little ammonium sulphide, which is decomposed by the chlorine into ammonium chloride and sulphur. It should, however, be cautiously used, since an excess of this compound is likewise poisonous. A little ammonia, sufficiently diluted, may also be taken with advantage.

Properties.—Chlorine is a greenish-yellow, irrespirable, corrosive gas, having the spec. grav. 2.45 as compared with air, and becoming liquid at 15° C. (59° F.) under a pressure of four atmospheres. Liquid chlorine is dark yellow, congeals at — 102° C. (— 152° F.), and boils at — 33.6° C. (— 28.5° F.). Chlorine is not inflammable, but is capable of supporting combustion.

Chlorine-water is a clear, greenish-yellow liquid possessing the suffocating odor and acrid, irritating taste of chlorine, evaporating without leaving any residue, but separating crystals of chlorine hydrate when cooled to the freezing-point of water. Its specific gravity is 1.003 (*Br.*) when saturated at 6° C. (42.8° F.) (Berthollet). It instantly discharges the color of diluted solutions of indigo and litmus, and bleaches vegetable coloring-matters generally. Exposed to light, it is decomposed into hydrochloric acid and oxygen. It is a powerful oxidizing agent, and this property serves to readily ascertain its strength. A fluidounce of it, mixed with a solution of 14 grains of pure ferrous sulphate, does not produce a blue precipitate with potassium ferricyanide, indicating that the salt has been completely oxidized to ferric sulphate, and proving that the water contains 0.4 per cent. of chlorine.

Tests.—Chlorine-water should evaporate without leaving any residue. Agitated with an excess of mercury until the odor of chlorine has disappeared, the remaining liquid reddens litmus-paper but faintly, if at all (limit of hydrochloric acid) (*U. S.*). The test of the British Pharmacopœia indicates a strength of 0.6 per cent. It is applied as follows: A solution of 20 grains of potassium iodide in an ounce of water yields with 439 grains of chlorine-water a deep red-colored liquid, which requires for the discharge of its color 750 grain-measures of the volumetric solution of sodium thiosulphate, corresponding to 2.66 grains of chlorine.

On mixing 17.7 Gm. of chlorine-water with a solution of 1 Gm. of potassium iodide in 10 Gm. of water, the resulting deep-red liquid should require for complete decoloration at least 20 Cc. of decinormal solution of sodium thiosulphate (corresponding to at least 0.4 per cent. of chlorine.)—*U. S.* The requirements of the German Pharmacopœia are identical with these, 25 Gm. of chlorine-water, 1 Gm. of potassium iodide, and 28.2 Cc. of the thiosulphate solution being used.

The volumetric determination of the chlorine is indirectly accomplished, and is based upon the fact that chlorine is capable of displacing iodine and bromine in equivalent

proportions; thus, $2KI + Cl_2 = 2KCl + I_2$. In the pharmacopœial test the chlorine which should be present in 17.7 Gm. of chlorine-water will liberate 0.251 + Gm. of iodine (this being kept in solution by the remainder of the potassium iodide), and hence 20 Cc. of decinormal sodium thiosulphate solution, containing (0.024764 × 20) 0.49528 Gm. $Na_2S_2O_35H_2O$, will be required to discharge the color according to the equation: $I_2 + 2(Na_2S_2O_35H_2O) = 2(NaI) + Na_2S_2O_6 + 10H_2O$.

Action and Uses.—The action of chlorine-water in large doses and internally is that of an irritant poison. In a diluted state it acts locally as a stimulant and disinfectant, and on absorption is supposed to quicken all the functions and purify the blood in typhoid forms of disease depending upon an animal poison generated within the system or absorbed from without. It is highly probable that this view of its operation is derived chiefly from its power of neutralizing the foul odors of decomposition. The efficacy of chlorine in *typhus fever*, in *scarlet fever*, in *diphtheria*, in *small-pox*, etc. is wholly undemonstrated, except in so far as it is a palliative of certain local and subordinate symptoms, such as *putrid angina* and a burning heat of the skin. In all forms of *sore throat* attended with fetid discharges and an ulcerated or torpid condition of the mucous membrane, washes and gargles of chlorine-water may be used with the same advantage as other stimulant disinfectants. A like statement may be made regarding other forms of disease in which the intestinal discharges are peculiarly fetid, as in certain cases of *typhoid fever* and of typhoid types of *dysentery*, *small-pox*, etc. Chlorine-water is to be commended as a wash or dressing for all forms of *sores* which have a fetid discharge, even for *cancerous* ulcers, and as a lotion for the skin when the crusts formed by *small-pox* pustules become offensive. Chlorinated water has been reputed to have the power of preventing the infection of *syphilis* and of *puerperal fever*—in the one case by its use in washing the genitals after impure coition, and in the other by cleansing the hands of accoucheurs after attendance upon cases of the disease. Supposing the alleged effect to be real, which is by no means proven, it is not quite clear that an equally diligent use of soap would not have been followed by an equal degree of immunity. Chlorinated oil, made by passing chlorine gas through olive oil, has been found efficient in *scabies* and as a parasiticide generally. At one time chlorine gas was used by inhalation in various bronchial affections, and especially in *phthisis* and *fetid bronchitis*, but atomized chlorine-water is preferable.

Since the belief began to prevail that every infectious and contagious disease is represented by a specific germ through which it is disseminated, and the discovery was made that chlorine ranks highly among germicides, it has been held not only that the diseases in question are preventible and curable by chlorine, but also that it possesses this virtue through its germicide powers. The germ theory, when strictly examined, is seen to be little more than an hypothesis, and hence the manner and degree of the efficiency of chlorine cannot be regarded as established. As local and general stimulants, as deodorizers, and disinfectants, its preparations are valuable. Dr. Squibb has pointed out that the chlorides are not available disinfectants, while the hypochlorites are so because they give off chlorine during their reduction to chlorides.

The *dose* of chlorine-water is from Gm. 4–16 (fʒj–iv), largely diluted. For inhalation, when atomized, a solution of Gm. 0.30–0.60 (♏v–x) in water may be used. *Antidotes:* After emesis with warm water, albumen in the form of milk, white of egg, veal-broth, etc., flour and water, or lime-water.

AQUA CHLOROFORMI, *U. S., Br.*—Chloroform-water.

Eau de chloroforme, Fr.; *Chloroformwasser*, G.

Preparation.—Add enough Chloroform to a convenient quantity of Distilled Water, contained in a bottle, to have a portion remaining undissolved, after the contents have been repeatedly and thoroughly agitated.

When Chloroform Water is required for use, pour off a sufficient quantity of the solution, refill the bottle with Distilled Water, and saturate it by thorough agitation, taking care that there be always an excess of Chloroform present.—*U. S.*

Take of chloroform 1 fluidrachm; distilled water 25 fluidounces. Put them into a two-pint stoppered bottle, and shake them together until the chloroform is entirely dissolved in the water.—(*Br.*) A fluidounce represents about 2 minims of chloroform.

Both pharmacopœias aim to produce a saturated aqueous solution of chloroform, the solubility of the latter substance in water being considered as about 1 in 200.

Action and Uses.—The dose prescribed by the British Pharmacopœia is from ½ fluidounce to 2 fluidounces.

The wonderful preservative properties of chloroform-water make it a desirable solvent for many organic substances in cases where an aqueous menstruum is wanted.

Beurmann claims that chloroform remains unchanged for a long time in its watery solution (*Bull. de Thérap.*, cv. 97). It is convenient as an anti-fermentative solution of chloroform. It is well adapted for a mouth-wash or gargle, both to relieve the pain of *toothache* and *sore throat* and to stimulate the mucous membrane of the mouth and pharynx, and internally to relieve all abdominal pains, but especially those of *gastralgia*. It is also useful as a *hæmostatic*, especially in operations upon the mouth, throat, vagina, rectum, etc. The acrid taste of the preparation may be removed by mint-water, orange-flower water, etc. On the other hand, it may be used to mask the taste of various medicines or to render the stomach more tolerant of them. It is a convenient adjuvant to other anodynes, such as morphine, the bromides, etc., and to purgative mixtures that tend to occasion griping, and as a vehicle for hypodermic solutions that tend to undergo decomposition.

AQUA CINNAMOMI, *U. S., Br., P. G.*—Cinnamon-water.

Eau de canelle, Fr.; *Zimmtwasser*, G.; *Acqua distillata di cannella*, F. It., Sp.

Preparation.—Oil of Cinnamon, 2 Cc.; Precipitated Calcium Phosphate, 4 Gm.; Distilled Water, a sufficient quantity; to make 1000 Cc. Triturate the oil with the calcium phosphate, add the water gradually under constant trituration, and filter.—*U. S.*

(32 minims of oil of cinnamon may be triturated with 60 grains of calcium phosphate, and will require 2 pints of distilled water.)

The British Pharmacopœia directs the distillation of 1 Imperial gallon (10 pounds) of cinnamon-water from 20 ounces of bruised Ceylon cinnamon, or in proportion of 8 parts of water from 1 part of bark. The present German Pharmacopœia recognizes as *Aqua cinnamomi* a distilled water formerly called *Aqua cinnamomi spirituosa* (*s. vinosa*), and made by distilling 10 parts from a mixture of sufficient water, 1 part of alcohol specific gravity 0.832, and 1 part of Chinese cinnamon.

Properties.—Obtained by any one of these processes, cinnamon-water is somewhat turbid, but gradually becomes clear. Made from the oil, it has the odor and a somewhat harsh taste of cinnamon, but if distilled from the bark its odor is more fragrant and its taste decidedly sweet. Cinnamon-water made with magnesia has a yellowish color, unless carbon dioxide gas is passed through it or a small quantity of some other acid is added. In contact with the air the volatile oil is oxidized, and crystals of cinnamic acid and small particles of a brownish resin are frequently separated.

Action and Uses.—Cinnamon-water possess the stimulant and carminative properties of the bark from which it is derived, but is seldom used except as a vehicle for other medicines with which it can co-operate. It is most commonly employed in mixtures for flatulent *colic* and *diarrhœa*, and in the latter affection as a vehicle for chalk, astringents, and opiates.

AQUA CREOSOTI, *U. S.*—Creosote-Water.

Eau créosotée, Fr.; *Kreosotwasser*, G.

Preparation.—Creosote, 10 Cc.; Distilled Water, 990 Cc.; to make 1000 Cc. Agitate the creosote with the distilled water until dissolved, and filter through a well-wetted filter.—*U. S.*

(1 fluidrachm of creosote agitated with 99 fluidrachms of distilled water, and filtered, will furnish 12½ fluidounces of official creosote-water.)

Action and Uses.—This preparation contains in every 2 fluidrachms rather more than 1 minim of creasote, and is a convenient form of that medicine for all the cases in which it should be given diluted, and also as a topical application in *leucorrhœa*, *gleet*, *burns*, *chilblains*, *ulcers* (especially such as are attended with an excessive, thin, or fetid discharge), *gangrene*, and various cutaneous eruptions, particularly *prurigo*, *eczema*, *sycosis*, etc. *Dose*, Gm. 4–16 (fʒj–iv).

AQUA DESTILLATA, *U. S., Br., P. G.*—Distilled Water.

Eau distillée, Hydrolat simple, Fr.; *Destillirtes Wasser*, G.

Composition H_2O. Molecular weight 17.96.

Preparation.—Water 1000 volumes; to make 800 volumes. Distil the water from a suitable apparatus provided with a block-tin or glass condenser. Collect the first 100 volumes and throw them away. Then collect 800 volumes, and keep the distilled water in glass-stoppered bottles, rinsed with hot distilled water immediately before being filled.—*U. S.*

Take of water 10 gallons. Distil from a copper still connected with a block-tin worm; reject the first half gallon and preserve the next 8 gallons.—*Br.*

When ordinary water is heated to ebullition the gases and volatile compounds dissolved therein are also vaporized and carried off with the vapors of the water, which, if condensed, would then be more highly charged with these volatile compounds; hence the necessity of rejecting the first portion of the distillate, as directed by the pharmacopœias. On the other hand, if the distillation is continued until all the water is vaporized from the still, the last portions are apt to be contaminated with volatile products resulting from the decomposition of ammonia compounds and organic matter. The pharmacopœias avoid this possibility by discontinuing the distillation when 15 per cent. of the water is left in the still.

The material of which the distillatory apparatus used for this purpose is constructed is of considerable importance, but more particularly in relation to the condenser. Iron, copper, and lead condensers must not be used, since the water corrodes these metals, traces and sometimes larger quantities of which will always be found in the distillate. Where a glass condenser is available it may be regarded as the most desirable, apparatus made of metals (silver and platinum) which are not in the least corroded during distillation being too costly for general use. The material best adapted for practical purposes is block-tin, of which the condenser and all those portions of the apparatus should be made from which the vapors are made to descend. A minute quantity of tin is nearly always dissolved, but separates again on standing for a few days in contact with the air. The occasional appearance of confervæ in distilled water depends upon its direct contact with the air, and may be prevented by keeping it in vessels arranged in such a manner that the air can enter only after having passed through a layer of cotton, by which the spores are retained.

Properties and Tests.—Distilled water is a colorless, limpid liquid, without odor or taste, and of a neutral reaction. On evaporating 1 liter of distilled water no fixed residue should remain. The transparency or color of distilled water should not be affected by hydrogen sulphide or ammonium sulphide (absence of metals), by test-solutions of barium chloride (sulphate), silver nitrate (chloride), ammonium oxalate (calcium), or mercuric chloride, with or without the subsequent addition of potassium carbonate (ammonia and ammonium salts). On heating 100 Cc. of distilled water acidulated with 10 Cc. of diluted sulphuric acid to boiling, and adding 1 Cc. of a centi-normal solution of potassium permanganate, the color of the liquid should not be entirely destroyed by boiling for 10 minutes, nor by afterwards setting the vessel aside well covered, for 10 hours (absence of organic or other oxidizable matters). Distilled water should not be affected by solution of lime (absence of carbonic acid).—*U. S.* On continued exposure to the air distilled water will dissolve carbonic acid gas, and then become cloudy with clear lime-water.

AQUA FŒNICULI, *U. S., Br., P. G.*—Fennel Water.

Eau de Fenouil, Fr.; *Fenchelwasser*, G.; *Acqua distillata di finocchio*, F. It.

Preparation.—Oil of Fennel, 2 Cc.; Precipitated Calcium Phosphate, 4 Gm.; Distilled Water, a sufficient quantity; to make 1000 Cc. Triturate the oil with the calcium phosphate, add the water gradually under constant trituration, and filter.—*U. S.*

(32 minims of oil of fennel may be triturated with 60 grains of calcium phosphate, and will require 2 pints of distilled water.)

Take of bruised fennel 1 pound av.; water sufficient; distil 1 gallon Imperial measure or 10 pounds av. (*Br.*), 30 pounds av. (*P. G.*) If a good fennel is employed the water last mentioned separates a small portion of oil on standing, and is therefore a saturated solution.

Action and Uses.—Fennel-water is stimulant and carminative, and, like its associates, is used as a vehicle for medicines intended to correct *acidity* and relieve *flatulence* and *colic*. *Dose*, Gm. 4 (a teaspoonful) or more, according to the age of the patient and the degree of the derangement.

AQUA HAMAMELIDIS, *N. F.*—Hamamelis Water.

Witchhazel Water, Witchhazel Extract.

Preparation.—Take of Hamamelis, shoots and twigs, 10 pounds; Water 2½ gallons; Alcohol, 1½ pints. Place the hamamelis in a still, add the water and alcohol, and allow the mixture to macerate during twenty-four hours. Distil 10 pints by applying direct heat, or, preferably, by means of steam. *Note.*—This preparation should be made only from the fresh young twigs of hamamelis, collected for this purpose, preferably, when the plant is in flower, in the late autumn of the year.

Action and Uses.—See Hamamelis.

AQUA HYDROGENII DIOXIDI, *U. S.*—Solution of Hydrogen Dioxide.

Solution of Hydrogen Peroxide, E.; *Soluté de peroxide d'hydrogen*, F.; *Wasserstoffhyperoxidlösung*, G.; *Acqua ossigenata*, F. It.

A slightly acid aqueous solution of hydrogen dioxide, containing when freshly prepared, about 3 per cent., by weight, of the pure dioxide, corresponding to about 10 volumes of available oxygen.

Formula of hydrogen dioxide H_2O_2. Molecular weight 33.92.

Origin.—Thénard (1818) discovered hydrogen dioxide, which has also been called *oxygenated water* and *oxygen hydrate*, by acting with dilute acids upon barium peroxide. Meissner (1863) proved its presence in the rain-water collected during thunder-storms, and this observation has since been corroborated by Schönbein (1869), Struve, and others. Houzeau (1868) did not succeed in finding it.

Preparation.—Barium Dioxide, 300 Gm. (about 10½ av. ozs.); Phosphoric Acid, Diluted Sulphuric Acid, Distilled Water, of each a sufficient quantity. Pour 500 Cc. (about 16 fl. ozs.) of cold distilled water into a suitable bottle, add to it the barium dioxide in such a way that it shall not form lumps, and shake vigorously so that a uniform mixture may result. Provide suitable means of refrigeration, so that the bottle and contents may be kept at a temperature below 10° C. (50° F.), and shake it thoroughly every few minutes during half an hour. Afterward, continuing the refrigeration, shake it occasionally, but vigorously, until the dioxide has become fully hydrated, which may be recognized from the fact that only a small portion of the water separates from it on standing, and that it may be mixed with the separated water without great effort by shaking. Having introduced 150 Cc. (about 5 fl. ozs.) of phosphoric acid into a bottle having the capacity of about 2000 Cc. (about 67 fl. ozs.) add to it 320 Cc. (about 10¾ fl. ozs.) of distilled water, cool the mixture and remove 50 Cc. (about 1⅔ fl. ozs.) as a reserved portion. Now add the well-mixed magma to the acid liquid, and mix them intimately by frequent stirring and shaking, cooling the bottle if necessary. From time to time test the reaction of the liquid and, when it becomes alkaline, add to it, cautiously, a little of the reserved phosphoric acid, until the liquid has again acquired an acid character. Repeat the agitation or stirring from time to time, and also the cautious addition of phosphoric acid, until the liquid, after standing for some time, no longer turns alkaline, without containing more than a slight excess of the acid. If necessary, a further quantity of phosphoric acid should be diluted with distilled water, in the proportion above given, and a portion of this liquid used for acidification. Having finally shaken the bottle again very thoroughly, set it aside until the precipitate occupies only about one-third of the volume of the contents, and pour the supernatant liquid upon a wetted, double, rapidly-acting, white filter, of a diameter of 30 Cm. Then transfer the semi-liquid precipitate to the filter, rinse the bottle with 100 Cc. (about 3⅓ fl. ozs.) of distilled water, transfer this to the filter, and when the liquid has drained off, wash the barium phosphate on the filter with distilled water, until the filtrate measures 1000 Cc. (about 34 fldozs.). Now add to it, first, 20 Cc. and afterward, if necessary, further, smaller quantities of diluted sulphuric acid, until a small portion of the liquid, after filtration (which may be assisted by a little starch) is no longer rendered cloudy by diluted sulphuric acid. Mix the cloudy liquid with about 10 Gm. (150 grains) of starch

by agitation, so that the starch may be thoroughly distributed throughout the liquid, and then filter it through a well-wetted, white filter of a diameter of 25 Cm., returning the first portions until it runs through clear. When all the liquid has passed, ascertain the percentage of hydrogen dioxide contained in it by the method of assay given below and dilute the remaining liquid if necessary, so that it will contain 3 per cent. of absolute hydrogen dioxide. Keep the product in loosely-stoppered bottles, in a cool place.

Since solution of hydrogen dioxide will gradually diminish in strength, even when carefully kept, it should either be freshly made when wanted or kept on hand only in such quantity as will probably be consumed within a short time. Any solution which has become weaker need not, for this reason, be thrown away, but may be reserved for an occasion when a weaker or diluted solution is prescribed or demanded. Or it may be employed, when making a fresh supply, as a diluent of the stronger solution.—*U. S.*

Properties.—Solution of hydrogen dioxide is a colorless, odorless liquid, having at 15° C. (59° F.) a specific gravity of 1.006 to 1.012. It has a slightly acidulous taste, and produces a peculiar sensation and soapy froth in the mouth. Its acid reaction is due to the small amount of acid purposely added for preservation. It deteriorates by age, exposure to heat, and protracted agitation. Exposed to the air or cautiously heated on a water-bath to a temperature not above 60° C. (140° F.), it loses chiefly water, but if rapidly heated it is apt to decompose with explosive violence. If a few Cc. of ether be poured on top of a mixture of 10 Cc. of distilled water, 1 drop of potassium chromate test-solution, and 10 drops of diluted sulphuric acid, a blue color will appear at the line of contact upon addition of a few drops of hydrogen dioxide solution. After shaking the ethereal layer will separate with a blue color.

Solutions of official strength may be concentrated by freezing the last portions of water being evaporated in vacuo over sulphuric acid at a temperature not exceeding 20° C. (68° F.). This concentrated liquid is colorless and of a syrupy consistency, having the spec. grav. 1.452, and does not congeal at — 30° C. (— 22° F.). It volatilizes slowly in vacuo and without decomposition at ordinary temperatures. When exposed to sunlight, or when heated, or when brought into contact with charcoal, silver, gold, the platinum metals, the oxides of manganese, alkalies, or various other compounds, the dioxide is decomposed, often with explosive violence, and in presence of the oxides of the metals mentioned these are reduced to the metallic state. A number of other bodies act less energetically and are oxidized. Litmus- and turmeric-paper are gradually bleached. The dioxide is odorless and has a harsh and bitter taste; applied externally it colors the skin white and causes violent itching.

Tests.—When evaporated to dryness on a water-bath, 50 Cc. should not yield more than 0.25 Gm. of residue. The presence of barium is detected by addition of dilute sulphuric acid to the solution, no turbidity should occur. The limit of free acid is ascertained by means of normal potassa solution, 0.5 Cc. of which, if added to 50 Cc. of hydrogen-dioxide solution, should show an alkaline reaction (*U. S.*). When neutralized with soda solution and evaporated to dryness, the residue, moistened with sulphuric acid, should have no corroding action on glass if left in contact with the same for a few hours, (absence of hydrofluoric acid). The value of a solution of hydrogen dioxide may be ascertained as follows: "Dilute 10 Cc. of the solution with water to make 100 Cc. Transfer 17 Cc. of this liquid (containing 1.7 Cc. of the solution) to a beaker, add 5 Cc. of diluted sulphuric acid and then, from a burette, decinormal potassium permanganate solution, until the liquid just retains a faint pink tint after being stirred. Each Cc. of the decinormal potassium permanganate solution corresponds to 0.0017 Gm. of absolute hydrogen dioxide. To express the strength of any solution of hydrogen dioxide approximately in volume of available oxygen (that is in volumes of oxygen given off by 1 volume of the solution upon decomposition), multiply the number of Cc. of decinormal permanganate solution decolorized by 1 Cc. of the solution by 0.56 (0.5594); or those decolorized by 1.7 Cc. of the solution, by 0.33. To express the strength in percentage (by weight) of absolute hydrogen dioxide, multiply the number of Cc. of decinormal permanganate solution decolorized by 1 Cc. of it, by 0.17; or divide the number of Cc. of permanganate solution decolorized by 1.7 Cc. of it, by 10."—*U. S.*

Action and Uses.—The virtues of hydrogen dioxide appear to depend chiefly upon its readiness to yield oxygen to all oxidizable substances, including tissues devitalized by disease. At the same time, it appears, when taken internally, to stimulate the nervous system and increase the secretion of urine. Upon theoretical grounds it was introduced as a cure for *diabetes*, but it signally failed after a sufficient trial by competent judges. It would seem to have had a favorable influence on some forms of atonic

dyspepsia. It was also supposed to act as a palliative in various cases of *dyspnœa* due to an impeded circulation of blood through the heart and lungs. Dr. B. W. Richardson found, in many cases of *epilepsy*, benefit from a drachm of the ten-volume solution given in half a tumbler of water, the dose being gradually increased to two or three drachms (*Asclepiad*, Oct. 1885). He also stated that he never saw *whooping cough* cut short so quickly by any other mode of treatment except change of air (*Med. News*, l. 320). More recently very favorable results have been reported from its use in *asthma*, *whooping cough*, pulmonary *phthisis*, *angina pectoris*, in *diabetes* (especially when associated with codeine), *anæmia* and *chlorosis*, in the chronic forms of *syphilis* as a succedaneum for mercury and potassium iodide, and locally in the treatment of *ulcers* and *purulent* exudations (*Lancet*, March, 1891, pp. 707–719; compare Solis Cohen, *Med. News*, lxii. 596). Greene (*Med. Record*, xxxvi. 66) claims that it is efficient in acute *pneumonia* when given in half teaspoonfuls, diluted, every hour. In various cases of *asthma* it is said to have given relief. It has been used in an ointment (1 part to 7 of lard) to anoint the skin of *scarlet-fever* patients, with the alleged results of diminishing the mortality and preventing the spread of the disease. There is no sufficient ground for this opinion. Hydrogen dioxide may be given in tablespoonful doses of a solution of 1 part of the peroxide in 20 of water.

In 1878, Day claimed that the numerous hydrocarbons used in dressing *wounds*, etc. owed their utility to their faculty of absorbing oxygen and giving it up to the tissues, and hence that the aqueous solution of hydrogen dioxide, or any of the above substances capable of generating it, must prove valuable as a surgical dressing (*Times and Gaz.*, Aug. 1878, p. 193). Goolden also, and others, testified to the powers of the compound to limit ulceration (*Practitioner*, xxiv. 47). And in 1882, Péan and Baldy drew the following conclusions from their clinical experience: Water containing from two to six times its volume of oxygen appears to be a fit substitute for alcohol and carbolic acid. It can be used as a dressing for every sort of *wound* and *ulcer* by injection and in vapor; in some cases, partly surgical, it may be given internally. It greatly hastens the cicatrization of fresh or of old wounds, even when covered with gangrene. It lessens traumatic fever; it neither offends by its smell nor acts poisonously, as carbolic acid does; and it occasions no pain. It seems adapted to ulcers of every description, deep *abscesses*, *ozæna*, and purulent *cystitis*, purulent *ophthalmia*, *chancres*, *gonorrhœa*, and *leucorrhœa*, *otorrhœa* with fetid suppuration, *diphtheria* with putrid false membranes, fetid *bronchitis*, *fetid breath* from diseased tonsils (*Bull. de Thérap.*, ciii. 122; Morton, *Med. News*, lv. 716). Bleyer recommends the *spray* from 2 ounces of a 15-volume solution dissolved in 14 ounces of water; for a *gargle*, 2 ounces of the same diluted solution; for other local uses, from 3 to 10 ounces of the peroxide to 15 or 16 ounces of water. For *internal use*, from one to three teaspoonfuls of the 15-volume solution in one half-glass of water, three times daily, after meals. For *diphtheria*, a teaspoonful every hour or two hours of a mixture of 200 parts of a 10-volume solution with 3 parts of pure glycerin. The spraying instrument should be made of hard rubber, and the dioxide should be kept at a temperature of 60°–65° F. This spray is said to have instantly relieved the pain and inflammation of a hornet's *sting* (*Med. Record*, xxxvii. 148).

AQUA LAUROCERASI, *Br.*—Cherry-laurel Water.

Eau distillée de laurier-cerise, Fr.; *Kirschlorbeerwasser*, G.

Preparation.—Take of fresh leaves of Cherry Laurel 1 pound; Water 2½ pints (50 ounces). Chop the leaves, crush them in a mortar, introduce them with the water into a retort, and distil 1 pint of liquid. Shake the product, filter through paper, and adjust the strength of the finished product either by addition of hydrocyanic acid or by diluting the filtrate with distilled water, so that 810 grains of it, tested as described under Hydrocyanic Acid, shall require 150 grain measures of the volumetric solution of silver nitrate to be added before a permanent precipitate begins to form, which corresponds to 0.1 per cent. of real hydrocyanic acid.—*Br.*

To facilitate distillation, Pettenkofer suggests for this water the process recommended by him for bitter-almond water. (See Aqua Amygdalæ Amaræ.) The distillate contains oil of bitter almonds and hydrocyanic acid, and is similar to bitter-almond water.

Action and Uses.—This preparation has no virtues which it does not owe exclusively to the hydrocyanic acid it contains in the proportion of 0.1 per cent. Like all distilled waters, its strength is very uncertain, and it is altogether less eligible than a definite solution of hydrocyanic acid or of oil of bitter almonds in water, not only

because its strength is variable, but because the inequality of its effects may lead to disastrous results. The dose is stated to be from 2–8 Gm. (f℥ss-ij), very cautiously administered.

AQUA MENTHÆ PIPERITÆ, *U. S., Br., P. G.*—Peppermint-water.

Eau de menthe poivrée, Fr.; *Pfefferminzwasser*, G.; *Acqua distillata di menta piperita*, F. It.

Preparation.—Oil of Peppermint 2 Cc.; Precipitated Calcium Phosphate 4 Gm.; Distilled Water a sufficient quantity; to make 1000 Cc. Triturate the oil with the calcium phosphate, add the water gradually under constant trituration, and filter.—*U. S.*

(32 minims of oil of peppermint may be triturated with 60 grains of calcium phosphate, and will require 2 pints of distilled water.)

Take of Oil of Peppermint 1½ fluidrachms; Water 1½ gallons; distil 1 gallon (10 pounds).—*Br.*

P. G. distils 10 parts of water from 1 part of the herb; *Fr. Cod.* 1 part from 1 part of the fresh herb.

Action and Uses.—Peppermint-water is used as a vehicle for many medicines which are unpleasant to the taste or which occasion nausea or griping. It is the most common domestic remedy for flatulent *colic*, and in hot water is frequently resorted to for relief from the pains of *dysmenorrhœa*. Like other diffusible and aromatic stimulants, it palliates *headache, palpitation, hiccup*, etc. produced by laborious digestion. *Dose*, Gm. 16 (f℥ss) or more.

AQUA MENTHÆ VIRIDIS, *U. S., Br.*—Spearmint-water.

Eau de menthe verte, Fr.; *Römisch-Minzwasser*, G.; *Agua de yerba buena*, Sp.

Preparation.—Oil of Spearmint 2 Cc.; Precipitated Calcium Phosphate 4 Gm.; Distilled Water a sufficient quantity; to make 1000 Cc. Triturate the oil with the calcium phosphate, add the water gradually under constant trituration and filter.—*U. S.*

(32 minims of oil of spearmint may be triturated with 60 grains of calcium phosphate, and will require 2 pints of distilled water.)

Take of Oil of Spearmint 1½ fluidrachms; Water 1½ gallons. Distil 1 gallon (10 pounds).—*Br.*

On the continent of Europe curled-mint water is used instead. *Aqua menthæ crispæ* is prepared by mixing curled-mint leaves 1 part with sufficient water, and distilling 10 parts.

Action and Uses.—Spearmint-water has the same virtues as peppermint-water, but is much milder in its action. It is particularly appropriate in cases of infantile *colic*, for which it may be prescribed with a little bicarbonate of sodium or magnesium in doses of a teaspoonful. The average *dose* for an adult is Gm. 16 (f℥ss).

AQUA PICIS, *P. G.*—Tar-water.

Theerwasser, G.; *Acqua di catrame*, F. It.; *Agua de alquibran*, Sp.

Preparation.—1 part of tar is mixed with 3 parts of powdered pumice-stone which has been previously washed with water and dried, and of this mixture 2 parts are added to 5 parts of water, well shaken for five minutes and filtered.—*P. G.* Tar 1 part, water 46 parts.—*F. It.*

Tar-water should be clear, of yellowish or brownish-yellow color, and possess the odor and taste of tar. It is best prepared fresh when wanted.

Action and Uses.—See Pix liquida.

AQUA PIMENTÆ, *Br.*—Pimento-Water.

Eau de piment de la Jamaïque, Fr.; *Nelkenpfeffer-Wasser*, G.

Preparation.—Take of Pimento, bruised, 14 ounces; Water 2 gallons. Distil 1 gallon (10 pounds).—*Br.*

On standing it separates a brownish resin.

Action and Uses.—Pimento-water is a stimulant carminative. Its effects are less transient than those of fennel- and anise-water, for example, and more like such as are produced by an infusion of cloves. *Dose*, Gm. 16–32 (f℥ss–℥j).

AQUA ROSÆ, *U. S., Br., P. G.*—Rose-water.

Aqua Rosarum.—Eau distillée de rose, Fr.; *Rosenwasser*, G.; *Acqua distillata di rose*, F. It.; *Agua rosada*, Sp.

Preparation.—Stronger Rose-water, Distilled Water, of each, 1 volume. Mix them immediately before use.—*U. S.*

Take of fresh petals of the hundred-leaved rose (or an equivalent quantity of the petals preserved while fresh with common salt) 10 pounds; water 5 gallons (Imperial). Distil 1 gallon (10 pounds).—*Br.*

Add 4 drops of oil of rose to 1000 Cc. (about 34 fluidounces) of lukewarm water, agitate for some time and filter.—*P. G.*

Action and Uses.—Rose-water has no strictly medicinal virtues. It is an agreeable excipient for collyria, urethral injections, and lotions.

AQUA ROSÆ FORTIOR, *U. S.*—Stronger Rose-water.

Triple rose-water, E.; *Stärkeres Rosenwasser*, G.

Water saturated with volatile oil of rose petals, obtained as a by-product in the distillation of oil of rose.

Strong rose-water should be kept in well-stoppered bottles, in a dark place.—*U. S.*

Like orange-flower water, the finest rose-water is obtained by distillation of the fresh petals; it should be clear and colorless, not mucilaginous, and free from metallic impurities, which latter may be detected by hydrogen sulphide and ammonium sulphide, neither of which should produce turbidity in the water.

Pharmaceutical Uses.—It is only used for preparing Aqua Rosæ.

AQUA SAMBUCI, *Br.*—Elderflower-Water.

Eau distillée de sureau, Fr.; *Fliederblumen- (Hollunderblüthen-) Wasser*, G.

Preparation.—Take of Fresh Elderflowers, separated from the stalks, 10 pounds (or an equivalent quantity of the flowers preserved while fresh with common salt); Water 5 gallons. Distil 1 gallon (10 pounds).—*Br.*

Elderflowers 1 part; Water sufficient. Distil 10 parts.—*P. G.* 1872.

On standing it is inclined to separate a mucilaginous sediment, which must be removed by filtration.

Action and Uses.—Elderflower-water is used in England as a excipient for more active medicines. It possesses no definite virtues. *Dose*, Gm. 32 (℥j) or more.

AQUA SEDATIVA, *N. F.*—Sedative Water.

Eau sédative de Raspail, Lotio ammoniacalis camphorata, Fr. Cod.

Take of Ammonia Water 2 fluidounces; Spirit of Camphor 90 minims; Sodium Chloride 1 troyounce; Water enough to make 16 fluidounces. Dissolve the sodium chloride in about 8 fluidounces of water, add the ammonia-water and spirit of camphor, and finally enough water to make 16 fluidounces. Shake the liquid when it is to be dispensed.

Action and Uses.—The anodyne, sedative, and stimulant qualities of this mixture have been found useful in palliating nervous and congestive *headaches;* and in promoting the resolution of *contusions* and *sprains*. It should be applied to the painful parts on saturated compresses, with or without friction.

AQUÆ MINERALES.—Mineral Waters.

Eaux minérales, Eaux médicinales naturelles, Fr.; *Mineralwässer*, G.

These are spring-waters which are charged with certain gases or salts to such a degree that they are unfit for ordinary use, and exert a peculiar operation on the economy.

The following summary gives the composition of a few of the most important mineral waters, which may be divided into the following classes:

1. Sulphuretted waters contain sulphides and hydrogen sulphide, in consequence of which they possess a more or less fetid odor:

Barèges.—The *Source de l'entrée* contains in 10,000 parts: 0.360 sodium sulphide, 0.219 sodium chloride, 0.240 alkali carbonates, 0.300 sodium sulphate, and traces of iodine and organic matter (Henry).

Baden (Austria), *Leopoldsquelle.*—10,000 Gm. contain 0.065 sodium carbonate, 0.800 calcium carbonate, 1.780 sodium sulphate, 3.467 calcium sulphate, 0.610 potassium sulphate, 0.700 magnesium chloride, 0.030 silica, 0.013 magnesium sulphate, 1.705 sodium chloride, 1340.19 Cc. carbon dioxide, 2836.09 nitrogen, 335.19 oxygen, and 232.73 hydrogen sulphide (Keller).

Harrowgate, Old Sulphur Well.—10,000 parts contain 0.26 calcium sulphate, 1.75 calcium carbonate, 11.55 calcium chloride, 7.86 magnesium chloride, 9.14 potassium chloride, 122.38 sodium chloride, 2.19 sodium sulphide, 0.03 silica, and traces of sodium, calcium, ammonium, iron, and manganese fluoride, bromide, iodide, and carbonate, and organic matter. Also the following gases in 1 Imperial gallon: 22 cubic inches carbon dioxide, 5.3 hydrogen sulphide, 5.8 carburetted hydrogen, and 2.9 nitrogen (A. W. Hofmann.)

Massena, St. Regis.—1 U. S. gallon contains 79.692 grains sodium chloride, 0.508 potassium chloride, 29.927 magnesium chloride, 0.673 magnesium bromide, 4.852 calcium bicarbonate, 0.4888 ferrous bicarbonate, 60.931 calcium sulphate, 3.501 sodium sulphate, 1.320 sodium phosphate, 4.205 sodium hyposulphite, 1.405 sodium sulphide, 11.176 sodium silicate, and organic matter; total, 198.678 grains, and 5.307 cubic inches of hydrogen sulphide (F. F. Mayer).

2. Alkaline waters.—Sodium carbonate predominates and free carbonic acid is often present in considerable quantity:

Ems, Kränchen.—10,000 parts contain the following carbonates: 13.651 sodium, 1.559 calcium, 1.292 magnesium, 0.016 iron, 0.007 manganese, 0.001 barium; 9.224 sodium chloride, 0.004 aluminum phosphate, 0.494 silica, traces of sodium iodide and lithium carbonate, and 9991 Cc. carbon dioxide (Fresenius).

Vichy, Source Lucas.—10,000 parts contain the following bicarbonates: 50.04 sodium, 2.82 potassium, 2.75 magnesium, 0.05 strontium, 5.45 calcium, and 0.04 iron; 2.91 sodium sulphate, 0.70 sodium phosphate, 0.02 sodium arsenate, 5.18 sodium chloride, 0.50 silica, and 17.51 carbon dioxide; total solids, 70.46 (Bouquet).

The water of the Grande Grille spring has nearly the same composition with 70.33 solids, but contains only 9.08 parts of carbon dioxide. Tichborne found in 16 ounces of the bottled water 44.408 grains of solids.

Gettysburg.—1 Imperial gallon contains 46.05 grains sodium bicarbonate with lithium, 76.05 magnesium bicarbonate, 81.00 calcium bicarbonate, 53.20 calcium sulphate, 10.00 silica, with traces of potassium and iron chlorides and phosphates; total 266.30 grains (Mayer).

3. Saline waters contain various salts of alkalies and alkaline earths, occasionally bromides and iodides. Dieulafait (1881) believes that the saline waters of Western Europe are mineralized in the salt-bearing strata of the Trias and Tertiary formation, and that the mineralizing compounds were formerly contained in ordinary seas, and have been deposited by simple evaporation.

Bedford Springs, Pa.—1 pint contains calcium sulphate 11.274 grains, magnesium sulphate 3.974 grs., aluminum and iron sulphates 1.280 grs., sodium sulphate 3.092 grs., sodium chloride 0.343gr., calcium carbonate 2.120 grs., sulphuric acid (?) 0.128 gr., organic matter and silica trace (J. C. Morris).

Cheltenham Royal Old Wells.—10,000 parts contain 34,202 sodium chloride, 1.141 magnesium chloride, 13,541 sodium sulphate, 0.970 magnesium carbonate, 1.433 calcium carbonate, 0.436 magnesium bromide, 0.069 magnesium iodide, 0.381 silica, 1.473 crenic acid, 2.574 organic matter, and 92 Cc. carbon dioxide (Abel and Rowney).

Carlsbad (Bohemia), *Sprudel.*—10,000 parts contain 24.05 sodium sulphate. 18.612 sodium bicarbonate, 10.223 sodium chloride, 4.638 calcium bicarbonate, 2.537 magnesium bicarbonate,1, 862 potassium sulphate, .141 lithium chloride, .715 silica, .051 sodium fluoride, .041 ferrous bicarbonate, .040 sodium borate, and much smaller quantities of sodium phosphate, strontium, manganese, and alumina, besides carbon dioxide; total solids, 62.928 (Ludwig). The numerous other Carlsbad springs analyzed by Ludwig (1879) have a similar composition, the total solids decreasing to 60.798 parts in the water of the *Schlossbrunnen.*

Friedrichshall (Saxe-Meiningen) *Bitter-water.*—16 ounces contain 61.102 sodium chloride, 46.510 sodium sulphate, 39.533 magnesium sulphate, 30.252 magnesium chloride, 3.992 magnesium carbonate, .876 magnesium bromide, 1.523 potassium sulphate, 10.341 calcium sulphate, .113 calcium carbonate; total salts, 194.242 grains; carbon dioxide 5.322 cubic inches (Liebig). The bottled water contains in 16 ounces 99.722 grains sodium chloride, 71.535 sodium sulphate, 64.138 magnesium sulphate, 50.114 magnesium chloride, 2.102 magnesium carbonate, .275 magnesium bromide, 2.518 potassium sul-

phate, 17.130 calcium sulphate,. 440 silica; solids, 307.974 grains, and carbon dioxide (Tichborne).

Hunyadi János.—16 ounces of the bottled water contain free carbonic acid and 337.066 grains of solids, consisting of 157.957 sodium sulphate, 156.350 magnesium sulphate, .716 potassium sulphate, 10.531 sodium chloride, 6.051 calcium carbonate, 5.152 sodium carbonate, .20 strontium carbonate, and .029 iron and alumina (Tichborne).

Seidlitz.—16 ounces contain 104 grains sulphate, 3 grains carbonate, and 3 grains magnesium chloride, 8 grains carbonate and 8 grains calcium sulphate, total, 126 grains (Naumann).

4. ACIDULOUS SALINE WATERS contain various salts and are sparkling from the large amount of carbonic acid contained in them:

Neuenahr, Apollinaris.—16 ounces of the bottled water contain free carbonic acid and 25.868 grains of salts, consisting of 10.621 sodium bicarbonate, 5.023 sodium chloride, 2.402 sodium sulphate, .141 potassium sulphate, 4.50 magnesium carbonate, 2.880 calcium carbonate, .10 ferric oxide, .080 alumina, .121 silica, and traces of sodium phosphate, lithium, ammonia, and nitric acid (Tichborne).

Grosskarben, Taunus.—16 ounces of the bottled water contain 32.403 grains of free carbonic acid and 31.262 grains of solids, consisting of 18.004 sodium chloride, 1.890 potassium chloride, 9.590 calcium carbonate, 1.232 magnesium carbonate, .140 sodium carbonate, .406 calcium sulphate, and traces of calcium phosphate, silica, and alumina (Taylor, Tichborne).

Pyrmont, Hauptquelle.—160 ounces contain the following sulphates: 0.023 grain barium, 0.280 strontium, 60.897 calcium, 1.266 potassium, 3.220 sodium, and 34.813 magnesium; the following chlorides: 12.202 sodium, 0.161 ammonium, and 0.076 lithium; the following bicarbonates: 86.832 calcium, 6.160 magnesium, 5.919 iron, and 0.344 manganium; 0.001 sodium iodide, 0.007 sodium bromide, 0.012 sodium nitrate, 0.006 aluminium phosphate, 0.004 calcium phosphate, 2.441 silica, 183.956 grains carbon dioxide and a trace of hydrogen sulphide (Fresenius).

Selters.—16 ounces contain 0.248 grain sodium sulphate, 16.285 sodium chloride, 5.855 sodium carbonate, 1.595 magnesium carbonate, 1.867 calcium carbonate, 0.154 ferrous carbonate, 0.281 sodium phosphate, 0.289 silica, and 31 cubic inches carbon dioxide (Bischof).

Saratoga Empire Spring.—1 U. S. gallon contains 506.63 grains sodium chloride, 4.292 potassium chloride, 0.266 sodium bromide, 0.006 sodium iodide, 2.769 potassium sulphate, 0.023 sodium phosphate, 1.458 silica, 0.418 alumina, with the following bicarbonates: 42.953 magnesium, 109.656 calcium, 2.080 lithium, 9.022 sodium, 0.070 barium, 0.793 iron, and trace of strontium; also traces of calcium fluoride, borax and organic matters; total, 680.436 grains, and 344.67 cubic inches carbon dioxide (Chandler and Cairns).

The acidulous saline waters of the numerous other springs of Saratoga have a similar composition; in the following table they are arranged according to the abundance of carbonic acid gas, in addition to which we give, in grains, the total solids and the weight of the most important saline constituents contained in one gallon:

Name.	CO_2, cub. inch.	Total solids.	NaCl.	$NaHCO_3$.	$MgO(CO_2)_2$.	$CaO(CO_2)_2$.	$FeO(CO_2)_2$.	$LiHCO_3$.
Champion	465.458	1195.583	702.236	17.624	193.912	227.070	0.647	6.247
Geyser	454.082	991.546	562.080	71.232	149.343	168.392	0.979	9.004
High Rock	409.458	628.039	390.127	34.888	54.924	131.739	1.478	
Star	407.650	617.397	398.361	2.662	61.912	124.459	1.213	1.586
Congress	392.289	700.859	400.440	10.775	121.757	143.399	0.340	4.761
Union	384.969	701.174	453.299	17.010	109.685	96.703	0.269	2.605
Vichy	383.071	315.176	128.629	82.873	41.503	45.522	0.052	1.760
Hathorn	375.747	888.403	509.968	4.288	176.463	180.646	1.128	11.447
Washington	363.770	350.227	182.733	.....	65.973	84.096	3.800	
Kissingen	361.500	644.627	338.500	67.617	70.470	140.260	1.557	5.129
Putnam	348.880	361.010	214.000	14.320	51.600	68.800	7.000	
Pavilion	332.458	687.275	459.903	3.764	76.267	120.169	2.570	9.486
Seltzer	324.080	302.017	234.291	29.428	40.339	89.869	.....	1.703
Crystal	317.452	537.155	328.468	10.064	75.161	101.881	2.038	4.326
Hamilton	316.000	460.326	297.300	27.036	35.200	92.400	5.390	
Excelsior	250.000	514.746	370.642	15.000	32.333	77.000	3.215	
United States	245.734	331.837	141.872	4.666	72.888	93.119	0.714	4.847
Eureka	239.000	258.365	166.811	8.750	29.340	41.321	3.000	
Saratoga, A	212.000	656.911	565.300	6.752	20.480	56.852	.....	1.724

The temperature of these springs is between 45° F. (Washington) and 52° F. (High Rock and Star); the water of the Kissingen springs is 40° F.

Whitehall (N. Y.) Adirondack Springs.—1 Imperial gallon contains 14.340 grains sodium chloride, 11.134 calcium sulphate, 18.543 calcium carbonate, 16.618 magnesium carbonate, 5.040 ferrous carbonate, 5.317 potassium carbonate, 5.135 sodium carbonate, 0.023 lithium carbonate, traces of magnesium carbonate and alumina, 7.42 insoluble residue, and 67.3 cubic inches of carbon dioxide (Collier).

Kissingen, Rakoczy.—16 ounces contain 0.242 grain ferrous carbonate, 0.131 magnesium carbonate, 8.148 calcium carbonate, 0.043 calcium phosphate, 0.099 silica, 2.990 calcium sulphate, 44.713 sodium chloride, 4.509 magnesium sulphate, 2.203 potassium chloride, 2.333 magnesium chloride, 0.064 sodium bromide, 0.071 sodium nitrate, 0.153 lithium chloride, 0.007 ammonium carbonate; total, 65.706 grains, and 41.77 cubic inches of carbon dioxide (Liebig).

5. Chalybeate Waters.—This name is applied to those mineral waters which contain iron in sufficient quantity to impart to them a ferruginous taste. The iron is present either as sulphate or frequently as ferrous carbonate, held in solution by excess of carbonic acid, hydrogen sulphide being also occasionally present. Iron being found in several of the waters named before in larger quantities than mere traces, it is evident that the classification must be somewhat arbitrary.

Homburg Stahlbrunnen.—16 ounces contain 0.937 ferrous carbonate, 7.534 calcium carbonate, 10.667 calcium chloride, 5.330 magnesium chloride, 79,864 sodium chloride, 0.176 potassium sulphate, 0.146 calcium sulphate, 0.315 silica; total, 104.969 grains, and 46.90 cubic inches carbon dioxide (Liebig).

Spa, Source du Pouhon.—10,000 parts contain the following bicarbonates: 1.266 sodium, 0.105 potassium, 1.730 calcium, 1.674 magnesium, and 0.714 iron; 0.203 sodium sulphate, 0.256 sodium chloride, 0.629 silica, and 21.409 carbon dioxide (Plateau).

Pyrmont, Trinkquelle.—16 ounces contain 0.490 ferrous carbonate, 1.126 magnesium chloride, 0.323 magnesium carbonate, 0.048 manganese carbonate, 5.988 calcium carbonate, 0.014 aluminum phosphate, 0.496 silica; and the following sulphates: 2.697 magnesium, 7.221 calcium, 0.020 strontium, 0.009 lithium, 0.042 potassium, and 2.145 sodium; total, 20.619 grains, and 1.68 volumes of carbon dioxide (Struve).

Cheltenham (chalybeate).—1,000 parts contain 0.066 ferrous carbonate, 0.159 calcium carbonate, 0.735 calcium chloride, 0.484 magnesium chloride, 0.390 potassium chloride, 22.62 sodium chloride, 0.020 silica, 0.040 organic matter; total 4.156. 1 gallon contains also 1.95 cubic inches carbon dioxide and 5 cubic inches carburetted hydrogen (A. W. Hofmann).

Church Hill Alum-Water.—1 U. S. gallon contains 24.991 grains ferrous sulphate, 51.270 ferric sulphate (neutral), 83.355 ferric sulphate (one-third basic) 72.928 aluminum sulphate, 86.064 magnesium sulphate, 88.836 calcium sulphate, 0.643 ammonium sulphate, 2.444 potassium sulphate, 1.943 sodium sulphate, 4.627 sodium chloride, 10.429 silica, and a trace of phosphoric acid; total, 427.530 grains (J. C. Booth).

6. Thermal Springs.—Their temperature is above that of the locality in which they are situated, and they serve an important use for baths, although most of these waters are also used internally. In the following we give some of the best known, arranged according to their temperature:

Carlsbad, Sprudel.—Temperature 73.5° C. (172.4° F.). (See above, under Saline Waters.) The temperature of eight other hot springs ranges between 60.2° and 43° C. (140.4° and 109.4° F.), and the average amount of solids is 61.966 in 10,000 parts.

Wiesbaden, Kochbrunnen.—Temperature 68.8° C. (155.8° F.). 10,000 parts of the water contain 68.356 sodium chloride, 1.458 potassium chloride, .002 lithium chloride, .167 ammonium chloride, 4.710 calcium chloride, 2.039 magnesium chloride, .035 magnesium bromide, .902 calcium sulphate, .004 calcium phosphate, 4.180 calcium carbonate, .104 magnesium carbonate, .056 ferrous carbonate, .006 manganum carbonate, .001 calcium arsenate, .604 silica and alumina, and .34 volumes carbon dioxide, total solids, 82.624 (Fresenius). The temperature of other springs range from 66° to 49.5° C. (150.8° to 120.2° F.)

Baden-Baden.—The temperature of nine springs ranges between 68.63° and 44.4° C. (156° and 112° F.), and the solid constituents of 10,000 parts between 29.528 and 27.0213, of which between 22.244 and 18.892 parts are sodium chloride.

Hot Springs, Arkansas.—The fifty-seven springs range in temperature between 65.5° and 33.9° C. (150° and 93° F.); the solid constituents amount to a little over a grain in the pint.

Aix-la-Chapelle (Aachen).—Four springs range in temperature between 55° and 45.4°

C. (131° and 113.7° F.), and the solids in 10,000 parts between 44.4815 and 40.1446, of which 60 per cent. is sodium chloride and 20 per cent. sodium bicarbonate.

Bath, King's Spring.—Temperature 46.2° C. (115° F.). 10,000 parts contain 20.597 solids, consisting of 11.425 calcium sulphate, 0.662 potassium sulphate, 2.744 sodium sulphate, 1.259 calcium carbonate, 0.047 magnesium carbonate, 0.152 ferrous carbonate, 1.802 sodium chloride, 2.081 magnesium chloride, 0.425 silica, with traces of lithia, manganese, and iodine; carbonic acid not determined (Merck and Galloway).

Gastein, Wildbad.—Temperature 49° to 25° C. (120.2° to 77° F.); salts, 3.483 in 10,000 parts.

Ems.—Thirteen springs range in temperature between 46.64° and 27.9° C. (116° and 82.2° F.). 10,000 parts of water contain 31.74 to 38.194 solids, mostly carbonates with chlorides.

Idaho Springs, Colorado.—Range of temperature 46.1° to 29.5° C. (115° to 85° F.). A gallon contains 107 grains of salts, mostly sulphates with carbonates.

Vichy.—Eight springs range in temperature between 43.5° and 22° C. (108.5° and 71.6° F.). (See above, under ALKALINE WATERS.)

Hot Springs, Virginia.—Temperature between 43.3° and 25.5° C. (110° and 78° F.). A gallon of water contains 18 to 33 grains of salts, mostly carbonates with chlorides and sulphates.

ARTIFICIAL MINERAL WATERS have been manufactured and used for many years both in Europe and the United States; many of these are close imitations of the natural waters. Works giving instructions on the manufacture of such waters have been published by (among others) Dr. H. Hager, Dr. Græger, and recently (1883) by Dr. F. Raspe. We append here a few formulas which have been recommended as yielding tolerably good substitutes for the waters of the springs named:

Baden (chalybeate).—Sodium chloride 28 grains, magnesium chloride 2 grains, calcium chloride 13 grains, sodium sulphate 11.5 grains, iron and potassium tartrate $\frac{1}{3}$ grains, water 21 fluidounces; dissolve and impregnate with carbon dioxide gas (Soubeiran).

Carlsbad.—Sodium sulphate 54 grains, magnesium sulphate $5\frac{1}{4}$ grains, sodium carbonate $36\frac{3}{4}$ grains, sodium chloride 7 grains, calcium chloride 7 grains, potassium and iron tartrate $\frac{1}{8}$ grain, water 21 fluidounces; proceed as before (Soubeiran).

Seidlitz.—Magnesium sulphate $7\frac{1}{2}$ drachms, water 22 fluidounces; proceed as before; or

Dissolve $7\frac{1}{2}$ drachms magnesium sulphate and 1 drachm of sodium bicarbonate in 22 fluidounces of water; add 1 drachm of crystallized tartaric acid, and cork the bottle well (*Fr. Cod*).

Sulphur-water.—(to imitate *Barèges, St. Sauveur*, etc.). Crystallized sodium sulphide and sodium chloride 2 grains, water previously boiled to deprive it of air 22 fluidounces; dissolve (*Fr. Cod*).

Vichy.—Sodium carbonate 112 grains, potassium carbonate $2\frac{1}{2}$ grains, magnesium sulphate 5 grains, fused calcium chloride $4\frac{1}{2}$ grains, sodium chloride $1\frac{1}{4}$ grains, sodium arsenate $\frac{1}{2\frac{1}{2}}$ grain, powdered iron $\frac{1}{6\frac{1}{5}}$ grain, water 21 fluidounces; dissolve and impregnate with carbon dioxide gas (Lefort).

Action and Uses.—The use of spring-waters more or less impregnated with substances imbibed by them in the bowels of the earth has existed in all ages. A knowledge of their virtues, as of many other useful medicines, was very probably learned by observing the instinctive use of them by the lower animals. Tradition runs that some of the most famous of German springs owe their reputation originally to their use by sick animals, and that others were eagerly visited by the kine at certain seasons of the year. It is certain that our own Saratoga, which is now annually crowded by gay votaries of fashion as well as by the dejected victims of a morbid civilization, was long resorted to by the aboriginal savages for the cure of their infirmities. In ancient Greece temples were in many places erected near mineral springs, whose waters were used under the direction of the priests, who thus became the earliest physicians, and who taught that hygiene and medicine must go hand in hand, and proved that faith has no small share in the cure of disease. But the "scientific medicine" of the present day treats the human body as if it were so much brute matter to be subjected to analytical and synthetical reagents for the purpose of evolving definite results: the true physician, on the other hand, never neglects the vital and psychical elements of man, and sagaciously enlists in behalf of his patients all the power of external nature as well as the quickening influences of faith and hope. Formerly, mineral waters could be made use of by those persons only who were able to visit the springs, but now they are carried to great distances, and even across the ocean, for those who require them; their saline

residue, after evaporation of the water, has equally become an article of commerce; and chemical ingenuity has imitated the solid constituents of the most important springs, without, however, securing the effects produced by the natural combinations.

Attempts to explain the action of medicines exclusively by scientific methods have not resulted satisfactorily. Upon this subject we are entirely in accord with Trousseau, who addressed his clinical class in these words: "Distrust medical theories that originate in the laboratory. Although Chemistry may be the handmaid of Medicine, she goes beyond her sphere when she applies the conclusions of the laboratory to the treatment of the sick. Chemistry stands no nearer to Medicine because she teaches us how to prepare or to analyze medicines, than she does to the art of painting because she prepares the painter's colors. . . . . Say what the chemist may, mineral waters do not operate alone by means of their predominant mineral constituent. It is associated with many others which they have demonstrated, and probably with others still that have escaped their research; and nature has done for this element what we attempt every day to do in pharmacy when we seek to enhance or to mitigate the power of a medicine by associating it with others." Then, referring to the well-known fact that the therapeutical reputation and efficacy of mineral waters does not depend upon the amount of their mineral constituents, this sagacious teacher in substance observed: "The *malarial cachexia*, for instance, is wonderfully modified by springs whose mineral elements really elude discovery, and are far less than those which impregnate the drinking-water of Paris; and certain intractable dyspeptic disorders are cured by them in a manner which I neither can nor seek to explain. Under their salutary influence the appetite revives, the constitution becomes reorganized; patients affected with dropsy or visceral engorgements arrive at Plombières or Bigorre in a deplorable condition, and after a single season have been greatly improved and often most unexpectedly cured." Even anciently it was understood that the medicinal virtues of a spring do not depend altogether upon the degree of its mineralization, for Pliny refers to the Paduan waters as having neither taste nor smell. It would, however, be unjust to these natural medicines to suppose that they are not, on the whole, valuable in proportion to their mineralization; indeed, we may go further, and measure and define their value by the proportion of their predominant ingredient, be it saline, alkaline, sulphurous, or chalybeate, for if we subtract this one element the special virtues of the water vanish. On the other hand, it is notorious that the medicinal use of such elements isolated from their natural associations no longer produce the effects of the original mineral waters. In these facts again we perceive the excellence of nature and the insufficiency of self-sufficient art.

There are, indeed, two classes of patients who require the use of very different mineral waters. The first is composed of that large body of invalids in whom there exists no organic change of structure, but whose functions are merely weakened or clogged by the strain of business, the exhaustion of pleasure, sensual excesses in eating or drinking, or, in this country especially, by the manifold errors committed in the preparation and consumption of food and the disregard of hygienic rules in the habits of living. The second consists of that smaller but still numerous class of persons who, besides being more or less injured by the causes of ill-health just enumerated, have been affected with definite diseases, and especially rheumatism, gout, calculous disorders, cutaneous eruptions, scrofula, syphilis, diabetes, paralysis, uterine disorders, etc. Of these two classes, the former are benefited most by a visit to the less mineralized springs, while the latter require a course of active medicinal treatment such as the stronger mineral waters afford. In both classes of patients, but particularly in the first, the action of the water is only one out of many influences that combine to restore the health. Toward that end a total change of habits is one of the most influential agencies in very many cases. Escape from the anxieties and fatigues of business, from the excitement of fashionable life, the mental tension of political and professional pursuits, the worrying annoyances of domestic affairs, endured perhaps in a large city with all its enervating social duties, its Babel-like sounds, and its polluted atmosphere,—escape from these alone often suffices to restore the disturbed balance of health. When we consider how much more probable must this result become when fatigue, anxiety, contention, wearisome routine, and foul air are exchanged for repose and peace in the midst of novel scenes and new associates, and freedom from the onerous conventionalities of fashionable life, for different apartments, food, and occupation, it may even seem doubtful whether, after all, some other new residence would not profit the invalid as much as the frequented springs. But there are two reasons against this conclusion: the one is, that with many persons relief would be impossible without an exercise of the faith which gives potency to waters as well as to

other remedial agents; and the other is, that even the purest of these waters, systematically used, especially in conjunction with bathing and regular exercise, does in a greater or less degree depurate the system through the kidneys, bowels, and skin, and by a gentle but sustained action gradually remove effete products of tissue-change from the system and free the organs from the burdens that oppressed and the poisons that tainted them. Judiciously used under the advice of a competent physician, these almost neutral waters and the milder saline springs are capable in a few weeks of changing the languid, indifferent, pale, and feeble invalid into the lively and energetic leader of the gay crowd. Such rapid transformations are frequently witnessed, especially at the hot springs of Virginia and Arkansas, and certain European spas, such as Wildbad, Gastein, and Pfeffers, none of which contain any considerable proportion of mineral ingredients. But these waters, whether drunk warm or cold, if they are largely used act as organic purgatives, and increase materially the total amount of solids, and especially of urea, excreted with the urine, without causing the debility which an equal discharge from the bowels would occasion.

Waters of the other class, rich in mineral ingredients, have a more direct relation to certain special forms of disease. Alkaline waters, for example, are particularly adapted to the treatment of *gout* and *rheumatism;* sulphurous waters to that of the same diseases and of scaly *eruptions* of the skin; ferruginous waters to the cure of *anæmic* disorders; salines to that of chronic *dyspepsia*, *constipation*, *hæmorrhoids*, etc. But as these several waters are classed only according to their predominant ingredient, and each one contains several others of real even if of secondary importance, it is evident, as before intimated, that neither their physiological nor their curative operation can be regarded as the effect of only one of their constituents, although it may happen to be the principal one. Moreover, it cannot be assumed that the same water or class of waters has but a single mode of action; for, although it is probably true that alkaline waters cure both gout and rheumatism in virtue of their alkalinity, yet sulphurous waters which cure rheumatism, but do not cure gout, must necessarily produce their effect in a different manner. It is evident, therefore, that while it may be possible to determine a certain scientific relation between particular mineral waters and the diseases they generally relieve, we are as far from comprehending their *modus operandi* as we are from understanding the actions of mercury, iodine, opium, quinine, or colchicum in the several conditions which they palliate or cure.

The temperature at which mineral waters are used materially influences their effects, whether they are taken internally or employed as baths. Indeed, as above stated, some hot springs which have for ages maintained their fame are but faintly or not at all mineralized; but there is hardly an instance of a cold spring destitute of active medicinal properties that enjoys much credit as a medicine. The operation of warm and hot water is described elsewhere (v. AQUA). The highest reputation belongs, perhaps, to those mineral waters which are both hot and strong, and which modify nutrition in every part and quicken depuration through the bowels, the kidneys, and the skin. The energy with which they act is shown by the occurrence of phenomena which are known as "crises" when they are caused by the internal use of thermal waters, and as the "bath fever" when due to their external application. Both have in common a feverish condition, attended by languor, debility, and lightness of the head—symptoms which appear to be due to a rapid and excessive loss of tissue, for they are identical with the effects of over-fatigue. When this state is induced by bathing it is usually accompanied with papular, vesicular, or erythematous eruptions upon the skin, which may be ascribed in part to the copious sweating induced, but partly also to the irritating action of the caloric and of the mineral constituents of the waters.

It may be proper to add that the use of mineral waters by persons suffering from organic heart disease, obstruction of the glandular portion of the kidneys (Bright's disease); a tendency to cerebral disease, the advanced stages of pulmonary consumption, etc., should be very cautiously advised and very watchfully conducted.

To describe in detail the application of mineral waters to the cure of diseases is here impossible; we shall only endeavor to sketch an outline of the subject, which is deserving of far more attention than it generally receives:

1. *Sulphur Springs* are extremely numerous in the United States and Canada, and are found from the Eastern to the Western limits of the continent. The most frequented are the Red and White Sulphur Springs of Virginia, Blue Lick, Ky., Sharon and Richfield, N. Y. In Europe they also abound. Their virtues vary greatly according to the qualties of the waters themselves, and particularly according to their

purgative action and their internal or external employment. That they affect the whole system is proved by the elimination of hydrogen sulphide during their use, so that silver articles worn near the skin are blackened. They differ from other mineral waters in having a sedative operation when applied externally, especially when their sulphurous element exceeds their saline or calcareous in energy. They are employed in a great variety of disorders, both internally and externally. The more purgative varieties have a great vogue in almost all forms of chronic *dyspepsia*, but especially in those which result from high living and are attended with congestion of the liver, constipation, and jaundice. In such cases the non-purgative sulphur-waters are more injurious than useful, causing plethora and its consequences. Indeed, the dyspeptic cases held to be profited by these waters are much more so by the non-sulphurous salines. Sulphur waters, on the other hand, are more useful in chronic *skin diseases*, including eczema, psoriasis, pityriasis, lichen, and acne, and they are most so when used in baths. Their internal use, apart from special indications, is superfluous. Such indications may be presented by *scrofula*, especially of the glandular sort, in which a long-continued but moderate use of the waters is most profitable. In this affection the baths should be prolonged as much as possible. When *gout* is connected with the above conditions these waters are less serviceable than the saline and alkaline. Probably, in the cure of chronic *rheumatism* more than in that of any other disease sulphur-waters stand pre-eminent—in the muscular forms first, and in the articular less conspicuously. They probably act as diaphoretics and diuretics, and hence as eliminants when taken internally; while in warm baths, which is the best mode of using them, they both promote elimination and by their local action remove the pain, swelling, and stiffness of the joints. The hotels at sulphur springs often contain museums of crutches, wheel-chairs, etc. left behind by patients who arrived as cripples and departed with supple limbs. In ancient times such articles would have formed *ex-voto* offerings in the temples. As *syphilis* is a specific poison in the system, it might be supposed that the searching operation of sulphur-waters, in their several modes of application, would tend to remove it, but such is seldom the result; and, indeed, very often the use of these waters revives the signs of the disease in persons who have been regarded as entirely cured. On the other hand, when there is a cachectic condition present, induced by an excessive mercurial treatment, such waters may greatly contribute to improve the health. *Lead-poisoning*, it is well known, in its chronic and constitutional forms, is more successfully treated by sulphur-baths than by any other agent except potassium iodide. They form a most important adjuvant to the latter medicine. Their utility in *paralysis* will depend upon its nature, as whether it be of central origin with substantial lesions or due to imperfect nutrition, or else wholly peripheral. In the first they can only be adjuvants; in the other cases they may effect a cure. But it is probable that they act in no other way than by promoting the general health through their internal use, and stimulating the paralyzed muscles externally in the same way as friction, electricity, etc. In paralysis following cerebral or spinal apoplexy there is great danger in using thermal sulphur-waters to excess. Of local diseases for which the waters are useful may be mentioned—first, chronic *pharyngitis*, especially of that granular form, which is so often associated with dyspepsia, and was formerly known as "clergyman's sore throat." Saline sulphur-waters internally and also applied by atomization are very successful in relieving it. The same may be said of chronic *bronchitis*, especially when it occurs in gouty or rheumatic persons and with dilatation of the bronchia, and in a less degree of chronic *laryngitis* of the simple form. Yet the tubercular and the syphilitic forms may sometimes be improved by them. Sulphur-waters have been much used in diseases of the uterine system, especially in *sterility*, *amenorrhœa*, and *leucorrhœa;* but little is to be expected from them in such affections unless they are used as baths, warm or cold according to the patient's condition. The feebler sulphur-waters, if they contain iron, may be drunk with advantage. Enemas of sulphur-water have been used for *ascarides* of the rectum. Finally, sulphur-waters are useful in various *surgical diseases*, but chiefly waters of the thermal variety, which operate by their heat rather than by the sulphurous compounds they contain. It may be admitted, however, that the latter elements increase their stimulating power.

2. *Alkaline Waters.*—The dominant part which the chemical reaction of the animal humors plays in vital processes explains the extraordinary potency of alkaline, and in some degree of saline, mineral waters; for the functions of digestion, respiration, etc. depend in a great measure upon the relative degrees of acidity or alkalinity of the animal fluids. Alkaline mineral waters, then, may be used so as to neutralize or diminish this acidity, and thereby produce a corresponding change in the physiological action. In

point of fact, these waters have long been known as the most efficient in chronic gout and rheumatism and the numerous disorders which depend on them; and the form of *dyspepsia* most successfully treated by their use is attended with excessive acidity of the gastro-intestinal secretions, with sour or rancid eructations and regurgitations, flatulent distension of the abdomen, tenderness of the epigastrium, etc.; and all the more so if it is connected with a gouty diathesis. The waters are most efficient when they are highly charged with carbonic acid gas. If there is gastric irritability, they must be taken in small doses. *Skin diseases* are not favorably influenced by alkaline waters internally or in baths, and the same is true of *scrofula*. Among all the known alkaline springs, there is only one which can be regarded as pre-eminently curative in *gout*, and that is at Vichy in France. The waters are most usefully as well as conveniently employed internally, but care must be taken not to drink of them too copiously, lest plethoric phenomena arise, nor to run the risk of impoverishing the blood by using them for too long at a time. In this country there is no alkaline spring, properly so called; the nearest approach to belonging to the category of such springs is made by the St. Louis Spring, Mich., but its water contains only 7.684 grains of sodium carbonate to the pint, while the Grande Grille Spring at Vichy contains nearly three times as much. Moreover, the former spring holds calcium carbonate and sulphate in large amount, while the latter contains a very small proportion of the former, and of the latter none at all. *Gastralgia*, occurring paroxysmally, is reputed to be frequently cured by these waters taken hot and in the intervals between the paroxysms. It may be doubted whether the heat does not act curatively—as much, at least, as the mineral constituents of the water. Certainly, solutions of sodium bicarbonate will not relieve gastralgia unless great acidity of the stomach is also present. In chronic *rheumatism* (which is the only form of rheumatism in which the medication by alkaline mineral waters can conveniently be tried), whether muscular or articular, alkaline waters are very highly esteemed, but they are chiefly used in warm baths. No doubt can exist in regard to the efficacy of alkaline waters in removing the symptoms of *gall-stones*. Some persons suppose that these concretions are dissolved by the waters, but of this there is no proof whatever. Others believe that the bile itself is rendered more watery by their use. It is certain that the salts of Vichy and of Carlsbad waters even in this country relieve the symptoms of this affection, provided they are administered in hot water and so as to represent nearly the strength of the natural springs. In the treatment of acid *urinary concretions* and their effects alkaline waters are of great value. They operate as diuretics, and also by neutralizing the excessive acidity of the urine. In the former way they often cause a copious discharge of acid sand. By removing the chief cause of irritation in the urinary passages they tend to cure the catarrh which may affect their mucous membrane. The usefulness of alkaline waters in *diabetes* does not admit of any doubt, however difficult it may be to explain their mode of action. It has been remarked that they are more efficacious when the patient is stout than when he is thin. In favorable examples the progress of the disease may be stayed by them for years. But "diabetes mellitus is an incurable disease," even by Carlsbad water. (See Mayer, *Med. Record*, xvii. 120.)

3. *Alkaline-saline* mineral waters, which form some of the most famous European springs, including those of Carlsbad (Leclerc, *Med. Record*, xxxv. 113; Hofmeister, *Centralbl. f. Therap.*, vii. 15), are represented in this country chiefly by the Gettysburg Springs, Pa., the St. Louis Spring, Mich., Capon Springs, Va., and the so-called Lithia Springs of that State and of Arkansas; Sheldon Springs, Vt., and several in Colorado and California (Denison, *Med. News*, lv. 284). They are more or less purgative and diuretic, and are used with great advantage in the same diseases for which alkaline waters proper are employed, but especially in chronic *dyspepsia*, disorder of the *liver*, *gall-stones*, *gout*, *rheumatism*, *gravel*, and morbid *mental* conditions associated with digestive derangements. They are very useful in *uterine* engorgements and *irritability*. They are palliatives of saccharine *diabetes* and of *Bright's disease*, especially those of them which contain a considerable proportion of iron; they have also some repute in the treatment of chronic inflammation of the *pharynx* and *larynx*. According to the purpose for which they are used, the dose should be large or small—the former when a purgative operation is desired, the latter when an alterative action is sought. In the laryngeal and pharyngeal affections named these waters are very useful in the form of an atomized spray.

4. *Acidulous saline* waters are employed in almost the same diseases as the last-mentioned class. Above all others, they are to be preferred to cure *constipation* or irregularity of bowels in persons of sedentary habits who eat and drink largely and neglect the

calls of nature, or whose digestion is impaired by mental causes. Loss of relish for food; a pasty tongue; flatulent bowels; hæmorrhoidal swelling; suspension or irregularity of the stools, which are apt to be alternately diarrhœal and scybalous or pale and dark; a high-colored and sedimentary urine; a dusky or even a jaundiced complexion; hypochondria, sleeplessness, distressing dreams,—these are the most notable symptoms which are removed by natural purgative mineral waters better than by any other cathartics. They wash out the loaded cells of the colon without impairing the appetite or strength or confirming the constipated habit, as many other purgatives do. It is this array of symptoms that is apt to be called "liver complaint." Their usefulness is notably increased by the carbon dioxide gas with which many of them are charged, and which serves to mask the taste of the sulphates of sodium and magnesium or of the sodium chloride which they contain, and to make them more acceptable to the stomach. Their mode of action is through a gradual elimination of the accumulated tissue-waste, and the increased activity which is thereby communicated to the whole glandular system. The most celebrated of American springs of this class are those of Saratoga. They are said to attract more than eighty thousand persons annually. Although they are not identical in composition, they differ so little from one another as to exert essentially the same influence on the system. It is so far from negative or indifferent that the use of such waters at unseasonable times and in improper quantities, and by persons who do not need them at all, has been the cause of incalculable mischief. Every one who requires them is also in need of judicious advice in using them. This is seldom to be obtained from the resident physicians or from those who are casual visitors. On the continent of Europe every mineral spring is provided with one or several physicians who are entitled by their knowledge and skill, as well as by their official station, to give wholesome advice regarding the use of the waters. Medical advisers of like competency are greatly needed at the popular watering-places of this country.

5. *Chalybeate* mineral waters are the best representatives of ferruginous medicines, because they not only enter the system more readily, and therefore improve the blood more rapidly, than artificial preparations of iron, but because the hygienic conditions attending their use are of the most salutary effect. When they contain sulphate of iron (as in the Rockbridge Alum Springs and several others in Virginia), they are especially serviceable in profluvia, as chronic *diarrhœa*, *dysentery*, *diabetes*, *bronchorrhœa*, *leucorrhœa*, etc.

ARALIA SPINOSA.—Aralia-Bark.

Angelica tree, *Toothache bush*, *Prickly ash*, *Prickly elder*, *Hercules' club*, E.; *Écorce d'aralie épineuse*, Fr.; *Dornige Aralienrinde*, G.

The bark of Aralia spinosa, *Linné*.

Nat. Ord.—Araliaceæ.

Origin and Description.—This shrub grows in swampy localities from Florida to Mississippi, and northward to Southern Pennsylvania and Indiana. It attains the height of 3.5 to 9 M. (12–30 feet), and has the large leaves crowded toward the summit, and bi- or tri-pinnately decomposed, with ovate pointed, serrated, and sessile leaflets, which are glaucous beneath. All parts of it are medicinal, but the bark is usually employed. It is in thin quills or curved pieces, the inner surface of which is nearly smooth and yellowish; the outer surface gray, scarcely fissured, smooth or with slight longitudinal ridges, and beset with slender prickles in transverse rows or marked with some short transverse ledges. The layer beneath the thin cork is green or brownish-green; the inner bark whitish, composed of concentric layers, and breaks with a rather tough but nearly smooth fracture. The bark has a slight aromatic odor and a bitterish, pungent, and acrid taste.

Constituents.—The acrid taste of aralia-bark is due to a resinous compound which is soluble in alcohol, but insoluble in ether. A saponin-like glucoside, *araliin*, was prepared by Holden (1880), and obtained pure by Lilly (1882) by exhausting the bark with boiling alcohol, from which it separates on cooling; it is soluble in water and diluted alcohol, insoluble in ether and chloroform, precipitated by basic lead acetate, and on boiling with dilute acids yields glucose and tasteless white *araliretin*, which is insoluble in water. The bitter principle was obtained as an extract-like mass, soluble in water, alcohol, and ether. An astringent principle colors ferric salts green and precipitates lead acetate, but not gelatin. The alcoholic extract, on being treated with water, yielded the bitter compound and crystals possessing a slight astringency. A little volatile oil, glu-

cose, starch, pectin, albuminoids, chlorophyll, fixed oil, and tasteless resin have also been found.

Allied Drugs.—Aralia nudicaulis, *Linné.*—False or wild sarsaparilla, Small spikenard, Wild liquorice, *E.;* Aralie à tige nue, Petit nard, *Fr.;* Nackte Aralienwurzel, *G.*—It is a perennial plant indigenous to Canada and the United States, where it grows in rich and rocky woodlands as far south as Carolina and Tennessee, and west to the Rocky Mountains. The rhizome sends up a single petiole about 30 Cm. (12 inches) long, and three-parted at the summit, each division bearing five ovate or oval, serrate, and subsessile leaflets. The scape is divided into three or five peduncles, each bearing a globose umbel of many greenish flowers. The rhizome, which is the part employed, is several feet long, horizontal, with some slender branches, and sparingly beset with a few radicles. The internodes are indistinct and the undeveloped buds alternate. The dry rhizome is about 6 Mm. (¼ inch) in diameter; the few scape-scars are shallow cup-shaped, and approximate at the upper annulated end of the branches; the bark is longitudinally wrinkled, of a somewhat glossy pale brownish-gray color externally, the corky layer being easily removed from the white inner bark, which does not firmly adhere to the cylindrical wood. The latter is about 3 Mm. (⅛ inch) in diameter, of a yellowish color, and encloses a spongy white amylaceous pith. The rhizome breaks with a short fracture, is somewhat aromatic, has a mawkish taste, and contains a little volatile oil, resin, sugar, pectin, and starch.

Aralia racemosa, *Linné.*—American spikenard, Spignet, Pettymorrel, *E.;* Nard américain, *Fr.;* Amerikanische Narde, *G.*—This plant grows in similar localities as the preceding, but is found southward to Georgia. It has an herbaceous stem about 1 M. (40 inches) high, and ternately and quinately divided leaves with ovate or heart-ovate doubly serrate leaflets; the flowers are in small umbels arranged in branching racemes. The rhizome with the roots was, like the preceding drug, formerly known as *Nardus americanus.* The rhizome is oblique, 10 to 15 Cm. (4–6 inches) long, and half as wide; the nodes are approximate, and the stem-scars prominent, about 25 to 38 Mm. (1–1½ inches) in diameter, the older ones deeply concave. The roots are numerous, from 50 to 75 Cm. (20–30 inches) long, about 25 Mm. (1 inch) thick near the rhizome, and little branched below. It has a stronger aromatic odor and taste than the preceding, and has similar constituents.

The *California spikenard*, Aralia californica, *Watson*, resembles the preceding, but the plant and the root are much larger.

Aralia edulis, *Siebold*, is indigenous to Japan and cultivated there. In appearance and size the rhizome resembles Solomon's seal, but the circular stem-scars are somewhat spirally arranged, about half an inch apart, and the wood is in radiating bundles.

Aralia papyrifera, *Hooker*, indigenous to Formosa, contains a thick white pith, which, cut into thin layers, constitutes the so-called Chinese *rice-paper.*

Aralia (Panax, *Linné*) quinquefolia, *Decaisne et Planchon;* Ginseng, *E., Fr., G.*—This perennial herb is indigenous to cool woodlands from New England to Minnesota and south to the mountains of Georgia. The stem bears at the summit three large palmately five-foliate leaves, with long-stalked, obovate-oblong, pointed, doubly serrate leaflets. The greenish-white flowers are in a terminal subglobular umbel, and produce globular scarlet-red two-celled and two-seeded berries. The root is fusiform, 5–10 Cm. (2–4 inches) long, with a rounded head, closely annulate, and with few wrinkles above, dividing below into two, or occasionally three, branches of even size, and when dry longitudinally wrinkled. It is of a light brownish-yellow color, internally white, breaks with a short and mealy fracture, and has a faint sweetish odor and a sweet slightly aromatic taste. The transverse section shows a thick bark, with numerous scattered brown-red resin-cells, and in older roots is radially striate from the bast-wedges; it is separated by a brown cambium-line from the central portion, which consists of linear wedge-shaped yellowish wood-bundles and broad medullary rays. Besides starch, gum, albumen, and resin, S. S. Garrigues (1854) isolated a sweet principle, *panaquilon*, $C_{12}H_{25}O_9$, by adding to the syrupy infusion a concentrated solution of sodium sulphate and dissolving the precipitate in alcohol. It is yellow, amorphous, sweet, insoluble in ether, and precipitated by tannin. Concentrated sulphuric acid dissolves it with a purple-red color, converting it at the same time into *panacon*, $C_{11}H_{19}O_4$, which is white, tasteless, and insoluble in water and ether, but soluble in alcohol.

Aralia (Panax, *Nees*) Ginseng, *A. Meyer*, is indigenous to Eastern Asia, and much cultivated. It furnishes the *Chinese ginseng*, which is larger than the preceding, but otherwise resembles it; it is often scalded while fresh, and then has a yellowish translucent appearance after drying.

Action and Uses.—The name of "false sarsaparilla" applied to Aralia nudicaulis denotes the qualities which have been attributed to it—viz. of being stimulant, diaphoretic, and alterative. But the proofs of its virtues are unsatisfactory. It is used in decoction and infusion, both internally and externally.

Aralia spinosa is thought to be more stimulating than A. nudicaulis, but its uses are nearly the same. In South Carolina it was reputed to be a valuable remedy for chronic *rheumatism* and diseases of the skin, and it is said to be implicitly relied upon by the negroes as an antidote to the *rattlesnake's bite.* The bark is used for this purpose both internally and externally. A saturated tincture is said to have been given in the dose

of 16 Gm. (f℥ss) three times a day, and a decoction was used prepared with 32 Gm. (℥j) of the bark and a quart of water.

It is unsettled whether or not the American and Chinese species of *ginseng* are identical. It is at least certain that while the former is only agreeable in taste, and perhaps useful as a mild stomachic, the latter enjoys in its native country the reputation of a panacea, and especially of being aphrodisiac. The affections for whose cure it is most esteemed are such as are usually treated by aromatic stimulants, including *dyspepsia*, *vomiting*, and *nervous disorder*. It is used as a masticatory, and also in infusion.

ARECA, *Br. Add.*—Areca-Nut.

Semen Arecæ.—Betel-nut, E.; *Noix d'arec*, Fr.; *Arekanuss, Betelnuss*, G.

The seed of Areca Catechu, *Linné*, the betel-nut tree. Bentley and Trimen, *Med. Plants*, 276.

Nat. Ord.—Palmæ.

Origin.—This elegant palm, which attains a height of about 50 feet (15 M.), is indigenous to the East Indies and the East Indian Islands, and is extensively cultivated there and in the Philippine Islands. The orange-colored fruit is of about the size and shape of a hen's egg, and contains under a fibrous pericarp a single seed.

Description.—The seed, which is the so-called areca- or betel-nut, is about an inch (25 Mm.) in length, roundish-conical in shape, and somewhat depressed at the base. It is of a brown color externally, with numerous reddish veins, originating at the hilum and forming a network which penetrates into the white albumen, and gives to the latter internally a marbled appearance; the small embryo is situated near the base of the seed. Areca-nuts are heavy, very hard, and have, when recently broken, a feeble somewhat cheese-like odor and an astringent and slightly acrid taste.

Constituents.—Areca-nuts contain about 14 per cent. of fixed oil, which is solid and crystalline at the ordinary temperature, and about the same amount of a red tannin which is insoluble in ether, slightly soluble in water, and resembles catechu-tannic acid in producing a green and afterward a brown color with ferric salts. According to E. Jahns (1889), areca-nuts contain three alkaloids: *arecoline* (*arekane*, Bombalon, 1885), 0.07–0.1 per cent.; *arecaine*, 0.1 per cent.; and the third only in small quantity. *Arecoline*, $C_8H_{13}NO_2$, is a strongly alkaline colorless oily liquid, miscible with water, alcohol, ether, and chloroform. It boils at or near 22° C. Its salts are mostly crystallizable, easily soluble, and some deliquescent. *Arecaine*, $C_7H_{11}NO_2 . H_2O$, forms colorless crystals which are permanent in air, freely soluble in water and dilute alcohol, and nearly insoluble in absolute alcohol; ether, chloroform, and benzine do not dissolve it. At 100° C. (212° F.) it loses its water of crystallization, and melts with frothing at 213° C. (415.5° F.). The salts are crystalline, possess an acid reaction, are freely soluble in water, and less so in alcohol. Catechin is not present. The nuts yield 2.26 per cent. of ashes containing ferric oxide and magnesium phosphate (Flückiger and Hanbury). The aqueous extract of these seeds yields a kind of catechu.

Action and Uses.—Areca is astringent, and is chiefly used for the expulsion of *tape-worms*. From Gm. 8–12 (℥ij–℥iij), powdered and mixed with syrup, is stated to be the proper dose. Before being used to destroy these parasites in man it was largely employed for a similar purpose in dogs. Bombelon procured from it an alkaloid which increased the salivary secretion, slowed the pulse, and had a purgative action (*Lond. Med. Record*, Apr. 15, 1886). Another alkaloid, arecoline, was found to reduce both respiration and pulse, proving fatal through arrest of the former (*Lancet*, Mar. 1889, p. 496).

ARGEMONE.—Prickly Poppy.

Argémone, F.; *Stachelmohn*, G.

Argemone mexicana, *Linné*.

Nat. Ord.—Papaveraceæ.

Description.—This annual is indigenous to Mexico, Colorado, and the West Indies, but has been introduced and naturalized in most tropical and subtropical countries. It is about 2 feet (60 Cm.) high, has alternate sessile, sinuate-lobed leaves with prickly teeth and white spots, and yellow or white flowers, about 1½ inches (38 Mm.) in diameter, with 6 petals and many stamens. The ovate prickly capsule is about an inch (25 Mm.) thick, crowned with the nearly sessile radiate stigmas, and contains numerous blackish finely-

pitted seeds. The plant has a bitter and acrid taste, and when wounded exudes a yellowish milky juice.

Constituents.—Charbonnier (1868) claims to have found a small proportion of morphine in the leaves and capsules; like several allied plants, it probably contains sanguinarine. (See CHELIDONIUM.) The seeds yielded him 36.2 per cent. (by pressure 18 per cent., Lepine, 1861) of a drying fixed oil of a light-yellow color and bland taste. O. Frölich (1871) obtained from the oil a pretty hard soda-soap, and found in the soap-liquor butyric, valerianic, acetic, and a little benzoic acid. According to Flückiger (1871), the oil has the spec. grav. .919 at 16.5° C. (61.8° F.), remains clear at −6° C. (21.2° F.), dries slowly and incompletely, is not soluble in 6 volumes of 90 per cent. alcohol, as stated by Charbonnier, and has a mild purgative effect in doses of 4 or 5 grains.

Action and Uses.—The principal quality of this plant appears to be its acrimony, in which, as well as in the physical properties of its inspissated juice, it resembles gamboge. In Mexico and in Java its fresh juice is applied to *warts* and indolent *ulcers* and in *psorophthalmia* and *opacities of the cornea*. The fresh leaves are also bruised and used as a dressing for ulcers. The juice is employed as a hydragogue cathartic in *dropsy*. Charbonnier states that the fatty oil of the seeds is used in the West Indies and in Mexico to relieve headache, and that twenty drops of it occasion vomiting and watery stools. Some narcotic virtue has been ascribed to the seeds, which are said to be used for smoking when mixed with tobacco. But while one authority describes them as suitable, like opium, for checking diarrhœa, another compares them to ipecacuanha, a third holds them to be purgative, and a fourth as purgative and anodyne also. The oil, derived by expression from the seeds, is reported to purge in the dose of Gm. 2 (gtt. xxx). An infusion of the herb is stated to be used in Mexico as a sudorific.

ARGENTI CYANIDUM, *U. S.*—SILVER CYANIDE.

Argentum cyanatum.—Cyanure d'argent, Fr.; *Silbercyanid, Cyansilber*, G.

Formula $AgCN = AgCy$. Molecular weight 133.64.

Preparation.—Take of Silver Nitrate, Potassium Ferrocyanide, each 2 troyounces; Sulphuric Acid 1½ troyounces; Distilled Water a sufficient quantity. Dissolve the silver nitrate in a pint of distilled water and pour the solution into a tubulated glass receiver. Dissolve potassium ferrocyanide in 10 fluidounces of distilled water, and pour the solution into a tubulated retort previously adapted to the receiver. Having mixed the sulphuric acid with 4 fluidounces of distilled water, add the mixture to the solution in the retort, and distil by means of a sand-bath, with a moderate heat, until 6 fluidounces have passed over or until the distillate no longer produces a precipitate in the receiver. Lastly, wash the precipitate with distilled water and dry it.—*U. S.* 1870.

On distilling potassium ferrocyanide, with sulphuric acid, hydrocyanic acid passes over (see ACIDUM HYDROCYANICUM), which reacts with silver nitrate, forming nitric acid, and silver cyanide, which precipitates; $HCy + AgNO_3 = HNO_3 + AgCy$. To avoid loss of silver the distillation should be continued as long as a precipitate is produced in the solution.

Properties.—Silver cyanide may also be conveniently prepared by adding a solution of silver nitrate to a solution of pure potassium cyanide as long as a precipitate continues to be formed, and then filtering and washing the precipitate well with distilled water. When silver nitrate solution is first added, no precipitate occurs, owing to the formation of a soluble compound, $KAg(CN)_2$; but this is decomposed by further addition of the silver solution, and silver cyanide is then precipitated. About 170 grains of silver nitrate will require 65 grains of potassium cyanide, producing about 133 grains of silver cyanide, the two reactions taking place being as follows: (1) $2KCN + AgNO_3 = KAg(CN)_2 + KNO_3$; (2) $KAg(CN)_2 + AgNO_3 = 2AgCN + KNO_3$. Silver cyanide, when dry, forms a white amorphous inodorous and tasteless powder, which gradually turns brown on exposure to the light, and is best preserved in amber-colored or black vials. When heated it fuses, giving off one-half of its cyanogen, and suffering further decomposition by a higher heat, leaving finally metallic silver amounting to 80.56 per cent. of the original weight. It is insoluble in simple solvents and in diluted acids, but is decomposed by chlorine-water, by warm solutions of chlorides and iodides, and by boiling concentrated acids, with the evolution of hydrocyanic acid, furnishing with boiling nitric acid silver nitrate, but crystallizing from hot diluted nitric acid, partly in minute

prisms. It is readily soluble in ammonia and sodium thiosulphate, somewhat soluble in ammoniacal salts, and forms soluble double salts with the alkali cyanides. Dilute hydrochloric acid decomposes it, yielding silver chloride and hydrocyanic acid.

The only use of this salt in medicine is to serve for the extemporaneous preparation of diluted hydrocyanic acid.

ARGENTI IODIDUM, *U. S.*—Silver Iodide.

Argentum iodatum.—Iodure d'argent, Fr.; *Silberjodid, Jodsilber*, G.

Formula AgI. Molecular weight 234.19.

Preparation.—Dissolve 1 part each of silver nitrate and potassium iodide separately in 10 or 12 parts of water; pour the silver solution gradually and with continued stirring into the solution of potassium iodide; collect the precipitate upon a filter; wash it well with distilled water and dry it upon bibulous paper. 1 ounce of silver nitrate yields 1.34 to 1.37 ounce of silver iodide. By mutual decomposition of the two salts silver iodide and potassium nitrate are produced; $AgNO_3 + KI$ yields $AgI + KNO_3$. The former salt being insoluble in water, is freed from the latter by washing with distilled water. The use of a slight excess of the potassium salt ensures the stability of the silver iodide in the light (H. Vogel). Should the potassium iodide be contaminated with chloride, the precipitate will likewise contain silver chloride, which, being freely soluble in ammonia, is readily removed by adding to the mother-liquor before decantation 1 or 2 parts of ammonia-water, stirring well and allowing to settle. It is advisable to keep the salt in amber-colored vials, protected from the light.

Properties.—Silver iodide is "a heavy, amorphous, light-yellowish powder, unaltered by light if pure, but generally becoming somewhat greenish-yellow, without odor and taste, and insoluble in water, alcohol, diluted acids, or in solution of ammonium carbonate, soluble in about 2500 parts of stronger ammonia-water. When heated to about 400° C. (752° F.) it melts to a dark-red liquid, which on cooling congeals to a soft, yellow, slightly translucent mass. When mixed with ammonia-water it turns white, but regains its yellowish color by washing with water. It is dissolved by an aqueous solution of potassium cyanide, and also by a concentrated aqueous solution of potassium iodide, and the resulting solutions yield a black precipitate with hydrogen sulphide or ammonium sulphide. If a small quantity of chlorine-water be agitated with an excess of the salt, the filtrate acquires a dark-blue color on the addition of gelatinized starch."—*U. S.* The color of melting silver iodide varies according to the temperature between yellow, red, and dark red-brown. At a white heat the salt may be sublimed, but when heated before the blowpipe upon charcoal it burns with a green flame and white smoke, leaving a little silver behind. Warm potassa solution imparts a brownish color to the salt and decomposes it on continued boiling. A concentrated solution of potassium iodide dissolves the salt, which is reprecipitated on dilution with water.

Tests.—"If 0.5 Gm. of the salt be digested with 10 Cc. of a cold 15 per cent. solution of ammonium carbonate the resulting filtrate, on being supersaturated with nitric acid, should not be rendered more than faintly opalescent (absence of chloride.) On digesting a portion of the salt—which has been found to be free from chloride, or from which the latter has been completely removed by repeated digestion with ammonium carbonate—for five minutes with 10 Cc. of ammonia-water, and supersaturating the filtrate with nitric acid, only a slight opalescence, but no yellowish-white precipitate, should be produced (absence of bromide)."—*U. S.*

Action and Uses.—This appears to be a superfluous addition to the Pharmacopœia. Long since obsolete, it was at one time vaunted in the treatment of *syphilis*, of visceral *neuralgia*, *asthma*, *chorea* (Guibert, *Nouveaux Médicaments*, p. 427), and even of *whooping cough* (*Practitioner*, iv. 373). The dose prescribed varied from Gm. 0.008–0.13. (⅛ grain to 2 grains).

ARGENTI NITRAS, *U. S., Br.*—Silver Nitrate.

Argentum nitricum crystallisatum, Azotas (Nitras) argenticus.—Nitrate (Azotate) d'argent, Nitre lunaire, Fr.; *Silbernitrat, Saltpetersaures Silberoxyd, Silbersalpeter*, G.; *Nitrato di plata*, Sp.; *Nitrato di argento crystallizzato*, F. It.

Formula $AgNO_3$. Molecular weight 169.55.

Preparation.—Take Purified Silver 3 ounces; Nitric acid 2½ fluidounces; Dis-

tilled Water 5 ounces. Add the nitric acid and the water to the silver in a flask, and apply a gentle heat till the metal is dissolved. Decant the clear liquid from any black powder which may be present into a porcelain dish, evaporate and set aside to crystallize; pour off the liquor and again evaporate and crystallize. Let the crystals drain in a glass funnel, and dry them by exposure to the air, carefully avoiding the contact of all organic substances. Silver nitrate must be preserved in bottles carefully stoppered.—*Br.*

When silver is dissolved in nitric acid, silver nitrate is formed and hydrogen set free; the latter reacts with another portion of nitric acid, forming water and nitric oxide, which is a colorless gas, but on contact with the atmosphere is oxidized, so as to form red vapors of nitrogen tetroxide. These reactions are explained by the following equations: $6HNO_3 + 3Ag_2$ yields $6AgNO_3 + 3H_2$; $3H_2 + 2HNO_3$ yields $4H_2O + 2NO$; $2NO + O_2$ yields N_2O_4 or $2NO_2$. The results of the process under the circumstances stated are therefore water, silver nitrate, which remains in solution, and nitrogen tetroxide, which escapes. If insufficient heat is applied during the reaction the nitric oxide generated remains wholly or in part in solution, reducing the excess of nitric acid to nitrogen trioxide and tetroxide. Should the solution be made in a porcelain capsule, it will be found of advantage to invert a glass funnel over the mixture, whereby not only some nitric acid, which would otherwise escape, is condensed and flows back into the dish, but the loss of silver solution by sputtering is likewise prevented. Since the best refined silver usually contains minute quantities of other metals, particularly copper, their removal becomes necessary, and is effected either by crystallization, when the impurities, together with some silver, will remain in the mother-liquor, or the solution is evaporated to dryness and the crystalline or granular mass further heated until it is fused and ceases to give off acid vapors. The copper nitrate and other metals are decomposed by heat before the silver nitrate is affected, and the fused mass acquires a more or less dark-gray color in proportion to the amount of cupric oxide contained in it. The latter, being insoluble in water, is easily removed by dissolving the cooled salt in distilled water and decanting or filtering the solution before evaporating it. The purification of silver nitrate by fusion was the process recommended by the U. S. P. 1870. In following it, unless the heat be very carefully regulated, some silver nitrate will be reduced to nitrite, and contact with organic matter will tend to deoxidize it. It is therefore advisable to acidulate the solution with a little nitric acid.

Both processes are applicable in cases where the metallic impurities are small in quantity. If silver coin is used, the first crystallization will not be pure, and if evaporated to dryness and fused a portion of silver oxide will be separated. In such a case it is advisable either to treat the first crop of crystals by fusion or to purify the silver by one of the processes given elsewhere. (See ARGENTUM.)

Properties.—Silver nitrate exists in colorless shining tabular crystals of the rhombic system, which are inodorous and have a caustic and strongly metallic taste and a neutral reaction. It is soluble at 15° C. (59° F.) in 0.6 part of water and in 26 parts of alcohol (*U. S.*); in 0.6 part of water and in 10 parts of alcohol, spec. grav. 0.832 (*P. G.*); also in 0.1 part of boiling water and in 5 parts of boiling alcohol (*U. S.*). Kremers (1854) ascertained that 1 part of silver nitrate dissolves at 0° C. (32° F.) in 0.82 parts, at 11° C. (51.8° F.) in 7.83 parts (Schnauss), at 19.5° C. (67° F.) in 0.44 parts, at 54° C. (129.2° F.) in 0.20 parts, and at 110° C. (230° F.) in 0.09 parts of water. Eder found the salt soluble at 15° C. (59° F.) in 26 parts, at 50° C. (122° F.) in 13.7 parts, and at 75° C. (167° F.) in 5.5 parts of alcohol (sp. gr. .817). It is likewise, though less freely, soluble in ordinary ether, but nearly insoluble in absolute ether, freely soluble in diluted, but sparingly soluble in strong nitric acid. It melts at 200° C. (392° F.) to a faintly yellow liquid, and on cooling congeals to a white crystalline mass; at a higher temperature nitrous vapors are given off, leaving silver oxide and nitrate; heated to a dull-red heat, metallic silver is left. The crystals and the aqueous solution are permanent in the air and light, except in the presence of organic matter, whereby they acquire a dark color. The alcoholic solution when exposed to the light is gradually reduced, silver being separated. Hydrochloric acid produces in the solution a white curdy precipitate of argentic chloride, which is insoluble in dilute nitric acid, but dissolves readily in ammonia. Stains produced by silver nitrate upon the skin are removed by rubbing them with a strong solution of potassium cyanide, or by moistening them first with a solution of iodine and afterward with sodium thiosulphate. The solution of silver nitrate acidulated with nitric acid and heated with alcohol produces the violently explosive compound known as *fulminating silver.*

Silver nitrate contains no water of crystallization.

Tests.—10 grains of silver nitrate yield 8.44 grains of chloride.—*Br.* The salt should yield with ammonia a clear and colorless solution (absence of copper, lead, etc.), and its aqueous solution, when precipitated by an excess of hydrochloric acid, should yield a filtrate which is not colored by hydrogen sulphide, and when evaporated leaves no residue (absence of other salts). A 10 per cent. aqueous solution, mixed with four times its volume of diluted sulphuric acid and heated to boiling, should not become turbid.—*U. S.*, *P. G.* This test indicates the absence of lead, the sulphate of which is insoluble, while silver sulphate is soluble in 68.6 parts of boiling water. "0.3391 Gm. of silver nitrate, dissolved in 10 Cc. of water, should require, for complete precipitation, 20 Cc. of decinormal sodium chloride solution (corresponding to 100 per cent. of the pure salt)."—*U. S.*

Pharmaceutical Uses.—Silver nitrate is used in the preparation of the other medicinal compounds of silver and of indelible ink.

INDELIBLE INK is frequently made of silver nitrate. From the numerous formulas recommended we select the following: Dissolve 2 drachm's of silver nitrate in 7 fluidrachms of distilled water, and add 1 fluidrachm of mucilage of gum-arabic colored with sap-green or other coloring matter. This ink is used after a mordant, which is a solution of sodium carbonate and gum in water, of the strength of 1 part of the former to from 5 to 10 of the latter (Cooley).

1 part of silver is dissolved in 6 parts each of distilled water and mucilage of gum. It is to be used with a mordant composed of 1 part of sodium hypophosphite, 2 of gum-arabic, and 16 of distilled water (Kuhr).

The following indelible inks are used without mordant:

8 parts of silver nitrate and 3 parts of tartaric acid are triturated together; a little water is then added, and afterward a sufficient amount of ammonia-water to neutralize the free acid and dissolve the silver tartrate; lastly, a little gum and coloring matter is added (Reade).

Silver nitrate and potassium bitartrate, of each 8 drachms, are rubbed together and dissolved in 4 ounces of ammonia-water; 4 drachms of archil, 6 of white sugar, and 10 of powdered gum are added, and when solution has taken place sufficient water to make the whole measure 6 fluidounces (Redwood).

ARGENTI NITRAS DILUTUS, *U. S.*—DILUTED SILVER NITRATE.

Argenti et potassii nitras, Br.; *Argentum nitricum cum kalio-nitrico*, P. G.; *Argentum nitricum fusum mitigatum, Lapis infernalis nitratus.—Nitrate of silver and potassium, Mitigated caustic*, E.; *Azotate d'argent mitigé, Pierre infernale diluée*, Fr.; *Salpeterhaltiger Höllenstein*, G.; *Nitrato di argento fuso con nitrato di potassio*, F. It.

Preparation.—Silver Nitrate 30 Gm.; Potassium Nitrate 60 Gm. Melt the salts together in a porcelain crucible at as low a temperature as possible, stirring the melted mass well until it flows smoothly. Then cast it in suitable moulds. Keep the product in dark amber-colored vials, protected from light.—*U. S.*

Silver nitrate 1 part, potassium nitrate 2 parts.—*P. G.*, *Br.*

Properties.—"A white, hard solid, generally in form of pencils or cones of a finely granular fracture, becoming gray or grayish black on exposure to light in presence of organic matter; odorless, having a caustic metallic taste and a neutral reaction. Each of its constituents retains the solubility in water and in alcohol, mentioned respectively under ARGENTI NITRAS and POTASSII NITRAS."—*U. S.* The pencils are less fragile and more opaque than those made of pure silver nitrate. They will contain silver nitrite, and blacken on exposure to light if the salts had been melted at too high a heat. If made with sodium nitrate they become superficially moist in a damp atmosphere.

Tests.—"An aqueous solution of diluted silver nitrate yields with a slight excess of hydrochloric acid, a white precipitate, which is readily soluble in ammonia-water. The filtrate from the precipitate, when evaporated to dryness, yields a white residue which is completely soluble in water, and this solution affords a yellow, crystalline precipitate with platinic chloride test-solution, and a white crystalline precipitate with sodium bitartrate test-solution. If to an aqueous solution of diluted silver nitrate a slight excess of ammonia-water be added, it should neither assume a blue color (absence of *copper*) nor afford any turbidity (absence of *lead* and *bismuth*). If 1 Gm. of diluted silver nitrate, dissolved in 10 Cc. of water, be mixed with 20 Cc. of decinormal sodium chloride solution, and then a few drops of potassium chromate solution added, not more

than 0.5 Cc. of decinormal silver nitrate solution should be required to impart to the liquid a permanent red color (corresponding to at least 33 per cent. of pure silver nitrate.—*U. S.*

Action and Uses.—This is merely a mitigated form of moulded silver nitrate, and may sometimes be found convenient when a slight caustic action is intended.

ARGENTI NITRAS FUSUS, *U. S.*—Moulded Silver Nitrate.

Argentum nitricum (fusum), P. G.; *Lapis-infernalis, Azotas (Nitras) argenticus fusus.*—*Fused nitrate of silver, Lunar caustic*, E.; *Nitrate (Azotate) d'argent fondu, Pierre infernale*, Fr.; *Höllenstein, Geschmolzenes salpetersaures Silberoxyd*, G.

Preparation.—Silver Nitrate 100 Gm.; Hydrochloric Acid 4 Gm. To the silver nitrate contained in a porcelain capsule, add the hydrochloric acid, and melt the mixture at as low a temperature as possible. Stir well, and pour the melted mass into suitable moulds. Keep the product in dark amber-colored vials, protected from light.—*U. S.*

To obtain the nitrate in rods, fuse the crystals in a capsule of thin porcelain or platinum, and pour the melted salt into proper moulds.—*Br.*

The reasons for the cautious application of heat when fusing silver nitrate have been pointed out above. (See Argenti Nitras.) The salt being decomposed by nearly all the metals when heated with them, capsules of platinum or of the best porcelain are the only vessels suitable for this operation. When fused it has the appearance of a colorless, transparent, oily liquid, and is then ready to be poured into the moulds, which should be faced with pure silver. Brass moulds are sometimes used, but they are liable to contaminate the product with copper. Steel or porcelain moulds may be used after they have been rubbed with some powdered French chalk, which prevents the fused salt from adhering to the mould. If the moulds have been previously warmed to about 40° or 50° C. (104° or 122° F.), the fused mass will not congeal too rapidly. Oiling the moulds should be avoided, lest a reduction of the salt should take place.

Properties.—Moulded *pure* silver nitrate is met with in nearly colorless thin cylinders or pointed cones, which when broken show a crystalline texture upon the fractured surface; in solubility, chemical behavior, and composition it agrees with the crystallized nitrate. It is not affected by light unless it has been partly reduced by too high a heat to silver nitrite or been in contact with organic matter; wrapping the sticks in paper or handling them with the fingers should therefore be avoided. The pencils are rather brittle, but the addition of a little silver chloride, as proposed by Dr. Squibb (1858), renders the sticks more opaque and tough. This is now recognized by the U. S. P., and contains about 5 per cent. of silver chloride, which is left undissolved on treatment with water; it is likewise insoluble in dilute nitric acid, but is completely soluble in ammonia-water. "Toughened caustic," *Br.*, consists of silver nitrate 95 parts, and potassium nitrate 5 parts.

Tests.—For the pure lunar caustic the same tests may be applied as for the crystals. Oxide or metallic silver in very fine division is occasionally present, either in consequence of too high a heat having been employed or because the sticks have been in contact with organic matter; it will be left behind as a black powder on treating the sticks with distilled water. "If 0.34 Gm. of moulded silver nitrate, dissolved as completely as possible in 10 Cc. of water, be mixed with 20 Cc. of decinormal sodium chloride solution, and then a few drops of potassium chromate test-solution added, not more than 1 Cc. of decinormal silver nitrate solution should be required to impart to the liquid a permanent red color (corresponding to 95 per cent. of pure silver nitrate)."—*U. S.*

Action and Uses.—Applied to a mucous membrane or to the raw skin, nitrate of silver causes a severe smarting and burning pain, and forms a white pellicle, by coagulating the albumen and fibrin of the part, which speedily dries. Repeated applications may occasion permanent stains. Upon the sound skin its prolonged application occasions vesication with a surrounding red border, but it does not cause ulceration of the chorion, and the superficial loss of substance is rapidly restored. The cauterized surface, by exposure to the light, gradually turns brown, and even black. The case is recorded of a man who for the space of a year was accustomed to dye his hair and beard with a solution of nitrate of silver. He suffered from general depression, giddiness, mental debility, hardness of hearing and tinnitus, spasm of the muscles of the eyes and face; all of which symptoms speedily disappeared on ceasing to use the hair-dye. Taken internally, by far the larger portion of the salt is discharged as a chloride of silver with the feces, but that a portion also is retained is certain, partly from the therapeutical effects,

but more evidently from the peculiar violet discoloration of the exposed portions of the skin produced by its prolonged use, as well as from its detection in the kidneys, choroid plexuses, etc. An analogous stain is sometimes observed on the gums and inner surface of the cheeks before the skin is affected. As long ago as 1814, Roget reported the case (*Med.-Chir. Trans.*, vii. 290) of a lady who, after taking nitrate of silver for some time, "observed that the tongue and fauces had acquired a dark color as if stained with ink," and that subsequently the complexion grew dark. A recent case has been reported by Shellenberger (*Med. News*, l. 417). Several cases are recorded in which the characteristic stain followed repeated applications of lunar caustic to the throat, but doubtless the salt was swallowed (*Phila. Med. Times* ix. 479; *Therap. Gaz.*, xii. 711; *Med. News*, li. 735). Nitric acid and also iodide of potassium taken internally are reported to lessen the intensity of the discoloration caused by the absorption of this salt. It is worthy of notice that when discoloration of the skin is produced by the prolonged use of small doses of the salt, no other symptoms occur which can be attributed to its operation.

Doses of one-half a grain occasion no special symptoms, but larger quantities are apt to cause gastric heat, pain, and nausea. But much depends upon whether the stomach contains food or not. In poisonous doses it occasions gastric irritation and diarrhœa as direct effects, and indirectly loss of consciousness, anæsthesia, convulsions, muscular exhaustion, a faint pulse, and a cold, clammy skin. In some cases of chronic poisoning by it a scorbutic condition is alleged to have been observed, resembling that produced by this salt in animals. Nitrate of silver by its long-continued use has ulcerated the stomach, and a portion of fused nitrate has been arrested in the fauces and caused swelling of the glottis, in both instances destroying life.

In various disorders of the *stomach*, including morbid sensibility of that organ from chronic *inflammation*, *neuralgia*, and chronic *ulcer*, the use of nitrate of silver has sometimes relieved pain, checked vomiting and acid eructations, and restored health by promoting healthy digestion. The difficult diagnosis of such cases renders the application of the remedy uncertain, but its benefits are sometimes striking. *Diarrhœa*, whether dependent upon debility of the intestine or upon ulceration due to tuberculosis, or chronic dysentery, or prolonged typhoid fever, is favorably modified by nitrate of silver. In *dysentery* which is either subacute or has not entirely passed into the chronic stage enemata containing the salt are to be preferred. They should consist of two or three pints of water in which are dissolved from 20 to 60, and sometimes even 80 grains, Gm. 1.30–1.45 and the solution should be introduced through a long rectal tube from an irrigating vessel, and more or less slowly or rapidly according to the sensibility of the patient. Even in Asiatic *cholera* the medicine may be advantageously exhibited both by mouth and rectum. There is some evidence of its utility in chronic *jaundice* from an accumulation of thick bile in the ducts. Its sedative action upon the heart, demonstrated by experiments upon animals, receives a confirmation from experience, which shows it to be a palliative of abnormal action of the *heart* in organic as well as functional disease of that organ. In like manner, its action upon the lungs is illustrated by its beneficial effects in some cases of *bronchitis* with muco-purulent expectoration and hectic fever. But its efficacy in nervous diseases is still more evident in the apparent cures of *epilepsy* attributed to its use. The special forms of the disease which it most favorably influences are undetermined. It must be given for a long time, commencing with doses of Gm. 0.016 (gr. $\frac{1}{4}$) three times a day, and gradually increased. Every three or four weeks its administration should be suspended for a few days in order to diminish the risk of staining the skin. Since the introduction of the bromides this medicine has, like many other anti-epileptic remedies, been almost entirely neglected. In that form of paralysis known as *locomotor ataxia* (sclerosis either disseminated or limited to the lateral columns) nitrate of silver is reported to have effected cures; but a close scrutiny of the matter shows that the cases cured were not examples of this disease, but of *congestion of the cord*, generally associated with rheumatism, but sometimes resulting from concussion (*St. Bart.'s Hosp. Rep.*, xv. 176; Bókai, *Centralb. f. Ther.*, ii. 64; Rosenbaum, *Therap. Monatsh.*, iv. 232). In not a few instances this salt, in doses of Gm. 0.006–0.013 (gr. $\frac{1}{10}$–$\frac{1}{5}$) several times a day, has effected cures when other methods failed. Relief of *dysmenorrhœa* has been attributed to the internal use of this medicine in doses of Gm. 0.008 (gr. $\frac{1}{8}$) three times a day (Blackwood, *Phila. Med. Times*, xii. 518).

Lunar caustic has been extensively employed in the treatment of *diphtheritic exudations* of all kinds, in *diphtheria*, *croup*, etc., and there is no doubt that it sometimes appears to modify favorably the affected surfaces and to prevent the increase and extension of false membranes. In the case of laryngeal croup it was at one time the custom

to introduce into the larynx a strong solution of the salt (40 grains to the ounce of water) by means of a sponge or brush, but more recently an atomized solution of the same strength has been substituted. In pharyngeal diphtheria, in which the existence and condition of the false membrane are more demonstrable, as well as the influence of treatment upon it, the tendency of opinion among the most judicious physicians is less favorable than formerly to any form of local cauterization. It is alleged—and our own observation leads us to believe—that this method, which was at one time regarded as essential, is often injurious by the irritation it causes and the extension of the deposit which follows its use. In laryngeal *croup* the results of the treatment appear to be more favorable, but it must not be forgotten that the diagnosis of the disease from simple laryngitis is often obscure, and also that the immediate dependence of life upon the freedom of the larynx and trachea from obstruction must modify the conclusions arrived at in regard to the laryngeal as compared with the pharyngeal affection. The advantages of nitrate of silver in *chronic ulceration* and *simple inflammation* of the larynx and trachea are unequivocal. It exerts here the same stimulant and protective influence that it does over similar lesions elsewhere, and thus promotes the restoration of the parts to health as far as possible. Ulcers of the larynx are never primary, but always dependent upon a diathetic influence (tubercle, syphilis, cancer), a cure of them by local treatment alone is not to be expected; but this method is invaluable for the relief it affords to suffering by palliating the symptoms which the local lesions occasion. In *simple chronic laryngitis* the same treatment may suffice for a permanent cure. Many cases of *aphonia* depending upon this affection may thus be permanently cured. The stimulant action of solutions of nitrate of silver, applied by sponge, brush, syringe, or atomizer, is most efficient in the various forms of simple laryngitis, and also in nervous aphonia and in *whooping cough*. In the last-mentioned affection the pharynx as well as the larynx should be impressed by means of an atomized solution of the salt. In all inflammations of the *pharynx*, whether acute or chronic, solutions of nitrate of silver have been used, diluted in the more acute and superficial forms, and stronger in the chronic follicular and ulcerous affections of the part. They are signally useful in that form known as *clergyman's sore throat*, and are the best palliatives of *tubercular* and *syphilitic* ulcers of this part. A comparatively weak atomized solution is more efficient in these cases than a strong solution applied with a sponge or brush. Caution must be used in applying the caustic to the *auditory canal*. A case in which this was done after the loss of a portion of the tympanum presented alarming symptoms (*Lancet*, Feb. 4, 1888).

If in any case it is possible to prevent *tonsillitis* from passing into *quinsy*, this end may be most securely reached by the application of lunar caustic freely to the swollen gland. But the termination in suppuration can never, in a particular case, be predicted with certainty. It sometimes happens also that this use of the caustic appears to promote and not to hinder suppuration. Local vesication by means of a saturated solution of the crystallized salt or with the fused nitrate is an efficient means of treating various local ailments. It may be used over the superficial portions of nerves in various *neuralgiæ;* superficially also over *lymphatic vessels* and *glands* in the first stage of inflammation; *paronychia* and other forms of local inflammation, such as *abscesses*, may be treated in the same way. It has been used to blister the brow in *iritis*. It has been also applied by deep injection in *sciatica*. The value of this treatment may be measured by the fact that a precisely similar result ensued upon the injection of pure water. The silver salt so injected causes severe pain, followed by abscess. The substitutive action of nitrate of silver is pre-eminently useful in *ophthalmia* or *conjunctivitis*. In different degrees of strength it may arrest the development of a mild inflammation or so modify the membrane as to cure the most chronic forms of this affection. It is by no means the stronger solutions that are most efficacious. A solution of one grain to the ounce, applied every hour or two, is preferable to one of twice the strength used at intervals of two or four hours. The case is recorded of wellnigh fatal hæmorrhage caused by applying a 2 per cent. solution of the salt to the eyes of a new-born child (*Med. Record*, xxxii. 213). The disused practice of producing counter-irritation in these affections by blistering the brow with this caustic has been recommended anew (*Med. Times and Gaz.*, Dec. 1879, p. 635). In treating *ulcers* of the *cornea* care should be taken lest the undissolved or precipitated salt should permanently stain the structure and form an obstacle to distinct vision. *Blepharitis*, or inflammation of the follicles of the edges of the lids, is said to be well treated with an ointment of nitrate of silver (gr. iij to ℥j), but it is better to touch the parts with a strong solution of the salt and then cover them with simple ointment. Of all agents for modifying *ulcers*, none is so frequently applied as nitrate of

silver. Its internal use for this purpose has already been noticed, but it is still more commonly applied to ulcers of the external integument—to the irritable in weak solution as an astringent, stimulant, and protective, and to the indolent in caustic form to destroy inert tissue, or rather to revive its dormant vitality. Probably no other single agent is so useful in the treatment of ulcers, and none whose effects can be so readily modified by the degrees of action allowed in its application. Thiersch has used a solution of 1 part of the salt to 1000 of water to make subcutaneous injections around and beneath indurated ulcers, with the effect of curing some which resisted all other methods. The operation is painful and should be performed during anæsthesia (*Boston Med. and Surg. Jour.*, May, 1881. p. 500). Fused nitrate of silver, in the form of a fine point, is an efficient means of arresting hæmorrhage from *leech-bites*. This caustic has been used with advantage in treating punctured and lacerated *wounds*, and especially *poisoned* wounds. In the former case it produces a protective film, and in the latter probably tends to destroy the virus. It is one of the best remedies for *mercurial sore mouth* in its ulcerative stage. Its stimulant and protective actions combined make it a useful application to *ulcers* of the skin, and especially to those of an indolent character; and these, as well as its action upon the specific virus of *chancres*, render it a valuable agent in their first stage. It is generally held that if induration have already taken place this treatment will not prevent constitutional infection, but some maintain that it is useless, no matter how early it is employed. A similar ectrotic method has been used to prevent pitting in *small-pox*, and often with apparent success. The application of a strong solution of the salt during the papular, or early in the vesicular, stage sometimes arrests the development of the pocks. The same method has been used in *zona*, *herpes*, and *intertrigo*, but in the last-named affection the solution should be weak (gr. v to f℥j). In the treatment of *sore nipples* the caustic pencil may be applied to the fissures or ulcers or the part may be enveloped with lint wet with a weak solution of the salt. A case is recorded in which a *vascular nævus* of the hand was injected with a few drops of a concentrated solution of the salt. Intense pain immediately followed and coldness of the limb, and two fingers became black and dry up to the second joint, and subsequently were amputated (*Phila. Med. Times*, xi. 795). It is claimed that sebaceous cysts may be cured by puncture with a cataract knife, evacuation of the contents, and the introduction of a small piece of silver nitrate. The capsule, it is said, may be withdrawn with the forceps at the end of twenty-four hours (*Brit. Med. Jour.*, June, 1888. p. 1160).

Burns, if superficial, may be treated with the fused nitrate or brushed over with a strong solution of the crystallized salt, and then closely enveloped in lint or carded cotton. The same method has been much employed in *erysipelas* when it affects the face alone, and also when it involves the scalp. A strong solution is to be preferred, and the earlier in the attack it is used the more apt are its effects to be beneficial. It must, however, be remembered that erysipelas of the face is not usually a local inflammation merely, and it is by no means proven that its treatment by nitrate of silver shortens its duration or mitigates its symptoms (Polatebenoff, *Therap. Gaz.*, xii. 251). Nitrate of silver is of great value in treating several diseases with purulent discharges, as *otorrhœa*, *gonorrhœa*, and *leucorrhœa*. In the second of these affections it should be cautiously used, at least in the male, during the acute stage; too strong a solution has been known to cause violent inflammation of the urethra and bladder, orchitis, etc. Theoretical notions of the dependence of the affection upon gonococci have caused the old and disused practice of employing very strong injections to be revived by Neisser, Picard, and others. The former custom of treating inflammation of the *neck of the bladder* by means of Lallemand's *porte-caustique* has been imitated by injecting a solution (1 part to 50) from a hypodermic syringe with a very long nozzle enclosed in a fenestrated bougie with an olive-shaped extremity (*Bulletin de Thérap.*, xcvii. 580). It is the best application in gonorrhœa of the glans penis, or *balanitis;* if the prepuce cannot be withdrawn, a solution of the salt may be injected. It should be of the strength of gr. xx–xxx to f℥j, and a similar one may be used for gonorrhœa in the female and for leucorrhœa. If the latter affection has its source in the neck or body of the uterus, the solution or the solid caustic may be introduced into that organ. But this is an operation attended with serious risks unless performed with the utmost caution. It has been successfully employed to cure *amenorrhœa* from uterine torpor, a solution of 1 or 2 grains to the ounce being injected into the cavity of the uterus. Braun of Vienna, who is opposed to the production of abortion to relieve the *vomiting of pregnancy*, states that he has arrested this symptom completely by applying to the vaginal portion of the neck of the uterus a 10 per cent. solution of nitrate of silver (*Practitioner*, xxviii. 447).

A solution of 1 or 2 grains to the ounce injected into the bladder is efficient in the treatment of *vesical catarrh.* Solutions containing from 20 to 30 grains of the nitrate to an ounce of water have been employed, but in general weaker ones are preferred. They are best administered in large bulk by means of a gravity syringe. *Strictures of the urethra* are habitually treated with the solid nitrate applied by means of the caustic-holder of Lallemand. This method is most applicable to linear and spasmodic strictures. The same treatment, applied to the prostatic portion of the urethra, has been much in vogue as a remedy for *involuntary seminal emissions*, and is often efficient where these discharges depend upon debility, and therefore morbid excitability, of the sexual organs, induced by prolonged self-abuse. This method, which fell into disuse, doubtless owing to an improper use of it, has been revived with advantage by Keyes (*Med. Record*, xxxv. 598) and by Hall, who treated by its means enlarged *prostate gland* (*Boston Med. and Surg. Jour.*, Jan. 1887, p. 9). Nitrate of silver may assist in removing *corns* after the hardened and thickened cuticle has been removed by prolonged maceration in warm water or by a poultice. As often as the blackened lamina exfoliates the operation should be repeated. *Ascarides* of the rectum are said to be destroyed by injections of nitrate of silver containing about 3 grains of the salt to an ounce of water.

By the mouth nitrate of silver is nearly always given in a pill, which should be made with some bitter vegetable extract, but not with bread-crumb, which contains salt. But even such precautions do not long prevent its decomposition. It should be administered when the pills are freshly made and the stomach is empty, in order to delay this result. Such, at least, is the usual direction, but it is pretty certain that under no circumstances is the nitrate of silver absorbed unchanged. For this reason Curci has proposed to use in its stead the double hyposulphite of sodium and silver, which is very soluble and absorbable, does not coagulate albumen, and is not irritant. The dose is from Gm. 0.01–0.06 ($\frac{1}{6}$ grain to 1 grain) three times a day. A convenient mode of preserving fused nitrate of silver is to dip the stick into melted sealing-wax, which gives it a coating that protects it from the air and prevents its staining the fingers. A tougher preparation than the fused nitrate is prepared by mixing with the latter a portion of oxide of silver: 5 parts of nitrate of silver melted with 1 part of nitrate of lead form another compound, of which cylinders are made not liable to fracture and that can be cut like a lead-pencil. The stick of lunar caustic may be pointed by rotating it upon a hot silver coin. The stain of nitrate of silver upon the skin, clothing, etc. may be removed by a solution of cyanide, and somewhat less perfectly by a solution of iodide, of potassium; or the stain may be moistened with tincture of iodine, and then with ammonia, and the colorless residue removed with water. A solution of 1 part each of ammonium chloride and corrosive sublimate in 10 parts of distilled water will remove the stains from the skin, and from woven stuffs without injuring the fabric. It must be kept in glass-stoppered bottles (Kaetzer). Flaxseed mucilage is also recommended for the same purpose. The proper *antidote* to nitrate of silver in the stomach is a large draught of a weak solution of table-salt, so as to decompose the nitrate and induce vomiting. The resulting irritation may be allayed by milk, which should also serve for food until the stomach is restored. The excessive action of the nitrate upon the fauces, vagina, skin, etc. may also be checked by salt and water.

ARGENTI OXIDUM, *U. S.*, *Br.*—Silver Oxide.

Oxidum argenticum, *Argentum oxydatum.*—*Argentic oxide*, E.; *Oxyde d'argent*, Fr.; *Silberoxyd*, G.

Formula Ag_2O. Molecular weight 231.28.

Silver oxide should be kept in dark amber-colored vials, protected from light. It should not be triturated with readily oxidizable or combustible substances, and should not be brought in contact with ammonia.—*U. S.*

Preparation.—Take of Silver Nitrate in crystals $\frac{1}{2}$ ounce; Solution of Lime 70 fluidounces; Distilled Water 10 fluidounces. Dissolve the silver nitrate in 4 ounces of the distilled water, and, having poured the solution into a bottle containing the solution of lime, shake the mixture well and set it aside to allow the deposit to settle. Draw off the supernatant liquid, collect the deposit on a filter, wash it with the remainder of the distilled water, and dry it at a heat not exceeding 100° C. (212° F.). Keep it in a stoppered bottle.—*Br.*

A similar process, but using a sufficient amount of solution of potassa in place of the lime-water, was recognized by the U. S. P. 1870. In both cases the silver nitrate is

decomposed, yielding silver oxide, water, and potassium or calcium nitrate, $2AgNO_3 + 2KOH$ yields $Ag_2O + H_2O + 2KNO_3$, and $2AgNO_3 + Ca(OH)_2$ yields $Ag_2O + H_2O + Ca(NO_3)_2$. It is important that these alkaline solutions, in place of which solution of soda may be used, should be free from chlorides, which would precipitate a portion of the metal as silver chloride, and the presence of carbonate in the potassa or soda solution would cause the oxide to be contaminated with silver carbonate. Silver oxide may be likewise obtained, according to Gregory, by boiling recently precipitated moist silver chloride with an excess of potassa solution, specific gravity 1.25 to 1.3, until a portion of the sediment is completely soluble in diluted nitric acid. To prevent the chloride from caking together, Mohr recommended the diffusion of it in some water and its gradual addition to the boiling potassa solution.

Properties.—Prepared by precipitation from the nitrate, silver oxide is an inodorous olive-brown or blackish powder, having the spec. grav. 7.52 and a disagreeable metallic taste. Obtained by Gregory's process, it is black or bluish-black. It is slightly soluble in 3000 parts (Bineau) of water, the solution having an alkaline reaction and a metallic taste; the solution acquires a reddish tint in the light, and in the presence of carbonic acid becomes at first turbid and afterward clear again. The oxide is insoluble in alcohol and ether, forms carbonate when kept moist, and is slowly decomposed by exposure to light, and rapidly and completely by heating it to 300° C. (572° F.), into silver and oxygen; it should therefore be well dried and kept in dark amber-colored bottles, protected from light. Freshly-prepared silver oxide is wholly, after drying and keeping only partly, soluble in ammonia-water, leaving a black powder, *Berthollet's fulminating silver*, and the solution depositing black crystals of the same compound, which is violently explosive. The oxide, moistened with creosote or when mixed with tannin, amorphous phosphorus, precipitated sulphur, the sulphides of arsenic and antimony, or with other readily oxidizable or combustible substances, renders these spontaneously inflammable.

Silver oxide is soluble in solution of barium nitrate, and yields with solutions of chlorides, bromides, and iodides the corresponding silver salts. It combines with acids, forming salts, many of which are colorless or white, and become dark-colored on exposure to light, some only in the presence of organic matter. Many metals, like zinc, lead, iron, copper, etc., precipitate metallic silver from the solutions of its salts, and a similar reaction takes place with phosphorus, phosphorous acid, many organic compounds, and deoxidizing agents.

The most characteristic reactions of silver salts are obtained with potassium chromate, which produces a deep purplish-red precipitate soluble in nitric acid. Chlorides and cyanides yield white curdy precipitates insoluble in dilute nitric acid, soluble in ammonia and potassium cyanide; bromides give a yellowish-white precipitate little soluble in ammonia; and with iodides a yellowish precipitate is obtained which is nearly insoluble in ammonia. The lemon-yellow precipitate obtained with sodium orthophosphate is readily soluble in ammonia and nitric acid.

Tests.—Silver oxide should be completely dissolved without effervescence in dilute nitric acid, (absence of carbonate), and the solution, when precipitated by an excess of hydrochloric acid, should yield a filtrate leaving no residue on evaporation to dryness. 29 grains of the oxide, when heated to redness, leave a residue of metallic silver weighing 27 grains.—*Br.* "0.5 Gm. of the oxide when ignited in a porcelain crucible should yield 0.465 Gm. (or 93.1 per cent.) of metallic silver."—*U. S.*

Action and Uses.—Silver oxide appears to possess the virtues which belong to the nitrate, but in a much less degree. It is slightly caustic, and its prolonged internal use occasions a purplish color of the skin. It was at one time supposed to possess a peculiar power over passive *hæmorrhages*, particularly from the uterus, but it is not to be compared with several salts of iron, or even with certain vegetable astringents, in this respect. It has also been used to check profuse *sweats*. Owing to its less caustic qualities it may possibly be preferable to the nitrate in *gastralgia*, simple *gastric ulcer*, and painful *dyspepsia* depending upon irritability of the mucous membrane of the stomach. In all local affections which call for a mild stimulant and astringent, such as *catarrhal affections* of the nostrils, throat, larynx, vagina, urethra, etc., a weak solution of the silver nitrate is greatly to be preferred. *Dose*, from 0.03–0.13 Gm. (gr. ½–2) two or three times a day, incorporated with a vegetable extract. An ointment is used containing from 2.60–5.20 Gm. (40 to 80 grains) of the oxide to 32 Gm. (℥j) of lard.

ARGENTUM.—Silver.

Argentum purificatum, Br.—*Refined Silver*, E.; *Argent*, *Argent raffiné*, Fr.; *Silber*, *Raffinirtes Silber*, G.; *Argento*, F. It.

Symbol Ag. Atomicity univalent. Atomic weight 107.66.

Origin.—This metal was known and in use in the earliest historic period, and was called *Luna* or *Diana* by the alchemists. It is found pure and in combination with various metals, and with sulphur, chlorine, bromine, iodine, etc., the richest silver ores being in the Western United States, Mexico, Peru, Norway, Russia, Germany and Spain.

Preparation.—The extraction of the metal is effected by different processes, the details varying considerably with the richness and the composition of the ore. The process of *amalgamation* is based upon the formation of an alloy between metallic mercury and silver. The finely-powdered ore is intimately mixed with sodium chloride and then roasted, when the mass contains, besides metallic silver, its chloride, the latter being converted to the metallic state by agitation in a revolving cylinder with water and iron. Mercury is now added and the agitation continued, when the silver, gold, and copper unite with the mercury, the amalgam being obtained by subsidence and washing, and afterward separated into a liquid and solid portion by subjecting it to pressure in strong linen or leather bags. By distilling the solid portion the mercury is evaporated off and recovered, while the silver remains behind, containing copper and gold.

In the process of *cupellation* the galena containing silver is first reduced and the metallic lead allowed to cool slowly, when almost pure lead crystallizes, and is removed by means of a ladle or by carefully draining off the liquid portion, which is rich in silver. This is exposed to a red heat, and air directed upon it by means of a blast, whereby the lead is oxidized and the litharge blown off, leaving silver containing some lead. This is now transferred to a dish made of bone-ash and heated to redness; the plumbic oxide formed is absorbed by the porous vessel, and finally almost chemically pure silver is left.

By the careful roasting of the ore containing the metals as sulphides these are converted into sulphates, which are treated with hot water; from this solution the silver is precipitated by metallic copper, the latter being subsequently recovered by precipitation with iron.

Many modifications of these and some other processes are employed, the silver obtained on the large scale always retaining a small portion of other metals.

Chemically pure silver is obtained in various ways from the chloride, which is readily prepared free from other chlorides by precipitating the solution in nitric acid with hydrochloric acid and washing it thoroughly with water. The silver chloride is then reduced by boiling it with glucose and sodium carbonate; the powdered silver thus obtained is well washed with acetic acid and water and then fused. Or the chloride is mixed with acidulated water and a rod of zinc introduced, the silver being afterward fused with borax and saltpeter. Or a mixture of the chloride with sodium and potassium carbonate is heated, whereby silver, alkali chlorides, carbon dioxide, and oxygen are formed; $2AgCl + KNaCO_3$ yields $Ag_2 + KCl + NaCl + CO_2 + O$.

Properties.—Silver is a brilliant white metal, very ductile and malleable, having the specific gravity 10.47 when obtained by fusion; the pressed and the distilled silver have a density of 10.57. It may be drawn into very fine wire and beaten into very thin *silver-leaf*, *Argentum foliatum*.—(P. G.). It melts at about 1000° C. (1832° F.), absorbs oxygen, which on cooling is again given off, but it does not oxidize in contact with the air or at a red or white heat, and distils at the heat of the oxyhydrogen blast. It tarnishes superficially through the hydrogen sulphide contained in the atmosphere, and dissolves completely in diluted nitric acid.

Various allotropic modifications of metallic silver have been obtained by treating solutions of silver salts with different reducing agents; some of these have been found soluble in water, and nearly all of them can be reduced to powder by moderate trituration. The particular allotropic form appears to depend upon the reducing agent employed and the conditions under which reduction takes place; thus blue, lilac, green, gold-colored, and reddish-brown silver have been obtained. The usual methods followed are (1) reduction of silver citrate or tartrate by ferrous citrate or tartrate; (2) action of dextrin and fixed alkali hydroxides on silver nitrate or oxide; (3) action of tannin and fixed alkali carbonates on silver nitrate or carbonate. More complete accounts of this interesting subject will be found in the papers by M. Carey Lea. (See *Proceed. A. P. A.* for 1890, 1891, 1892).

Tests.—The solution of chemically pure silver in hot diluted nitric acid, when precipitated by hydrochloric acid, yields a filtrate which is not darkened by hydrogen sulphide, and on evaporation to dryness leaves no residue.

Pharmaceutical Uses.—Metallic silver is employed for making the official silver compounds, and in the form of silver-leaf serves occasionally as a coating for pills.

Action and Uses.—In its metallic form silver possesses no direct medicinal virtues. Its ductility, malleability, and slight susceptibility to oxidation fit it peculiarly for a vast number of uses in surgery.

ARMORACIÆ RADIX, *Br.*—Horseradish-Root.

Raifort, Cran de Bretagne, Moutarde des moines, Fr. Cod.; *Meerrettig*, G.; *Rábano rusticano*, Sp.

The fresh root of Cochlearia (Nasturtium, *Fries*) Armoracia, *Linné*, s. Armoracia (Cochlearia, *Lamarck*) rusticana, *Gærtner*. Bentley and Trimen, *Med. Plants*, 21.

Nat. Ord.—Cruciferæ, Alyssineæ.

Origin.—This perennial plant is indigenous to Eastern Europe, and is naturalized in Western Europe and North America. It has large oblong crenate or sometimes pinnatifid root-leaves on long channelled petioles, lanceolate stem-leaves, and a long racemose inflorescence; the flowers are white and the ascending pods roundish.

Description.—The root attains a length of from 30 to 75 Cm. (1–2½ feet) and a thickness of 12 to 25 Mm. (½–1 inch); it is cylindrical in shape and crowned with several somewhat conical annulated heads. It is covered with a light yellowish-brown corky layer, is internally white and fleshy, and breaks with a short fracture. The bark is thin, and contains a number of yellow thick-walled cells. The cambium forms a dark-colored line; the meditullium shows a radiate arrangement of the small vascular bundles, and consists mainly of parenchyma. A large central pith is found in the head. In its unbroken state it is nearly inodorous, but when broken or bruised it has a very pungent odor and a sharp acrid taste. It is employed in the fresh state only.

Constituents.—The volatile oil to which the odor and taste of horseradish are due has the same chemical composition as oil of mustard, $CSN.C_3H_5$, though it differs from it somewhat in odor; the crude oil, of which about $\frac{1}{2.0}$ per cent. of the weight of the fresh root is obtained, is of a light-yellow color; the rectified is nearly colorless, of 1.01 specific gravity, and becomes dark-colored by age. It does not pre-exist in the root, but, according to Boutron and Frémy (1840), is formed in a manner similar to that of the volatile oil of mustard. Besides the volatile oil, Gutret (1792) ascertained the presence of some bitter resin, extractive, sugar, starch, gum, albumen, acetates and other salts, 12.5 per cent. of lignin, and 78.1 per cent. of water. Mutschler (1878) found the fresh root to lose 83.45 per cent. on drying, and then to yield 11.75 per cent. of ash, consisting mainly of potassium and calcium salts.

Action and Uses.—Horseradish, in the fresh state or pickled, has a very pungent and acrid taste, irritates the fauces and the nostrils, and causes a flow of tears. It is a familiar condiment, especially for beef. It excites a sense of warmth in the stomach, stimulates the appetite, and promotes digestion. In excessive doses it occasions burning at the epigastrium, nausea, and vomiting. It augments the urine, and probably the perspiration also, and gives to the former a peculiar odor. Externally applied, it reddens and sometimes blisters the skin. These qualities depend upon its volatile oil, which has at first a sweetish and then an extremely acrid taste and a pungent and very diffusive odor. Horseradish has had great renown as a remedy for *scurvy*, and the resemblance of its taste to that of scurvy-grass (Cochlearia officinalis) is noteworthy. In the treatment of *dropsy* it has been replaced by more potent drugs. Nevertheless, it deserves its reputation as a diuretic in all forms of cardiac, renal, hepatic, and splenic dropsy which are characterized by a feeble, atonic condition of the system. It is advantageous as a condiment in many cases of *dyspepsia* with feeble appetite, oppression after eating, and flatulence, and in gastric debility attended with *vomiting* even when excited by reflex irritation. As a local irritant it is sometimes used to relieve *toothache*, to stimulate the *fauces*, to correct relaxed states of the mucous membrane, and to remove the hoarseness produced by congestion of the *larynx*. For these purposes it may be employed as a masticatory or a strong infusion of it may be used as a gargle. It may be resorted to as a counter-irritant in all the cases in which mustard is appropriate, to arouse sensibility, to relieve pain, excite motility, etc. A mixture of the juice with vinegar has been applied to remove *freckles* and *tan* (*ephelis*). The compound spirit of horseradish is a

convenient addition to diuretic infusions and mixtures. An infusion may be made with Gm. 32 (℥j) each of freshly-grated horseradish and bruised mustard-seed in Gm. 480 (Oj) of hot water, macerated for two hours. A wine-glassful may be taken three or four times a day.

ARNICA.—Arnica.

Arnique, Arnica, Fr.; *Wohlverleih, Fallkraut, Arnika*, G.; *Arnica*, F. It., Sp.

Arnica montana, *Linné.* Woodville, t. 17; Bentley and Trimen, *Med. Plants*, 158.

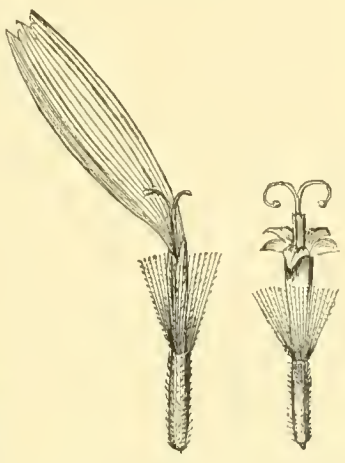
Nat. Ord.—Compositæ, Senecionideæ.

Officinal Parts.—1. Arnicæ Flores, *U. S.*; Flores arnicæ, *P. G.*; Arnica-flowers, *E.*; Fleurs d'arnica, *Fr.*; Arnikablüthen, *G.* The flowers.

2. Arnicæ Radix, *U. S.*; Arnicæ rhizoma, *Br.*—Arnica-root, *E.*; Racine d'arnica, *Fr.*; Arnikawurzel, *G.*—The rhizome and rootlets.

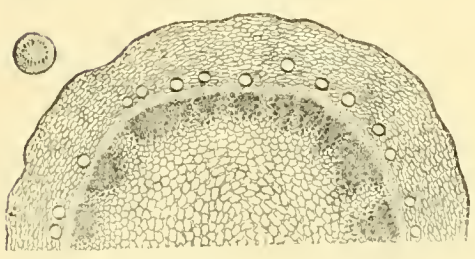
Origin.—This species of arnica is indigenous to Europe, growing upon the mountains of Switzerland and Germany and farther north in the plains. It is likewise met with in Northern Asia and in the northwestern part of America. It bears a tuft of ovate or oblong-obtuse radical leaves with a nearly entire and ciliate margin, and produces a stem about 25 to 30 Cm. (10 to 12 inches) high, with a few lanceolate leaves and a few branches, each of which bears one flower. The flowers appear in May, and on drying lose about 80 per cent. of their weight.

Fig. 31.



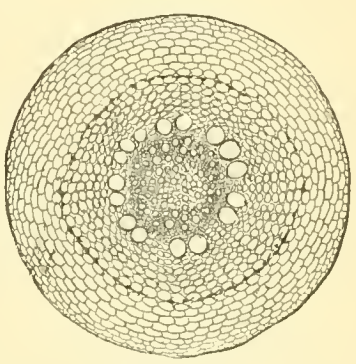
Arnica montana, *Linné:* ray- and disk-floret.

Fig. 30.



Arnica: transverse section of rhizome, natural size and magnified 10 diam.

Fig. 32.



Arnica: section through rootlet magnified 25 diam.

Description.—1. The Rhizome. It is horizontal, somewhat contorted, 5 to 7 Cm. (2 or 3 inches) long, and 3 or 4 Mm. (⅛ or ⅙ inch) or less in diameter, longitudinally wrinkled, uneven, and rough from the scars of the decayed stems and leaves. Its color externally is dark-brown; the rather thick bark has about one-eighth the diameter of the rhizome, is internally whitish, and contains a circle of brown-yellow resin-cells. The yellowish wood forms broad wedge-shaped bundles and encloses a large central spongy pith. The numerous rootlets issue from the lower side of the rhizome, are 5 to 10 Cm. (2 to 4 inches) long, thin and fragile, and consist of a thick bark and a thin cylindrical cord of yellowish wood, which is surrounded by a circle of resin-cells.

Arnica root is collected in the spring, and is occasionally found in the market with the radical leaves, which should be removed when used for medicinal purposes. It has a faintly aromatic odor and a rather persistent acrid taste.

2. The Flowers. The heads, which are from 25 to 50 Mm. (1 to 2 inches) in diameter, are surrounded by a campanulate cylindrical involucre consisting of a double row of imbricated equal and hairy scales. The slightly convex, finely-pitted, and chaffy receptacle is about 6 Mm. (¼ inch) in diameter, and bears one row of fifteen to twenty pistillate bright yellow, parallel, ten-veined, and three-toothed ligulate ray-florets about 25 Mm. (one inch) in length, and many perfect tubular five-toothed disk-florets. The brown and hairy akenes are slender, spindle-shaped, obtusely five-angled, brown, short-hairy, about 6 Mm. (¼ inch) long, and are crowned by a pappus consisting of a single row of denticulate gray hairs about 8 Mm. (⅓ inch) in length. The odor of the flowers

is feebly aromatic and their taste acrid and bitter. The German Pharmacopœia directs the removal of the involucre and receptacle. The flowers, and more particularly the receptacle, are often attacked by the black larvæ of the arnica-fly, Trypeta arnicivora, *Loew.*, which must be removed. The powder of arnica-flowers is irritant and sternutatory.

Constituents.—Besides gum, wax, and salts the root and flowers contain two different volatile oils. The dry root yields about ½ to 1 per cent. of volatile oil, of nearly the density of water, and isobutyric acid, with small quantities of formic and angelic acid; old root yields more acids and less volatile oil than fresh root. The volatile oil, which boils between 214° and 263° C. (417° and 505° F.), is remarkable for containing at least three rare ethers—phloryl-isobutyrate, a phlorol-methylic ether, and, in largest proportion, the dimethylic ether of thymo-hydroquinone (Sigel, 1873). The name of *arnicin* has been applied to different principles found in the root and flowers. Pavesi's arnicin (1859), obtained by the process for preparing santonin, is a dark-yellow, sticky resin of a disagreeable bitter taste, which is not freely soluble in alcohol and ether, but readily in alkalies, from which solutions it is again precipitated by acids. Bastick's arnicine (1851) was obtained by exhausting the flowers with alcohol acidulated with sulphuric acid, treating the tincture with an excess of lime, adding to the filtrate sufficient sulphuric acid, evaporating, diluting with water, filtering, neutralizing with potassium carbonate, again filtering, treating the liquid with excess of potassium carbonate, and agitating with ether, on the evaporation of which arnicine is left. It is stated to have a bitter taste and alkaline reaction, and to yield with acids crystallizable salts. The arnicin of Walz (1861) is a golden-yellow amorphous acrid mass, which is slightly soluble in water and soluble in alkaline liquids, in alcohol, and in ether. It may be prepared from the flowers, which contain it in larger proportion than the root, by passing the tincture through animal charcoal, evaporating, and treating the residue with ether, which dissolves arnicin and fat, the former of which is afterward dissolved by alcohol of 0.85 specific gravity. It is also obtained by precipitating the watery decoction with tannin, exhausting the precipitate with alcohol, and removing the tannin by oxide of lead, and the lead by hydrogen sulphide. By decomposition with alkalies and acids, resin, oil, and a volatile acid have been obtained.

Arnica root and flowers appear also to contain several resins, at least one of which is insoluble in ether and has an acrid taste. The root contains 10 per cent. of inulin, according to Dragendorff (1870).

Adulterations and Substitutions.—The flowers are said to be occasionally adulterated with other yellow composite flowers, but are easily distinguished by the characters given above: those of calendula and anthemis are destitute of pappus; those of inula, doronicum, and senecio have a naked receptacle; and those of scorzonera and tragopogon have all the florets ligulate. The rhizomes and roots of other Compositæ which are said to be occasionally collected by mistake for arnica-root differ from it in physical characters; there is no difficulty in distinguishing the latter from the root of Geum urbanum, noticed as an adulteration by E. M. Holmes (1874).

Action and Uses.—The local action both of the root and the flowers of arnica is irritant, but that of the flowers is the more powerful. The tincture, used for insignificant injuries, has occasioned inflammation and vesication. Fayrer relates that six days after having applied it to his wrist for a sprain the part was slightly stung by a nettle; immediately an inflammation of the skin arose, limited accurately to the previous contact of the arnica, but causing inflammation of the lymphatics of the limb (*Practitioner*, xvi. 52). Numerous analogous examples might be cited. (Compare, *Practitioner*, xxxiii. 45; Cartier, *Therap. Gaz.*, viii. 477; Cagny, *ib.*, ix. 52.) Internally, a strong infusion irritates the throat, produces a burning pain in the stomach, tends to excite vomiting, increases the frequency of the heart's action and respiration, and the secretions of the skin, bronchia, and kidneys, and occasions headache, giddiness, inability to stand or walk, and disturbed sleep. These symptoms are followed by depression and exhaustion. After excessive doses the phenomena of stimulation are not observed, but in their stead vomiting, purging, giddiness, oppression, debility, cold extremities, frequent pulse, dilated pupils, muscular spasms, and collapse, with infrequent pulse. Death is reported to have occurred in the case of a man who drank from 2 to 2½ ounces of the tincture (*Lancet*, July 10, 1880). The nauseant properties are said to belong to the flowers rather than to the root.

The conclusions respecting the operation of arnica to be drawn from the foregoing phenomena are essentially the same as those which its use as a medicine indicates. Its

vogue has always been greatest in the treatment of affections that require stimulation. Especially has it been reputed to be an efficient stimulant in all diseases presenting the *typhoid state*, in the continued fevers which most frequently assume that condition, and in the various inflammations which it may complicate. As a disease which partakes of both natures, and which often presents the typhoid type, *dysentery* may be mentioned, and arnica is said to have been efficient in its treatment. Its stimulant local action has been thought sufficiently powerful to suggest its use in liniments and tinctures applied by friction to paralyzed muscles. In Germany this action has long been popularly employed for the relief of local *paralyses*, *bruises*, *sprains*, *abrasions*, slight *wounds*, etc.; whence its name *Fallkraut*, which may be translated *accident-plant*. It is alleged that only the infusion or decoction, and not the tincture, should be used for these purposes—a statement which popular experience would seem to contradict. Frictions with the tincture need not, however, prevent the more permanent influence of fomentations made with the flowers steeped in water or vinegar. Powdered arnica-flowers are said to limit the progress of *mortification*. 1 part of an extract of fresh arnica-flowers and 2 parts of honey, thickened with an inert powder if necessary, and kept applied to *boils*, is said to arrest their development at any stage (Planat, *Amer. Jour. of Med. Sci.*, April, 1878, p. 545). The watery preparations are, however, more suitable internally in the cases above alluded to of febrile disease, and also in those of exhaustion from shock; but their use should not prevent the more serviceable employment of alcoholic stimulants. The *dose* of the powdered root may be stated to be from Gm 0.60–2.00 (10 to 30 grains). A decoction may be made with Gm. 8 (℥ij) of the root in Gm. 288 (f℥ix) of water, reduced by boiling to Gm. 192 (f℥vj). Of this the dose is a tablespoonful or more every two hours. An infusion is made with Gm. 4–30 (℥j–℥j) of the flowers in Gm. 192 (f℥vj) of water. *Dose*, a tablespoonful or more.

ARNOTTA.—Annota.

Orellana, *Orleana*.—*Rocou*, *Terre de la Nouvelle-Orléans*, F.; *Orlean*, G.; *Achiotillo*, Sp.

A coloring matter obtained from the seeds of Bixa Orellana, *Linné*.

Nat. Ord.—Bixaceæ.

Origin and Preparation.—This medium-sized tree is indigenous to tropical America, and produces roundish, heart-shaped, or subreniform capsules, containing numerous obovate, angular, whitish seeds, which are about 3 Mm. (⅛ inch) long and are covered with a dark-red pulp. The seeds are soaked or allowed to ferment in water, rubbed between the hands and upon a sieve, crushed, and finally completely mashed and again washed with water. The coloring matter subsides and is formed into cakes; the water likewise contains a coloring matter. (See paper by Th. Peckolt, in *Amer. Jour. Phar.*, 1859, p. 360.) The importation of annotta-cake and seed into this country has increased from 160,500 pounds in 1876 to 412,610 pounds in 1882.

Description.—Annotta, also called *annatto*, exists in cakes which are either plastic or hard, of a nearly blood-red color, becoming red-brown on exposure, of a peculiar odor and disagreeable saline and bitter taste. It is nearly insoluble in water, but colors it yellow, and dissolves almost completely in alcohol, ether, fixed oils, and alkalies, with an orange-red or dark-red color.

Constituents.—According to the investigations of John Kerndt (1849), Piccard (1861), Mylius (1864), and W. Stein (1867), annotta contains *orellin*, a yellow coloring matter soluble in water, and bright red *bixin*, which is not freely soluble in cold alcohol and ether, but readily dissolves in alkalies. The latter is colored blue by strong sulphuric acid, and with nitric acid produces a yellow body of a musk-like odor. Its composition is, according to Stein, $C_{15}H_{18}O_4$, according to Etti (1878), $C_{28}H_{34}O_5$. Annotta contains also a fatty acid, a turpentine-like body, and various other compounds. A. E. Ebert (1868) obtained from the air-dry seeds 5.15 per cent. of ash, the chief constituents of which are potassa, silica, and phosphoric acid.

Uses.—It is to some extent employed as a dyestuff for silk and other fabrics, and for the coloring of plasters and ointments, as well as of butter and cheese. For *butter-coloring* annotta is digested with alcohol until completely disintegrated, and then heated with four or five times its weight of olive or other bland oil, or 1 part of extract is used to 10 parts of oil; for *cheese-coloring* a little turmeric is used.

Adulterations with ochre, brickdust, sand, gypsum, and the like are discovered by their insolubility in hot alcohol.

ARSENI IODIDUM, *U. S.*—Arsenic Iodide.

Arsenii iodidum, Br.; *Ioduretum arseniosum*, *Arsenicum* (*Arsenum*) *jodatum*; *Arsenici iodidum*, U. S. 1870.—*Iodide of arsenium*, *Arsenous iodide*, E.; *Iodure d'arsenic*, Fr.; *Arsentrijodid*, G.

Formula AsI_3. Molecular weight 454.49.

Preparation.—Triturate in a mortar finely-powdered metallic arsenic 75 grains and iodine 380 grains until they are thoroughly mixed. Put the mixture into a small flask or test-tube loosely stoppered, and heat it very gently until liquefaction occurs. Then incline the vessel in different directions, in order that any portion of the iodine which may have condensed on its surface may be returned into the melted mass. Lastly, pour the melted iodide on a porcelain slab, and when it is cold break it into pieces and keep it in a well-stoppered bottle. This is the process of the U. S. P. 1870, with the iodine slightly increased in quantity, so as to correspond with the combining weights of the two elements, the union of which is readily effected by the aid of heat. The salt may be prepared in an ordinary prescription-vial placed in a sand-bath; after the fused mass has cooled the vial is broken to obtain the compound; loss of iodine is thereby avoided. Although sufficiently pure for medicinal purposes, it is difficult to produce in this way a uniform chemical compound, which, according to Berzelius, is obtained on subjecting the mechanical mixture to sublimation from a retort the body of which is completely imbedded in sand. Or the iodine is dissolved in carbon disulphide; the solution is gently heated, and, after the gradual addition of the powdered arsenic, is digested until the purple color of free iodine has disappeared; the clear solution is decanted if necessary, and the solvent distilled or evaporated, when the arsenous iodide is obtained in crystals and may be recrystallized from alcohol. Or, according to Bamberger and Phillip, it may be made by mixing a hot solution of arsenous acid in hydrochlorie acid with a concentrated solution of potassium iodide, and washing the precipitate with hydrochloric acid, sp. gr. 1.12.

Properties.—Obtained by fusion, arsenic iodide is a glossy orange-red crystalline mass; if made by sublimation or crystallization it appears in shining brick-red or orange-red hexagonal scales. It has an iodine-like odor and taste, and slowly gives off iodine on exposure to the air. Its density is 4.39. It is soluble, with a neutral reaction and without decomposition, in water, alcohol, ether, and carbon disulphide, but is gradually decomposed on being boiled with water or alcohol. It is soluble in 7 parts of water and in 30 parts of alcohol at 15° C. (59° F.) It is difficultly soluble in hydrochloric acid. "The aqueous solution has a yellow color, is neutral to litmus paper, and on standing gradually decomposes into arsenous and hydriodic acids. On passing hydrogen sulphide through the solution a lemon-yellow precipitate is thrown down. If the salt be heated with diluted nitric acid vapor of iodine is given off."—*U. S.*

Tests.—The purity is ascertained by the complete solubility of the salt in water and alcohol, and by its volatilizing on the application of heat without leaving any residue.

Action and Uses.—The action of this compound in small doses may be called alterative; in large doses it is an irritant poison.

The continued use of from Gm. 0.004–0.005 (gr. $\frac{1}{16}$ to $\frac{1}{12}$) twice a day occasions perspiration, with dryness of the throat and intestines; sometimes headache is complained of, but neuralgic pain in the head, if it previously existed, may disappear. At one time it was supposed on very good authority to possess the power of preventing the development of *scirrhous tumors* of the breast, but continued observation has not confirmed the belief, although it has shown that when such tumors affect persons of a feeble and cachectic constitution their progress may be retarded by the improvement of the general health under the use of this medicine. Its influence upon certain *cutaneous diseases* is more demonstrable, particularly upon psoriasis, lepra, chronic eczema, and tinea capitis; but as identical results are obtained from arsenic alone, the influence of the iodine in the combination is very questionable. The same remark applies to its use in *lupus* and *tuberculosis*. The quantity of iodine in the small dose of the compound administered ($\frac{1}{20}$ to $\frac{1}{4}$ grain) is too minute to be considered efficient. Indeed, most of the benefits said to have been derived from it were in reality obtained from mixtures of Fowler's arsenical solution with iodide of potassium in true medicinal doses. (See Acidum Arseniosum.) The *dose* of iodide of arsenic should at first not exceed Gm. 0.003 ($\frac{1}{20}$ grain) three times a day, and it should gradually be increased until derangement of the stomach or dryness of the throat denotes it full effect. It is best given in solution. An ointment containing Gm. 0.20 (gr. ij) in Gm. 32.00 (℥j) of lard has been used as a local application in the disease above mentioned. Where the skin is broken it should not be employed.

ARSENUM.—Arsenic.

Arsenium, *Arsenicum.*—*Arsenic*, Fr.; *Arsen*, *Arsenik*, G.

Symbol As. Atomicity trivalent and quinquivalent. Atomic weight 74.9.

Origin.—Arsenic, which is classed by some chemists with the metals, by others with the non-metallic elements, is widely diffused in nature, but is found usually in small quantities. It exists in the uncombined state as *native arsenic*, known also under the name of *cobaltum* or *flystone*, but more frequently in combination with sulphur and sulphides, as *red orpiment* or *realgar*, As_2S_2; *yellow orpiment*, As_2S_3; *arsenical pyrites* or *mispickel*, $FeS_2.FeAs_2$; *cobalt-glance*, $CoS_2.CoAs_2$; *tin-white cobalt*, $CoAs_2$; and in other minerals. It was first obtained in the metallic state by Albertus Magnus in the thirteenth century by heating together white arsenic and soap.

Preparation.—On heating arsenical pyrites in earthen cylinders most of the arsenic volatilizes and is collected in iron receivers, where it congeals. $FeS_2.FeAs_2$ yields $As + 2FeS$. A portion of the arsenic remains behind with the iron sulphide, and may be recovered as arsenous acid by roasting. The crude metallic arsenic should be purified by mixing it with charcoal and subliming at the heat of a sand-bath. It is obtained on a small scale by mixing arsenous acid with half its weight of powdered charcoal, introducing the mixture into a crucible, covering it with a layer of granular charcoal 2 or 3 inches thick, and cementing over the crucible in an inverted position another one having a small hole drilled through the bottom; on heating the crucible the arsenous acid is reduced to arsenic, which sublimes, carbon monoxide escaping; $As_2O_3 + C_3$ yields $As_2 + 3CO$.

Properties.—It is a brittle, steel-gray, crystalline mass having a bright metallic lustre, gradually changing on exposure to the air to a grayish-black color devoid of gloss. Its specific gravity is 5.73 to 5.96. Heated in a sealed tube, it fuses, but if heated in the open air it volatilizes, without melting, at a temperature of 180° C. (356° F.), a portion of it being oxidized to arsenous acid. Its vapor has a yellow color and a garlic-like odor. On immersing the metal in water the air dissolved in the latter oxidizes a portion to arsenous oxide, which explains the use of cobaltum as a fly-poison. Metallic arsenic is insoluble in simple solvents, but dissolves on heating in some fixed oils, and unites readily with most of the metals, with sulphur, chlorine, iodine, and other elements.

Compounds of Arsenic.—Hydrogen arsenide or arsine, AsH_3, is a colorless gas of a garlic-like odor and the density 2.695, and when ignited burning with a bluish flame, yielding water and arsenous oxide; but on cooling the flame, by holding in it a piece of porcelain or glass, metallic arsenic is deposited. Arsenous hydride is generated in applying Marsh's and several other tests for arsenic. (See pages 27, 28.)

Arsenic oxide, As_2O_5, is a white mass melting at a low-red heat, and at a higher heat decomposed into arsenous oxide and oxygen; in damp air or in contact with water it deliquesces to an oily-looking liquid, which is a concentrated solution of *arsenic acid*, H_3AsO_4. This is poisonous, however, in a less degree than arsenous oxide; the concentrated solution is corrosive. It is much employed in the manufacture of certain aniline colors and for other purposes in the arts. *Pyroarsenic* and *meta-arsenic acids* are analogous to the corresponding phosphoric acids, but on dissolving in water yield at once the above *ortho-arsenic acid*.

Arsenous chloride, As_2Cl_3, is a colorless, oily, very poisonous liquid, which has the specific gravity 2.205, boils at 134° C. (273.2 F.), and is by water decomposed into HCl and As_2O_3. (See Liquor Acidi Arsenosi.)

Arsenous bromide, As_2Br_3, is formed from the two elements in the presence of carbon disulphide, like the iodide. It is colorless, crystalline, of a peculiar odor, has the density 3.86, melts at above 20° C. (68° F.), and boils at 202° C. (428° F.). It is deliquescent, and by water decomposed into As_2O_3 and HBr.

Three sulphides of arsenic are known, but the pentasulphide, As_2S_5, is of no practical importance.

Realgar, or red orpiment, As_2S_2, is a mineral which consists of handsome orange-red scales. It is made by fusing together 5 parts of arsenous acid and 3 parts of sulphur, when sulphur dioxide is given off. It burns with a blue flame, but when mixed with potassium nitrate with a white flame; a mixture for fireworks and signal-lights consists of red orpiment 2 parts, sulphur 7 parts, potassium nitrate 24 to 26 parts.

Orpiment, King's yellow, or auripigmentum, As_2S_3, is likewise a mineral, crystallizes in prisms or scales, and is artificially obtained by fusing together 5 parts of arsenous acid with 4 to 5 parts of sulphur. It was formerly much employed as a pigment; at

present it is used in fireworks, and occasionally, mixed with considerable lime, as a depilatory.

The medicinal action and uses of arsenic are treated of under Acidum Arsenosum.

ARUM.—Indian Turnip.

Wake-robin, *Dragon-root*, E.; *Gouet à feuilles*, Fr.; *Dreiblättriger Aron*, G.; *Aro*, Sp.

The tuber (corm) of Arisæma (Arum, *Linné*) triphyllum, *Torrey*.

Nat. Ord.—Araceæ.

Origin.—The plant is indigenous to North America, produces one or two leaves, which are divided into three elliptical-ovate acuminate leaflets, and a green or dark-purple often striped spathe which is convolute at the base, bent hood-like at the apex, and encloses the club-shaped spadix, having the flowers sessile at the base. The fruit is a scarlet berry.

Description.—The tuber is of a depressed globular shape, with a flat and rugose base and slightly conical above. The numerous simple rootlets are attached to the upper half of the tuber, leaving the base free. It is of a brown-gray color externally, and internally white, with scattered vascular bundles. It is inodorous, and has a burning acrid taste, which it retains, to some extent, for a long time if carefully dried and preserved.

The tuberous rhizome of the European Arum maculatum, *Linné*, or *cuckoo-pint*, is similar in appearance, but of an oblong shape, and larger than the former; in commerce it is usually found in transverse slices or pieces which are of a mealy aspect. The starch was formerly prepared from it on the isle of Portland on the south coast of England, and used as *Portland arrow-root*.

Constituents.—The two tubers are most likely similar in composition, but their acrid principle has not been obtained in an isolated state. The European arum has been analyzed by Bucholz and Enz, and the American by D. S. Jones, who proved the presence of starch, sugar, gum, albumen, resin, fat, and extractive, besides the volatile acrid principle, which is soluble in ether. Enz (1858) obtained also saponin, and Bird believes that a volatile alkaloid may be present.

Allied Plants.—Colocasia esculenta, *Schott*, s. Caladium (Arum, *Linné*) esculentum, *Ventenat*, and Colocasia antiquorum, *Schott*, s. Arum Colocasia, *Linné*, are extensively cultivated in many tropical and subtropical countries under the name of *cocco* or *eddoes*, the thick starchy rhizomes being used for food. These and several other species are often seen under cultivation in our gardens for their ornamental foliage. All are more or less acrid in the fresh state.

Richardia (Calla, *Linné*) æthiopica, *Kunth*, Egyptian calla, a well-known ornamental plant, has likewise an acrid and farinaceous tuber.

Allied Drugs.—Tonga. A drug introduced under this name from the Fiji Islands was found by A. W. Gerrard (1880) to be a mixture of bark, leaves, and woody fibre tied into bundles by means of the inner bark of the cocoanut tree. E. M. Holmes (1880) referred the fibrous material to Rhaphidophora vitiensis, *Seemann*: F. von Mueller ascertained this to be correct. The plant belongs to the natural order of Araceæ, and is a creeper having a stem from the size of a quill to an inch or more in diameter. The scraped stem is used, and contains prismatic rhaphides and starch, the latter resembling arum starch. Gerrard found potassium chloride and a volatile alkaloid, *tongine*, which has not been further examined.

The bark comes from Premna taitensis, *De Candolle*, nat. ord. Verbenaceæ, which is shrubby or a large tree; the inner bark is sweet and slightly astringent, and, according to Gerrard, contains a little volatile oil, sugar, pectin, and fat.

Action and Uses.—The juice of the fresh plant applied to the skin may cause vesication, and when a portion of the corm is chewed, it leaves in the mouth and fauces a burning and acrid taste. The acrid principle, however, is dissipated by drying and by heat. In a partially dry state the corm has been used to relieve *flatulence* and *colic* and as a remedy for chronic *bronchitis*, but its virtues are not very decided. Its powder made into a paste with honey or syrup has been used for *aphthous* sores of the mouth, and an ointment formed by stewing the fresh root with lard has been applied to *ringworm* and other local cutaneous affections. The *dose* of the powder is stated to be Gm. 0.60 (gr. x) or more. It may be administered in honey or syrup.

In 1880, Ringer and Murrell employed a liquid extract of *tonga* in the treatment of *neuralgia* with "gratifying results." They gave half-ounce doses at intervals of half an hour, and repeated them again in two hours, without producing any effect except slight drowsiness (*Lancet*, March 6, 1880). One or two cases reported by Wallace gave similar results, although he prescribed only half-drachm doses of the fluid extract (*Med. Record*, xxii. 91); and a like report was made by Berger (*Therap. Gaz.*, viii. 161). Further evidence of its virtues is desirable.

ASAFŒTIDA, *U. S., Br.*—Asafetida.

Assafœtida, Br.; *Asa fœtida*, P. G., F. Cod.; *Gummi-resina Asafœtida.*—*Asafœtida*, E.; *Asefétide*, Fr.; *Asant, Stinkasant, Teufelsdreck*, G.; *Asafetida* Sp.; *Assa fetida*, F. It.

A gum-resin obtained by incision from the living root of Ferula fœtida (*Bunge*) *Regel*, s. Ferula Scorodosma, *Bentley et Trimen.* Bentley and Trimen, *Med. Plants*, 127.

Nat. Ord. Umbelliferæ, Orthospermæ.

Origin.—The plant is a large perennial herb. It was found by Lehmann (1841) in Turkestan and Bokhara, and by Bunge (1858) in Western Afghanistan. It is largely cultivated in Northern and Western Afghanistan, and grows wild in the barren regions between the Sea of Aral and the Persian Gulf, south to Laristan. Its stem is from 1.5 to2 M. (5 to 7 feet) high, and has but few bipinnate leaves, which are very much smaller than the large radical leaves. The numerous umbels are long-stalked and crowded at the summit of the stem, and the flat and winged fruit has very inconspicuous vittæ. Ferula alliacea, *Boissier*, of North-eastern Persia, has likewise a strong asafetida odor.

Collection.—Asafetida is obtained from the roots of the plant, which attain a considerable size, being several inches in thickness. In April, after the leaves commence to wither, a pit about 6 inches wide and 6 inches deep is dug around the root, so as to bare its upper portion, which is protected against the sun by a layer of leaves and earth, and left in this condition for about 40 days. Near the latter end of May the covering is removed, a slice of the root is cut off, and the exuded juice scraped off on the third day. The cutting of the root, which is in the mean time sheltered from the sun, is repeated twice, after which the root remains undisturbed for a week, when the same operation is repeated and a much thicker milk-juice is obtained. After another rest of several weeks the root, early in July, is again cut, and this operation is continued until the root is exhausted.

This is substantially the account of Kämpfer, who witnessed the collection of asafetida in Laristan in 1687. Dr. H. W. Bellew gives a similar account of the collection of asafetida, which he observed in 1857 near Kandahar, but it differs from the former account in the statement that the newly-sprouted radical leaves and the withered stem of the previous year are cut off from the root, in the upper bare part of which deep incisions are made, where the milk-juice concretes in tears, or, if very abundant, flows into the trench dug around the root.

Commerce.—Asafetida enters commerce by way of Bombay, to which port it is shipped from Persia and from Afghanistan, the Afghanistan drug being probably derived in part from Narthex, and the Persian chiefly from Scorodosma. It comes packed in skins and in boxes, the purest kind, which is called *hing*, being often soft, but gradually becoming hard and translucent and of a yellowish-brown or golden-yellow color. The brown variety, which comes principally from Abushaher and Bunder Abbas, is, according to W. Dymock (1875), the produce of Ferula alliacea, *Boissier*. The yellow variety is brought from Kandahar and is principally consumed in Northern India. The asafetida which reaches Bombay from Laristan is known as *anghuzeh i Lari*, and is mostly shipped abroad. The inferior qualities, the *hingra* of the Bombay market, are more or less adulterated at the place of collection, and constitute the varieties which are found in the European and American markets. The transparent *hing* may probably be obtained from the stem. In the fiscal year 1866–67, 51,869 pounds of asafetida were imported into the United States, against 173,000 pounds in 1879–80 and 78,010 pounds in 1882.

Description.—Occasionally asafetida is met with in a fluid or semi-fluid condition of a uniformly whitish color, which gradually becomes darker. Mostly, however, it forms masses of larger or smaller opaque tears of a white color internally, which are imbedded in a yellowish- or brownish-gray sticky and more or less granular mass, in which gypsum, sand, and other earthy admixtures are found. It has a strong garlicky odor and an alliaceous, acrid, and bitter taste. The tears, separated from the granular mass, are sometimes met with in the market, and should alone be used in medicine; they are externally brownish, internally milk-white; they break with a conchoidal fracture, and the surface acquires in a few hours a bright-pink color, which changes gradually to brown. Incinerated, they leave rather less than 1 per cent. of ash. When triturated with water they readily form a milk-white emulsion, which becomes yellow on the addition of potassa or soda. Ether dissolves the volatile oil and a little resin. Rubbed with strong sulphuric acid, then diluted with water and neutralized with an alkali, a slightly colored liquid is obtained which exhibits a bluish fluorescence. Exposed to cold, asafetida becomes quite

brittle and readily pulverizable, and when broken into small pieces and dried for a week or two over unslaked lime in a close box it may likewise be powdered on cool days. The powder should be preserved in paper bags kept over lime, when it will retain its pulverulent condition (Hager).

A very impure asafetida is occasionally met with, which consists altogether of earthy matter mixed with a very small proportion of the milk-juice. For medicinal uses asafetida consisting of well-defined and large tears, and containing but little of the intervening sticky mass, should be selected. Asafetida should yield to alcohol at least 60 per cent. of soluble matter (*U. S.*). In contact with hydrochloric acid only slight effervescence should be produced, and after 6 hours the acid should remain almost uncolored; when incinerated, asafetida should leave not over 10 per cent. of ash (*P. G.*).

Constituents.—The odor is due to a volatile oil which is obtainable to the amount of from 6 to 9 per cent. (Flückiger), and is a mixture of several sulphides of ferulyl or laseryl, C_6H_{11}. It is of a light-yellow color, and becomes darker on exposure to the air, acquiring at the same time an acid reaction and changing in odor. Spread upon water, it acquires a violet-red color with the vapor of bromine, at the same time becoming heavier than water; dissolved in disulphide of carbon, it is colored red by sulphuric acid (Flückiger). The gum amounts to between 20 and 30 per cent., and from 45 to 65 or 71 per cent. of the asafetida is resin, a small portion of which is insoluble in ether. It contains *ferulaic acid*, $C_{10}H_{10}O_4$, which was obtained by Hlasiwetz and Barth (1866) in iridescent, inodorous, and tasteless needles soluble in boiling water, and yielding, when fused with potassa, among other products, acetic and protocatechuic acids. It dissolves in alkalies with a yellow color, and gives with ferric chloride a brown precipitate. It is chemically related to vanillin, eugenol, and cinnamic acid. The amorphous red-brown resin is likewise acid, but when fused with potassa yields resorcin, $C_6H_6O_2$, and on dry distillation furnishes a small quantity of unbelliferon, $C_9H_6O_3$, and blue-colored oils. The so-called gum of which, in Kandahar *hing*, Flückiger found 47.9 per cent. with only 10.8 per cent. of resin, is but little soluble in water; the insoluble portion dissolves in alkalies and is reprecipitated by acids; both portions differ in their behavior from gum-arabic. According to older analyses, asafetida contains also formic, acetic, valerianic, and malic acids.

Impurities.—Besides the earthy admixtures mentioned above, pieces of a translucent gum are sometimes found in asafetida; they do not yield an emulsion with water. The amount of earthy admixtures in commercial asafetida of good appearance sometimes reaches 40 per cent.

Action and Uses.—Asafetida in substance, or its volatile oil, acts as a general and local stimulant, but during health the former operation is scarcely perceptible. This stimulation seems to be due entirely to the oil, and so is the peculiar garlicky or alliaceous odor exhaled by the breath and discharges of wind from the stomach and rectum. But in appropriate disorders, those especially connected with a depressed and therefore excitable condition of the nervous system, and in cases of gastro-intestinal flatulence aasociated with atony of the bowels, it displays incontestable and highly salutary powers. Its use as a condiment in Persia for the very same purposes for which garlic is employed in European cookery proves it to be a stimulant of the bowels and a promoter of digestion.

Asafetida is generally regarded as a nervine and as remarkable for its usefulness in *hysteria*. In two ways it may influence this disease: by allaying the nervous disorders of the paroxysm when it is announced by premonitory symptoms or by moderating its violence when fully formed; and, on the other hand, by tending to correct some of the derangements which predispose to the attacks. In the former way, however, its influence is most distinct. For this purpose it is best exhibited in enema. It is also of use in preventing or in mitigating the tympanites which is so common in hysteria. In the allied disorder, *hypochondriasis*, the medicine is often of service in removing the digestive ailments with which the mental disorder is apt to be associated. In *chronic bronchitis* attended with spasmodic dyspnœa it is probable that asafetida both diminishes the secretion in the lungs and controls the spasmodic element. The latter action is sometimes evident in *whooping cough*, and possibly both actions may concur. When *constipation* and *tympanites* are met with, as they often are, in persons of a feeble and nervous habit, this medicine is one of the very best that can employed, either as a temporary remedy for the latter symptom or as a more permanent cure for the former when combined with appropriate purgatives, of which aloes is the best. Asafetida suppositories (U. S. P. 1870) are very convenient and efficient under the circumstances, and also during *hysterical* attacks, as are also the compound pills of galbanum, which contain myrrh and

asafetida. In tympanites a large enema of asafetida mixture often gives prompt and complete relief. This condition, when it occurs in typhoid fever, may be greatly reduced by such an enema, which also acts favorably upon the typhoid element of the disease. The exhausted condition of the nervous system and the partial paralysis which often follow *a nervous apoplexy* may be removed more or less by the same means, as well as by administering the drug by the mouth. Asafetida should not be neglected in *chorea* occurring in feeble, nervous girls about the age of puberty, particularly when the nervous disorder is accompanied with tardy or irregular menstruation.

In substance the dose of asafetida is from Gm. 0.20–1.00 (gr. iij–xv). It should be given in pill or in the official mixture. For prompt effects the latter form or the tincture is to be preferred.

ASARUM.—Wild Ginger.

Radix asari Canadensis.—Canada snakeroot, E.; *Asaret*, Fr.; *Hazelwurzel*, G.; *Azaro*, Sp.

The rhizome with rootlets of Asarum canadense, *Linné*.

Nat. Ord.—Aristolochiaceæ.

Origin.—The plant is indigenous to North America, growing in rich woodlands as far south as South Carolina, but is more frequent in the States farther north and in Canada. The creeping rhizome sends up a very short stem, bearing at its summit two broad reniform leaves upon petioles about 15 or 20 Cm. (6 or 8 inches) in length, from the fork of which a single brownish-purple nodding flower is produced.

Description.—The rhizome, which is in some places known as *colt's-foot root*, is from 7 to 15 Cm. (3 to 6 inches) long and about 3 Mm. ($\frac{1}{8}$ inch) thick, somewhat bent and curved and with few branches. It is finely wrinkled longitudinally; the internodes are about 12 Mm. (half an inch) or more in length, the nodes often of a jointed appearance from the remnants of leaves, and beset with several thin nearly simple radicles 50 to 75 Mm. (2 or 3 inches) in length. Externally the color is deep purplish-brown, internally whitish. The bark is about one-sixth the diameter of the rhizome, and contains a volatile oil in many of its parenchyma-cells; the wood is in about twelve small wedge-shaped bundles, forming an interrupted circle and enclosing a large pith. The rootlets have a thick bark and a thin, soft woody cord. Wild ginger has an aromatic odor and a warm, pungent, and bitterish taste.

Allied Species.—Asarum europæum, *Linné*, *asarabacca*. The rhizome and rootlets of this plant resemble the above; are, however, thinner, 1.5—2 Mm. ($\frac{1}{16}$ or $\frac{1}{12}$ inch) in diameter, and usually quadrangular in the dry state.

Asarum Sieboldii, *Miquel*. This plant grows in Japan, where it is known as *to-sai-shin*. The slender rhizome somewhat resembles serpentary, is marked by numerous *stem-scars*, and has dense tufts of pale-brown simple rootlets attached, which are about 10 Cm. (4 inches) long, and are internally mealy, white, and with a thin yellow ligneous cord. The drug has a slight aromatic odor and a taste which is at first aromatic, resembling a mixture of nutmeg and sassafras, and afterward very pungent and irritating.

Constituents.—Wild ginger contains a yellowish volatile oil and an acrid bitter resin, to which its medicinal properties are probably due. Van Gorder (1876) obtained 2 per cent. of aromatic volatile oil and a neutral resin having a different agreeable odor and a pungent, warm, and lasting taste. It also contains starch, gum, fixed oil, coloring matter, and salts. F. B. Power (1880) ascertained also the presence of a yellow coloring matter corresponding to Graeger's *asarin*, which is precipitated by basic lead acetate and colored dark-green by ferric salts, but not precipitated by tannin. A minute quantity of a body was found giving precipitates with most group-reagents for alkaloids. The volatile oil, of which Dr. Squibb obtained 3.12 per cent., had the specific gravity .953 at 17° C. (62.6° F.). It is of a yellowish- or greenish-amber color, and consists of a very small amount of *asarene*, $C_{10}H_{16}$, of the acetic and a small amount of the valerianic ether of *asarol*, $C_{10}H_{18}O$, of an indifferent neutral body, *asarin*, $C_{12}H_{16}O_2$, and of a small amount of dark-blue azulene. The volatile oil has been introduced for use in perfumery, and, according to Boerner (1878), is also adapted for the preparation of a medicated water and for flavoring elixirs. The fully-dried root yielded 13.43 per cent of ash.

The impure bitter principle of asarabacca has been named *asarin*. The camphor-like bodies *asaron* and *asarit* appear to be chemically identical, differing only in the latter separating from the watery distillate in fine crystals, while asaron or asarum camphor separates first in an oily condition before it crystallizes. It is inodorous and tasteless, has the composition $C_{20}H_{26}O_5$, and volatilizes with the production of irritating vapors.

Action and Uses.—Canada snakeroot is an aromatic and tonic stimulant. In hot infusion it is diaphoretic; it palliates *colic*, and is sometimes used in low forms of *febrile disease* as a substitute for serpentaria. An infusion may be made with Gm. 16 (℥ss) of the root and a pint of boiling water, and given in doses of a wineglassful. A decoction of it is reported to have acted as an irritant poison, and to have produced extensive erythematous and vesicular inflammation of the skin (*Med. News*, lviii. 283). The European species of asarum is not officinal. It is much more irritating than the native plant, producing violent vomiting and purging. The powder of its root is employed as an errhine.

ASCLEPIAS, *U. S.*—Asclepias.

Pleurisy-root, E.; *Racine d'asclépiade tubereuse*, Fr.; *Knollige Schwalbenwurzel*, G.

The root of Asclepias tuberosa, *Linné*.

Nat. Ord.—Asclepiadeæ, Cynancheæ.

Origin.—This perennial plant, which is known also as *butterfly-weed* and *orange swallow-wort*, is a native of Canada, and the United States south to Florida and west to Texas and Southern Colorado, and grows in sandy fields. The large fusiform, tuberous root sends up several rather weak and branching hirsute stems, with alternate lanceolate or lance-linear leaves and a corymb of numerous umbels with handsome bright orange-red flowers.

Description.—The root is usually found in the market cut into pieces from 2 to 15 Cm. (1–6 inches) in length and 12 to 25 Mm. (½–1 inch) or more thick. The head is irregular, knotty, and slightly but closely annulate, and, like the longitudinally wrinkled root, externally of a brownish-orange color and white or yellowish-white within. It has an irregular, tough fracture, a very thin bark (composed of an outer brownish and an inner white layer) and a distinctly striate meditullium composed of yellowish ligneous and broader white medullary rays. It is inodorous and has a slightly bitterish, acrid taste. When long kept it acquires a gray color externally and internally.

Constituents.—Besides starch, which is present in considerable proportion, the root contains, according to Elam Rhoads (1861), tannin, albumen, pectin, gum, two resins, fixed oil, an odorous volatile matter, and a peculiar principle possessing the taste of the root, which is precipitated by tannin from the concentrated infusion. This precipitate, if decomposed by oxide of lead and exhausted by alcohol, yields the principle as a yellowish-white powder which is soluble in alcohol, ether, and much water. Alton Clabaugh (1881) observed that this principle is colored brown by sulphuric acid, and pink, changing to purple, by nitric acid. The stearopten melted at 41° C. (106 F.), and was sublimable in prismatic needles. The air-dry root yielded 5.4 per cent. of ash, of which 21.5 per cent. was soluble in water. The principle referred to was obtained by Quackenbush (1889) in crystals, and ascertained to be a glucoside, and to crystallize also from chloroform; tannin could not be detected, but the presence of a fluorescent principle was noticed.

Allied Plants.—1. Asclepias incarnata, *Linné*.—Flesh-colored asclepias, Swamp milkweed, *E.*; Asclépiade incarnate, *Fr.*; Fleischfarbige Schwalbenwurzel, *G.*—The plant is indigenous to Canada, and to the United States as far south as Georgia. It grows in wet grounds, and has a smoothish or pubescent stem, bearing petiolate oblong-lanceolate and acute leaves, umbels of rose-purplish flowers, and smooth pods. The variety named *pulchra* has shorter petioles and broader hairy leaves. The rhizome is irregularly globular, about 25 Mm. (1 inch) in diameter, above with several more or less elongated branches, bearing the scars of the over-ground stems and frequently remnants of the same. Externally the color is yellowish-brown, internally whitish. The bark is thin, and covers a firm wood having fine medullary rays. The rhizome is surrounded on all sides with nearly simple light-brownish rootlets about 10 to 15 Cm. (4–6 inches) long, having a thick white bark, and a thin ligneous cord in the centre. In the fresh state the rhizome has a somewhat heavy odor, which is but slightly apparent after drying; the taste is sweetish, somewhat acrid, and afterward bitter.

Examined by Jos. Y. Taylor (1875), the root contains a trace of volatile oil, two acrid resins, an alkaloid which was not obtained in the pure state, fixed oil, albumen, pectin, starch, glucose, and yields 8.25 per cent. of ash. C. Gram (1886) isolated the emetic principle *asclepiadin* (see below).

2. Asclepias Cornuti, *Decaisne*, s. A. syriaca, *Linné*.—Milkweed, Common silkweed, Wild cotton, *E.*; Asclépiade à la soie, Herbe à la ouate, *Fr.*; Seidenflanze, *G.*; Soliman vegetal, *Sp.*—The rather stout and smoothish stem of this common plant, which is indigenous to Canada, and the United States southward to North Carolina, has oval-oblong acute and shortly petiolate

opposite leaves, which are about 15 to 20 Cm. (6–8 inches) long, and bears three or four axillary umbels with numerous sweet-scented, light greenish-purple flowers. It grows along roadsides and in waste places. The rhizome is horizontal, 30 Cm. (1 foot) or more in length, slightly branched, 6 to 25 Mm. (¼–1 inch) thick, externally grayish-brown, finely wrinkled longitudinally, beset with few simple rootlets or marked with their scars, but often tuberculated or knotty from undeveloped branches or stem-scars. When dry it breaks with a short fracture, exhibiting a thick white bark containing slender milk-vessels, and a soft, brittle, porous, yellowish wood dissected by rather broad medullary rays. It is without odor and has a bitterish, unpleasant taste. The parenchyma contains starch. John found in the milk-juice of the plant caoutchouc and resin, and List separated from it (1849) a white, crystalline, tasteless principle, *asclepion*, having the composition $C_{20}H_{34}O_3$, by exhausting the congealed milk-juice with ether. Sultz found (1845) in 80 parts of the milk-juice 69 water, 3½ wax and fat, 5 caoutchouc, ½ gum, and 2 sugar and salts. W. L. Hinchman (1881) ascertained also the presence in the rhizome of a little volatile oil, tannin, gummy matter, and a bitter principle, and in the fresh rhizome probably a volatile acrid compound. Quackenbush found no tannin, but isolated crystals identical with those from A. tuberosa (*Am. Jour. Phar.*, 1889, p. 114); the ash amounts to about 5.4 per cent. Kassner (1886) procured from the plant in September 1.61 per cent. of caoutchouc; the extract, prepared with benzol, contains about 50 per cent. of wax and 20 to 25 per cent. of caoutchouc, the remainder being chlorophyll and yellow and brown coloring matters.

3. Asclepias curassavica, *Linné*.—This perennial herb, known as *bastard ipecacuanha*, is indigenous to Central and South America and the West Indies. The root consists of a very short root-stock, which is abruptly divided into numerous thin, pale yellowish-brown, and internally whitish rootlets. The leaves are petiolate, 5 to 10 Cm. (2–4 inches) long, lanceolate or oblong-lanceolate, acute at both ends, and smooth. The flowers are bright-red, occasionally white. The glossy seed-hairs, sometimes called *vegetable silk*, are firmer than those of the preceding species. Gram (*Arch. f. exper. Pathol.*, xix. 389) prepared *asclepiadin* from the herb by treating the alcoholic extract with water, precipitating the solution with basic lead acetate and ammonia, and, after washing the filtrate with ether, precipitating it with tannin; on decomposing this precipitate with lead oxide, alcohol dissolves the glucoside, which is sparingly soluble in ether, and is readily altered, yielding the less active *asclepin*, this being contained in the ether used for washing. The inactive *asclepion* is a decomposition product, melting at 104° C., readily soluble in chloroform, and less soluble in ether. In Central America the plant is called *cancerillo* or *ponchisluiz*.

4. Cynanchum (Asclepias, *Linné*) Vincetoxicum, *Persoon*, s. Vincetoxicum officinale, *Moench*.—Swallow-wort, *E.*; Dompte-venin, Hirundinaria, *Fr.*; Schwalbenwurz, Giftwende, *G.*—This plant, indigenous to the greater part of Europe, has nearly sessile cordate-ovate leaves, and small umbels of about nine white and yellowish flowers. The root, which is the part used, consists of a very knotty, many-headed horizontal root-stock, with cup-shaped stem-scars, and with numerous nearly simple pale-brownish rootlets, which are about 15 Cm. (6 inches) long, and show upon the transverse fracture a rather thick brownish bark with white dots and a finely porous yellowish meditullium. The peculiar odor of the fresh root, which resembles that of valerian, disappears nearly altogether on drying; the taste is sweet, bitterish, and acrid.

Feneulle (1825) obtained from the root volatile oil, fat, pectin, and resinous *asclepin*, which C. Gram (see above) ascertained to be a derivative of the emetic principle *asclepiadin*. This seems to be identical with Tanret's *vincetoxin* (*Jour. de Phar. et de Chim.*, 1885, xi. 210), which is amorphous, soluble in alcohol and chloroform, insoluble in ether, and exists in two modifications—one insoluble and the other soluble in water; this solution is precipitated by sodium chloride, by tannin, and by ammoniacal lead acetate, in the presence of acids also by potassio-mercuric iodide; it has a sweet and bitter taste, is a glucoside, and is not emetic.

5. Calotropis (Asclepias, *Willdenow*) gigantea, *Rob. Brown*, and Cal. procera, *R. Brown*, s. Cal. Hamiltonii, *Wight* (Bentley and Trimen, *Med. Pl.*, 176), are shrubs, the former being indigenous to Southern India and the East Indian islands, the latter to Northern India and westward through Asia and tropical Africa. Both species yield *mudar-bark*, which consists of irregular fragments 5 Mm. (⅕ inch) or less thick, externally yellowish-gray, fissured, or after separation of the corky layer whitish, and upon the transverse section striate with the narrow brown bast-rays. The bark is brittle, of a slight odor, and of a mucilaginous bitter and acrid taste, and has often attached to it fragments of the light-yellow fibrous wood. It contains starch, an acrid acid resin soluble in alcohol and ether, and a colorless bitter principle soluble in alcohol, ether, and chloroform and precipitated by tannin, but not by lead acetate (*Pharmacographia*). Warden and Waddell obtained a principle in nodular crystals resembling *asclepion*, caoutchouc, and several resins.

Medical Action and Uses.—The qualities of the three species of Asclepias are practically identical, but those of *A. tuberosa* are best known. Like many other medicines, it has been alleged to possess specific powers in the cure of particular diseases, but a comparison of the reports concerning it show that it is one of the numerous class of vegetable products which under certain conditions act as emetics, and even purgatives, and more commonly as sudorifics, expectorants, carminatives, and anodynes. Being an irritant, it has not escaped being ranked as a cholagogue. *A. incarnata* is reported by J. H. Fraser (*Birmingham Med. Rev.*, April, 1884) to affect the heart and arteries like digitalis, but without disturbing the stomach and bowels; it frequently acts as a stoma-

chie. He administered it in an infusion and also in a fluid extract, giving from Cc. 2 to 4 (f℥ss–f℥j) of the latter every three hours, and declared it to be "a speedy, potten, and reliable diuretic." *A. syriaca* is said to be diuretic. Its general qualities account for the reputation of the officinal plant as a diaphoretic in the forming stage of *fevers*. It is, however, thought to produce sweating, not by stimulating, but by lowering, the action of the heart. The same characteristic renders it useful in acute *rheumatism*, *bronchitis*, *pneumonia*, and *pleurisy*, so far as sedation of the nervous and circulatory systems can be so; that is, by lessening local congestions. The "pleurisy" it is credited with relieving was most probably muscular rheumatism of the walls of the chest. Flatulent *colic* and *dyspepsia* are affections to which it has been regarded as peculiarly appropriate. The milky juice of *A. syriaca*, applied to the skin, soon becomes a tough, adhesive pellicle, and has been used to coat recent *wounds* and superficial *ulcers* and promote their cicatrization. The *dose* of the powdered root of the officinal plant is from Gm. 1.30–4.00 (20 to 60 grains). A decoction is made with Gm. 32 (an ounce) of pleurisy-root to a quart (Cc. 1000) of water, and is given in doses of 4 fluidounces every 2 hours as a diaphoretic. A fluid extract has also been prepared.

In 1881, Dr. Guimaraës described the physiological action of *A. currasavica*, a native of Brazil. He found it to act directly upon the organic muscular system, and especially upon the heart and blood-vessels, causing great constriction of the latter and distension of the larger arteries. Secondarily, it occasioned great dyspnœa, vomiting, and diarrhœa (*Times and Gaz.*, Dec., 1881, p. 661).

Mudar-bark is used in India as a tonic and alterative medicine, and in full doses as a diaphoretic and emetic, in the treatment of rheumatism, dysentery, and diseases of the skin. The dose of the powdered bark is stated to be Gm. 0.18–20 (gr. iij–iv) as a tonic, and Gm. 2–4 (gr. xx–lx) as an emetic. The inspissated juice is used by the natives as an abortifacient.

ASPARAGUS.—Asparagus.

Asperge, Fr.; *Spargel*, G.; *Esparraguera*, Sp.; *Asparago*, F. It. (*Rhizoma et turiones*).

Asparagus officinalis, *Linné*.

Nat. Ord.—Lilliaceæ, Asparagineæ.

Origin and Description.—This herbaceous perennial is indigenous to Europe, and is extensively cultivated. Its stem is 1.5 M. (4 or 5 feet) high, has the thread-like leaves (branchlets, *Gray*) clustered in the axil of a short, ovate sheathing bract (leaf, *Gray*), and small, greenish, axillary, nodding flowers, producing red berries. The following parts have been medicinally employed:

1. Asparagi radix consists of a short horizontal rhizome about three-quarters of an inch (19 Mm.) thick, on the upper side marked by stem-scars, and below by numerous long, whitish, nearly simple roots, which on drying become deeply wrinkled longitudinally. It is inodorous and has an insipid sweetish taste.

2. Asparagi turiones, the well-known young shoots which are used as food.

Constituents.—Examined by Dulong, the root was found to contain yellow resin, sugar, gum, albumen, chlorides, phosphates, malates, and acetates. Vauquelin and Robiquet (1805) discovered *asparagin* in the shoots, which has since been found in many other plants (see p. 162). Reinsch (1870) found in the berries considerable grape-sugar and *spargancin*, an orange-red sublimable coloring matter soluble in ether and crystallizing in scales. The seeds contain fixed oil, aromatic resin, crystallizable sugar, and a crystallizable bitter principle, *spargin*.

Pharmaceutical Uses.—Syrupus asparagi, which is employed in France, is prepared by dissolving 190 parts of sugar in 100 parts of the clarified juice of asparagus-shoots.

The tubers of Asparagus ascendens, racemosus, and sarmentosus, *Linné*, are employed in India like salep.

Action and Uses.—The offensive odor given to the urine of persons who eat the young asparagus-plant is well known; some attribute to it a diuretic virtue which there is not sufficient reason to accept; others have reported that it may cause urethritis; and one, at least, that it renders the urine saccharine. If any part of the plant is diuretic, it is probably the root. It has no true medicinal virtues. Asparagin, in doses of from 2 to 5 grains, is said to cause headache, fulness of the eyes, and general depression, with some slowing of the pulse (Dendrick); but other experimenters produced no such

effects even with much larger doses (Husemann and Hilger, *Die Pflanzenstoffe*, p. 270). An infusion of the wild herb has been credited with controlling *metrorrhagia* (*Lond. Med. Record*, Jan. 1888, p. 30).

ASPIDIUM, *U. S.*—Aspidium.

Filix mas, Br., U. S. 1870; *Rhizoma filicis*, P. G.; *Radix filicis maris.—Male fern, Male shield fern*, E.; *Fougère mâle*, Fr.; *Wurmfarn, Waldfarn, Johanniswurzel*, G.; *Helecho macho*, Sp.; *Felce maschio*, F. It.

The rhizome, covered with portions of the stipes, of Dryopteris (Aspidium, *Swartz*, Nephrodium, *Brown*, Polypodium, *Linné*) Filix mas, *Schott*, and of Dryopteris (Aspidium, *Willdenow*, Nephrodium, *Michaux*, Polypodium, *Linné*) marginale, *Asa Gray* Woodv. *Med. Bot.*, plate 271; Bentley and Trimen, *Med. Plants*, 300.

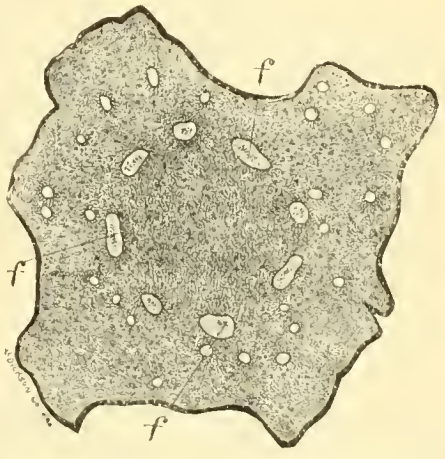
Nat. Ord.—Filices.

Origin.—Male fern is indigenous to Canada westward to the Pacific Ocean, thence south along the Rocky Mountains to Mexico and a considerable portion of South America; to some of the Polynesian Islands; to the greater portion of Asia north of the Himalaya Mountains; and to Europe and some parts of Africa. The marginal shield fern grows in rich rocky woods in Canada and the United States. The fronds of both species are from 30 to 60 or 90 Cm. (1 to 2 or 3 feet) high, bipinnate, at the tip pinnate or pinnatifid, lanceolate, or the latter ovate-lanceolate in outline and evergreen; the circular fruit-dots are situated on the veins—in the male fern near the midrib of the lower half of the pinnules, or in the marginal shield fern at the base of the serratures along the lower side of the pinnules, and are covered with an orbicular heart-shaped indusium. The fronds arise from the living somewhat ascending end of the horizontal rhizome, which is 15 to 30 Cm. (6 to 12 inches) long, and the old portion densely covered with the remnants of the stipes. It is collected early in autumn or in summer, as directed by the British Pharmacopœia.

Fig. 33.

Aspidium: surface of peeled rhizome.

Fig. 34.



Dryopteris Filix mas, *Schott:* transverse section of rhizome; *f.* fibro-vascular bundles.

Description.—As found in commerce, it is 7 to 15 Cm. (3 to 6 inches) long, and with the closely imbricated and slightly curved remnants of the stipes 50 to 75 Mm. (2 to 3 inches) thick. The latter remain green in their lower portion for several years, and are, like the rhizome itself, densely covered with a brown, glossy, and soft chaff consisting of thin transparent scales; between the stipes are the black wiry rootlets. The rhizome itself is fleshy, 12 to 25 Mm. (½ to 1 inch) in diameter, externally dark-brown, internally of a pale green color and spongy texture, and shows upon the transverse section near the surface eight or twelve larger fibro-vascular bundles arranged in an interrupted circle, outside of which are a number of smaller ones. The stipes have about eight small vascular bundles in a loose circle. The rhizome of the marginal shield fern corresponds with this description in all respects, except that it has about six fibro-vascular bundles and does not fully attain the diameter of the thickest male fern rhizomes. The spongy texture is due to the thin-walled parenchyma and to the large intercellular spaces, into which stalked glands project which exude a green liquid. These glands were observed in male fern by Herman Schacht (1863), and in marginal shield fern by Flückiger (1880); many allied species do not contain such glands. Aspidium has a slight disagreeable odor and a sweetish afterward somewhat bitter astringent and nauseous taste. For medicinal purposes the dead portions of the stipes and rhizome must be removed, and the green part only retained, which should be at once dried, powdered, and exhausted by ether for preparing the oleoresin.

Constituents.—Male fern has been frequently analyzed. Geiger (1826) obtained 6.9 per cent. of green fixed oil, which Luck (1851) found to consist of the glycerides of *filixolic* and *filosmylic acids*, the last of which is volatile. The tannin of older authors was separated by Luck into two acids, *tannaspidic* and *pteritannic acids*, the last only

being soluble in ether, both coloring ferric salts green. Malin (1867) found only one tannin, *filitannic acid*, which, with fusing potassium hydroxide, yields phloroglucin and protocatechuic acid, and on being boiled with dilute sulphuric acid is split into sugar and *filix-red*, the latter in an impure condition, being Luck's tannaspidic acid. Peschier (1826) obtained from the ethereal extract granular crystals, which Luck named *filicic acid*. Grabowski (1867) gave it the formula $C_{14}H_{18}O_5$, and found it to be *dibutyryl-phloroglucin*, which is decomposed by potassa near the fusing-point into phloroglucin and butyric acid. Pavesi's *aspidin* (1861) is a very impure filicic acid, which is probably the main active ingredient. Bock (1851) determined the tannin to amount to 10 per cent., and found also a trace of volatile oil, wax, chlorophyll, gallic acid, albumen, pectin, starch, gummy matter, sugar, and 2 to 3 per cent. of inorganic salts. J. L. Patterson (1875) obtained from the rhizome of the marginal shield fern filicic acid and a tannin similar to, if not identical with, that of filix mas; and C. H. Cressler (1878) found the oleoresin effectual in several cases of tape-worm.

Action and Uses.—Male fern was anciently known to be a remedy for *tænia* and other intestinal worms, but its reputation was more firmly established in the last century. It is more efficacious in removing the unarmed than the armed tænia, unless the latter be young. The methods employed by different physicians in the treatment of tænia by male fern are for the most part very complicated, and seem devised more in a spirit of charlatanism than of art. It is, as a rule, essential that the bowels should contain no accumulation of partially-digested food or of feces, and that the vigor of the parasite should be reduced by as low and simple a diet as can well be borne, and chiefly in a liquid form, as milk or broth. Early in the morning, fasting, the patient should take from Gm. 2–6 (gr. xxx–xc) of powdered male fern at a single dose or in divided doses at short intervals. The oleoresin of male fern, in the dose of from Gm. 0.60–1.30 (♏ x–xx), may be administered along with the powdered root or in feeble persons by itself. About an hour after either preparation an active purge of calomel with jalap or gamboge is sometimes administered, but generally an ounce of castor oil will suffice. Some prefer Epsom salts. It is by certain authorities recommended to give a full dose of sulphuric ether shortly after the specific medicine, for the purpose of rendering the detachment of the parasite easier. The oleoresin is conveniently administered in gelatin capsules. (See *Oleoresina Aspidii*). The *dose* of filicic acid is about Gm. 2 (gr xxx).

Aspidium marginale appears to posses the same properties as male fern. Suesserott employed a fluid extract of it in the treatment of *tænia* with entire success (*Trans. Med. Soc. Penna.*, 1875, p. 637), and Cressler, who gave the oleoresin in capsules containing each about 10 minims, caused the expulsion of tæniæ on two occasions. The usual associated treatment of abstinence from food before the medicine and a purgative after its administration was also carried out (*Am. Jour. Phar.*, June, 1878).

Polypodium incanum is stated to possess emmenagogue qualities. The negro women of Alabama are reported to have used it before menstruating and to prevent conception; and the ladies of that region to relieve *dysmenorrhœa* (Mastin, *Phila. Med. Times*, xi. 607). *Osmunda regalis* is astringent and tonic.

ASPIDOSPERMA, *U. S.*—Aspidosperma.

Quebracho, E., Fr., G., F. It.

The bark of Aspidosperma Quebracho, *Schlechtendal.*

Nat. Ord.—Apocynaceæ.

Origin.—The term *quebracho* (*quebrar hacho*) signifies "breaking the axe," and is applied in South America to trees having a very hard wood. The above species is called *quebracho blanco*, on account of its light-colored wood. It is a large evergreen tree, having thin drooping branchlets. The leaves are small, opposite, or in whorls of three, nearly sessile, elliptic-lanceolate, sharply pointed, and with an entire and callous margin; the small yellow flowers are in axillary cymes, and produce woody somewhat compressed capsules with broadly-winged seeds. The plant was discovered by Burmeister (1860); specimens of the bark were sent to Europe by Schickedanz (1878), and chemically examined by Fraude and Hesse. A thorough histological examination of the bark was made by A. Hansen (1880). The bark is collected from old trees after the corky layer has been well developed; though it contains only 3.48 per cent. of tannin, according to Paschkins, it is used in the Argentine Republic to some extent for tanning.

Description.—Quebracho bark is seen in flattish or curved pieces varying in size and having a thickness of 12–30 Mm. ($\frac{1}{2}$ to $1\frac{1}{5}$ inches). The outward surface is deeply fis-

sured and warty, dingy ochre-colored or pale-brownish, or, after abrasion of this layer, brownish-red or of a bright orange-brown color; the inner surface is usually deep-brown, but occasionally pale-colored. The bark is nearly inodorous, has a bitter and slightly aromatic taste, and breaks in the outer layer with a short granular, and in the inner layer with a fibrous, fracture. Upon transverse section about one-half or more of the bark is seen to consist of an irregular corky layer, orange-brown in the interior, marked with irregular tangential lines of alternating suberous bands and parenchyma, and in the latter with numerous whitish dots formed by groups of stone-cells. The inner bark forms a brown (or yellowish) layer nearly uniform in thickness, having narrow medullary rays, numerous whitish dots of stone-cells in groups, and scattered bast-fibres, each being almost completely enveloped in a sheath of small crystal-cells.

Constituents.—Schickedanz isolated a crystalline alkaloid, which Fraude named *aspidospermine;* Hesse found in addition five other alkaloids, one of which (*quebrachamine*) appears to be sometimes wanting. The extract, prepared with hot alcohol, is treated with soda and chloroform, the latter solution evaporated, the residue taken up with diluted sulphuric acid, and the filtrate precipitated by soda. On dissolving the mixed alkaloids in a little boiling alcohol, aspidospermine, quebrachine, and quebrachamine will crystallize on cooling, and are separated by crystallization from diluted hydrochloric acid, aspidospermine remaining in the mother-liquor. The alcoholic mother-liquor contains the remaining three bases, which are combined with acetic acid; from this solution ammonia precipitates aspidosamine; aspidospermatine and hypoquebrachine are precipitated by soda and separated by boiling benzin, in which the latter is nearly insoluble. All these alkaloids are more or less soluble in alcohol, ether, and chloroform. *Aspidospermine*, $C_{22}H_{30}N_2O_2$, melts at 205° C. (401° F.), and is a weak base, forming mostly amorphous salts; warm perchloric acid colors the solution permanently deep-red; platinic chloride gives a blue precipitate; sulphuric acid and lead peroxide (or potassium bichromate) color the alkaloid brown, afterward cherry-red or purplish. *Aspidospermatine*, $C_{22}H_{28}N_2O_2$, melts at 162° C. (324° F.), is a strong base, and yields amorphous salts; it is colored, like the preceding, by perchloric acid, but not by sulphuric acid and chromate. *Aspidosamine*, $C_{22}H_{28}N_2O_2$, melts near 100° C. (212° F.), is a strong base, is colored blue by sulphuric acid and chromate, and gives with boiling perchloric acid a fuchsine-red liquid. *Quebrachine*, $C_{21}H_{26}N_2O_3$, melts at 215° C. (419° F.), yields crystallizable salts, is colored yellow by sunlight, also by warming with perchloric acid, and gives with sulphuric acid a colorless solution becoming blue on standing or more rapidly by lead peroxide or potassium chromate, the color produced by the latter changing to red-brown. *Quebrachamine* resembles the preceding, but melts at 142° C. (288° F.), and is freely soluble in cold alcohol and ether. *Hypoquebrachine* is yellow, amorphous, melts near 80° C. (176° F.), and gives in solution a cherry-red color with ferric chloride.

Tests.—For recognizing quebracho-bark Fraude recommends the following: Boil 5 Gm. of the bruised bark with 25 Gm. of benzin; filter while hot, agitate the liquid with 10 Cc. of diluted sulphuric acid, separate the aqueous solution, supersaturate with ammonia, agitate with ether, evaporate the ethereal solution, and boil the residue with perchloric acid; or, dissolve it in a little water with 4 drops of sulphuric acid, add a minute crystal of potassium chlorate, and boil; the solution should acquire a fuchsine-red color.

Pharmaceutical Preparations.—Tinctura quebracho. Quebracho-bark 1 part; diluted alcohol sufficient for obtaining 5 parts of tincture.

Vinum quebracho. Quebracho-bark 1 part; diluted alcohol 2 parts; white wine sufficient for obtaining 15 parts of liquid.

Allied Drugs.—Loxopterygium Lorentzii, *Grisebach* (nat. ord. Terebinthaceae, Anacardieæ). This tree is known in the Argentine Republic as *quebracho colorado*, the wood of which is red-brown and contains about 20 per cent. of tannin. Hansen (1880) describes the bark as being externally dingy-yellow or brown, usually covered with lichens; the transverse section is light-brown, and shows numerous parallel dark-colored corky bands, which are traversed at right angles by many fine light-colored medullary rays: between the latter are regular tangential rows of groups of stone-cells, imparting to the tissue a checkered appearance; the bast-fibres are the same as in white quebracho-bark, surrounded by a sheath of crystal-cells, but they are always much smaller, and are arranged in nearly rectangular groups. Hesse considers its tannin to be very similar to that of catechu, and has obtained two bitter alkaloids: *loxopterygine* is very soluble in alcohol, ether, and chloroform, and is colored blood-red by nitric acid; the second alkaloid is very easily decomposed, and yields with diluted sulphuric acid a beautiful blue solution. The resinous exudation of the bark resembles kino in appearance and taste, and, according to Arate (1878), is soluble in alcohol, amylic alcohol, acetone, acetic ether, acetic acid, and hot water.

Iodina rhombifolia, *Hooker et Arnott* (nat. ord. Aquifoliaceæ), is known as *quebracho flojo*, and Machærium fertile, *Grisebach* (nat. ord. Leguminosæ), as *tipa*. The wood and bark of both species are used like the preceding, and occasionally collected with it.

Copalchi-bark has been sold as quebracho.

(See also *paytine* and Geissospermum.)

Action and Uses.—In 1879, Penzoldt described quebracho as a medicine that without any injurious collateral effects promptly diminishes or removes sundry forms of dyspnœa in diseases of the respiratory and circulatory apparatus. He observed a reduction of the respiration-rate under its influence, without any corresponding lowering of the pulse-rate. It seemed to produce a sense of warmth in the head, but neither vertigo nor somnolence. Sometimes it excited diaphoresis, sometimes also salivation, and in some cases of pulmonary disease the cough and expectoration grew less. Penzoldt saw no bad consequences from its use, but other physicians have noted its disagreeable taste and the nausea it is apt to occasion. According to Laquer, if the use of the medicine is prolonged it is apt to cause headache, dulness of the senses, vertigo, and salivation, and the patients acquire an extreme disgust for it (*Bull. de Thérap.*, xcviii. 379). Picot assures us that it enabled him to ascend a mountain without shortness of breath—a feat which he could not otherwise accomplish (*Bull. de Thérap.*, xcviii. 379).

Penzoldt states that of all diseases *asthma* with emphysema is most benefited by it, and that it does not fail of its effects even when pleurisy or bronchitis is also present. In *phthisis*, *bronchial asthma*, and some diseases of the *heart* its palliative action was marked, and was also evident in a case of pulmonary embolism; but when the heart-muscle was weak the influence of the medicine was not salutary, nor indeed in any case in which the condition of that organ was the primary cause of the dyspnœa. In this respect it is no substitute for digitalis. In a case of uræmic asthma it was very efficient. In opposition to one of these statements, Berthold reports two cases of fatty degeneration of the heart in which the dyspnœa was greatly relieved by the medicine (*Bull. de Therap.*, xcviii. 379), but it is probable that the dyspnœa arose from some other cause added to the degeneration of the heart-tissue. In a word, the medicine appears to be a palliative for the symptom dyspnœa; the degree and the duration of the relief which it affords will in each case depend upon the nature and the degree of the physical cause of that symptom. In this country we have the statement that the late Dr. Austin Flint tried quebracho in several cases of dyspnœa from phthisis and pneumonia without avail, but that in extreme cases of dyspnœa from mitral regurgitation it was very efficacious (*Med News*, May, 1881, p. 273). Dr. Andrew H. Smith has reported the results of his use of the medicine in thirty-two cases of various diseases, including eleven of *spasmodic asthma*. Of the latter, nine cases were relieved, and of the total number of cases, including diseases of the lungs, heart, and kidneys, twenty-two were benefited more or less (*Med. Record*, xx. 559). Quite a similar result is reported by Gottheil (*ibid.*, xxiv. 259), by Mariasi (*Bull. de Therap.*, cv. 311), by DaCosta (*Boston Med. and Surg. Jour.*, Dec. 1883, p. 620), and by Maragliano (*Centralblatt f. d. g. Therapie*, ii. 63). It is difficult to assign to the medicine its precise clinical value, but the general impression conveyed by a study of its effects is, that the more nearly the symptom dyspnœa is independent of an organic cause the better will be the influence of the medicine upon it. Harnack and Hoffmann attribute the relief afforded by it in part to its sedative and nauseating action, and point to the analogy of similar effects produced by various emetics. The close functional and mechanical relations of the lungs and heart are here to be taken into account. Fluid extract of quebracho has been, like compound tincture of benzoin, applied to protect and stimulate *wounds*.

The preparation recommended by Penzoldt is as follows: Take 10 parts of the powdered bark; treat for several days with 100 parts of alcohol; evaporate the latter, and dissolve the extract in 20 parts of warm water. *Dose*, 1 or 2 teaspoonfuls three times a day. The solution, he says, is of a clear sherry color, has a slightly astringment and aromatic taste, and is not hard to take. Huchard states that commercial aspidospermine really contains all the alkaloids of quebracho. According to Maragliano, quebrachine and aspidospermine act in about half an hour by the mouth and in from 5 to 10 minutes hypodermically. For the latter purpose he employed the sulphate in doses of Gm. 0.05–0.10 (gr. j–ij), and a solution of 1 grain in 15 grains of water caused neither local nor general disturbance. The muriate has also been employed.

ATROPINA, *U. S., Br., F. Cod.*—Atropine.

Atropia, Atropinum.—Atropia, E.; *Atropine*, Fr.; *Atropin*, G.

Formula $C_{17}H_{23}NO_3$. Molecular weight 288.38.

Preparation.—Take of Belladonna-Root, recently dried and in coarse powder, 2 pounds; Rectified Spirit 10 pints; Slaked Lime 1 ounce; Diluted Sulphuric Acid, Potassium Carbonate, each a sufficiency; Chloroform 3 fluidounces; Purified Animal Charcoal a sufficiency; Distilled Water 10 fluidounces. Macerate the root in 4 pints of the spirit for twenty-four hours, with frequent stirring. Transfer to a displacement apparatus, and exhaust the root with the remainder of the spirit by slow percolation. Add the lime to the tincture placed in a bottle and shake them occasionally several times. Filter, add the diluted sulphuric acid in very feeble excess to the filtrate, and filter again. Distil off three-fourths of the spirit, add to the residue the distilled water; evaporate at a gentle heat, but as rapidly as possible, until the liquor is reduced to one-third of its volume and no longer smells of alcohol; then let it cool. Add very cautiously, with constant stirring, a solution of the potassium carbonate, so as to nearly neutralize the acid, care, however, being taken that an excess is not used. Set to rest for six hours, then filter, and add potassium carbonate in such quantity that the liquid shall acquire a decided alkaline reaction. Place it in a bottle with the chloroform, mix well by frequently-repeated brisk agitations, and pour the mixed liquids into a funnel furnished with a glass stopcock. When the chloroform has subsided, draw it off by the stopcock, and distil it by a water-bath from a retort connected with a condenser. Dissolve the residue in warm rectified spirit; digest the solution with a little animal charcoal; filter, evaporate, and cool until colorless crystals are obtained.—*Br.*

The British process is that proposed by Mein, except that the alkaloid, instead of being simply precipitated from the watery solution of its sulphate, is removed by agitation with chloroform, in accordance with the suggestion of Rabourdin (1850). The lime, on being agitated with the tincture of the root, removes considerable resin and fat, the little lime which enters into solution being afterward precipitated by sulphuric acid as calcium sulphate, while the atropine remains in the liquid as sulphate, which is readily soluble in alcohol and water. On neutralizing the free acid with potassium carbonate another quantity of resin is separated, and on rendering the liquid alkaline the atropine is set free, and is taken up by the chloroform on being agitated with it. Treatment with alcohol and animal charcoal is resorted to for the purpose of removing the last traces of coloring matter and obtaining the alkaloid crystallized.

A process similar to the preceding was proposed by Prof. Wm. Procter, Jr., in 1860, who, after treating the tincture with lime and sulphuric acid and evaporating the alcohol, as described above, removed most of the remaining oil and resin by diluting the residue with water, filtering, and agitating with chloroform, in which the sulphate of atropine is insoluble; after the addition of caustic potassa, chloroform was used for extracting the alkaloid, of which 0.39 per cent. was obtained in a crystalline condition and of a fawn color, which was removed by treating the alcoholic solution with animal charcoal. The process of the U. S. P. 1870 arrived at the same result by converting the alkaloid contained in the tincture of belladonna-root into a sulphate. After most of the alcohol had been distilled off, the residuary liquid was poured into water, which retained the sulphate of atropine in solution, while nearly all the resin and oil was separated and removed by filtration. By means of potassa and chloroform the alkaloid was obtained, on evaporating the latter, in yellowish crystals, which, although then considered sufficiently pure for medicinal purposes, contain variable amounts of impurities; these, however, are removed without much trouble and loss by recrystallization from alcohol of 50 per cent.

In all the above-mentioned processes it is of importance that the treatment with the alkalies and alkali carbonate should take place at a low temperature and not be unnecessarily prolonged, since potassium carbonate alters the atropine and renders it inert when acting upon its aqueous solution at an elevated temperature; caustic potassa effects a similar decomposition already in the cold during a contact for 24 hours.

Properties and Tests.—Pure atropine is in colorless or white, glossy acicular crystals without odor, and has a disagreeably bitter and acrid taste. It melts at 113.5° C. (236.3° F.), according to Ladenburg (1880); at 115.5° C. (240° F.), according to E. Schmidt (1881); when carefully heated it volatilizes at 140° C. (284° F.), partly unchanged, and at a higher heat is completely decomposed, leaving no residue. It is soluble in 300 parts (Von Planta), 500 parts (Geiger), 130 parts (*U. S. P.*), of water at 15° C. (59° F.), and on continued boiling in 30 parts of boiling water (Geiger and Hesse).

It is very freely soluble in alcohol (3 parts, *U. S.*), dissolves in warm oil of turpentine; according to Geiger and Hesse, in 63 parts (16 parts, *U. S. P.*) of ether, in 4 parts of chloroform, 58 parts of olive oil, also in 50 parts of glycerin. It has a strong alkaline reaction and neutralizes acids, forming salts which are crystallizable with difficulty and are soluble in water and alcohol, but insoluble in ether and chloroform. The solutions of the salts are not precipitated by platinic chloride except when very concentrated; their characteristic reactions, according to Ladenburg, are the following: With tannin, a white precipitate soluble in diluted acids; with iodine, a brown oily precipitate, becoming crystalline; with potassio-mercuric iodide, a white curdy precipitate; with picric acid, a crystalline precipitate; with chloride of gold, a yellow oily precipitate, crystallizing after some time, the dry crystals melting at 135° C. (275° F.), and when recrystallized from boiling diluted hydrochloric acid are again deposited in minute crystals, and after drying form a dull, lustreless powder (difference from hyoscyamine); the alcoholic solution of atropine, on passing cyanogen gas through it, becomes blood-red (Hinterberger, 1851); warmed with sulphuric acid and potassium bichromate after the addition of water, atropine develops a pleasant benzoin-like odor, the liquid becoming green (Ludwig, 1861); with cold sulphuric acid it yields a colorless solution, and on warming gives an odor resembling orange-flowers (Gulielmo, 1863). The sulphuric acid solution is not colored red by nitric acid (difference from morphine, narcotine, etc.), nor blue or purple by manganese dioxide or potassium bichromate (difference from strychnine); the last-named reagent causes a green color.

When heated with baryta-water, soda, or strong hydrochloric acid, atropine is decomposed, yielding tropic acid, $C_9H_{10}O_3$ (by continued action atropic and isatropic acids, $C_9H_8O_2$), and tropine, which is a crystallizable, strongly alkaline compound having the formula $C_8H_{15}NO$ (Kraut, 1863; Lossau, 1864); it crystallizes in white hygroscopic needles or plates, is freely soluble in water, alcohol, and ether, and may be distilled in a current of hydrogen. Tropine tropate has no effect on the eye, but when heated with excess of dilute hydrochloric acid in a water-bath separates at first an oil, and when now treated with potassium carbonate yields atropine (Ladenburg, 1879).

According to Hübschmann (1858), commercial atropine frequently contains an uncrystallizable alkaloid, *belladonnine*, which is sparingly soluble in water and has a faintly bitter, burning, acrid taste. It may be removed from atropine by adding to the watery solution of the salt a small quantity of carbonate of potassium, when it is precipitated before any atropine is liberated; its identity with hyoscyamine has been suggested by Ladenburg. But Buchheim (1876) stated that it is decomposed by alcoholic potassa (not by barium hydrate) into tropine and *belladonnic acid*. In 1850, Von Planta stated atropine to be chemically identical with daturine, the alkaloid of stramonium; and since that time it is said the latter alkaloid has not unfrequently been manufactured and sold as atropine, notwithstanding the researches of Von Schroff and others have proved it to exert a more powerful physiological action than the latter. Ladenburg (1880) has shown that after the removal of belladonnine the product from belladonna consists of atropine, described above, and a small quantity of light atropine or hyoscyamine, while daturine is a mixture of the same two alkaloids, but hyoscyamine predominating.

Apatropine, $C_{17}H_{21}NO_2$, according to Pesci (1882), is obtained by treating atropine with fuming nitric acid, and is converted into *hydro-apoatropine*, $C_{17}H_{13}NO_2$, by treatment with sodium-amalgam.

ATROPINÆ SULPHAS, *U. S., Br.*—Atropine Sulphate.

Sulfas atropinæ, F. Cod.; *Atropinum sulfuricum*, P. G.—*Sulphate of atropia*, E.; *Sulfate d'atropine*, Fr.; *Atropinsulfat, Schwefelsaures Atropin*, G.

Formula $(C_{17}H_{23}NO_3)_2H_2SO_4$. Molecular weight 674.58.

Preparation.—Take of Atropine 120 grains; Distilled Water 4 fluidrachms; Diluted Sulphuric Acid a sufficiency. Mix the atropine with the water and add the acid gradually, stirring them together until the alkaloid is dissolved and the solution is neutral. Evaporate it to dryness at a temperature not exceeding 37.7° C. (100° F.).—*Br.*

In preparing this salt it is important that the acid be very carefully neutralized, and that in evaporation the heat be cautiously applied. The salt is left behind in an amorphous condition, but may be obtained crystalline by dissolving it in absolute alcohol and evaporating spontaneously, or by pouring this solution into anhydrous ether. Ch. Maitre (1856) proposed a process which was recognized in the U. S. P. 1870. The atropine is dissolved in anhydrous ether, and sulphuric acid diluted with strong alcohol is carefully

dropped in until the liquid just acquires a permanent acid reaction; the precipitate is washed with a little ether and dried at a low temperature.

Properties.—Atropine sulphate is "permanent in the air, colorless, having a very bitter, nauseating taste and a neutral reaction; soluble in 0.4 part of water and in 6.5 parts of alcohol at 15° C. (59° F.); 2270 parts of ether, or 694 parts of chloroform. When heated on platinum-foil the salt is decomposed and wholly dissipated, emitting acrid vapors. On adding test-solution of sodium carbonate to a concentrated aqueous solution of the salt a white precipitate is obtained, which answers to the reactions of atropine. (See ATROPINA.) The salt or its solution when applied to the eye strongly dilates the pupil. An aqueous solution of the salt yields with test-solution of barium chloride a white precipitate insoluble in hydrochloric acid."—*U. S.* "It is soluble in 3 parts of alcohol sp. gr. 832, in 1 part of water, and is insoluble in ether and in chloroform. Heat .01 Gm. of it in a test-tube until white vapors are visible; then add 1.5 Cc. sulphuric acid; heat again until the mixture begins to turn brown, and dilute with 2 Gm. of water; a characteristic very agreeable odor should be given off; now add a small crystal of potassium permanganate, when the odor of oil of bitter almonds should be developed. The aqueous solution should be rendered turbid by solution of soda, but not by ammonia-water; 1 part of the salt dissolved in 1000 parts of water should have a distinct acrid and bitter taste."—*P. G.*

Allied Salt.—ATROPINÆ SALICYLAS, *Atropine salicylate*, is prepared by Tichborne (1877) by dissolving 289 grains of atropine and 138 grains of salicylic acid in about 20 ounces of water, and evaporating, when 432 grains of the salt will be obtained as an uncrystallizable colloidal mass, which it is difficult to powder, and which is soluble in alcohol and in 20 parts of water at 15° C. (59° F.).

Action and Uses.—Herbivorous animals and birds are but little affected by doses of atropine or its salts, which are fatal to carnivora; pigeons will often recover after the hypodermic injection of 2 grains of the alkaloid, and their pupils are not dilated by any dose of it. Even upon dogs the toxical action of atropine is relatively slight. The injection of 2 or 3 grains into the connective tissue of these animals may produce a staggering gait and agitation; and the same quantity thrown into the crural vein, although it may cause rigidity and apparent death, will not necessarily destroy the animal's life. In a few hours it may appear entirely well. The action upon the several physiological systems varies with the dose of atropine. In non-poisonous doses it raises the temperature, causes great acceleration of the heart's action with a tonic contraction of the ventricles, and also a primary contraction followed by dilatation of the blood-vessels, while a general quieting effect on the cerebro-spinal system is observed. Poisonous doses seem to render morbidly acute the general and the special senses, although the perceptions do not appear to be normal, and there is no tendency to narcotism. Death, apparently, is due to exhaustion of the forces which move the heart and the respiratory organs, and is preceded by general muscular paralysis. On examination the heart, lungs, and brain are found surcharged with blood. The experiments of Cavazzani on frogs seem to show that the action of atropine on the circulation is to weaken, and then paralyze, the heart, while it constricts the capillaries, and that either in this manner or more directly the red blood-corpuscles lose their power of absorbing oxygen (*Phila. Med. Times*, ix. 623). Experimenters are generally agreed that the action of moderate doses of atropine upon the heart is nearly the same as that of cocaïne.

The pupils of a nursing infant are dilated by the milk of its mother using belladonna or atropine (*Boston Med. and Surg. Jour.*, Sept. 1886, p. 242). In man the hypodermic injection of one-twentieth of a grain of atropine causes the pulse in twenty minutes to rise from 72 to 110, the mouth to grow dry, and the pupils to begin to dilate; the sight grows indistinct, and usually there are grotesque hallucinations, and sometimes actual delirium; there is giddiness, with an inclination to sleep, and the dryness of the mouth and throat may last for twenty-four hours, with dysphagia, anæsthesia, aphonia, more or less nervousness and instability in walking. An erythematous eruption of the skin closely resembling that of scarlatina is generally observed (*e. g. Med. Record*, xxiii. 457), but occasionally there is an "erythematous and pseudo-erysipelatous swelling of the face and neck" (*Times and Gaz.*, April, 1880, p. 431). Epistaxis has followed the instillation of a solution of atropine into the eye (*Centralbl. f. Therap.*, viii. 169). Homatropine is not free from the risk of causing glaucoma, as atropine does, of which an illustration may be found in *Quart. Epit. Amer. Med. and Surg.*, vi. 366. (Compare Stewart, *Med. News*, lii. 234.)

For the relief of *pain* atropine is, next to opium, of the highest value, and especially

for two of its severest forms, the pain of *neuralgia* and the pain of *spasm*. It should be employed for both hypodermically. Sciatica is the most unyielding, and intercostal neuralgia the most amenable, to this medicine. Neuralgia of the trigeminus holds in this respect a middle position. In sciatica the dose must be large. One-sixteenth of a grain has been used with curative effect. For the pain of *cancer* and other local pains of analogous origin a solution of 1 part of atropine in 1000 of water has been applied with great advantage on compresses covered with oiled silk or sheet rubber (Auger). A 1 per cent. solution instilled into the ear is one of the most efficient remedies for *earache*, especially when due to inflammation of the middle ear. If given early in the attack, it is often successful in arresting *coryza*. Spasm itself, as it occurs in *tetanus* and in *poisoning by strychnine*, has been successfully combated by the hypodermic use of atropine. In such cases the dose must be large, being not less then one-twentieth of a grain repeated at intervals of not more than an hour until its characteristic effects are developed. In a case of traumatic *tetanus* the dose, varying from $\frac{1}{60}$ to $\frac{1}{40}$ of a grain, was given from two to four times a day for eleven days, when convalescence was established. The usual physiological effects of the drug were not developed (*Practitioner*, xxiii. 209). Hypodermic injections of atropine have repeatedly been used to relieve or cure *wryneck* since they were first proposed by Dr. DaCosta (*Penna. Hosp. Rep.*, 1868, p. 391). As more convenient for administration than belladonna, atropine may be used in the treatment of *whooping cough*, in the dose of $\frac{1}{120}$ grain once a day or oftener, and avoiding the production of its physiological effects. Various other forms of spasm are more or less subject to the power of this medicine. They will be found more fully described in connection with BELLADONNA, but it may be stated that almost every spasmodic affection may be influenced by that medicine or by atropine. Sulphate of atropine administered hypodermically in the dose of from $\frac{1}{100}$ to $\frac{1}{50}$ of a grain has prevented the full development of the *epileptic* paroxysm and lessened the frequency of its occurrence. Indeed, it has been claimed to be more certain in its results, and attended with less inconvenience to the patients, than bromide of potassium (Weiss, *Centralbl. f. Therapie*, i. 268). In the following spasmodic disorders it may also be employed: spasm of the *anus*, the *urethra*, the *bladder*, the *ureter*, the *uterus*, the *vagina*, the *rectum*, the *large and small intestine*, the *biliary ducts*, the *bronchia*, the *larynx*, the *œsophagus*, etc. In all of these affections the hypodermic injection of atropine may be substituted for the use of any preparation of belladonna, internal or local. In the very opposite condition which occurs in poisoning by *Calabar bean* it has been proved that atropine is a true antidote in nearly the whole range of its action. But atropine counteracts or prevents the lethal action of physostigma when given in doses which are far below the minimum fatal doses of the former. Sulphate of atropine should be injected subcutaneously in doses of from $\frac{1}{50}$ to $\frac{1}{30}$ of a grain, and repeated until the pupils become dilated, the pulse-rate increased, and the secretion of bronchial mucus is checked. The therapeutical antagonism of belladonna and atropine to opium and morphine is confirmed by many cases of *opium-poisoning* treated by the hypodermic injection of atropine. Johnson of Shanghai is said to have used this treatment successfully in upward of three hundred cases (*Practitioner*, xxvi. 138). The hypodermic dose of atropine and the frequency of its repetition have varied in different cases between remote extremes. In one case, for example, five doses, each of $\frac{1}{12}$ grain, were given within as many hours, and the case was of a desperate character, but ended in recovery (*Med. News*, xl. 318). In another instance with a like termination $\frac{1}{10}$ grain of atropine was injected, and afterward $\frac{1}{4}$ grain (*Practitioner*, xxiii. 123). It is evident that the dose must be determined by the exigencies of each case. Among the most striking of recent cases in which atropine proved an antidote to morphine in enormous doses are these: A woman who took 15 grains of sulphate of morphine (King, *Med. News*, xl. 68); one who took 10 grains of morphine sulphate (Stuver, *Med. News*, xli. 592); a man who in the course of four hours took 30 grains of sulphate of morphine (Clarke, *Med. Record*, xxvi. 514); a pregnant woman who had taken a like quantity of the acetate of morphine (Forster, *Boston Med. and Surg. Jour.*, Mar. 1885, p. 267); and another woman, who took about 30 grains of acetate of morphine and half an ounce of tincture of opium (Javorsky, *Jour. Amer. Med. Assoc.*, vi. 517). It has been proposed to use atropine as a physiological antidote to *chloroform* by administering a hypodermic injection of $\frac{1}{120}$ to $\frac{1}{60}$ grain of atropine with $\frac{1}{8}$ or $\frac{1}{12}$ grain of a morphine salt before the inhalation of the anæsthetic is commenced (Fraser). An important advantage of this expedient is that the senses of the patient are blunted and he is not apt to become excited, as when the anæsthetic is administered without such preparation. A less quantity of the latter is required, and its influence is prolonged, and the

patient therefore remains passive for a longer time. Dr. J. C. Reeve, who advocated this method, stated that the amount generally used by him "was seven to ten minims of a solution of 16 grains of morphine and ½ grain of atropine to the ounce of water. . . . . Fifteen to twenty minutes should elapse between the administration of the hypodermic injection and the beginning of the administration of the anæsthetic." (*Jour. Amer. Med. Assoc.*, ii. 233.) A similar use of atropine has been advocated in *ether narcosis* by Amidon, except that he would have it administered to overcome the symptoms when they arise (*Med. Record*, xxvii. 477). The effects of *heat-exhaustion* (one of the forms of sunstroke) have been treated with alleged success by the hypodermic injection of atropine, strengthening the heart, stimulating the brain, restoring consciousness, and preserving life; and so have those of *nervous shock*.

In various diseases of the eye the use of atropine is appropriate; it was formerly employed for dilating the *pupil*, so as to permit the inspection of the parts behind the iris, and to facilitate operations for *cataract*, etc., but owing to its more transient action, homatropine is to be preferred for this purpose, and also because it is less irritating than atropine. When *prolapse* of the *iris* takes place through a corneal ulcer, or when adhesion occurs between the two, the action of atropine, by contracting the iris toward its periphery, tends to prevent permanent deformity of the organ and impairment of the sight. *Myopia*, or short-sightedness, being often produced by an excessive strain of the eyes through spasm of accommodation, may sometimes be prevented from reaching its full development by resting the organs and maintaining for several weeks a paralysis of accommodation by means of atropine. By a similar method it is claimed that a number of cases of *strabismus* in its early stage have been cured (*Phila. Med. Times*, xi. 144). Atropine should never be used in *glaucoma*. It has, indeed, been objected to atropine in all diseases of the eye that it irritates the conjunctiva, causing œdema of this tissue and of the eyelids, and that the tension it produces of the eyeball in certain cases endangers the safety of the organ. It is probably through the power involved in its various actions that atropine has been found efficient in *profuse sweating* and also in *sialorrhœa*, *galactorrhœa*, and *metrorrhagia*. The power of sulphate of atropine to control the *night-sweats* of *phthisis* and other debilitating diseases is well established. About $\frac{1}{100}$ grain hypodermically is the average commencing dose required. The condition of the patient in other respects need not influence the use of the medicine—not even the fact of perspiration having already commenced. Sometimes existing profuse perspiration is checked by the medicine within a few minutes. Its effects may also extend over several nights, but occasionally they are not immediate, but are developed at the end of twenty-four hours or more. It is not essential to give the injection at bed-time. It may be administered hypodermically, or by the mouth in camphor-water, or in pill. In the latter way the commencing dose should be about $\frac{1}{75}$ grain (*Practitioner*, xxiii. 93). Atropine is a physiological antidote to *jaborandi* and *pilocarpine*, and arrests the profuse sweats they cause. Homatropine, used for the same purpose, is decidedly inferior not only to atropine, but also to "Dover's powder, picrotoxin, and other means" (Murrell). Fronmüller, however, states that in a case of profuse sweating and salivation produced by pilocarpine these symptoms disappeared within two minutes after the injection of gr. $\frac{1}{8}$ of hydrobromate of homatropine (*Med. News*, xlii. 556). Atropine has been found useful in serous *diarrhœa;* in the *salivation* of the insane; in the forming stage of *coryza*, when given in very minute doses (*Boston Med. and Surg. Jour.*, Aug. 1883, p. 151); and in *incontinence of urine* and *œsophagism* (Girard, *Bull. de Thérap.*, xcviii. 481). In regard to the former affection, it should be observed that the infirmity is only suspended while the action of the medicine is maintained; when this ceases the eneuresis, in most cases, returns. In *spermatorrhœa*, due to atony and morbid irritability of the genital system, erections may be produced by the use of atropine and the passive seminal discharges arrested. *Menorrhagia* has been controlled by injecting hypodermically $\frac{1}{200}$ grain of atropine twice a day (Tacke). A similar hypodermic dose is one of the means which may be used to check *pulmonary hæmorrhage* (Hausmann, *Therap. Monatsch.*, Jan. 1887; Sterling, *Therap. Gaz.*, xiii. 101), and also to control non-mercurial *ptyalism* (*Bull. de Thérap.*, cxi. 470). A like dose, given internally and repeated until its specific effects appear, has been found useful in *hay fever* (*Med. News.*, liii. 305). *Urticaria* has been cured, temporarily at least, by means of $\frac{1}{15}$ grain of sulphate of atropine taken twice a day (Schwimmer). The antagonism of atropine and *prussic acid* has been both maintained and denied; but even if it were real in a physiological sense, it would practically be of little importance, since the rapid action of a lethal dose of prussic acid cannot be overtaken by the slower operation of atropine. This alkaloid, used along with morphine in hypo-

dermic injections, tends to prevent the nausea and vomiting which are apt to be caused by morphine alone.

Atropine has also been used hypodermically in *chloroform syncope* (Reeve). *Homatropine hydrobromate*, which is, on the whole, inferior to atropine, is claimed by Jackson (*Med. News*, xlix. 88) to be a perfectly reliable mydriatic when applied in a sufficient quantity by cumulative instillation. *Atropine santonate* is recommended by Bombelon as perfectly unirritating, and not liable, in solution, to fungoid growths. Its action is said to be mild, like that of homatropine, while as a mydriatic it is equal to atropine sulphate; "one drop of a solution of 0.01 grain in 20 grains (1 : 2000) of water is sufficient to dilate the pupil in six minutes, the dilatation disappearing in from ten to twenty-four hours" (*Edin. Med. Jour.*, xxxii. 79; *Practitioner*, xxxviii. 458).

Except where otherwise stated, a solution of atropine used for any of the above purposes, including hypodermic injection, should not exced the strength of 1 part in 100 of water. Dr. Squibb recommends a solution of 2 grains of the sulphate in a fluidounce of water. Of this each fluidrachm contains one-quarter of a grain of the salt. About Gm. 0.01 (♏iv) of this solution is regarded as the maximum dose for an adult to begin with. Either solution may be applied to the eye by means of a fine camel's-hair brush, while the lower punctum lachrymale is compressed to prevent the passage of the solution into the nasal passages and its consequent absorption. Several cases of atropine-poisoning have arisen in this manner. Klein recommends a mixture of 1 part of sulphate of atropine to 200 parts of vaseline as preferable to a solution. Thin gelatin disks, imbued with a solution of the salt, 1 : 100, are sometimes inserted between the lower lid and the eyeball, in order to prevent the accident just alluded to. A solution of homatropine hydrobromate containing Gm. 1 to Gm. 32 (gr. xv to f℥j) of distilled water is convenient for ophthalmological purposes. An ointment of atropine may be used containing Gm. 0.06 to Gm. 4.00 (gr. i–℥j) of lard).

Scopoline, an alkaloid discovered in *Scopolia japonica*, dilates the pupil more rapidly than atropine, and for a longer time. On the third day the pupils are more dilated than after the instillation of atropine. It appears not to irritate the conjunctiva, and is a strong antagonist to eserine.

Ephedrin, the alkaloid of E. helvetica, (or according to others, of E. monostachya), in combination with muriatic acid, has been proposed by Nagai of Tokio, Japan, as a superior mydriatic. It killed frogs in the dose of Gm. 0.008–010 ($\frac{1}{8}$ to $\frac{1}{6}$ gr.), gradually producing paralysis, arrest of breathing, dilatation of the pupils, and death with dilated heart. Mammalia were similarly affected. In man one or two drops of a 10 per cent. solution occasioned dilatation of the pupil in from five to twenty hours, but was in no case complete. The advantages of this preparation are denied by Königstein, who declares that ephedrin is an inconvenient mydriatic on account of the long time required to develop its effects (*Centralbl. f. d. Therap.*, v. 649.) On the other hand, its cheapness, easy preparation, and innocuousness are thought to give it a superiority over homatropine. Wreise alleges that ephedra contains two alkaloids, ephedrin and pseudo-ephedrin, of which the latter is the more efficient as a mydriatic (*Med. News*, lv. 11).

AURANTIUM AMARUM, *U. S., Br., P. G.*—Bitter Orange.

Orange amère, Fr.; *Pomeranze*, G.; *Arancio amaro*, *A. forte*, It.; *Naranjo*, Sp.

Citrus vulgaris, *Risso*, s. C. Aurantium, var. amara, *Linné*, s. C. Bigaradia, *Duhamel.* Bentley and Trimen, *Med. Plants*, 50.

Nat. Ord.—Aurantiaceæ.

Official Parts. — *1. Aurantii amari cortex*, U. S.; *Aurantii cortex*, Br.; *Cortex fructus aurantii*, P. G.; *Cortex aurantiorum*, *Cortex pomorum aurantii.*—*Bitter orange-peel*, E.; *Écorce (zestes) d'orange amère*, *Écorce de bigarade*, Fr.; *Pomeranzenschale*, G.; *Corteccia arancio amaro*, F. It.; *Curazao*, Sp.

The rind of the fruit.

2. Aurantii fructus, Br.; *Poma aurantiorum*, *Aurantia.*—*Seville Orange*, *Bitter Orange*, E.; *Orange amère*, *Bigarade*, Fr.; *Pomeranzen*, G.; *Naranjo agrio*, Sp.

The ripe fruit.

Origin.—The bigarade orange is a small tree which is indigenous to the northern portion of India, but is largely cultivated near the Mediterranean, and in some of the West India Islands, and in that part of the United States which borders on the Gulf of

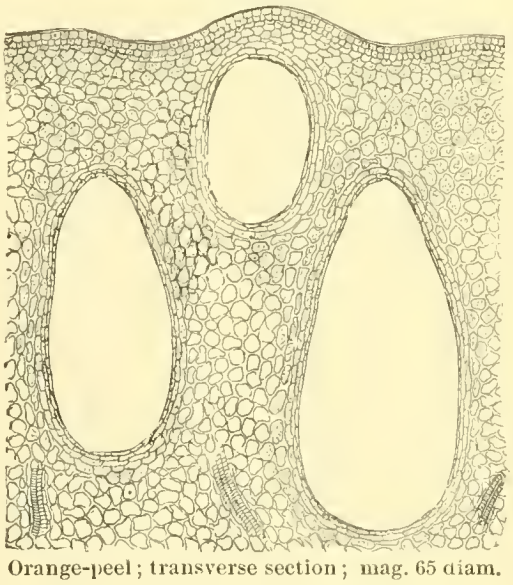
Mexico. It closely resembles the sweet orange, excepting in the fruit, leaves, and flowers, the latter being more fragrant.

Description.—1. The Fruit. The unripe fruit falling from the tree is collected and extensively used on the continent of Europe, where it is known as orange-berries (E.), *orangettes* or *petits grains* (Fr.), *Unreife Pomeranzen* (G.), and is officinal as *Fructus*

Fig. 35.

Citrus vulgaris, *Risso.*

Fig. 36.



Orange-peel; transverse section; mag. 65 diam.

(*Baccæ*) *aurantii immaturi* vel *Aurantia immatura*, P. G. They are globular or ovate-globose, 3–15 Mm. ($\frac{1}{8}$ to $\frac{3}{5}$ inch) in diameter, with a circular depressed scar at the base surrounded by eight to twelve smaller depressions, and with a slightly projecting remnant of the style at the apex. They are greenish to brownish-black in color, densely rugose, and consist of eight to ten or twelve cells having a central placenta, and two rows of ovules in each cell. Their odor is agreeably aromatic, their taste aromatic and bitter, the aromatic properties being due to a volatile oil which is contained in large oil-cells situated in the pericarp near the epidermis.

The ripe fruit is of the size and shape of a sweet orange, but is rougher externally, and of a reddish-orange color, the spongy parenchyma underneath being white, and the juice having an acid and bitter taste. It has been made official in the British Pharmacopœia for the purpose of preparing the Tinctura aurantii recentis.

2. The Peel. Orange-peel is dried in narrow, thin bands or in quarters, the epidermis being glandular and of a dark brownish-green color; it has a fragrant odor and an aromatic bitter taste. It should have very little of the spongy, white inner layer adhering to it. In commerce it is usually found in flat or curved elliptical pieces, about 37 Mm. (3 inches) long and 3 Mm. ($\frac{1}{8}$ inch) or more in thickness, the surface being of an uneven somewhat glandular appearance, covering the numerous large oil-cells and the spongy white parenchyma. This latter is directed to be removed by most pharmacopœias, only the yellowish rind (*flavedo aurantii*) being used. The Curaçoa orange-peel is obtained from a variety of the bitter orange cultivated in the island of Curaçoa. It is scarcely half the thickness of the ordinary orange-peel, and externally of a dark-greenish color. The commercial article sold under this name frequently consists merely of thin slices or spiral bands cut from the fully-developed but still unripe fruit grown elsewhere. The white parenchyma is colored yellow by alkalies and black by ferric salts.

3. The leaves, *Folia aurantii*, are smooth, ovate, or ovate-oblong, entire or slightly crenate on the margin, pellucid-punctate, aromatic, and have a jointed petiole, with a broadly obovate or obcordate wing.

Constituents.—The white parenchyma of orange- and lemon-peel, but more particularly the unripe bitter orange, contains a crystalline bitter principle which was named *hesperidin* by Lebreton, its discoverer (1828). Hilger (1876) obtained from 5 to 8 per cent. of it from orange-berries by exhausting them first with water, afterward with diluted alcohol containing 1 per cent. of potassa, and precipitating the tincture with hydrochloric

acid. Crude hesperidin is purified by Ed. Hoffman (1876) by recrystallization from hot alcohol, when it is obtained in white needles requiring about 5000 parts of hot water for solution; it is insoluble in ether, benzene, fats, and volatile oils, but is readily soluble in alcohol and hot acetic acid; its solutions in alkalies become yellow and orange-colored; the potassa solution, evaporated and the residue warmed with dilute sulphuric acid, shows a red and violet color. Hesperidin, $C_{22}H_{26}O_{12}$, melts at 245° C. (473° F.), becomes brown-red (dingy blackish-brown on warming, Flückiger) with ferric chloride, and by dilute acids is split into glucose and *hesperetin*, which melts at 223° C. (433.4° F.) and is soluble in alcohol and ether. Orange-peel also contains gum, albumen, some fixed oil, resin, volatile oil (see OLEUM AURANTII CORTICIS), and a principle resembling tannin in its behavior to iron salts.

The volatile oil obtained by the distillation of orange-berries with water was formerly known as *essence de petit grain*, but much of that which is now found in commerce is obtained from the leaves and young shoots. In chemical composition it resembles the oil of orange, but differs from it in odor, which varies even to some extent in the different cultivated varieties of the bitter orange.

Pharmaceutical Preparations.—ELIXIR AURANTIORUM COMPOSITUM, s. Elix. viscerale Hoffmanni, *P. G.* Macerate for 8 days bitter orange-peel 50 parts, cinnamon 10 parts, and potassium carbonate 2.5 parts in sherry wine 250 parts; express, and dissolve in the liquid 5 parts each of the extracts of gentian, wormwood, buckbean, and cascarilla; set aside and filter.

ELIXIR AMARUM, *P. G.*, Bitter Elixir. Dissolve extract of absinth 2 parts and oil sugar of peppermint 1 part in water 5 parts, and add bitter tincture and aromatic tincture of each 1 part.

TINCTURA AMARA, *P. G.*, Bitter tincture. Digest for a week centaury, gentian, of each 3 parts, bitter orange-peel 2 parts, orange-berries and zedoary of each 1 part, in alcohol (spec. gr. .894) 50 parts, express and filter.

Action and Uses.—The simple and compound infusions of orange-peel (*Br.*) are used as vehicles for other medicines and to allay *indigestion*, *flatulence*, and *colic*. They may be taken in doses of Gm. 32–64 (f℥j–ij).

AURANTII DULCIS CORTEX, *U. S.*—SWEET ORANGE-PEEL.

Cortex aurantiorum dulcium.—*Écorce* (*zestes*) *d'orange douce*, Fr.; *Apfelsinenschalen*, G.

The rind of the fruit of Citrus Aurantium, *Risso*, s. Cit. dulcis, *Link*. Woodville, *Med. Bot.*, 188; Risso, *Hist. Orang.*, 3, 39; Bentley and Trimen, *Med. Plants*, 51.

Nat. Ord.—Aurantiaceæ.

Origin.—This variety of the orange tree, known as the sweet or Portugal orange, is extensively cultivated in warm countries; it differs from the preceding in the leaves having the petioles more narrowly winged, and in the fruit having an agreeable sweetish acidulous taste; many varieties have been produced by cultivation.

Description.—Sweet orange-peel agrees in structure and in most of its physical properties with bitter orange-peel; it is, however, always of a lighter and more yellow color, of an agreeable sweetish aromatic odor, and of a slightly bitter taste. Its composition is the same as that of the bigarade orange, except the bitter principle, which is present in much smaller proportion. (See also OLEUM AURANTII CORTICIS.)

Pharmaceutical Preparations.—CONFECTIO AURANTII CORTICIS. *U. S.* 1870; Conserva aurantii.—Confection of orange-peel, *E.*; Conserve d'écorce d'orange, *Fr.*; Apfelsinenschalen-conserve, *G.*—Take of sweet orange-peel, recently separated from the fruit by grating, 1 part, and beat it with sugar 3 parts, gradually added, until they are thoroughly mixed.—*U. S.* 1870.

Action and Uses.—Orange-peel is a mild stimulant of digestion, because it contains an essential oil which, in the fresh bitter orange, is endowed with very active irritant properties and acts upon the nervous system, in small doses stimulating it, but in large doses or by continued use depressing and deranging all the nervous functions. Dried-orange-peel and its preparations are employed along with pure bitters, to render them stimulant and more acceptable to the stomach, as well as to improve their taste. They are also associated with purgatives which tend to *gripe* and when the bowels are *flatulent*. Orange-peel is prescribed as an addition to many infusions and decoctions. It should not be added to the latter until ebullition has terminated. The confection of orange-peel (Pharm. 1870) may be used for disguising the taste and qualifying the

acrid action of various medicinal powders, especially those of the cathartic class. The orange fruit has had attributed to it a *galactagogue* power, but the statement needs confirmation.

AURANTII FLORES.—Orange-Flowers.

Flores naphæ.—Fleurs d'oranger, Fr.; *Orangenblüthen, Pomeranzenblüthen*, G.; *Azahar*, Sp.; *Aranelo amaro*, F. It.

The partly expanded flowers of Citrus Aurantium and of C. vulgaris, *Risso.*

Origin.—See Aurantii Fructus.

Description.—The flowers grow singly in the axils of the upper leaves, and consist of a small cup-shaped five-toothed calyx, and of five oblong, obtuse, fleshy, and glandular punctate petals, which are white, or in the dried state pale brownish-white, and about 12 Mm. (½ inch) long. The numerous (about twenty) stamens are united by the lower part of their filaments into three or more bundles. The globular ovary rises from a small fleshy disk, and bears a cylindrical style with a globular stigma. Orange-flowers have a highly fragrant odor, the bitter variety being more aromatic than the sweet; their taste is aromatic and bitterish.

When it is desired to keep fresh orange-flowers for some time, they may be preserved by mixing them well with half their weight of sodium chloride, pressing the mixture in a suitable jar and keeping it, well closed, in a cool place.—*U. S.*

Lemon-flowers are externally of a reddish color and have a different odor.

Constituents.—Boullay found (1828) in orange-flowers, beside the volatile oil (see Oleum Aurantii Florum), gum, bitter extractive, acetic acid, and salts. The bitter taste is probably due to the presence of hesperidin. (See Aurantii Amari Cortex.)

Action and Uses.—Orange-flowers are chiefly used to prepare a distilled water which is an agreeable vehicle for some medicines, and is believed to stimulate the nervous system slightly, allaying its superficial disorders in very susceptible persons.

AURI ET SODII CHLORIDUM, *U. S.*—Gold and Sodium Chloride.

Auro-natrium chloratum, P. G.; *Chloruretum aurico-sodicum.—Chloraurate de sodium, Chlorure d'or et de sodium*, Fr.; *Natriumgoldchlorid*, G.; *Cloruro di oro e di sodio*, F. It., Sp.

A mixture composed of equal parts of dry gold chloride, [$AuCl_3$; 302.81] and sodium chloride [NaCl; 58.37].—*U. S.*

Preparation.—Dissolve with the aid of a gentle heat pure gold 13 parts in a mixture composed of nitric acid 16 parts and hydrochloric acid 48 parts; dilute the solution with water 40 parts, add pure dry sodium chloride 20 parts, and evaporate in a water-bath, with constant stirring, to dryness. Result 40 parts.—*P. G.*

This is an improvement on the process of the former German Pharmacopœia, according to which the gold solution was evaporated nearly to dryness before it was mixed with the sodium chloride. Constant stirring is necessary during the final evaporation, in order to secure a uniform mixture, which persistently retains from 6 to 7 per cent. of water.

Properties.—This preparation is "an orange-yellow powder slightly deliquescent in damp air, odorless, and having a saline and metallic taste. The compound is very soluble in water; at least one-half of it should be dissolved by cold alcohol. When exposed to a red heat it is decomposed and metallic gold is separated. A fragment of the compound imparts an intense, persistent yellow color to a non-luminous flame. Its aqueous solution has a slightly acid reaction and yields with test-solution of silver nitrate a white precipitate insoluble in nitric acid.—*U. S.*

The French Codex orders the crystallized double salt, $NaCl.AuCl_3.2H_2O$ (mol. weight 397.1), to be prepared by dissolving the auric chloride prepared from 10 parts of gold in sufficient distilled water, adding 3 parts of sodium chloride and evaporating to crystallization. It forms orange-colored rhombic prisms or plates which are soluble in water and alcohol, not deliquescent, fusible, and at a red heat are gradually decomposed, 49.4 per cent. of metallic gold being separated. It is known in France as *sel de Chrestien* and *sel de Figuier*.

Tests.—"On bringing a glass rod dipped into water of ammonia close to a portion of the compound no white fumes should make their appearance (absence of free acid). If 0.5 Gm. of gold and sodium chloride be dissolved, in a porcelain capsule, in 50 Cc. of water, the solution acidulated with 5 Cc. of diluted sulphuric acid, and, after the addition

of 1 Gm. of pure oxalic acid, heated for about two hours, on a water-bath, a precipitate of metallic gold will be obtained, which, when washed, dried and ignited, should weigh not less than 0.15 Gm. (corresponding to at least 30 per cent. of metallic gold). The filtrate from the precipitated gold should not be affected by hydrogen sulphide test-solution, nor after being supersaturated with ammonia water, by ammonium sulphide test-solution, (absence of metallic impurities)."—*U. S.* If 0.5 Gm. of it be slowly heated to redness and afterward washed with water, the residue after drying should weigh not less than .150 Gm., corresponding to 30 per cent. of gold.—*P. G.* This test corresponds to 46.27 per cent. of $AuCl_3$ and to 60.67 per cent. of $NaCl.AuCl_3.2H_2O$.

AURUM.—Gold.

Or, Fr.; *Gold*, G.; *Oro*, F. It.; Sp.

Symbol Au. Atomicity univalent and trivalent. Atomic weight 196.7.

Origin and Properties.—This well-known metal is chiefly found in the metallic state, always associated with other metals and frequently in various native sulphides. It is the most ductile of all metals, softer than silver, fuses at nearly 1200° C. (2200° F.), has the density 19.3, and is of a reddish-yellow color and metallic lustre, but when powdered of a brown color, acquiring lustre by pressure. It is not altered by exposure to air and water, and does not dissolve in acids, but is soluble in liquids containing or generating chlorine. The following preparations of gold have been used:

Aurum foliatum, *gold-leaf*, is used for coating pills; is transparent, with blue or green color; it should not be attacked by nitric acid nor become tarnished by ammonia.

Auri pulvis, *powdered gold*, may be prepared by triturating gold-leaf with crystals of milk-sugar, potassium sulphate, or other hard soluble substance, until the metallic lustre has completely disappeared, when the compound is washed out with water. A solution of gold chloride yields the metal in a finely-divided condition when added to solution of ferrous sulphate, oxalic acid, or other oxidizable compound.

Auri chloridum, *gold chloride or auric chloride*, $AuCl_3$. On dissolving pure gold in nitro-muriatic acid and crystallizing, yellow *hydrogen-gold chloride*, $AuHCl_4.4H_2O$, is obtained, which in a dry atmosphere loses $1H_2O$ (Julius Thomsen, 1878, 1883). But on evaporating the solution to dryness, dissolving in water, filtering from some aurous chloride, AuCl, and again evaporating, auric chloride is obtained as a dark-red or red-brown salt. It is decomposed above 150° C. (302° F.), dissolves readily in water, and is also soluble in alcohol, ether, and volatile oils, which solutions are gradually reduced. Its solution yields with stannous chloride a dark-brown or purple precipitate known as *purple of Cassius*, the exact composition of which is still unknown. J. A. Koenig (1882) ascertained that an aqueous solution of gold chloride in contact with charcoal previously deprived of all foreign constituents is slowly reduced to metallic gold, hydrochloric acid and carbon dioxide being formed at the same time.

Auri et ammonii chloridum, *gold-ammonium chloride*. Equal parts of auric chloride and ammonium chloride are dissolved in water, acidulated with hydrochloric acid, and the solution evaporated to dryness (Dorvault). It resembles the preceding.

Auri cyanidum, *gold cyanide* is best prepared, according to Figuier (1874) by dissolving pure auric chloride in water, and adding a solution of an equivalent weight of pure potassium cyanide, when a lemon-yellow precipitate will be obtained; a larger quantity of the latter solution would change the color to brownish or orange-yellow. It is inodorous and tasteless, and contains 75 per cent. of gold. With an excess of potassium cyanide, used in a concentrated hot solution, *auro-potassium cyanide*, containing 55 per cent. of gold, is obtained in colorless tabular crystals, which on exposure become white from loss of water of crystallization.

Auri iodidum, *gold iodide*, AuI_3, is obtained by precipitating a solution of auric chloride with potassium iodide, avoiding an excess of the latter, washing with water, and drying carefully. It is a dark-green powder, which is soluble in solution of potassium iodide, and on exposure loses iodine, being first converted into yellow *aurous iodide*, AuI, and finally into metallic gold.

Auri oxidum, *auric acid*, *gold hydroxide*, $Au(OH)_3$. Pelletier directs the boiling of a solution of auric chloride with an excess of magnesia or zinc oxide, collecting the precipitate upon a filter, and washing it first with dilute nitric acid (which must be free from chlorine), and afterward with water. Frémy (1850) adds to auric chloride sufficient solution of potassa until the precipitate is redissolved, the solution is boiled for fifteen minutes, or until its dark-brown color has changed to light-yellow, when it is acidulated

with sulphuric acid and the precipitate washed and dried; it retains a trace of potassium. Gold hydroxide is a blackish-brown powder which is readily soluble in hydrochloric and hydrobromic acids, and when heated to 245° C. (473° F.) or boiled with alcohol yields metallic gold.

Action and Uses.—The action of gold, has to some extent, an analogy with that of mercury, its salts producing local effects varying between irritation and causticity, and internally developing a state of erethism which resembles strongly mercurial fever. Within this limit it is represented as stimulating the functions generally, and in man especially the genital activity, while in women it is said to augment the menstrual flux. The virtues anciently attributed to this metal were imaginary, since it was used in substance, and therefore in an insoluble form. The alchemists Paracelsus and Basil Valentine proclaimed its excellence in chronic nervous diseases, in hypochondriasis, insanity, and convulsive affections, and also in syphilis, salivation, etc., especially when given in the solution known as aurum potabile, etc. Many zealous apostles of the faith in gold flourished in the first quarter of the nineteenth century, and attributed to it cures of uterine and lingual schirrus, chronic induration of the testes and liver, elephantiasis (Arabian), goitre, osteosarcoma, chlorosis, amenorrhæa, amaurosis, paralysis of the bladder, dropsy, and, above all, syphilis, in which it was for a time regarded as a valuable succedaneum of mercury (Richter). In 1857, Rouault conceived that the salt of gold and sodium had an elective potency in the treatment of *glandular tumors*, generally more energetic and certain than the preparations of iodine, and also that it was beneficial in certain benignant and even malignant tumors of the breast (*Brit. and For. Med.-Chir. Rev.* July, 1857, p. 228).

It appears that gold compounds, when persistently employed, may, through the febrile erethism above referred to, tend to eliminate the *syphilitic* poison from the system and arouse the sluggish vital forces as they exist in *scrofula*. Indeed, it is said that this action sometimes goes so far as to give a destructive energy to the morbid process. In 1884, Dr. Bartholow reported that he found the double chloride of gold and sodium, in the dose of one-twentieth of a grain three times a day, exhibit as it primary action an increased vigor of nutrition, but if its use was kept up for some time it occasioned a waste of the tissues, and especially of the connective tissue. Hence he conceived it should be useful in chronic *sclerosis* of the *spinal cord*, of the *liver*, and the *kidney*, and believed that clinical observation justified this prevision. He also found it useful in some forms of *hypochondriasis*, *asthma*, *laryngismus stridulus*, *singultus*, *dysmenorrhœa*, and *sexual debility* (*Med. News*, xlv. 118). These expectations and results have not been confirmed. But Goubert used the bromide of gold for *migraine*, *epilepsy*, *chorea*, and *Basedow's disease*, in most of which affections he prescribed it until the characteristic headache produced by the medicine was experienced. He gave it to adults in daily doses of Gm. 0.008–0.01 (gr. $\frac{1}{8}$–$\frac{1}{6}$) (*Centralbl. f. Therap.*, viii. 120). Meerhecvski, Rosenbach, and Danillo have applied it to the treatment of *epilepsy*, and *hysteria* with favorable results, especially in the latter affection. It was given in doses of Gm. 0.016–0.03 (gr. $\frac{1}{4}$–$\frac{1}{2}$). It has been estimated that bromide of gold is ten times more active than the bromides commonly used (*Lancet*, Aug. 1890, p. 869), but this estimate appears to be far too low. It will be observed that originally gold compounds were employed almost exclusively in the treatment of nervous diseases; more recently in those comprehended under the general title of "obstructions;" and then once more its original application was revived. The most novel uses of the chloride of gold and sodium have been in the treatment of *pulmonary consumption*, for which it was vaunted as a specific, and in that of habitual *inebriety*. In neither case, any more than in earlier instances, has it made good the claims that were set up for it. (Compare *Med. News*, lx. 559, 581; *Proceedings of Amer. Climatolog. Soc.*, 1892, p. 76.) It has been used with apparent advantage by Martineau in a case of inveterate syphilis, thus: Water, Gm. 1000; chloride of gold and chloride of sodium, of each 1 Gm.; dose, 1 to 3 teaspoonfuls daily (*Bull. et Mém. Soc. de Thérap.*, 1883, p. 52). Powdered gold or its oxide is applied by friction upon the sides of the tongue in the dose of Gm. 0.01.–0.20 (gr. $\frac{1}{5}$–iii–iv) daily. The oxide is given internally in pill, and in the dose of Gm. 0.006 (gr. $\frac{1}{10}$) after meals, and gradually augmented. Chloride of gold and sodium is a caustic, but in a diluted condition may be applied to the interior of the mouth, as above mentioned. The salivation which follows this manœuvre is due to a local and not to a constitutional action of the metal. The dose of this preparation is about Gm. 0.003 (gr. $\frac{1}{20}$). Chloride of gold is also a caustic, resembling in its action nitrate of silver. It has been applied to *lupoid*, *cancerous*, and other *ulcers*.

AVENÆ FARINA, *U. S.* 1870.—Oatmeal.

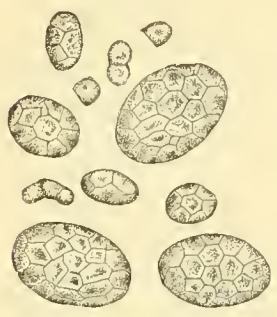
Farine d'avoine, Fr.; *Hafermehl*, G.

The meal prepared from the seed of Avena sativa, *Linné*. Bentley and Trimen, *Med. Pl.*, 292.

Nat Ord.—Graminaceæ.

Origin.—The native country of oat has not been ascertained, though it is supposed to have originated from one of the wild species indigenous to Europe. It is cultivated in most civilized countries, even in the subarctic regions, and many varieties or species are known, all having a loose panicle and two- or occasionally three-flowered spikelets. The kinds more rarely found in cultivation, except in certain localities, are A. orientalis, *Schreber*, A. strigosa, *Schreber*, A. nuda, *Linné*, and A. brevis, *Roth*. The fruit is closely invested by the paleæ, lanceolate, pointed, and grooved on the inner side. Oats deprived of the paleæ or husk are called *groats*. By grinding the grains oatmeal is obtained.

Fig. 37.



Oat Starch, magnified 250 diameters.

Description.—Oatmeal is a grayish-white not uniform powder, in which fragments of the tissue are observed by the naked eye; it has a slight odor and a somewhat bitterish taste. Viewed under the microscope, the starch consists of medium-sized polyhedral or muller-shaped granules, with a rather distinct hilum, but without observable laminæ. Frequently two or three are united, or even a larger number, forming a nearly spherical mass with a checkered surface, and readily separating by pressure into the separate granules.

Constituents.—Oats consist on an average of 25 per cent. of husks and 75 per cent. of grain; the former contain 1 to 1½ per cent. of fixed oil, ½ to ¾ per cent. of sugar and gum, nearly 2 per cent. of protein compounds, and 6½ to 7 per cent. of ash, the remainder being cellulose. The grain contains 64½ to 66 per cent. of starch, 5 to 7 of fat, 18 to 21 per cent. of protein compounds, 1 to 3 per cent. of salts, the remainder being sugar, gum, and cellulose. The largest portion of the protein compounds is *avenin*, which may be obtained from oatmeal by treating it in the cold with a weak solution of potassa, decanting from the sediment, and precipitating by acetic acid; the impure avenin is washed with diluted and strong alcohol and ether, redissolved in weak potassa solution, and precipitated by acetic acid (Kreusler, 1869). Avenin closely resembles legumin in its behavior to solvents; it contains 17 per cent. of nitrogen and ¾ to 1 per cent. of oxygen.

Action and Uses.—Oatmeal is an excellent article of food, but is apt to undergo fermentation in the stomach, producing flatulence and sour eructations. It is more nutritious than purely starchy articles, such as arrow-root and sago; and, being somewhat laxative, in consequence partly of its usually containing a portion of bran, it forms an appropriate article of diet in cases of habitual *constipation* and inertia of the intestines. The insoluble bran is, however, prone to accumulate, and sometimes forms concretions. Oatmeal gruel is prepared by slowly boiling from Gm. 32–64 (℥j–ij) of oatmeal with 3 pints of water until reduced to 2 pints, straining the decoction, allowing it to stand until cool, and then rejecting the supernatant liquid. Its flavor may be improved by the addition of slit raisins toward the end of the boiling, and also by means of sugar and nutmeg.

AZEDARACH.—Azedarach.

Pride of India, *Pride of China*, E.; *Écorce d'azédarach*, *Écorce de margousier*, Fr.; *Zedrachrinde*, G.

The bark of the root of Melia Azedarach, *Linné*.

Nat. Ord.—Meliaceæ.

Origin.—Azedarach is a handsome tree which is indigenous to China and India, and cultivated as an ornamental tree in Southern Europe and in the United States from Virginia southward; in the Gulf States it has been completely naturalized. It grows rapidly to the height of 9 to 12 M. (30 or 40 feet) has large deciduous and glabrous bipinnate leaves, the leaflets being lance-ovate, acuminate, and serrate, and bears panicles of lilac-colored fragrant flowers and yellowish globular drupes of the size of a cherry, which by fermentation yield considerable alcohol. In the East Indies the bark of the *nim tree* or *margosa*, Melia Azadirachta, *Linné* (Azadirachta indiea, *Jussieu*), is used as a tonic and febrifuge; the simply pinnate leaves are employed as a local stimu-

lant, and a fixed oil which is expressed from the fruit has a strongly bitter taste and is employed as an anthelmintic, and externally in rheumatic complaints.—Bentley and Trimen, *Med. Plants*, 62.

Description.—The bark is met with in irregular curved pieces and quills, 25 Mm. (1 inch) or more long and 6 Mm. (¼ inch) or more in diameter. The first layer of corky tissue is thin, of a blackish-brown color, somewhat glossy, and forms irregular longitudinal ridges or patches upon the bright red-brown cork underneath. In older barks the corky layer is rust-brown and two or three times thicker than the remaining portion of the white inner bark, which contains a few scattered pale-yellow bast-fibres and is tangentially striate. The inner surface is whitish or pale-brownish, uneven, and longitudinally striate. The bark breaks with a short and smooth, and in the inner portion more or less fibrous, fracture. The cork has very little taste, but the inner bark is at first sweetish, afterward bitter and nauseous. It should be collected from the smaller roots or deprived of the thick rust-brown nearly tasteless corky layer. It yields its virtues to hot water and diluted alcohol.

Constituents.—The bitter principle was isolated by Jacobs (1879) in the form of a yellowish-white resin which is almost insoluble in water, oil of turpentine, and petroleum benzin, slightly soluble in carbon bisulphide, and freely soluble in alcohol, ether, and chloroform. The inner bark contains no tannin. Its constituents may be analogous to those of *nim-bark*, in which Broughton (1873) found a bitter, dark-brown resin-like principle, $C_{36}H_{50}O_{11}$, which is slightly soluble in water, but dissolves in alcohol, benzol, carbon bisulphide, and ether. Another amorphous principle, more soluble in water, and a crystalline fatty substance, were likewise obtained. Cornish (1856) had separated a bitter crystalline principle, *margosin*, besides volatile oil, resin, and other widely-diffused constituents.

Allied Plants.—The bark and other parts of different species of Guarea and Moschoxylon, indigenous to the West Indies and tropical America, possess the odor of musk. The bark of several species of Trichilia, met with in India, Africa, and South America, is purgative and emetic. Carapa guianensis, *Aublet*, and Car. Touloucouna, *Guillemin et Perrottet*, yield anthelmintic bark and a bitter fixed oil, known as *crab oil*, *kundah*, *or callicoonah oil*, the latter being expressed from the seeds. Swietenia Mahagoni, *Linné*, indigenous to the West Indies and tropical America, particularly Mexico, yields the well-known *mahogany-wood*, and a similar wood is obtained in Western Africa from Khaya senegalensis, *Guillemin et Perottet*; both species have a bitter and strongly astringent bark. Cedrela odorata, *Linné*, is the *Jamaica red cedar*: all parts of it are bitter and unpleasantly odorous, but old wood is fragrant. Soymida (Swietenia, *Willdenow*) febrifuga, *Jussieu*, yields the East Indian *rohun-bark*, a useful astringent tonic. Mahogany-wood contains *catechin*, according to Cazeneuve and Latour (1875).

Action and Uses.—Even from the period of Arabian medicine the poisonous properties of azedarach have been known, and then, as now, it was stated to have produced faintness, giddiness, dimness of sight, mental confusion, and vomiting; later observers have added to these symptoms stertorous breathing, stupor, dilatation of the pupils, cold sweat, and purging. All of these effects resemble those produced by spigelia. The active properties appear to reside in the bark of the root. The berries are often eaten without injury by children, and also by birds. Cows and horses are not injured by the leaves. Indeed, they are said to be given to horses infested with "bots," and the berries have been found an attractive and nutritious food for horses. In India and the southern portions of the United States azedarach-bark is stated to be the most popular *vermifuge* for lumbricoid ascarides. It is usually administered in a decoction made by boiling Gm. 64 (℥ij) of the bark (fresh, if possible) in a pint of water until reduced one-half. For a child the dose is a tablespoonful every two or three hours until it affects the stomach and bowels. It should be followed by a cathartic. A tincture has also been used both as vermifuge and a tonic in doses of from Gm. 2–8 (f℥ss–f℥ij).

Margosin is obtained from *Aradirachata Indica* bark, and an oil expressed from its almonds is used in India. The bark is regarded as antiperiodic and tonic, and the leaves are applied as stimulants to indolent ulcers, etc. The oil is used as an anthelmintic and insecticide, and as an embrocation in rheumatism (*Amer. Jour. Phar.*, lx. 629).

Naregamia is said to be in use by the natives of the Malabar coast as an emetic in bilious and dyspeptic disorders and in rheumatism, as well as in dysentery and bronchitis (*Therap. Gaz.*, xiii. 720). Employed by Schoengut, it seemed to benefit *bronchial affections* by rendering the sputa thinner and less tenacious, and therefore acting after the manner of ipecac and senega. The tincture was prescribed to the extent of Gm. 1–3 daily (*Cent. f. Therap.*, viii. 129).

BALSAMUM PERUVIANUM, *U. S., Br., P. G.*—Balsam of Peru.

Balsamum peruvianum nigrum, Balsamum indicum.—Baume de Pérou, Baume des Indes, Fr.; *Perubalsam*, G.; *Balsamo negro, B. de San Salvador*, Sp.; *Balsamo peruviano*, F. It.

A balsam obtained from Toluifera (Myroxylon, *Klotzsch*, Myrospermum, *Royle*) Pereiræ, *Baillon*. Bentley and Trimen, *Med Plants*, 83.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—Balsam of Peru was for a long time supposed to be derived from Myroxylon peruiferum, *Linné filius*, a tree growing in Brazil and near the west coast of South America. Pereira (1850) showed that the drug produced in the state of San Salvador in Central America comes from an apparently different species,which he provisionally distinguished as Myrospermum Sonsonate. Carson regarded the two species as identical, but, according to Royle, Klotzsch, and others, they are specifically distinct. (See *Am. Jour. Pharm.*, 1860, pp. 296 and 411; 1864, p. 145.) The plant in question is a tree attaining a height of about 15 M. (50 feet), and branching from 2 to 3 M. (7 to 10 feet) above ground. It has imparpinnate leaves with the leaflets oval-lanceolate, somewhat attenuate above, and slightly emarginate, the flowers in subaxillary racemes, and oblanceolate indehiscent one-seeded legumes about 10 Cm. (4 inches) long.

Collection.—According to Dorat (1860, 1863) and Wyss (1878), at the beginning of the dry season, early in November or December, the bark for some distance up the trunk is beaten with the back of an axe or other blunt instrument until it has separated from the wood without breaking, This is done on four sides, leaving four intermediate strips untouched, so as not to destroy the vitality of the tree. Five or six days later the loosened bark is charred by means of torches, and in the course of another week the charred pieces fall off, when the bare wood is covered by rags, which absorb the exuding balsam, and which, when saturated, are gently boiled in water until most of the heavy balsam sinks to the bottom, the remainder being obtained by wringing the partly-exhausted rags in a bag made of stout rope. The wounds of the tree are covered with fresh rags as long as any balsam exudes during the dry season. The strips left untouched in one season are similarly treated the following year, and the tree will thus yield an annual supply of balsam for 30 years, but it is allowed to rest for some time after 5 or 6 years in order not to exhaust its productiveness. The balsam obtained from the rags by boiling and pressing is on the following day separated from the water and put into suitable vessels.

Commerce.—Balsam of Peru comes to us in earthen jugs and metallic drums, and is principally exported from the port of Acajutla on the Pacific coast and from Balize on the Atlantic side. Formerly it reached Europe by way of Peru, and was supposed to be a product of that country. The importation into the United States amounted in 1876 to 1271 pounds, and in 1878 reached 8924 pounds.

Description.—The balsam is a thick liquid of the consistence and appearance of molasses, of a dark brown-black color when examined in bulk; in thin layers, red-brown and perfectly transparent. It has an acid reaction, an agreeable, fragrant, slightly smoky odor and a warm bitterish taste, followed by a burning sensation in the fauces. Its specific gravity is 1.135 to 1.150 (1.137 to 1.145, *P. G.*). Exposed to the air, it is but little changed and scarcely thickened in the course of several years, but ultimately forms a soft solid. It is readily soluble in all proportions in pure acetone, absolute alcohol, chloroform, and glacial acetic acid, and with an equal bulk of alcohol and ether yields a clear solution, which on the further addition of the solvent becomes turbid and deposits a little resin. It yields a clear mixture with one-third its volume of carbon disulphide, but with more of the latter separates a blackish-brown resin. Petroleum benzin agitated with Peru balsam does not permanently mix with it, and remains colorless, but on evaporation leaves a colorless or pale-yellow oily liquid (cinnamein). Diluted alcohol and fixed and volatile oils dissolve only a small proportion of the balsam, but the latter takes up from 12 to 15 per cent. of castor oil, forming a clear solution.

By subjecting the fruit to pressure *white Peru Balsam* is obtained. It forms a thick yellowish-white liquid having an odor resembling that of tonka, and containing a crystallizable resin named *myroxocarpin*.

The tree exudes a gum-resin which, according to Attfield (1864), contains 77.4 per cent. of resin, but no aromatic principle or cinnamic acid.

Constituents.—The balsam has (1869 and 1870) been examined by K. Kraut and by J. Kachler, from whose analyses it appears to contain a little benzylic alcohol, benzylic

benzoate and cinnamate (about 60 per cent.), cinnamic and benzoic acids, and resin (32 per cent., Kachler). Kraut obtained in the distillate also stilbene. After complete saponification with potassa, Kachler obtained 20 per cent. of benzalcohol and 46 per cent. of cinnamic acid. Delafontaine's statement (1868), that styracin (cinnamylic cinnamate) is also present, was not corroborated by Kraut.

Benzylic cinnamate, or *cinnamein*, the principal constituent, has the composition C_9H_7-$(C_7H_7)O_2$, and is when pure a colorless oily liquid of a faint agreeable odor and an aromatic sharp taste. Its specific gravity is about 1.095, and its boiling-point somewhat above 300° C. (572° F.). By caustic alkalies it is decomposed into benzylic alcohol and cinnamic acid.

Benzalcohol, or *benzylic alcohol*. C_7H_8O, is a colorless, faintly aromatic oil heavier than water and boiling at 204° C. (399.2° F.), and by oxidizing agents is converted first into oil of bitter almonds, and finally into benzoic acid. It is considered to be the *peruvin* of Frémy in a pure state; as obtained by that author it was lighter than water.

Benzylic benzoate, $C_7H_5(C_7H_7)O_2$, is a colorless oil which crystallizes at a low temperature and boils at about 340 C. (674° F.).

Stilbene, $C_{14}H_{12}$, forms colorless and inodorous pearly scales or prisms which are fusible and boil above 290° C. (554° F.).

Adulterations.—Balsam of Peru is frequently adulterated with alcohol, fixed oils, copaiba, Canada turpentine, rosin, etc. If 10 drops of the balsam be triturated with 20 drops of sulphuric acid, a tough, homogeneous, brownish-red mixture should result. If this should be washed after a few minutes with cold water, it should be converted into a resinous mass which is brittle when cold (absence of fixed oils and oleoresins).—*U. S.*, *P. G.* (For modifications in manipulation see *Am. Jour. Phar.*, 1870, p. 404 and 1876, p. 166). According to Schlickum (1882), the resin left on applying this test should be perfectly soluble in ether, an insoluble residue indicating the presence of benzoin or storax: treated with acetone or alcohol, such a residue will completely dissolve unless storax was present, which will leave a small amount of a white powder undissolved, and yield it from chloroform in minute crystals. A mixture of 3 Cc. of the balsam with 1 Cc. of carbon disulphide should be clear, but on adding 8 Cc. more of carbon disulphide it separates about 15 per cent. of resin, which adheres to the sides of the vessel. The liquid poured off from the latter should be transparent, should not have a deeper color than light-brownish, and should not exhibit more than a faint fluorescence (absence of gurjun balsam).—*U. S.*, *P. G.* Flückiger states that the resin separated sometimes amounts to 38 per cent.; it is insoluble in ether, but dissolves in alcohol and alkalies, and according to Kachler (1869), yields protocatechuic acid when fused with potassium hydroxide, and on dry distillation yields styrolene, toluene, and benzoic acid. When distilled with water no volatile oil should pass over (absence of volatile oil, copaiba, etc.).—*U. S.* The addition of volatile oils lessens the specific gravity of Peru balsam; on distilling it with water in a flask its volatile constituents remain behind owing to their high boiling points, while volatile oils distil with the vapors of water. If 2 Cc. of the balsam be shaken in a dry test-tube with 8 Cc. of benzin, so that the balsam may be spread on the walls of the tube, the same should adhere to the walls, and subside only very slowly if the liquid is poured off immediately. The filtered liquid should be colorless or only slightly yellow, and show no deposit on standing (absence of appreciable quantities of storax, turpentine, copaiba, etc.).—*U. S.* If 2 Gm. of the balsam be agitated with 8 Gm. of benzin, and the filtrate be evaporated on the water-bath, a residue should be left, which when mixed with 5 drops of nitric acid should assume a pure yellow color (absence of turpentines, storax, copaiba, fixed oils, etc.).—*P. G.* Benzin, particularly when warmed with Peru balsam, takes up cinnamein, which after repeating the treatment may amount to 63 per cent. (Flückiger). The use of nitric acid in the above test was suggested by Doescher (1881); pure balsam gives a yellow color, but in the presence of storax the color is greenish-blue, and finally dingy green-yellow, and in the presence of rosin the same but brighter colors are produced. If 5 drops of the balsam be well agitated with 3 Cc. of ammonia-water, only a slight, rapidly-disappearing foam should be produced, and the mixture should not form a stiff jelly (absence of rosin, etc.).—*P. G.* By this test, which was proposed by Grote, turpentines and their resins are readily detected. If 2 parts balsam be triturated on a water-bath with 1 part slaked lime, the mixture should not solidify, nor should it have a fatty odor (absence of rosin, fatty oils, etc.).—*P. G.* This is Flückiger's test (1881), and depends on the formation of a solid calcium salt in presence of rosin and the evolution of acrolein vapors on heating to a higher temperature if castor oil or other fats are present.

Alcohol is best detected, according to Gavalowski (1875), by adding some of the suspected balsam to a solution of potassium bichromate, followed by concentrated sulphuric acid, when the characteristic odor of aldehyde, suggesting that of rotten apples, will be perceived. Or some of the balsam may be distilled with water and the distillate treated while warm with a little iodine, followed by caustic soda or potassa until decolorized. On cooling crystals of iodoform will separate (*Lieben's alcohol test*, 1869).

Pharmaceutical Uses.—Balsam of Peru is mixed with lard to preserve it from becoming rancid. A syrup is made of this balsam (see SYR. TOLUTANUS).

MISTURA OLEOSO-BALSAMICA, s. *Balsamum vitæ Hoffmanni*, P. G. Three parts of balsam of Peru and 1 part each of the volatile oils of lavender, cloves, cinnamon, thyme, lemon, mace, and orange-flowers are dissolved in 240 parts of alcohol; after several days the brownish-yellow liquid is filtered.

Action and Uses.—Balsam of Peru is a general stimulant, with a special tendency to the mucous membranes. In large doses it may irritate the digestive canal and cause vomiting and diarrhœa; but in medicinal doses it occasions some heat of skin, increased frequency of pulse, and an augmented action of the kidneys without, however, irritating them (Stockman, *Therap. Gaz.*, xiv. 615). Locally, it hastens repair of tissue, and is reputed to be a germicide and antiseptic. As an internal medicine it is most useful in checking bronchial secretion, and hence as a remedy in *chronic bronchitis* occurring alone or as a complication of pulmonary consumption. It should not be used if much fever exists: it may be prescribed for these purposes by inhalation, and also for the alleviation of *chronic laryngitis*. In 1889–90 much attention was paid to the use of this balsam in *scrofulous* sores and diseases of the bones and in pulmonary *phthisis*. This was a revival of a former practice. As we have elsewhere stated (*Therapeutics*, 4th ed., i. 573), it "has been much employed to promote the healing of *wounds* in parts of inferior vitality." Strumpf remarks that it cures them without suppuration or scar; and recently Rockwell has confirmed these statements (*Med. Record*, xxxiv. 423.) These old-established methods have been, in recent times, explained by attributing to the balsam an antibacillar virtue. It has been used as a dressing for external sores, and internally by the mouth, by inhalation, and also by subcutaneous injection. Undoubtedly it is a protective, a stimulant, and a tissue conservative. (Compare Brautigam, *Centralbl. f. Med.*, vii. 505; Joris, *ibid.*, p. 586; Opitz, *ibid.*, viii. p. 14; Szohner, *ibid.*, p. 308; Landerer, *Therap. Monatsch.*, iv. 88.) Special virtues have been ascribed to it in *diphtheria* (Ofner, *Centralbl. f. Therap.*, iii. 395). In chronic *dysentery* its action is often extremely salutary; and the same may be said of its use in the *diarrhœa* which is apt to persist in some cases of prolonged typhoid fever. As a dressing for various *ulcers*, especially those of the indolent sort, it promotes their cure by stimulation and by its protective agency. It is well suited for treating *sore nipples*, applied pure or in an ointment or liniment; for moderating the discharge of pus in *chronic catarrh* of the nostrils, ears, vagina, etc.; and as a application to *chilblains*. In some cases of obstinate local *eczema* its healing virtues are conspicuous. According to circumstances it may be applied pure or diluted with glycerin, almond or olive oil, lard, etc. It speedily kills itch-insects and destroys their eggs. In Germany it is much used in the treatment of *scabies*, as being no less efficient, and much more agreeable, than sulphur for this purpose. It causes but little smarting or irritation of the skin. Before applying it the patient takes a prolonged warm bath, with or without green soap, after which, and three times a day for about two days, all the body, and the seats of the eruption particularly, are rubbed with about 40 drops of the balsam. At the end of the time mentioned the cure is complete (Husemann). Balsam of Peru is one of the most useful of all applications for *pruritus vulvæ* and other forms of pruritus, especially the *senile*. It is best applied pure with the finger or with a soft brush. The addition of catechu improves its healing qualities in some instances. Internally it may be given in the doses of Gm. 2 (ʒss) in an emulsion of almonds, gum-arabic, or yelk of egg, with sugar or dissolved in glycerin.

Hoffmann's balsam is used in Germany as a nervine in doses of from Gm. 0.60–3.00 (gtt. x–xxx) on sugar, in wine, or in appropriate mixtures.

BALSAMUM TOLUTANUM, *U. S., Br.*—BALSAM OF TOLU.

Baume de Tolu, Baume de Carthagène, Fr.; *Tolubalsam*, G.; *Balsamo de Tolu, B. Blanco*, Sp.; *Balsamo Tolutano*, F. It.

A balsam obtained from Toluifera Balsamum, *Linné*, s. Myroxylon toluifera, *Kunth*,

s. Myrospermum toluiferum, *A. Richard.* Woodville, t. 215; Bentley and Trimen, *Med. Plants*, 84.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—This evergreen tree attains a height of 21 to 24 M. (70 to 80 feet), rising usually to about 12 or 18 M. (40 or 60 feet) from the ground without branching. Young trees always have a larger foliage than old ones, in which it is small and quite thin if they have been much bled. The leaflets are obovate, the flowers axillary-racemose, and the legume oblong-linear, not narrowed at the base. The tree is found in the high rolling country of Venezuela and New Granada. Prof. Baillon regards the tree yielding Peru balsam as identical with this, and the difference of the two products as due to the manner in which they are extracted (*Am. Jour. Pharm.*, 1874, p. 14).

Collection.—Two sloping notches are cut through the bark, meeting at their lower ends in a sharp angle, below which the bark and wood are hollowed out a little to receive the calabash cup into which the balsam flows. Similar cuts are made as high up as a man can reach, until often as many as twenty cups are found on one tree. When the lower part of the trunk is too full of scars a rude scaffold is sometimes made around the tree and new incisions made higher up. The balsam-gatherer collects the contents of the cups in flask-shaped bags made of raw-hide, a pair of them being slung over the back of a donkey. When filled these bags are sent to the ports of exportation on Magdalena River, where their contents are transferred into cylindrical tins (John Weir, *Am. Jour. Pharm.*, 1864, p. 449).

Commerce.—Tolu balsam is exported from the Venezuelan ports in tins holding 10 (and occasionally 25) pounds. The amount imported into the United States varies considerably. In 1876 it was 9221 pounds, and in 1880, 52,085 pounds.

Description.—Recently imported, Tolu balsam forms a semi-liquid mass which gradually hardens, becoming quite brittle in the cold, but softening between the teeth and fusing readily at a somewhat elevated temperature. In thin layers it is perfectly transparent and of a yellowish- or reddish-brown color. Viewed under the microscope, crystals of cinnamic acid are observed. It has an acid reaction, an agreeable aromatic odor, suggesting that of vanilla, which becomes more apparent on warming it, and a mild aromatic taste. It is readily soluble in alcohol, chloroform, potassa solution, and acetone; also in ether. Petroleum benzin, benzene, and carbon bisulphide scarcely act upon it.

Constituents.—The main constituent of Tolu balsam is an amorphous resin which, according to Kopp (1849), consists of a portion very soluble, and another but slightly soluble, in alcohol. Cinnamic acid, to the exclusion of benzoic acid, was found by Kopp (1849), Carles (1844), but Busse (1876) proved also the presence of benzoic acid and 8.5 per cent. of benzylic ethers of cinnamic and benzoic acids. On distillation with water about 1 per cent. of *tolene* is obtained, which is a colorless, thin, volatile oil boiling at 160° C. (170°, Deville), having a specific gravity of .858, an agreeable odor, an acrid peppery taste, and the composition $C_{10}H_{16}$. Dry distillation yields, in addition to the ethers and acids named above, also styrol (see STORAX), phenol (see page 39), and toluol.

Toluene, or *toluol*, C_7H_8, is *methylbenzene*, $C_6H_5.CH_3$. It is found in coal-tar and among the products of destructive distillation of wood, various resins, and many organic compounds. It is a colorless, oily, strongly refractive liquid, of the spec. grav. .86, boiling at 111° C. (231.8° F.), and not congealing at — 20° C. (— 40° F.). Its odor is similar to that of benzene. By suitable treatment it is converted into benzoic acid. (See page 35.)

Adulterations.—Turpentines are sometimes added, and may be detected by their solubility in carbon bisulphide. Concentrated sulphuric acid imparts to pure Tolu balsam a cherry-red color; in the presence of turpentine the acid becomes black. Naylor (1878) met with a spurious balsam of Tolu, which had a warm acrid taste, and was completely soluble in carbon bisulphide, benzene, chloroform, ether, and hot alcohol; its origin is unknown.

Allied Plants.—MYROXYLON PUNCTATUM, *Klotzsch*, s. Myrospermum balsamiferum, *Ruiz et Pavon*, s. Toluifera punctata, *Baillon*, is the *quino-quino* tree of Peru, and by Bentley, Flückiger, and others is regarded as not being distinct from the tolu balsam tree.

MYROXYLON PERUIFERUM, *Linné filius*, s. M. pedicellatum, *Klotzsch*, s. Toluifera peruifera, *Baillon*. Peckolt (1879, 1880) showed that a balsam resembling Peru balsam may be obtained from it, which, however, has only the spec. grav. 1.031, an aromatic, astringent, and slightly pungent taste, yields clear solutions with alcohol and castor oil in all proportions, and with sulphuric acid does not yield a brittle resin, but a sticky, somewhat greasy mass.

Action and Uses.—The general properties of balsam of Tolu resemble those of balsam of Peru, but are much less decided. Its agreeable flavor renders it an eligible ingredient

of mixtures, lozenges, vapors, etc. intended to modify subacute and chronic inflammations of the mucous membrane, especially the *bronchial*. It is much used by perfumers in the manufacture of burning pastilles. It may be administered in emulsion in doses of from Gm. 0.60–2.00 (10 to 30 grains). Its most usual form in medicine is the syrup.

Bowdichia major, known in Brazil as sebipira guacu, is said to be used in that country in the treatment of fevers and of rheumatic and gouty pains (*Med. Record*, xxviii. 697.)

BAPTISIA.—Wild Indigo.

Indigo sauvage, Fr.; *Baptisie*, G.

The root of Baptisia (Sophora, *Linné*, Podalyria, *Michaux*) tinctoria, *R. Brown*.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—Wild indigo is a common, smooth, perennial herb growing in dry sandy ground in the United States and Canada. The branching stem is about 60 Cm. (2 feet) high; the leaves are trifoliate, the leaflets roundish-obovate and wedge-shaped at base; the stipules minute and caducous; the yellow flowers are in small, loose racemes. On drying the herb becomes bluish-black.

Description.—The root consists of a short, knotty head which is 50 to 75 Mm. (2 to 3 inches) broad, with irregular and broad stem-scars above, and below divided into several long cylindrical branches about 12 Mm. (½ inch) in diameter, which are sparingly beset with branching fibres. The bark is externally of a dark-brown color, with small warts somewhat arranged in transverse rows or with a soft and friable corky layer; internally whitish, radially striate, thick and covering a whitish, tough, and tasteless wood with indistinct medullary rays. Roots of one year's growth are smaller, of a light-brown color externally, and have the ligneous meditullium about as thick as the bark. The root is nearly inodorous and has a bitterish, acrid, and nauseous taste residing in the bark.

Constituents.—Wild indigo-root contains resin, but no volatile or fixed oil (Smedley, 1862). An alkaloid, of which the hydrochlorate has a nauseous and acrid taste, was obtained by J. A. Weaver (1871). Dr. F. V. Greene (1879) found the alkaloid to be insoluble in chloroform, benzin, and benzene, but to dissolve in water, alcohol, and ether. According to Von Schrœder (1885), the root contains *baptisin* a bitter glucoside which is insoluble in water; *baptin*, a glucoside crystallizing in needles and soluble in water; and *baptitoxin*, a poisonous alkaloid.

Action and Uses.—The young shoots of baptisia, like those of phytolacca, have been eaten in the same manner as asparagus. When more mature the stalks and roots are violently emetic and cathartic, especially when fresh. A decoction of the bark has like effects. Rutherford's experiments led him to conclude that the extract, baptisin, "in the dog is an hepatic and also an intestinal stimulant of moderate power." Analogous results have been obtained by Desnos (*Bull. de Thérap.*, cx. 55.) Baptisia would seem to be a general stimulant, since it has been held in great repute as a remedy in *scarlatina*, *typhus*, and epidemic *dysentery*, and also as a topical application in *aphthæ*, *mercurial sore mouth*, and various *ulcers*, especially those affected with gangrene. For the last-mentioned purpose it has been applied in a poultice or an ointment. The leaves possess the same virtues as the root, but in a less degree. A tincture of the root, in the dose of from 1 to 5 drops every one to four hours, is credited with "almost entirely preventing delirium and diarrhœa, diminishing the heat, and soon effecting a cure" of *typhoid fever*. But as it was associated in the treatment with "cool lotions, milk, and stimulants," the alleged results cannot be ascribed to it; they indeed, are incompatible with the laws of typhoid fever (*Amer. Jour. Phar.*, l. 89). Wild indigo is given in decoction made with an ounce of the recent root to a pint of boiling water; the dose is about Gm. 16 (f℥ss) every three or four hours; its tendency to occasion vomiting and purging may be diminished by lessening the dose or adding laudanum to the liquid. *Baptisin* may be given in pill and in the dose of Gm. 0.10–0.40 (gr. ij–vj).

BARII DIOXIDUM, *U. S.*—Barium Dioxide.

Barium Peroxide, E.; *Peroxyde de baryum*, Fr.; *Bariumhyperoxyd*, G.

Formula BaO_2. Molecular weight 168.82.

Commercial anhydrous barium dioxide.—*U. S.*

Preparation.—Barium dioxide is prepared by conducting oxygen or atmospheric air over barium oxide or hydroxide heated to full redness.

Properties and Tests.—"A heavy, grayish-white, or pale yellowish-white, amorphous solid, odorless and tasteless, and permanent in the air. Almost insoluble in cold water, with which, however, it forms a definite hydrate, and to which it imparts a decidedly alkaline reaction. Hydrochloric, phosphoric, and most other mineral acids decompose it, producing the corresponding barium salts, and hydrogen dioxide which remains in solution for a considerable time, if the reaction has taken place in the cold and an excess of the acid is present. When heated to a bright-red heat, barium dioxide fuses, loses oxygen and is reduced to barium oxide. Barium dioxide should be dissolved by diluted hydrochloric acid without leaving more than a trace of residue. If 0.422 Gm. of barium dioxide, in powder, be dissolved, as completely as possible, in 10 Cc. of ice-cold water, with the aid of a sufficient quantity of phosphoric acid, it should require not less than 40 Cc. of decinormal potassium permanganate solution to impart to the liquid a permanent pink tint, corresponding to not less than 80 per cent. of pure barium dioxide (each Cc. of the volumetric solution indicating 2 per cent. of the latter)."—*U. S.*

Pharmaceutical Uses.—Barium dioxide is employed in making the official hydrogen dioxide solution.

BARIUM.—Barium.

Barium, E., G.; *Baryum*, Fr.

Symbol Ba. Atomicity bivalent. Atomic weight 136.9.

Origin.—The mineral *heavy spar* first attracted attention about 1602 through the discovery of a phosphorescent compound obtained by igniting a mixture of the mineral and organic substances. The presence in the mineral of sulphuric acid was demonstrated by Marggraf (1750), and of a peculiar earth by Scheele (1774) and Gahn (1775.) Crawford (1787) first used the barium chloride medicinally. An amalgam of barium was obtained (1808) by Berzelius and Pontin, and in the same year Davy isolated the metal by distilling the mercury from the amalgam.

Properties.—Barium is a lustrous, light-yellow metal of the spec. grav. 3.6, and is rapidly oxidized on exposure to air and in water. The following compounds are more or less employed in medicine, in chemistry, or in the arts:

1. Barii hydroxidum.—Barium hydroxide, *E.*; Hydrate de baryte, *Fr.*; Barythydrat, *G.* Formula $Ba(OH)_2$. Mol. weight 170.82.—Barium oxide is first prepared by calcining barium nitrate, or a mixture of this salt with barium sulphate; the oxide is dissolved in water, the solution decanted, if necessary, from the insoluble matter, then evaporated to dryness and heated to redness. It forms a white crystalline mass or a white powder, has the spec. grav. 4.5, a strong alkaline reaction, and is freely soluble in water. It is employed for the decomposition of sulphates, carbonates, etc. Its purity is determined in the same manner as that of barium carbonate; it does not effervesce with acids.

2. Barii carbonas, *U. S.* 1870; Barium carbonicum, Barya carbonica, Carbonas baryticus.—Barium carbonate, *E.*; Carbonate de baryte, *Fr.*; Kohlensaures Barium, Kohlensaurer Baryt, *G.* Formula $BaCO_3$. Mol. weight 196.85.—Barium carbonate is found native, as *witherite*, in large quantities in the lead-mines at Alston Moor and at Anglesark in Lancashire, England. It is also met with in Scotland and Sweden. It may be obtained artificially by precipitating a soluble barium salt with an alkali carbonate, or by heating to redness and fusion a mixture of 10 parts of heavy spar (barium sulphate), 2 of carbon, and 5 of potash, and washing the fused mass with water, when barium carbonate is left behind. Its formation is explained by the following equation: $BaSO_4 + C_2 + 2KOH = BaCO_3 + K_2S + CO_2 + H_2O$.

Witherite is found in pale-yellowish or grayish fibrous masses or in rhombic crystals varying in specific gravity between 4.3 and 4.56. The artificially-prepared barium carbonate forms a soft, white, amorphous or crystalline, tasteless powder. Its specific gravity is 4.22 to 4.307. It requires over 15,000 parts of boiling water for solution, but dissolves more readily in solution of chloride and some other salts of ammonium, and is also slightly soluble in some carbonates, and even sulphates. When recently precipitated it decomposes the solutions of many salts, precipitating the metals either as hydroxides or carbonates. Owing to its solubility in hydrochloric and other acids, it acts as a poison when taken internally.

Barium carbonate should be completely soluble, with effervescence, in dilute hydrochloric acid (absence of barium sulphate). The solution is not colored or precipitated by ammonia or hydrogen sulphide (absence of lead and other metals). When the solu-

tion is precipitated by excess of sulphuric acid the filtrate, on being evaporated, should leave no fixed residue (absence of alkalies), and should yield no precipitate with sodium carbonate (absence of calcium and other earths).

3. Barii sulphas, Heavy spar, *E.;* Spath pesant, *Fr.;* Schwerspath, *G.* Formula $BaSO_4$. Mol. weight 232.72.—This is a mineral from which other barium compounds are prepared by converting it first into soluble sulphide in the manner indicated below; on treating its solution with dilute sulphuric acid, barium sulphate is again formed, and this is used under the name of *permanent white* or *blanc fix* for glazing cards and by painters in place of white lead.

4. Barii chloridum, *U. S.* 1870; Baryum chloratum, Baryta muriatica.—Barium chloride, *E.;* Chlorure de baryum, *Fr.;* Chlorbaryum, Chlorbarium, *G.* Formula $BaCl_2.2H_2O$. Mol. weight 243.56.—It is prepared by dissolving barium carbonate in diluted hydrochloric acid, evaporating the solution, and crystallizing. On the large scale it is obtained sometimes as a secondary product, as in the preparation of ammonium carbonate (see page 182), or is made from native barium sulphate (heavy spar) by igniting its mixture with charcoal, so as to form barium sulphide, and carbon dioxide according to the equation $BaSO_4 + C_2 = BaS + 2CO_2$. The barium sulphide thus obtained is then dissolved in water and boiled with some excess of hydrochloric acid, whereby hydrogen sulphide is given off, barium chloride remaining in solution; $BaS + 2HCl$ yields $BaCl_2 + H_2S$. By evaporating the solution the salt is obtained in crystals.

Barium chloride exists in colorless, translucent rhomboidal tables or lamellæ. It is permanent in the air at the ordinary temperature, but loses one-half of its water above 55° C. (131° F.), and becomes anhydrous at 121° C. (249.8° F.). 100 parts of water retain at 105° C. (221° F.) 60 parts, at 40° C. (104° F.) about 41, at 20° C. (68° F.) 35.7, and at 10° C. (59° F.) 34.3 parts of the salt in solution (Molder). The aqueous solutions are partly precipitated by strong hydrochloric and nitric acids, in which the salt is less soluble than in water. It is insoluble in absolute alcohol, but dissolves in spirit containing water, and imparts to the alcohol-flame a yellow color. It possesses the persistently bitter and disagreeable astringent taste of the soluble barium salts. Its solution yields with silver nitrate and with potassium sulphate or dilute sulphuric acid copious white precipitates, which are insoluble in nitric acid. Phosphates, carbonates, and the salts of most organic acids yield with barium chloride precipitates which are insoluble in water, but dissolve in nitric or hydrochloric acid.

Barium chloride should be entirely soluble in water (absence of barium carbonate and sulphate), and the solution should not be colored or precipitated by ammonia or hydrogen sulphide (absence of lead and other metals). When precipitated by an excess of sulphuric acid the filtrate should leave no fixed residue on evaporation (absence of alkalies), and should yield no precipitate with sodium carbonate (absence of calcium and other earths). Alcohol shaken with the powdered salt, then poured off and ignited, should not burn with a red flame (absence of strontium chloride).

5. Liquor barii chloridi.—Solution of barium chloride, *E.;* Soluté de chlorure de baryum, *Fr.;* Chlorbarium-Lösung, *G.*—Dissolve barium chloride 1 troyounce in distilled water 3 fluidounces, *U. S.* 1870.

6. Barii bromidum.—Barium bromide, *E.;* Bromure de baryum, *Fr.;* Brombarium, *G.* $BaBr_2.2H_2O$. Mol. weight 332.34.—It is obtained on dissolving barium carbonate in hydrobromic acid, and crystallizes in colorless rhombic plates, which dissolve in their own weight of cold water and are freely soluble in alcohol. The salt has a very disagreeable taste.

7. Barii iodidum.—Barium iodide, *E.;* Iodure de baryum, *Fr.;* Jodbarium, *G.* $BaI_2.2H_2O$. Mol. weight 425.88.—It is conveniently made by boiling a solution of iodide of iron with excess of barium carbonate, filtering, and crystallizing. It forms large transparent rhombic prisms which are very freely soluble in water and alcohol, and when heated melt and become anhydrous.

Action and Uses.—An overdose of chloride of barium may produce the symptoms common to the irritant poisons—abdominal pain, vomiting, purging, collapse with thready pulse, general muscular asthenia, coma, convulsions, and death. The most characteristic symptoms are labored respiration and bronchial effusion. After death the lesions in the stomach consist of vascular injection and extravasation, and even ulceration. The carbonate is said to have destroyed life in at least three cases. Of four persons who were poisoned by this compound, three suffered from weakness of the lower limbs; the fourth had paralysis of the legs and trunk, and death occurred on the second day. No lesions whatever were found in the stomach or bowels (Reincke, *Practitioner,*

xxii. 49). In a case which ended in recovery the patient complained of dimness of sight, double vision, headache, tinnitus, and cramps, with occasional vomiting and purging. In another case the principal symptoms were numbness of the feet, cramps in the legs, and general coldness of the body (*Edinb. Med. Jour.*, xxviii. 651).

Hufeland claimed that in glandular scrofula its virtues "do not yield either to mercury or antimony;" which might very well be the case even if it were more injurious than useful. Yet a large number of writers might be cited who attribute to it a peculiar efficacy in this disease, for which it was one of the approved remedies in the first quarter of this century (Richter, *op. cit.*). More recently Phillips held that as a local discutient it is not inferior to iodine, and that in cases where "the tallow-like complexion, the pale tongue, and the languid circulation, accompanied by irritability of the mucous surfaces, are present, its virtues are remarkably demonstrated." A later and a better authority, Lebert, declares that he has "never obtained the slightest advantage from its use" in glandular scrofula. And this experience, we apprehend, is more weighty than that of a multitude of less competent judges. In other forms of scrofula affecting the joints, eyes, etc. the evidence of its utility is, if possible, still less. Dujardin-Beaumetz, however, attributes real antiscrofulous virtues to the medicine. Dr. F. Flint ascribes the apparent cure of an *aneurism* of the abdominal aorta to the administration of chloride of barium in doses of from $\frac{1}{5}$ to $\frac{2}{5}$ grain three times a day for nearly five months. This took place after the diet-and-rest cure had been tried for an equal period without benefit (*Practitioner*, xxiii. 37). Dr. DaCosta (*Amer. Jour. Med. Sci.*, Nov. 1888, p. 451) found it "both a general tonic and a *cardiac* tonic, a remedy that increases the tone of the blood-vessels, a fairly good diuretic, and one that can be taken for a long time without disordering the stomach;" and he particularly noted its virtues in cardiac pain or uneasiness caused by defective compensation. These conclusions were confirmed by the clinical observations of Dr. H. A. Hare, in which the pulse-rate was notably reduced, its tone improved, and its volume and duration increased (*Med. News*, liv. 183; *University Med. Mag.*, i. 366). The virtues attributed to natural mineral waters containing barium salts in the treatment of *cutaneous diseases* are no doubt more or less real, but that they are in any degree due to the minute proportion of those salts present in the waters is a groundless hypothesis. The dose originally was about $\frac{1}{8}$ grain (Richter). It may be stated at from Gm. 0.03–0.12 (gr. $\frac{1}{2}$–2) dissolved in a large quantity of water and taken after meals. Dr. DaCosta mentions $\frac{1}{10}$ grain as the proper dose.

Of the remaining salts of barium, the sulphate and nitrate have not been used in medicine; the oxide was formerly employed as a caustic, and the carbonate as an antiparasitic in certain *diseases of the skin*. The iodide, like the chloride, is an irritant poison when taken in large doses, but small doses of it are said to have the same virtues as the chloride in *scrofula*. Poisoning by barium salts should be treated by non-irritant emetics and draughts of weak solutions of sulphate of magnesium or sodium, followed by albuminous drinks and diffusible stimulants.

BEBERINÆ SULPHAS, *Br.*—Beberine Sulphate.

Sulfate de bébéerine, Fr.; *Schwefelsaures Bebirin*, G.; *Sulfato de bibirina*, Sp.

Prepared from nectandra- or bebeeru-bark.

Preparation.—Bebeeru-bark is exhausted by percolation with water acidulated with sulphuric acid; the percolate is concentrated; when cool, mixed with milk of lime, taking care that the fluid still retains a distinct acid reaction; after 2 hours it is filtered through calico, and the filtrate precipitated with ammonia; the precipitate is washed, dried, powdered, and exhausted with boiling rectified spirit; the spirituous solution, mixed with some distilled water, is distilled; the residue is slightly acidulated with diluted sulphuric acid, evaporated to complete dryness on the water-bath, the dry product powdered and mixed with cold distilled water; the solution filtered through paper, evaporated to the consistence of syrup, spread on flat porcelain or glass plates, and dried at a heat not exceeding 57° C. (140° F.).—*Br.*

The percolate obtained with acidulated water contains, besides the alkaloidal sulphates, beberic acid, which is almost completely removed by the lime. Ammonia precipitates from the filtrate impure beberine, together with some lime compounds. From this mixture alcohol takes up the alkaloids still contaminated with coloring matter, which is not removed by the subsequent treatment with sulphuric acid. But, after evaporating to dryness and redissolving in cold water, some foreign matters which are soluble in the acid solution remain on the filter.

Properties.—Thus prepared, sulphate of beberine (or *bibirine*) forms dark-brown, thin, translucent scales, yielding a brownish-yellow powder having a bitter taste and being completely soluble in water and in alcohol. The commercial salt yields with from 6 to 8 parts of water a clear solution, but on further dilution a precipitate is sometimes occasioned which J. Nesbit (1881) found to be due to a deficiency of sulphuric acid; on supplying this only a slight amount of oxidation-product remains undissolved. Dott (1881) found the scaly salt to contain about 15 per cent. of water, 7.8 per cent. of SO_3, and about 60 to 64 per cent. of mixed alkaloids, the remainder being extractive and coloring matter. Beberine, $C_{36}H_{42}N_2O_6$, is considered to be identical with buxine, paricine, and pelosine. Whether Maclagan's *sipirine* (1843) is identical with his *nectandrine*, obtained (1869) from nectandra-wood, has not been proved, though this is probable. That solutions of the salts of these mixed alkaloids are precipitated by certain acids and neutral salts has been repeatedly observed; Palm (1883) recommends the separation of beberine from the other alkaloids by precipitating its solution with sodium chloride. (See also NECTANDRA and PAREIRA BRAVA.)

Tests.—The official salt yields a white precipitate with barium chloride, and with caustic soda a yellowish-white precipitate which is soluble in ether, and on evaporating the solvent is again left as a yellow translucent residue entirely soluble in dilute acids. When ignited with free access of air, it should burn without leaving any fixed residue.

Medical Action and Uses.—Administered hypodermically to frogs, it produces tetanic rigidity without exaggerated reflex excitability, in which respect it resembles quinine, caffeine, and theine, and differs from strychnine. Internally, it does not produce the headache, tinnitus, deafness, gastric irritation, etc. which quinine sometimes occasions, while it equals that alkaloid in its tonic influences upon the appetite and digestion. Introduced as a substitute for quinine, it has not confirmed the estimate originally made of its efficacy: for although, like the greater number of vegetable bitters, it displays *anti-periodic* virtues, and like some of them also it will occasionally effect a cure of intermittent fever, yet on the whole its powers must be rated much lower than those of the cinchona salts. It has been found curative in some cases of periodical *headache* and *neuralgia* of the same type, and as a useful tonic in the general debility of pulmonary phthisis and of prolonged suppuration with *hectic fever*. In strumous *ophthalmia*, atonic *dyspepsia*, certain cases of *menorrhagia*, *leucorrhœa*, etc. it may be used as a substitute for quinine. The *dose* as a tonic is from Gm. 0.06 to 0.20 (gr. 1–3); as an anti-periodic, from Gm. 0.30 to 0.60 (gr. 5–10). It may be given, like sulphate of quinine, in a watery solution with an excess of aromatic sulphuric acid.

BELÆ FRUCTUS, *Br.*—BAEL-FRUIT.

Indian bael, *Bengal quince*, E.; *Coing du Bengale*, Fr.; *Bengalische Quitte*, G.

The dried, half-ripe fruit of Ægle Marmelos, *Correa*, s. Cratæva Marmelos, *Linné*, s. C. religiosa, *Ainslie*. Bentley and Trimen, *Med. Plants*, 55.

Nat. Ord.—Rutaceæ, Aurantieæ.

Origin.—The bael tree (also known as *bel* and *bela*) is of medium size, thorny, has ternate leaves and large white flowers, and is indigenous to the Himalaya Mountains and much cultivated throughout India. The leaves yield an aromatic volatile oil.

Description.—The fruit is from 5 to 10 Cm. (2–4 inches) in diameter, more or less globular in shape, and resembles an orange of large size in appearance and internal arrangement, it being divided into about twelve cells, containing in the ripe state a pleasant-flavored, highly mucilaginous juice, while the rind is quite aromatic. As found in commerce, the fruit is mostly broken, a portion of the dried pulp and seeds still adhering to the fragments of the rind. The latter is smooth and of a brownish-gray color externally, about 3 Mm. ($\frac{1}{8}$ inch) thick, hard, and destitute of aromatic properties. The exposed portion of the dried pulp is of a deep-orange, red-brown, or bright brownish-red color, whitish within, hard, of a mucilaginous very slightly acidulous taste, and encloses in each cell about eight oblong, flat, and woolly seeds.

Constituents.—These have not been well ascertained. The rind contains mucilaginous and pectin compounds, but appears to be free from tannin, which, according to Collas (1856), is found in the ripe fruit to the amount of 5 per cent. The infusion of bael is scarcely affected by iron salts. The pulp yields 3.72 per cent. of ash (Warnecke).

Allied Drugs.—FERONIA ELEPHANTUM, *Correa*. Its fruit is the *elephant-apple* or *wood-apple* of India, and resembles bael, but is externally scurfy, granular, and gray-green; is divided into about five cells, and contains several hundred seeds. The dry pulp contains mucilage and 15 per cent. of citric acid (*Pharmacogr. Indica*).

Action and Uses.—Bael is, and long has been, used in India, where the British practitioners ascribe to it astringent, aromatic, and demulcent qualities. It enjoys in that country great repute, especially in the treatment of some forms of bowel complaint. The pulp of the fresh ripe fruit is used with sugar to make a draught (sherbet) which, according to Waring, "is not only astringent when *diarrhœa* exists, but possesses the singular property of being also aperient if the bowels are *costive*." The rind of the unripe fruit and the bark of the root and of the trunk of the tree are tonic and astringent, and the first named is employed as a topical astringent; the expressed juice of the leaves "is commonly given in colds and incipient fevers when the patient complains of general dulness, pains in his limbs, and a sense of fulness in the stomach;" the young leaves are applied warm to the eyes in *ophthalmia;* and a decoction of the unripe fruit is prescribed in *diarrhœa* and *dysentery.* In chronic diarrhœa following typhoid fever Christison found it singularly efficient. He says: "It is an incomprehensible remedy—has neither aroma nor taste, and certainly no astringency," in the dried state. The liquid extract appears to be the best preparation of bael. It has been given in doses of Gm. 4 to 8 (f℥i–ij). (Fayrer, *Times and Gaz.*, June, 1878, pp. 661, 645; July, 1878, p. 86.)

BELLADONNA, *U. S., Br., P. G., F. It.*—Belladonna.

Deadly nightshade, Dwale, E.; *Belladone, Morelle furieuse,* Fr.; *Tollkirsche, Wolfskirsche, Tollkraut, Belladonna,* G.; *Belladona,* Sp.

Atropa Belladonna, *Linné.* Bentley and Trimen, *Med. Plants,* 193.

Nat. Ord.—Solanaceæ, Atropeæ.

Official Parts.—1. Belladonnæ folia, *U. S., Br., F. It.;* Folia (s. Herba) belladonnæ, *P. G.*—Belladonna-leaves, *E.;* Feuilles de belladone, *Fr.;* Belladonna-Blätter, *G.*

The leaves.

2. Belladonnæ radix, *U. S., Br., F. It.*—Belladonna-root, *E.;* Racine de belladone, *Fr.;* Belladonnawurzel, *G.*

The root.

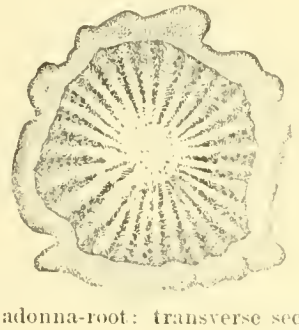
Origin.—Belladonna is a nearly glabrous, herbaceous, perennial plant, attaining a height of from 1.2 to 1.8 Mm. (4 to 6 feet), and has dark-purple bell-shaped flowers and glossy purplish-black berries of the size of a cherry. It is found in the woods, chiefly in mountainous districts, of Central and Southern Europe, and as far east as Asia Minor, Caucasia, and Central Asia. It is cultivated in Europe and in this country to a certain extent.

Fig. 38.

Atropa Belladonna, *Linné*; branch, fruit, seed, and section of seed, the last two magnified.

Description.—1. Belladonna-root. As collected from plants several years old, the roots are 30 Cm. (a foot) or more long, 12 to 25 Mm.

Fig. 39.



Belladonna-root: transverse section.

(½ inch to 1 inch) thick, cylindrical above and gradually tapering, fleshy, and in the dry state with deep longitudinal wrinkles. The head is frequently crowned with the hollow bases of the overground stems; the bark is covered with a brownish-gray cork, or, after its removal, is of a light gray or grayish-white color externally and somewhat lighter internally. A fine blackish cambium-line separates the bark from the meditullium in which the small yellow wood-bundles, with large vessels, are arranged in radiating wedges, separated by rather broad

medullary rays; near the centre and in the young branches the wood bundles are loosely scattered around a central ligneous cord, while in the old roots the woody tissue predominates considerably. When fresh the root has a disagreeable, heavy odor, which disappears on drying, leaving merely a faint earthy smell. The taste is not very marked, being at first sweetish, with a bitterish and somewhat acrid after-taste. The fracture of young roots is nearly smooth and mealy, of old roots woody and tough. Young branches, peeled and dried, have some resemblance to marshmallow-root. (See ALTHÆA.) Belladonna-root is best collected at or shortly after the flowering period; from old plants only soft root-branches should be preserved, but tough woody roots, which are sometimes 5 Cm. (2 inches) and more thick, should be rejected for pharmaceutical use. The former German Pharmacopœia directed the root to be kept not more than one year.

2. BELLADONNA-LEAVES.—The forking stem bears above numerous bright-green broadly ovate or ovate-oblong leaves, with the margin entire, and arranged in unequal pairs, one being about one-half the size of the other. They attain a length of 10 to 15 Cm. (4 to 6 inches; not over 20 Cm. *P. G.*), are about one-half as wide, tapering toward the apex and narrowed at the base into the petiole, 12 to 25 Mm. (½ to 1 inch) in length. The leaves are entirely smooth, a slight downiness on the nerves beneath excepted. They lose about 85 per cent. and become thin and papyraceous in drying, the upper surface readily assuming a brownish tint, the lower becoming grayish-green; they show, particularly on the lower surface, a whitish granular appearance under the magnifying-glass. Circular holes, resulting from the separation of suberous warts, are frequently observed. The heavy odor of the fresh leaves disappears on drying almost completely, but it is somewhat restored by moisture; the taste is slightly saline, bitterish, and nauseous.

Admixtures.—The root of Medicago sativa, *Linné*, has been observed as an adulteration of belladonna-root; it resembles the latter, but branches of the crown are solid, the bark is thinner, and the meditullium is tough, woody to the centre, and traversed by numerous fine medullary rays. Leaves of digitalis, hyoscyamus, verbascum, and other plants, occasionally met with in carelessly-gathered belladonna, are easily distinguished by their characters, particularly the hairs. The leaves of Solanum nigrum, *Linné* (Black night shade, *E.*; Morelle, *F. Cod.*; Schwarzer Nachtschatten, *G.*; Yerba mora, *Sp.*), are smaller, with the margin repand-dentate. In some parts of Southern Europe the oblong-obovate leaves of Scopolia atropoides, *Schultes* (s. Hyoscyamus Scopolia, *Linné*), are said to be collected with belladonna. They possess the same medicinal properties.

Constituents.—The most important principle contained in both belladonna-root and herb is atropine, the complex nature and chemistry of which have been described above. (See ATROPINA.) Estimated by potassium iodohydrargyrate, Lefort (1872) found young roots to contain 0.6, old roots 0.25, and dry leaves, both cultivated and wild-grown, collected in the flowering period, 0.44 per cent. of atropine. Buddel (1882) obtained from amylaceous belladonna-root from .41 to 1 per cent., and from non-amylaceous root between .143 and .625 per cent., of alkaloid. The alkaloids are probably combined with malic acid. Besides the usual vegetable constituents, albumen, gum, etc., the root contains *atrosin*, a red coloring principle found also in the berries, according to Hübschmann. Young roots contain a considerable amount of starch, which is present to a more limited extent in older and more woody roots, and, according to W. Merz, is almost entirely wanting during summer; the young roots are said to contain more starch in autumn than in spring. A comparative examination of air-dry tough and soft roots, made by E. M Holmes (1882), gave—

	Moisture.	Ash, soluble.	Ash, insoluble in water.	Alcohol extract.	Water extract.	Mayer's test, proportion.
Woody roots,	7.94	3.43	4.60	22.53	15.96 p. ct.	6
Soft roots,	10.28	2.20	3.68	29.87	10.50 "	10

The herb contains asparagin, which sometimes crystallizes in the extract (Biltz, 1839). By dialysis Attfield (1862) obtained crystals of potassium nitrate and of an organic magnesium salt. Flückiger found the ash of dry leaves to amount to 14.5 per cent., and to consist mainly of calcium and alkaline carbonates.

Allied Plants.—ATROPA MANDRAGORA, *Linné*, s. Mandragora officinalis, *Miller*, s. M. vernallis, *Bertero*, and M. autumnalis, *Bertero*.—Mandrake, *E.*; Mandragora, *Fr.*; Alraunwurzel, *G.*—These acaulescent plants are indigenous to Southern Europe, where their roots are employed, which have a sharp and bitter taste and a narcotic action. They are rarely met with in this country.

SCOPOLA CARNIOLICA, *Jacquin*, s. Hyoscyamus Scopolia, *Linné*, is indigenous to Southern Cen-

tral Europe. The rhizome is horizontal in growth about 2–4 Cm. (1–1½ inches) thick, and is almost jointed with few annulations. The tissues are similar to those of belladonna-root, but are not as distinctly marked. Alcohol, 94 per cent. yielded 13.15 per cent. extract containing 4.1 alkaloids—the same as in belladonna.

Scopola japonica, *Maximowicz*, *Japanese belladonna*, has appeared in commerce, and was described by Holmes (1880). It is a nearly cylindrical oblique rhizome about 10 Cm. (4 inches) long and 12 Mm. (½ inch) thick, on the upper surface marked with circular slightly alternate stem-scars, and below, on the node, with one or more rows of root-scars; it is externally brown, internally pale-brown, horn-like in appearance and with numerous whitish dots: has a mousy and narcotic odor and a slight bitter taste. It contains an alkaloid which Langgaard (1881) found to belong to the atropine group.

Action and Uses.—Although it is impossible to present a clear and consistent rationale of the mode of action of belladonna in producing its characteristic effects, it may be proper to state the most plausible views upon the subject. Like all other medicines which act directly through the nervous system, small and large doses of belladonna produce opposite effects, the former stimulating, the latter paralyzing it. The direct action of small doses upon the heart is to increase the vigor and the frequency of its contractions; but large doses render the pulse still more frequent, but more and more feeble and thready. Under moderate stimulant doses the number of visible capillary vessels is increased, owing, it is alleged, to the greater force with which the blood is propelled; but the individual vessels are said to undergo such a contraction (?) at the same time that the amount of blood in the part is diminished rather than increased. The continued use of such doses or the immediate administration of larger ones produces general dilatation of the capillary vascular system. Mr. T. W. Jones seeks, as had been often done before (Bartholow, *Trans. Amer. Med. Assoc.*, 1869, p. 662), to explain this effect by saying that constriction of the small arteries is the cause of the venous engorgement, and that the latter occasions the cerebral and muscular disturbance (*Amer. Jour. of Med. Sci.*, Apr. 1881, p. 362). This blood-stasis accounts for the dryness of the mouth and the redness of the skin, but it is not quite easy to explain by its means the absence of dryness of the external integument, nor the increased secretion of urine and bile, nor the greater facility of defecation, which are effects of medicinal doses of the medicine. The alleged hypnotic power of medicinal doses of belladonna has been referred to the diminution of blood which it occasions in the cerebral vessels; but more probably the insomnia, hallucinations, blindness, etc. which large doses induce may be attributed to the hyperæmia which they cause in the brain. The anodyne and anæsthetic powers of belladonna appear to be inherent, and not the indirect result of changes in the blood-supply. On the other hand, the spinal symptoms, as shown after toxical doses by the suspension of mental control over movements and their co-ordination, seem to result from impaired sensibility and motility.

Belladonna is probably powerless to remove any sort of malignant *tumor*, but it very certainly does retard the growth and lessen the pain even of *cancers*, and promote the removal of some other tumors, especially the glandular, which are susceptible of absorption. It may be presumed to do this by lessening the blood-supply, and thereby restricting the nutrition of the morbid growth and its pressure upon the sensitive nerves. The virtues of belladonna in certain forms of *neuralgia* illustrate the folly of too rapidly generalizing. The relations of opium to pain of all descriptions are so nearly identical that it was naturally to be inferred that the same was true of belladonna; and yet there is only one form of uncomplicated pain, neuralgia, in which this medicine is of much service as a direct anodyne, and one variety of that form chiefly. It is a powerful remedy for neuralgia, but almost exclusively for neuralgia of the face and head. It is next most useful in intercostal neuralgia, then in visceral neuralgia, and least of all in sciatica. It should be given internally to the production of slight constitutional effects, while local applications of belladonna in ointment or liniment are made upon the sound or blistered skin, or atropine is hypodermically employed. The application of a belladonna plaster—or, still better, of a plaster of belladonna and conium—over the *heart* is of signal service in many cases of the pain which is usually felt near the apex and is associated with palpitation, depending upon functional oftener than upon organic disease, and which is probably due to intercostal neuralgia.

The physiological action of belladonna, as revealed by experiments is far from pointing clearly to one of the most useful applications of the drug in *relaxing spasm*, which has long been well known as a clinical fact. Sometimes, doubtless, it is difficult to disengage from this symptom the often-associated element, pain, which by turn excites and is produced by spasm. This is evidently the case in spasm of the *sphincter ani* and

of the *urethra*, and probably in spasm of the *gall-ducts*, the *ureters*, the *bladder*, the *intestines*, and the *uterus*. It is probably so in pain depending upon muscular spasm in *rheumatism* and in that caused by the irritation of wounded and inflamed *nerves*. But the consideration of other cases of spasm without pain shows that the direct antispasmodic power of the medicine is very great. It will not be pretended that spasm of the *os uteri* during labor is the effect of the pain which accompanies it, and yet belladonna overcomes the rigidity in question, probably in the same manner in which it may be overcome by venesection. It is said to control nocturnal *seminal emissions* depending upon an over-excited state of the genital organs, and not on their mere debility. It is alleged that the medicine relieves *jaundice* supposed to be caused by the presence of inspissated bile in the ducts, but not necessarily occasioning pain; strangulated *hernia* is said to have been cured by local applications of belladonna, as it also has by the internal use of the drug (*Boston Med. and Surg. Jour.*, Nov. 1882, p. 419), and also *phimosis* and *paraphimosis;* and its relaxing influence on the bowels has frequently been resorted to successfully in cases of *obstinate constipation*, and especially in *lead colic*. The purely antispasmodic operation of the medicine is still more clearly seen in *whooping cough*. It should not be used until the inflammatory stage of the disease has declined, and then in doses not exceeding, at first, the eighth of a grain twice a day. The dose should be gradually increased until the pupils exhibit its effects. In other *nervous coughs* it is equally available, especially in such as depend upon laryngeal irritation. In *hay fever* or *summer catarrh* it is a valuable palliative, both when taken internally and when applied in watery solution to the nasal cavity. In *spasmodic asthma* it is one of the most reliable remedies, provided it be given in doses sufficient to produce its characteristic operation. For the purpose the hypodermic injection of atropine is to be preferred, and when the paroxysm occurs regularly its approach may be prevented by this remedy. The inhalation of an atomized preparation of belladonna may also be used. It is not without utility in spasmodic and membranous *croup*, and even in *laryngismus stridulus*, by moderating the laryngeal spasm. The *nervous vomiting* of pregnancy may be palliated by the internal use of the drug or by rubbing a solution of the extract upon the epigastrium. In *tetanus* the medicine has occasionally produced a cure, and also in cases of poisoning by *strychnine*, and in others of *epilepsy*, especially in children. It forms a valuable addition to the bromides in cases of epilepsy that resist the use of the latter alone.

The supposed power of belladonna to limit the amount of blood in the spinal cord has been invoked with apparent advantage in the treatment of *epidemic meningitis*. As it was given along with ergot, to which the same operation is attributed, the share of the former medicine in the cure is difficult to determine. These two medicines were originally associated in the treatment of *paraplegia* due to myelitis, ergot being at first administered alone, after which belladonna was given internally and applied in a plaster to the spine. Subsequently, iodide of potassium was prescribed in addition to the other remedies. It is a question, What was the value of the elements time and rest in this method of treatment?

One of its most useful applications is in the treatment of non-paralytic *incontinence of urine*, an affection presenting neither evident spasm nor pain, but in which probably the former state exists. By blunting the organic sensibility of the neck of the bladder it allays the spasm of this part, and prevents a call of nature until a due amount of urine has accumulated. It is best administered in suppositories or associated with bromide of potassium. In an ointment it allays the pain of *hæmorrhoids*. The power of belladonna to dilate the pupil is most valuable in permitting a thorough exploration of the interior of the *eye* by means of the ophthalmoscope or otherwise, in obviating the unnatural adhesions which are so apt to occur in *iritis*, and also in preventing or in remedying prolapse of the *iris*. It was first applied to facilitate the operation for *cataract* in 1795. It is probable that the medicine lessens the congestive process in the eye by diminishing the calibre of the blood-vessels and by lowering the sensibility of the retina to light. Both locally and internally it is one of the most efficient remedies for *photophobia*. Where the eye is concerned the action of belladonna may be obtained by smearing its extract, softened with water, around the orbit, but the use of atropine is both more cleanly and more efficient. The dryness of the skin produced by belladonna has been proved clinically to render it an efficient remedy for all forms of passive *perspiration*. The hectic sweats of phthisis, of profuse suppuration, of articular rheumatism, are all more or less under its control, and local and unilateral sweats have been arrested by its topical application. It is curious that in some cases the suspension of the cutane-

ous exhalation was followed by a compensatory diarrhœa. The requisite dose for checking perspiration is one that will produce a commencing dilatation of the pupil and a very slight dryness of the throat. A similar control over excessive *salivation* has been exerted by this medicine when the symptom in question followed hemiplegia. The dryness of the nostrils and throat produced by it has been employed to prevent the *coryza* which *iodide of potassium* frequently causes. The control of belladonna over the *mammary secretion* has long been known, and liniments containing it have been used for drying up the milk or for diminishing it when excessive. It should be applied before inflammation has set in. It does not appear to be secreted with the milk. It has been thought to increase the power of opium in the treatment of *diabetes;* and Mingot claims for it a directly stimulant action upon the female *organs* of *generation*. The similar action of belladonna upon the heart has been taken advantage of in *typhoid fever*. Under its use the pulse and temperature rather decline. Dr. Harley says: "My own impression is, that the stimulant action of belladonna on the heart is converted in the pyrexial state into a tonic, and, if not pushed too far, even a sedative, influence on the heart and blood-vessels generally; in other words. that it is a tonic and sedative to the sympathetic system generally. By this action the capillary circulation is accelerated, the contraction of the vessels promoted, and the arterial tension which attends congestion of the parenchymatous organs is relieved, and a load at once removed from the heart." There is reason to think that in some cases of cardiac *dropsy*, with feeble action of the heart through valvular obstruction or muscular degeneration, belladonna may be serviceable. In several instances also it appears to have rescued patients from fatal *collapse* (in endocarditis, diarrhœa, bronchitis) by sustaining the heart's action (Weber). The protective power of belladonna against the contagion of *scarlatina* has been both firmly maintained and vehemently denied. A careful examination of the evidence bearing upon the question has led us to the conclusion that so long as persons are under the influence of belladonna, as indicated by the state of the pupils, the throat, and the skin, the liability to contract scarlatina is very much diminished. Nor does there seem to be wanting a good reason why it should be so, since the mucous membrane of the throat and larynx is maintained by the drug in a condition unfavorable to absorbing the scarlatinous or any other morbid agent that enters the body through these channels.

The *antagonism of belladonna* and *opium* has long been known and practically tested in cases of poisoning by the one or the other of those agents. Doubtless their antidotal action was suggested by their opposite actions upon the pupil. More recent observations have shown other points of opposition, thus: opium tends to produce coma, belladonna cerebral excitement; opium diminishes the internal and increases the cutaneous secretions, while belladonna increases the secretions of the gastro-intestinal tract and diminishes those of the skin; opium lessens the secretion of urine, but belladonna augments it; and, above all, opium exerts a depressing action upon the lungs and heart, but the functions of these organs are stimulated by belladonna. These opposite actions of the two medicines may surely be described by the single word antagonism, and neither experiments upon animals, however numerous, nor any amount of reasoning, however ingenious, can diminish their significance or importance. Harley has shown, experimentally, that by removing the restraint due to partial collapse of the lungs, and by direct stimulation also, belladonna relieves the distended heart; and clinical observation demonstrates that this special stimulant operation is the very one that is needed to preserve life in opium-poisoning. Indeed, electricity, the cold dash, coffee, and other agents employed with success to combat the effects of opium can have no other mode of action. Every one who has witnessed the use of electricity or of flagellation in the successful treatment of opium-narcotism must have been convinced that these agents stimulate the lungs and heart, and so preserve life until the excess of the poison is eliminated or destroyed. It is evident that belladonna and its preparations can act in no other manner; and indeed clinical observation proves it, for unless the condition of the patient is such as to allow him to be impressed by the physiological antidote, it can do no good; and, on the other hand, unless the dose of the antidote is such as to attain, without exceeding, the due degree of stimulation, it may do serious harm. It results from experience that *repeated and small doses* of belladonna or of its alkaloid, Gm. 0.0010–0.0016 (gr. $\frac{1}{60}$–$\frac{1}{40}$), (the latter hypodermically is preferable) should be administered at intervals until the pulse and respiration acquire more force and the pupil begins to be dilated, but care must be taken not to substitute the narcotic action of belladonna for that of opium. By observing these rules a great many cases of opium-poisoning have terminated favorably which without treatment would probably have ended fatally. In poison-

ing by belladonna the appropriate antidote is morphine, and the test of its efficiency is the degree of contraction it occasions in the dilated pupils. Inhalations of oxygen have also been employed.

Although poisoning by *physostigma* (Calabar bean) is uncommon, it should be known that belladonna (in the form of atropine) is the appropriate antidote for its effects. Its administration should be conducted upon the principles just set forth, and the guide for its dose and the frequency of its administration are to be found also in the dilating effect produced by it upon the contracted pupil.

Gm. 0.06 (gr. j) is the the primary dose of the powder of belladonna, root or leaf. It should be gradually increased until the pupil begins to be affected. An infusion may be made with Gm. 1.30 (gr. xx) of the leaves in half a pint of water, of which the dose is half a fluidounce every four or five hours. The tincture, fluid extract, and alcoholic extract, and atropine, are more frequently prescribed than belladonna in substance. For external use the ointment and plaster, and various liniments containing these preparations, are employed.

ATROPA MANDRAGORA, or mandrake, which has such a resemblance to A. belladonna as to call for some notice here, is chiefly interesting from its anæsthetic virtues. It was fully described in the first century of our era by Dioscorides, and after him by Pliny, and their descriptions were handed down by the Arabians to modern times. Of these writers, the first particularly mentions that wine of mandrake was administered to persons about to suffer amputation or the actual cautery. He speaks also of its juice being used in a suppository to induce sleep, and states that the fruit of the plant, and even the emanations from it, have the same effect. Indeed, he describes two species, but attributes the same qualities to them both. In 1848, Sylvester drew attention to the ancient uses of this plant as an anæsthetic. For many centuries, said Dr. Richardson (1873 and 1888), Atropa mandragora was employed as a general anæsthetic, and poets and historians, not less than physicians, descanted on its singular efficacy. According to Crouzel, *Mandragora officinalis* furnishes an alkaloid which dilates the pupil.

SCOPOLINE, when first announced in 1885, was said to exceed atropine in the degree and persistency of its mydriatic action, and at the same time not to irritate the conjunctiva. This statement was confirmed, among others, by Dunn, who also found it a sedative of the inflammation and pain in rheumatic *iritis* (*Med. Record*, xxxi. 132), and by Duckworth, according to whom it does not, like belladonna, cause dryness of the throat, nor, when taken internally, dilatation of the pupil (*Therap. Gaz.*, xiv. 101). Meanwhile, Schmidt and others have proved that the active principle of the plant is compound, and contains atropine, hyoscine, and hyoscyamine (*ibid*, xi. 767; xii. 200).

EPHEDRIN, originally (1887) used in Japan as a mydriatic, appears to be uncertain in its action, and much slower than atropine. A 6–7 per cent. solution has been employed.

BENZENUM.—BENZENE (sometimes called BENZOL).

Benzole, *Benzène*, Fr.; *Benzol*, *Benzen*, G.

Formula C_6H_6. Molecular weight, 77.82.

The term benzol is still often used for this liquid, and has been retained by the U. S., Br., and Germ. Pharmacopœias in order to distinguish it readily from benzin or petroleum ether; at present, however, the ending "ol" is confined to the names of alcohols and phenols, while the more appropriate ending "ene" is used for hydrocarbons proper.

Preparation.—Benzene is obtained by the dry distillation of benzoic acid mixed with excess of lime, and by agitating the oily distillate with potassa solution and rectifying. It is largely obtained from *coal-tar*, one of the secondary products of the coal-gas manufacture: on subjecting it to distillation water and ammonia pass over, accompanied by a brown oily liquid (8 or 10 per cent. of the tar), known as *light oil*, because it floats on water. Subsequently *dead oil* is obtained as an oily liquid heavier than water, and containing aniline, quinoline, naphthaline, carbolic acid, etc.; the residue in the retort constitutes pitch, and is used in place of asphaltum. The light oil contains mainly *benzene*, *toluene* (C_7H_8), *xylene* (C_8H_{10}), and *isocumene* (C_9H_{12}), and after rectification to free it from some dead oil is known in commerce as *coal-naphtha*, which owes most of its disagreeable odor to volatile bases removable by agitation with dilute sulphuric acid. The hydrocarbons are separated from one another by repeated fractional distillation until liquids of a nearly constant boiling-point are obtained. The fraction boiling near 80° C. (176° F.) consists chiefly of benzene, that with the boiling-point 110° C. (230° F.) of toluene, that

distilling near 140° C. (284° F.) of xylene, and the portion coming over near 170° C. (337° F.) of isocumene. The benzene may be further purified by exposing it to a low temperature and expressing the portion remaining liquid.

Properties.—At the ordinary temperature benzene is a thin, colorless, very inflammable liquid, of considerable refractive power and strong odor of coal-gas; but when obtained from benzoic acid it has a peculiar aromatic odor and a sweetish aromatic taste. It has the density .899 at 0° C. (32° F.) and .878 at 15° C. (59° F.), congeals at the freezing-point of water, melts again at 5.5° C. (42° F.), and boils at 80.5 (177° F.). It is nearly insoluble in water, but readily soluble in 4 parts of alcohol, in methylic alcohol, ether, and acetone; it dissolves some phosphorus, sulphur, and iodine, and considerable quantities of fats, volatile oils, caoutchouc, gutta-percha, and some resins. W. Smith and G. W. Davis (1882) obtained a colorless crystalline compound with antimony trichloride, having the composition $3SbCl_3.2C_6H_6$, and on exposure becoming opaque and liquefying. The name *benzin* was formerly given, and is still used to some extent for benzene, but is best discarded as a synonym for the latter.

Composition.—Benzene is the hydride of phenyl, HC_6H_5; the hydroxide of the same radical, C_6H_5OH, is carbolic acid.

Tests.—To distinguish it readily from *petroleum benzin*, Pusch (1875) recommends iodine, which dissolves in the latter with a raspberry-red and in benzene with a violet-red color; the former color is so intense that a small admixture of benzin can be recognized by neutralizing the violet tint. Commercial benzene obtained from coal-tar always contains variable quantities of the hydrocarbons mentioned above; it should boil and evaporate completely between 80° and 85° C. (176° and 185° F.). Agitated with sulphuric acid, it should not acquire a dark color.

Action and Uses.—Benzene is useful as a solvent for some alkaloids and the substances mentioned above, but is chiefly employed in the manufacture of NITROBENZENE and ANILINE (which see). It has been recommended as a remedy for whooping cough (*Med. Record*, xxxiii. 15). The application of benzol, followed by that of calomel, is said to have cured *epithelioma* (*N. Y. Med. Jour.*, Sept. 26, 1885).

BENZINUM, *U. S.*—BENZIN.

Benzinum petrolei, P. G.; *Æther petrolei.—Petroleum benzin, Petroleum ether*, E.; *Benzine, Esprit* (*Naphté, Éther*) *de pétrole, Petroléine*, Fr.; *Petroleumbenzin, Petroläther, Benzin*, G.

Preparation.—The lower hydrocarbons present in American petroleum are separated from the heavier compounds by fractional distillation and from all the lightest hydrocarbons by fractional condensation. (See PETROLEUM.)

Purification.—The disagreeable odor of crude benzin is to a considerable extent removed by agitation with sulphuric acid. Fairthorne (1880) recommended quicklime for the purpose, which removes the peculiar sulphurous odor. Grazer (1883) obtained the best results with a mixture of solution of potassium bichromate and sulphuric acid. The adhering acid is removed by washing.

Properties.—Benzin is a transparent, colorless, diffusive liquid of a strong, characteristic odor slightly resembling that of petroleum, but much less disagreeable; neutral in reaction; insoluble in water, soluble in about 6 parts of alcohol, and readily so in ether, chloroform, benzene, and fixed and volatile oils. It is highly inflammable, and its vapor, when mixed with air and ignited, explodes violently. It has a sp. gr. from 0.670 to 0.675 (0.640 to 0.670, *P. G.*), and boils at 50° to 60° C. (122° to 140° F.) (55° to 75° C. = 131° to 167° F., *P. G.*). Benzin should be carefully kept in well-stopped bottles or cans, in a cool place, remote from lights or fire.—*U. S.*

Constituents.—*Pentane*, C_5H_{12}, boils at 38° C. (100.4° F.), *hexane*, C_6H_{14}, at 70° C. (158° F.). The benzin of the U. S. P. should therefore consist chiefly of the former, while that of P. G. consists mainly of hexane, with variable quantities of pentane and *heptane*, C_7H_{16}, the latter boiling at 98° C. (208.4° F.); this also agrees with the density, which is for pentane .60, for hexane .63, and for heptane .71.

Tests.—Benzin when evaporated upon the hand should leave no odor, and when evaporated in a warm dish should leave no residue (absence of heavy hydrocarbons). When boiled a few minutes with one-fourth its volume of spirit of ammonia and a few drops of test-solution of silver nitrate, the ammoniacal liquid should not turn brown (absence of pyrogenous products and sulphur compounds), and it should require 6 parts of official alcohol to dissolve it (difference from benzene). If 5 drops are added to a

mixture of 40 drops of sulphuric acid with 10 drops of nitric acid in a test-tube, the liquid warmed and set aside for half an hour, and then diluted in a shallow dish with twice its volume of water, it should not have the bitter-almond-like odor of nitro-benzene (difference from and absence of benzene.—*U. S.* On agitating 2 parts of benzin with a cold mixture of 1 part of sulphuric acid and 4 parts of fuming nitric acid, the liquid should not become colored, and should not acquire a bitter-almond-like odor.—*P. G.* Benzene being much higher in price than benzin, an adulteration of the latter with the former is not likely to occur; but these tests are useful for distinguishing the two liquids. (See also BENZENUM.)

Pharmaceutical Uses.—Benzin is directed in the preparation of Charta sinapis, *U. S.*, for depriving powdered mustard-seed of fat. It may be used for the extraction of fixed oils, and has been recommended by Dr. Wolff for the preparation of volatile oils. It is employed in the arts as a solvent for fats, for caoutchouc, and for certain resins.

Action and Uses.—Husemann states that the vapors of benzin are destructive to insects, but that pigs tolerate very large doses of it; *e. g.* 3 or 4 drachms. According to Gabalda, the poisonous action of benzin differs from that of nitrobenzin only in degree. It produces confusion of the senses, vertigo, unconsciousness, convulsions, coma, or sometimes only a sort of intoxication, like that of alcohol. As much as 50 drops has been given to *trichina* patients without injury, but the continued use of the oil produces some of the effects just mentioned, and without mitigating the disease. It has been employed locally in the treatment of *scabies*, but, although it destroys the itch-insects, it does not affect their eggs. It has also been used in *herpes tonsurans*, *favus*, *sycosis*, etc., and as an anæsthetic for the relief of pain in *rheumatism* and *neuralgia*. Like creosote and carbolic acid, it restrains fermentation in certain forms of *dyspepsia*. As a substitute for the emanations from gas-works it has been used by inhalation in *whooping cough*. The ordinary *dose* is Gm. 0.60–1.00 (♏ x–xv). It may be prescribed on sugar, in emulsion, or, preferably, in capsules.

BENZOINUM, *U. S. Br.*—BENZOIN.

Benzoe, P. G.; *Resina benzoe*, *Asa dulcis*.—*Gum benjamin*, E.; *Benjoin*, Fr.; *Benzoe*, G.; *Benjui*, Sp.; *Benzoino*, F. It.

A balsamic resin obtained from Styrax Benzoin, *Dryander*. *Philos. Trans.*, vol. lxxvii. plate 12; Bentley and Trimen, *Med. Plants*, 169.

Nat. Ord.—Styraceæ.

Origin.—The tree yielding benzoin is of medium height, has a hard dense wood, large branches forming a beautiful crown, a handsome dark-green underneath white hairy foliage, and reddish or white flowers in axillary racemes. It is indigenous to Borneo, Java, and Sumatra, and probably also to Cochin China and Siam, though it is not unlikely that the benzoin coming from the latter country may be produced by a different species.

Collection.—The tree is cultivated in Sumatra to a considerable extent, but benzoin is also obtained from wild trees. When about six or seven years old the trunks are about as many inches in diameter, and incisions are then made through the bark, when a white liquid resin commences to exude slowly. According to Tschirch (1890), the tree contains no resin-receptacle, and while in a healthy condition does not yield any resinous exudation, which he regards as a pathological result of injury. When sufficiently hard this is scraped from the bark. During the first three years the resin contains a large number of white tears, and is then called by the Malays *head benzoin*. During the next seven or eight years the white tears decrease in number, and the product is termed *belly benzoin*. At the expiration of this time the exudation is considerably diminished, the tree cut down and an inferior quality, called *foot benzoin*, scraped from the wood.

Siam benzoin is likewise collected from incisions, but the tree yielding it is not known.

Commerce.—At the ports of Sumatra benzoin is received in the form of cakes wrapped in matting, and after having been softened by heat is packed in chests and sent to Penang and Singapore, whence it finds its way into general commerce. In Siam benzoin is carried on bullocks' backs to the Menam River, and then shipped to Bangkok, whence it is exported to other countries. In the year 1866–67, 5827 pounds of benzoin were imported into the United States. In the recent statistical reports benzoin is enumerated with other resins and gum-resins.

Description.—Sumatra benzoin is met with in commerce usually in the form of

large rectangular blocks, which consist of milk-white opaque tears, varying in size and frequently quite small, always agglutinated by a brown-gray resin. In the interior it is often porous, presents a mere mottled or variegated but no distinct, amygdaloid appearance. It has an agreeable odor, distinct from and weaker than that of Siam benzoin. The tears melt at 85° C. (185° F.), the grayish-brown portion at 95° C. (203° F.) (Pharmacographia). It is always mixed with fragments of bark, of which the inferior kinds almost exclusively consist.

Penang benzoin is usually identical with Sumatra benzoin, but occasionally it differs from it in color, and more so in odor, which then suggests that of storax.

Siam benzoin has mostly a similar appearance, the inferior varieties consisting mainly of a grayish-red resin, which upon a fresh fracture is brown-red, glossy, translucent, and mottled with lighter spots, but containing few or no tears. The better quality is distinctly amygdaloid in appearance, on account of the milk-white tears, which are up to 12 Mm. (½ inch) and more in diameter. The resin is often porous, and crystals of benzoic acid are observed in the cavities. In the finest amygdaloid variety the tears largely preponderate over the red-brown translucent resin, which is nearly entirely absent in the *benzoin in tears*. This variety is met with in separate or loosely-agglutinated, roundish, or flattened pieces, 25 to 50 Mm. (1 or sometimes 2 inches) in diameter, which are of a reddish-yellow color externally, internally white or striped, and melt at 75° C. (167° F.). The odor of Siam benzoin is pleasantly balsamic, somewhat like that of vanilla.

Impurities, consisting of fragments of wood, bark, etc., are present to a larger or smaller extent in all varieties of cake benzoin, and remain behind on treatment with alcohol. With the exception of these impurities, benzoin should dissolve in five times its weight of alcohol; this solution gives with water a milky liquid having an acid reaction.—*P. G.* The tincture of Siam benzoin has a distinct red color; that of the other varieties is more of a brown or yellowish-brown color; rendered milky by the addition of water, the peculiar fragrance of the different varieties is best perceived.

False benzoin, from Terminalia benzoin, *Linné filius*, s. T. angustifolia, *Jacquin*, s. Catappa Benzoine, *Gaertner*, consists of white and brown fragments, which easily break in the hand. Dried, it yields a white powder which is used as a cosmetic. It is obtained from the tree by making incisions.

Constituents.—Benzoin contains several resins, a trace of volatile oil, and from 12 to 20 per cent. of benzoic acid. In addition to these, Siam benzoin contains vanillin, which was obtained by Rump (1878) from the mother-liquor of benzoic acid prepared by Scheele's process (see page 32) by agitating it with ether and evaporating. Kolbe and Lautemann (1860) found in Siam and Penang benzoin also cinnamic acid, and the same acid was observed in Sumatra benzoin by Aschoff (1861). The quantity of cinnamic acid varies considerably, and it is often altogether absent. The cause of its presence has not been ascertained. The white tears often contain less benzoic acid than the resin. This portion consists of about four resins, which dissolve partly in ether, but are alike, or nearly so, in their composition and behavior to alcohol, in which they are soluble, and to caustic potassa; by treating them with fused potassa, paraoxybenzoic acid, $C_7H_6O_3$, and protocatechuic acid are obtained, besides products of secondary decomposition.

Tests.—When benzoin is boiled with milk of lime the hot filtrate should not give off the odor of oil of bitter almond on the addition of test-solution of potassium permanganate (absence of cinnamic acid). For determining the presence of cinnamic acid the tincture of benzoin may be precipitated by hot water, filtered from the resin, and the filtrate treated with a solution of potassium permanganate or chlorinated lime; or the benzoin may be triturated with peroxide of lead and the mixture boiled with water.

Action and Uses.—The internal action of benzoin has been considered in connection with benzoic acid, upon whose presence the virtues of the balsam chiefly depend; but the resin and volatile oil which it also contains communicate to it other qualities which assimilate it with the resins in general. Like these, it is a general and local stimulant, tending to elimination by the mucous membranes. (Vid. TINCT. BENZOINI and TINCT. BENZOINI C.) This fact accounts for its established reputation in the treatment of chronic *bronchitis*, chronic *diarrhœa*, and *dysentery*. In the first of these affections the compound tincture of benzoin, or Turlington's balsam, has long been famous, and no medicine of its class excels it. Locally, the tincture is a most excellent stimulant and protective for *wounds*, and, like various other stimulants and protectives, may be used to arrest *coryza* in its forming stage. The *dose* is stated to be from Gm. 0.60–2.60 (gr. x–xl), but benzoin is never administered in substance.

BERBERIS.—Barberry.

Berbéride, Épine-vinette, Vinettier, Fr.; *Berberitzen, Saurach, Sauerdorn*, G.; *Berberos*, Sp.

The bark of the root of Berberis vulgaris, *Linné*. Bentley and Trimen, *Med. Plants*, 16. *Nat. Ord.*—Berberidaceæ.

Origin.—The barberry is a shrub 1.8 to 2.4 M. (6 to 8 feet) high, with three-parted spines, fascicles of obovate-spatulate and bristly serrulate leaves, yellow flowers in pendulous racemes, and oblong one-celled scarlet berries of an acidulous bitter taste. It is indigenous to Western Asia and the greater part of Europe, and has been naturalized in thickets and waste grounds in New England and other parts of North America. The bark of the root is the part mostly used in North America, while in Europe the entire root is usually employed, also the fruit and the juice expressed from it.

Description.—The thick and branching root has a tough wood of a pale lemon-yellow color, distinctly porous from the rather large vessels, which are arranged in concentric circles and with plainly-visible medullary rays. The rather thin bark is found in small irregular pieces, is externally of a yellowish-gray, and upon the nearly smooth inner surface of an orange-yellow color; the corky layer is soft, and the deep-yellow bast-fibres are in tangential rows imbedded in a yellow parenchyma which is striate by medullary rays. The nearly inodorous bark has a strongly bitter taste, and imparts to the saliva a yellow color; its infusion does not yield a black precipitate with ferric salts.

Constituents.—According to the analysis of Poles (1836), barberry-bark contains berberine, oxyacanthine, some starch, and tannin, producing dark green precipitates with iron salts, besides the usual constituents of vegetables. Besides these principles, V. Hesse (1886) isolated a third alkaloid, berbamine.

Berberine, or berberia, was first discovered by Chevallier and Pelletan (1826) in the bark of Xanthoxylum clavæ Herculis, *Linné*, and named *xanthopicrit;* its identity with berberine was proved by Perrins (1862). A. Buchner obtained it (1835) crystallized from barberry-root, believed it to possess acid properties, and named it berberin. It had been previously separated in an impure condition by Brandes (1825) and by Buchner (1830). G. Kemp (1841) noticed that it forms crystallizable compounds with various mineral and organic acids, but its alkaloidal nature was first proven by Fleitmann (1846). Since then it has been discovered in numerous plants of the orders Berberidaceæ, Ranunculaceæ, Menispermaceæ, etc. (See papers in *Am. Jour. of Pharm.*, 1863, pp. 97, 301, and 456.)

For the preparation of berberine Procter (1864) gives a process which is based upon those of Buchner and Fleitmann: The root of hydrastis is exhausted with boiling water, the decoction evaporated, the soft extract exhausted by strong alcohol, some water is added, most of the alcohol distilled off, and then an excess of sulphuric acid added, when, on cooling, berberine sulphate crystallizes, requiring recrystallization from hot water for purification. Its solution in hot water is then decomposed by freshly-precipitated lead oxide (caustic baryta, Fleitmann) and the filtrate allowed to crystallize. It forms fine yellow needles, which lose at 100° C. (212° F.) nearly 19.5 per cent. of water, fuse at 120° C. (248° F.), are insoluble in ether, petroleum benzin, and carbon disulphide, and dissolve slightly in cold water and benzene, and more freely in alcohol and alkalies. Its composition is $C_{20}H_{17}NO_4$ (Perrins), and crystallizes with $6H_2O$ (Schreiber, 1889). By adding to its hot solution an excess of acid, crystals of neutral or acid salts are obtained, which are usually of a bright or golden yellow color, have a bitter taste, and are very slightly soluble in acidulated water. Berberine dissolves in strong sulphuric acid with a dingy-green, and in nitric acid with a dark brown-red color. Solutions of its salts are precipitated greenish-brown by potassium ferrocyanide, and yellow by picric acid, phosphomolybdic acid, or chloride of gold, platinum, or mercury; the precipitates are mostly crystalline or crystallize readily; the phosphomolybdate dissolves in ammonia with a blue color. Dissolved in hot alcohol, the salts of berberine yield, with solution of iodine in potassium iodide, dark-green scales of a metallic lustre and appearing reddish-brown in transmitted light; if an excess of iodine be employed, the crystals are of a red-brown color in reflected light. This behavior is recommended by Perrins as a convenient test for this alkaloid. Berberine hydrochlorate assumes with chlorine a blood-red color (Buchner). This behavior furnishes a delicate test, by means of which, according to Klunge (1875), berberine may be detected in over 200,000 parts of solution; brucine, which gives a similar color with chlorine, yields with acids colorless solutions. L. Henry ascertained (1859) that berberine and its salts are colored blood-red by bromine, and that after the deposition of hydrobromate the solution gives a black precipitate with

ammonia. Fused with potassium hydroxide, berberine is decomposed, yielding two acids, one of which is sublimable, and vapors having the odor of quinolin (Hlasiwetz and Gilm). Berberine forms two well-characterized addition-products with chloroform, acetone and alcohol, containing 1 and 2 molecules of each of the latter respectively (Schreiber).

Oxyacanthine, $C_{32}H_{46}N_2O_{11}$, remains in the mother-liquor from which the berberine salt has been precipitated by an acid. To avoid confusion with principles in Cratægus Oxyacantha, Berzelius proposed to call it *berbine*, and Wacker suggested the name of *vinetine*. It is a white alkaloid, turning yellow in sunlight, nearly insoluble in water, and has a bitter taste and an alkaline reaction; it dissolves in 30 parts of cold and in 1 part of boiling alcohol, in 125 parts of cold and 4 parts of boiling ether, and is easily soluble in chloroform, benzene, fats, and volatile oils. It reduces iodic acid. Sulphuric acid colors it brown-red, the color changing on heating to bright-red and brown. Nitric acid imparts a yellow and, when heated, a purple color. Its salts give white precipitates with alkalies, soluble in excess, with alkali carbonates, potassium iodide, potassium ferrocyanide, potassium sulphocyanate, or mercuric chloride, and yellow precipitates with picric acid or potassium ferricyanide.

Berbamine, $C_{18}H_{19}NO_3 + 2H_2O$, can be isolated from the mother-liquor in the preparation of berberine hydrochlorate by precipitation with soda. The precipitate is dissolved in acetic acid, and after removal of oxyacanthine with Glauber salt, berbamine can be precipitated with sodium nitrate; the solution of the nitrate yields with ammonia a crystalline precipitate of berbamine. The salts crystallize easily and dissolve readily in water; with platinum chloride berbamine yields a yellow crystalline precipitate.

The first two alkaloids are also contained in the wood and, according to Lenssen (1870), in the flowers; the latter contain, in addition, volatile oil, and 3.57 per cent. of sugar and 6.62 per cent. of malic acid were found in the berries.

Allied Species.—In India the root-bark of BERBERIS ARISTATA, *De Candolle*, B. ASIATICA, *Roxburgh*, and B. LYCIUM, *Royle*, is employed as a tonic; it contains berberine in abundance.

Several species of Berberis, belonging to the section of Mahonia, are indigenous to the Pacific coast of North America, growing as far north as Vancouver Island, and are known as *Oregon grape*. BERBERIS REPENS, *Lindley*, is about 20 to 25 Cm. (8 or 10 inches) high; B. AQUIFOLIUM, *Pursh*, attains a height of 1.2 to 1.8 M. (4 to 6 feet), and B. NERVOSA, *Pursh*, of about 10 Cm. (4 inches). The rhizomes and roots of these low shrubs resemble each other closely, those of the first species being thinnest. Oregon grape-root varies in size from that of a quill to 25 or 50 Mm. (an inch or two) in diameter, is more or less knotty and crooked, has externally a yellowish-brown color, and is internally of a brighter yellow; the bark is thin, the wood tough, yellow, striate with fine medullary rays, and encloses a distinct pith. The bark has a bitter taste, and as obtained from B. nervosa was found by P. Neppack (1870) to contain berberine.

Action and Uses.—Berberis-bark, or that of an allied species, has long been used in India as a tonic and febrifuge. All parts of the plant are employed medicinally in Europe—the bark as a tonic and aperient, and the leaves as antiscorbutic, and as a depurative in low fevers. The juice, diluted with water, is used as a drink, and the bark is recommended in *dysentery* and *dropsy*. The experiments of Curci (*Bull. de Thérap.*, ci. 329; *Centralbl. f. Therap.*, v. 42) and others with berberine throw no light upon its alleged virtues. It is supposed to act as a stomachic tonic and to increase the secretion of bile. It has been given in atonic *dyspepsia*, and especially in that condition following cholera, in *diarrhœa* from the same cause, in infantile and tuberculous diarrhœa, etc. In a word, it seems to be adapted to such cases as are usually treated with calumba. It has also been used with alleged success in reducing the *spleen* enlarged by malarial poisoning. It may be given in doses from 0.10–0.30 Gm. (2 to 5 grains), in pill or powder, or in alcoholic solution. *Berberis aquifolium* is used in the Western States as a tonic and antiperiodic, particularly in the form of the fluid extract, which is also alleged to have cured inveterate cases of *psoriasis* and *eczema*. It is also recommended in *dyspeptic* disorders with *constipation* (*Med. News*, lvii. 418).

BETULA.—BIRCH.

Bouleau, Fr.; *Birke*, G.; *Abedul*, Sp.

The bark, leaves, and saccharine juice of different species of Betula.

Nat. Ord.—Cupuliferæ.

Origin.—The genus comprises shrubs and trees which are indigenous to the northern hemisphere, have alternate simple and straight-veined leaves, drooping staminate catkins,

and shorter cylindrical fertile catkins, producing broadly-winged nutlets. The young twigs and leaves of most species are pungently aromatic; the bark is more or less completely separable into thin concentric layers, and when wounded in the spring exudes a juice having a sweet and somewhat acidulous taste.

Description and Constituents.—BETULA ALBA, *Linné*, is a slender and graceful tree indigenous to Northern Asia, Europe, and America, in the latter continent as far south as Pennsylvania. There are several varieties, varying in height from 4.5 to 22.5 M. (15 to 75 feet). The bark of the branches is brownish and verrucose, of the trunk white, smooth, separating in thin sheets, and of an astringent somewhat bitterish taste. The leaves are triangular-deltoid, acuminate, doubly serrate, light-green, shining, and of an astringent taste; when young, glandular and pungent. The buds and young twigs yield by distillation $\frac{1}{3}$ per cent. of a colorless *volatile oil* having a balsamic and pungent odor, and by the dry distillation of the wood and bark dark red-brown *birch-tar* or *duggett* is obtained, which has a strong and persistent odor of Russia leather, and yields on distillation brown-red *empyreumatic oil of birch*, known as *oleum rusci*. The bark contains also a camphoraceous body, *betulin*, $C_{36}H_{60}O_3$, which forms light, flocculent, crystalline, tasteless masses fusible at about 258° C. (496° F.), subliming when heated with care, and soluble in ether, volatile oils, hot alcohol, and alkalies. On oxidation one or more acids are obtained, and on dry distillation an oily body, which, according to Hausmann (1878), has the characteristic odor of Russia leather. The whitish powder covering the young shoots and leaves is *betulo-resinic acid*, $C_{36}H_{26}O_5$, which, according to Kosmann (1854), has a bitter taste in alcoholic solution and dissolves in sulphuric acid with a red color.

BETULA PAPYRACEA, *Aiton*, the *canoe birch*, grows in Canada and the northern part of the United States, has ovate, heart-shaped, taper-pointed leaves, and a tough white bark splitting into thin papery layers, which are used by the Indians in making canoes.

BETULA LENTA, *Linné*, Sweet, black or cherry-birch. It is indigenous to Canada and the northern part of the United States, but grows in the mountains as far south as Georgia; has oblong heart-shaped and acuminate leaves, which are pubescent on the veins beneath, and a glossy brown bark, the outer layers of which are slightly laminate and the inner layers close and reddish-brown. The bark and leaves yield a volatile oil, which Procter (1843) found to be identical with oil of gaultheria, and which Kennedy showed (1882) is largely sold in place of the latter. Pettigrew (1883) found it to be pure methyl salicylate, and to have the spec. grav. 1.180 at 15° C., and the boiling-point to be constant at 218° C. (424.4° F.). It does not pre-exist in the plant, but is formed by the action of water and an unknown compound of the bark upon *gaultherin*. This principle is syrupy, colorless, soluble in alcohol and water, insoluble in ether, and when distilled with sulphuric or hydrochloric acid yields the volatile oil. The bark contains 3.3 per cent. of tannin (Bowman, 1869).

Action and Uses.—Experiment and observation show that oil of birch acts like oil of wintergreen, and is in fact identical with it. A man swallowed a half-pint of oil of birch, after which for several hours he walked about town on business and returned to his home by rail. Only late in the evening he fell into a drunken stupor; his face was flushed, and he was bathed in perspiration smelling of the oil. He vomited, but was not purged. His stupor increased during the night, and the next morning he died (Ott, *Therap. Gaz.*, ix. 302.) In the dose of 10 to 15 minims three or four times a a day it will usually cause some ringing in the ears. White birch is a popular remedy in the north of Europe. The sap is held to be a purifier of the blood, and is in general use for the cure of scaly diseases of the *skin*, *rheumatic* and *gouty* disorders, chronic affections of the *bladder*, *scurvy*, and *intermittent fever*. The fresh leaves are used to form a bed in which rheumatic patients lie, and which excites profuse sweating. Reduced to a pulp and mixed with gunpowder and cream, the bark is thought to be a sovereign remedy for the *itch*. A similar pulp mixed with oil is reputed to be efficient in discussing *scrofulous* enlargements of the glands. The oil of birch is likewise employed to cure chronic *cutaneous eruptions*, and is taken internally for the relief of *gonorrhœa*. It is said to have a more unpleasant odor than kindred oils, and when used should be scented with oil of rosemary or lavender. The American species (sweet birch) also appears to possess stimulant qualities; the bark and leaves are sometimes used to prepare diaphoretic infusions, and the oil is stated to have cured subacute articular *rheumatism*. The white rotten wood of this tree is sometimes boiled in a decoction of *Ledum latifolium* for an hour, and then, dried and powdered, is said to be useful as a dusting powder for children, and in *intertrigo* generally (*Amer. Jour. Phar.*, lvi. 620).

BIDENS.—Spanish Needles.

The herb of Bidens bipinnata, *Linné*.

Nat. Ord.—Compositæ, Senecionideæ.

Description.—This annual smooth weed is indigenous to the United States, and attains a height of about 3 feet (90 Cm.). The stem is quadrangular; the leaves are opposite, broadly ovate in outline, bipinnately dissected, the divisions lanceolate, mostly wedge-shaped at the base; the flower-heads are small, on long peduncles, have a double involucre, three or four short, yellow, and dark-veined ray-florets, and slender quadrangular three- or four-awned akenes. The plant has a disagreeable odor when rubbed, and a herbaceous afterward acrid taste. Its constituents have not been investigated.

Allied Species.—Bidens tripartita, *Linné*—Chanvre aquatique, *F.*; Wasserhanf, *G.*—indigenous to Europe, has three-lobed serrate leaves, yellow tubular florets, and two-awned akenes. It was employed like the preceding. The same common names are applied in Europe to Bidens cernua, *Linné*, Burmarigold, *E.*, which is also indigenous to Canada and the United States south to Virginia; it is known by its lanceolate, serrate, somewhat connate leaves, its nodding flower-heads with or without pale-yellow rays, and its flat, retrorsely-barbed, two-awned akenes.

Action and Uses.—A statement was long ago made respecting this plant that its roots and seeds have a popular reputation as *emmenagogues* and as a remedy for acute *laryngeal* and *bronchial* affections; more recently they have been used for the relief of *hay asthma*. Bidens is probably a stimulant, and, when suitably administered with hot water, a diaphoretic.

BISMUTHI CITRAS, *U. S.*, *Br.*—Bismuth Citrate.

Bismuthum citricum, *Citras bismuthicus*.—*Citraté de bismuth*, Fr.; *Wismutheitrat*, *Citronsaures Wismuthoxyd*, G.

Formula $BiC_6H_5O_7$. Molecular weight 397.44.

Preparation.—Bismuth Subnitrate 100 Gm.; Citric Acid 70 Gm.; Distilled Water a sufficient quantity. Boil the bismuth subnitrate and the citric acid with 400 Cc. of distilled water for about fifteen minutes or until a drop of the mixture yields a clear solution with ammonia water. Then add 5000 Cc. of distilled water, allow the suspended matter to deposit, wash the precipitate (first by decantation, and afterward on a strainer) with distilled water until the washings are tasteless, and dry the residue at a gentle heat.—*U. S.*

This is the process of R. Rother, first proposed in 1876, and consists simply in the decomposition at the boiling temperature of the bismuth subnitrate by the citric acid, anhydrous bismuthous citrate being formed, which is nearly insoluble in water and in the diluted nitric acid produced at the same time. The decomposition is ascertained to be completely by means of ammonia, which will then yield a clear solution with a drop of the turbid mixture. The yield is about 135 Gm.

Properties and Tests.—Bismuth citrate is a white, amorphous or micro-crystalline powder, odorless and tasteless, and permanent in the air, insoluble in water or alcohol, but soluble in ammonia water, and in solutions of the citrates of the alkalies. When strongly heated the salt chars, and on ignition leaves a more or less blackened residue having a yellow surface, and soluble in warm nitric acid. This solution, when dropped into water, occasions a white turbidity. The ammoniacal solution, when treated with hydrogen sulphide in excess, yields a black precipitate. If the filtrate from the latter be deprived by heat of the excess of hydrogen sulphide and cooled, a portion of it, boiled with lime-water, produces a white precipitate. If another portion of the filtrate be mixed with an equal volume of concentrated sulphuric acid and cooled, no brown or brownish-black color should appear around a crystal of ferrous sulphate dropped into the liquid (absence of nitrate)."—*U. S.*

BISMUTHI ET AMMONII CITRAS, *U. S.*, *Br.*—Bismuth and Ammonium Citrate.

Bismuthi ammonio-citras, *Bismuthum citricum ammoniatum*.—*Citrate de bismuth ammoniacal*, Fr.; *Wismuthammoncitrat*, *Citronensaures Wismuthammonium*, G.

Preparation.—Bismuth Citrate 100 Gm.; Ammonia-water, Distilled Water, each a sufficient quantity. Mix the bismuth citrate with 200 Cc. of distilled water to a smooth paste, and gradually add ammonia-water until the salt is dissolved and the liquid has a neutral or only faintly alkaline reaction. Then filter the solution, evaporate it to a

syrupy consistence, and spread it on plates of glass, so that on drying the salt may be obtained in scales. Keep the product in small, well-stoppered vials, protected from light.—*U. S.*

Rother (1876) states that dry bismuth citrate yields with ammonia-water a syrupy liquid and a hard white mass, the latter being unaffected by excess of ammonia, but dissolving on the application of a gentle heat; this solution crystallizes on cooling, and the crystals, after being dried on a water-bath, are again soluble in water, and may be regarded as a compound of triammonium citrate with bismuthous hydroxide, having the formula $(NH_4)_3C_6H_5O_7Bi(OH)_3$. Since the Pharmacopœia makes no provision for supplying the ammonia lost during the concentration of the liquid, the salt will have a more or less variable composition, probably approaching that determined by N. Gray Bartlett (1865) for a salt prepared by a similar process—namely, $BiC_6H_5O_7NH_4OH.2H_2O$ (molecular weight 470). The yield by the official process is about 120 Gm.

Properties.—Bismuth and ammonium citrate is in small, shining, pearly or translucent scales, odorless, having a slightly acidulous and metallic taste, and becoming opaque on exposure to the air, very soluble in water, and but very sparingly soluble in alcohol. When strongly heated, the salt fuses, then chars, and finally leaves a more or less blackened residue, having a yellow surface and soluble in warm nitric acid. This solution, when dropped into water, occasions a white turbidity. The aqueous solution of the salt is neutral or faintly alkaline to litmus-paper. When boiled with potassium or sodium hydroxide test-solution, it evolves the vapor of ammonia, and when treated with hydrogen sulphide it yields a black precipitate. If the filtrate from the latter be deprived by heat of the excess of hydrogen sulphide and cooled, a portion of it, boiled with lime-water, produces a white precipitate. If another portion of the filtrate be mixed with an equal volume of concentrated sulphuric acid and cooled, no brown or brownish-black zone should appear around a crystal of ferrous sulphate dropped into the liquid (absence of nitrate)."—*U. S.*

The dry salt slowly loses ammonia on keeping, thereby becoming partly insoluble in water; the cautious addition of a few drops of ammonia-water to such a turbid mixture will then usually make a perfect solution.

Action and Uses.—If the virtues of subcarbonate and subnitrate of bismuth depend upon the insolubility of these salts, as appears to be the case, then its soluble salts must act in quite a different manner; but of their special action we possess no evidence except that derived from experiments upon animals, in which they occasion the common symptoms of irritant poisons. The *dose* of the citrate of bismuth and ammonium is said to be Gm. 0.10–0.20 (gr. ij–iv), but if used at all this compound should only be applied locally as an astringent.

BISMUTHI OXIDUM, *Br.*—Bismuth Oxide.

Bismuthum oxydatum, Oxydum bismuthicum.—Oxyde de bismuth, Fr.; *Wismuthoxyd*, G.

Formula Bi_2O_3. Molecular weight 465.68.

Preparation.—Take of Bismuth Subnitrate 1 pound; Solution of Soda 4 pints. Mix and boil for five minutes; then, having allowed the mixture to cool and the oxide to subside, decant the supernatant liquid, wash the precipitate thoroughly with distilled water, and finally dry the oxide by the heat of a water-bath.—*Br.*

In this process the bismuth subnitrate is decomposed by the soda, sodium nitrate, and white bismuth hydroxide being formed, the former of which remains dissolved in the water; $2(BiONO_3.H_2O) + 2NaOH$ yields $2Bi(OH)_3$ or $Bi_2O_3.3H_2O + 2NaNO_3$. On drying the precipitate without heat it loses water and leaves *bismuthyl hydroxide*, BiO.OH, but at the temperature of boiling water the anhydrous oxide is left.

Properties.—Bismuth oxide forms a dull-yellow more or less crystalline powder, which dissolves in mineral acids without effervescence, and these solutions are colorless and yield black precipitates with hydrogen sulphide, and white ones with alkalies, alkali carbonates and much water, the precipitates being insoluble in an excess of the precipitants. When heated to incipient redness the oxide is not diminished in weight. At a higher temperature it fuses to a brown mass, which becomes yellow again on cooling. The oxides of lead and silver are likely to be present as impurities, and are detected by dissolving in nitric acid and testing as described under Bismuthi Subnitras.

Action and Uses.—Oxide of bismuth would appear to be nearly insoluble in the stomach; for in a woman with gastric cancer, to whom it was given, a mass of it weighing a pound, which must have remained there for at least two months, was found in the stomach after her death (*Practitioner*, xxviii. 293). It has been used for the same

purposes as the subcarbonate and the subnitrate, and has been particularly recommended, when mixed with powdered gum-acacia and muriate of morphia, as a snuff in *post-nasal catarrh* and *ozæna*. It may be prescribed in the dose of 0.20 Gm. (gr. iij) and upward.

BISMUTHI SUBCARBONAS, *U. S.*—Bismuth Subcarbonate.

Bismuthi carbonas, Br.; *Bismuthum subcarbonicum*, *Subcarbonas bismuthicus*.—*Carbonate of bismuth*, *Bismuthyl carbonate*, E.; *Sous-carbonate de bismuth*, Fr.; *Wismuthsubcarbonat*, *Basisches kohlensaures Wismuthoxyd*, G.

Formula $(BiO)_2CO_3.H_2O$? Molecular weight 527.53.?

Preparation.—Take of Purified Bismuth in small pieces 2 ounces; Nitric Acid 4 fluidounces; Ammonium Carbonate 6 ounces; Distilled Water a sufficiency. Mix the nitric acid with 3 ounces of distilled water and add the bismuth in successive portions. When the effervescence has ceased, apply for ten minutes a heat approaching that of ebullition, and afterward decant the solution from any insoluble matter that may be present. Evaporate the solution until it is reduced to 2 fluidounces, and add this in small quantities at a time to a cold filtered solution of the ammonium carbonate in 2 pints of distilled water, constantly stirring during admixture. Collect the precipitate on a calico filter, and wash it with distilled water until the washings pass tasteless. Remove now as much of the adhering water as can be separated from the precipitate by slight pressure with the hands, and finally dry the product at a temperature not exceeding 150° F.—*Br.*

In this process a solution of bismuthous nitrate is first formed and concentrated by evaporation, when it is added to a cold solution of an alkali carbonate. Most metallic bismuth contains some arsenic, which is also oxidized by the nitric acid, so that bismuth arsenate is found in the solution. In order to remove nearly the whole of the arsenic, the nitric acid solution may be diluted with sufficient distilled water until it remains faintly milky after stirring; on being set aside for a day most of the arsenate will be found deposited as a white crystalline precipitate. The clear solution, still retaining a small proportion of arsenic, may be almost completely deprived of it by pouring it into an excess of ammonia-water, whereby soluble ammonium nitrate and arsenate are formed, while bismuthous hydroxide is precipitated; this may then be converted into subcarbonate by dissolving in sufficient nitric acid, pouring the liquid slowly and with constant stirring into a solution of sodium carbonate, draining the precipitate upon a strainer, and washing it with distilled water. This process was originally proposed by Dr. Squibb, and adopted in the U. S. P. 1870 with the following working quantities: Bismuth 2 troyounces is dissolved in a mixture of nitric acid 4½ troyounces and water 4 fluidounces; the solution is diluted with water 10 fluidounces; on the next day decanted and filtered, diluted with water 4 pints, and mixed with ammonia-water 5 fluidounces; the precipitate is drained, washed, and dissolved in nitric acid 4 troyounces; the solution is mixed with water 4 fluidounces, next day filtered and slowly poured into a cold solution of sodium carbonate 10 troyounces in water 12 fluidounces; the precipitate is collected on a strainer, drained, and washed until the washings pass tasteless. In following this process it is important that the dilution with water should be carried far enough until a turbidity is observed which does not disappear completely on stirring; this solution should be set aside for a sufficient length of time, as indicated; the acid solutions should be added slowly and with continual stirring to the alkaline solutions, in order to ensure the complete decomposition of the acid salt; and the washing should not be continued for too long a time, in order to avoid gradual decomposition of the subcarbonate into hydrate. If the final precipitation be effected at a boiling temperature, an anhydrous subcarbonate would be precipitated.

The final reaction is explained by the equation $2Bi(NO_3)_3 + 3Na_2CO_3 + H_2O = (BiO)_2CO_3.H_2O + 6NaNO_3 + 2CO_2$, showing that carbon dioxide is given off.

Properties.—"Bismuth subcarbonate is a white or pale yellowish-white powder of somewhat varying chemical composition, odorless and tasteless, and permanent in the air. It is insoluble in water or alcohol, but completely soluble in nitric or hydrochloric acid, with copious effervescence. When heated to redness the salt loses water and carbon dioxide, and leaves from 87 to 91 per cent. of a yellow residue which is soluble in nitric or hydrochloric acid and blackened by hydrogen sulphide."—*U. S.*

Tests.—If 3 Gm. of the salt be dissolved in just a sufficient quantity (about 4 Cc.) of warm nitric acid, and the solution poured into 100 Cc. of water, a white precipitate is produced. After filtering, and evaporating the filtrate on a water-bath to 30 Cc.,

again filtering, and dividing this filtrate into portions of 5 Cc., these should respond to the following tests: On mixing one portion with an equal volume of diluted sulphuric acid it should not become cloudy (absence of lead). If another portion be precipitated with a slight excess of ammonia-water, the supernatant liquid should not exhibit a bluish tint (absence of copper). Other portions should not be affected by silver nitrate test-solution (absence of chloride), or barium nitrate test-solution (sulphate), nor yield, with hydrochloric acid, a precipitate which is insoluble in a slight excess of the latter (silver). If 1 Gm. of the salt be boiled with 10 Cc. of a mixture of equal parts of acetic acid and water, and the cold filtrate freed from bismuth by hydrogen sulphide, the new filtrate should leave no fixed residue on evaporation (absence of alkalies and alkaline earths). On boiling 1 Gm. of the salt with 10 Cc. of sodium hydroxide test-solution, it should not evolve the odor of ammonia. If 1 Gm. of the salt be heated with 10 Cc. of a mixture of equal parts of concentrated sulphuric acid and water, tinged slightly blue with indigo test-solution, the color of the latter should not be discharged (absence of nitrate). If 1 Gm. of the salt be ignited in a porcelain crucible, the residue, when cold, dissolved in 5 Cc. of stannous chloride test-solution, and a small piece of pure tin-foil added, no dark coloration or precipitate should be produced within fifteen minutes (limit of arsenic).—*U. S.*

Action and Uses.—Introduced as a substitute for subnitrate of bismuth, this preparation was claimed to possess the advantages of greater solubility in the gastric juices, and therefore to be less likely than the subnitrate to confine the bowels and color the stools. But these effects, so far from being advantages, would unfit the salt more or less for use in the class of cases in which the subnitrate has been found advantageous because it is nearly insoluble. *Dose*, Gm. 0.60–4.00 (gr. x–lx), suspended in water.

BISMUTHI SUBNITRAS, *U. S., Br.*—Bismuth Subnitrate.

Bismuthum subnitricum, P. G.; *Bismuthum hydrico-nitricum*, *Magisterium bismuthi*, *subazotas* (*s. Subnitras*) *bismuthicus.—Bismuthyl nitrate*, E.; *Sous-azotate* (*Sous-nitrate*) *de bismuth*,.Fr.; *Basisches Wismuthnitrat* (*salpetersaures Wismuthoxyd*), *Wismuthsubnitrat*, G.

Formula $BiONO_3H_2O$? Molecular weight 304.71?

Preparation.—Take of Purified Bismuth in small pieces 2 ounces; Nitric Acid 4 fluidounces; Distilled Water a sufficiency. Mix the nitric acid with 3 ounces of distilled water, and add the bismuth in successive portions. When effervescence has ceased,.apply for ten minutes a heat approaching that of ebullition, and decant the solution from any insoluble matter that may be present. Evaporate the solution until it is reduced to 2 fluidounces, and pour it into half a gallon of distilled water. When the precipitate which forms has subsided, decant the supernatant liquid, add half a gallon of distilled water to the precipitate, stir them well together, and after two hours decant off the liquid, collect and drain the precipitate in a calico filter, press it with the hands, and dry it at a temperature not exceeding 150° F.—*Br.*

By dissolving the metal in nitric acid the latter is partly decomposed, nitric oxide being evolved and water generated, while the bismuth dissolves, forming normal bismuth nitrate; thus: $Bi_2 + 8HNO_3 = 2Bi(NO_3)_3 + 2NO + 4H_2O$. Other metals likely to be present are dissolved with the formation of nitrates, except arsenic, which is oxidized to arsenic acid. The bismuth having been previously purified, the solution practically should contain only bismuth nitrate. The latter requires now to be converted into the subnitrate, which is accomplished by water. The most uniform results are obtained by adding the acid solution to a definite quantity of cold water; the decomposition taking place may be explained by the following equation: $6Bi(NO_3)_3 + 10H_2O = 5BiONO_3H_2O + Bi(NO_3)_3 + 10HNO_3$. The nitric acid which is liberated will retain a portion of normal bismuth nitrate in solution. Ditte ascertained that water containing in each liter 83 Gm. of $N_2O_5 = 96.83$ Gm. of HNO_3 will dissolve both normal and basic nitrate, forming with the latter the normal salt, so that no decomposition will take place on the further addition of the acid liquid. But if the precipitate is left for too long a time in contact with the acid mother-liquor, an oxynitrate of the formula $4BiONO_3.Bi(OH)_3.3H_2O$ is gradually formed; by precipitating the solution with water of about 50° C. (122° F.) an oxynitrate is obtained having the composition $5BiONO_3.Bi(OH)_3.3H_2O$; and by washing the official or the above compounds for some time with water they are decomposed into still more basic salts of the formulas $3BiONO_3.Bi(OH)_3.3H_2O$ and $3BiONO_3.2Bi(OH)_3.H_2O$. It is obvious from the foregoing that even with the most careful manipulation the product obtained is not likely to be of a definite composition, but to consist of a mixture of the above two salts or of intermediate basic salts.

The U. S. P. 1870 used commercial bismuth, which was freed from the contaminating metals by a process analogous to that described for the subcarbonate; the diluted and filtered solution in nitric acid was first precipitated by pouring it into an excess of solution of sodium carbonate; the bismuthous carbonate was redissolved in sufficient nitric acid, diluted with water, filtered and poured into a definite quantity of water, to which subsequently ammonia was added to *partly* neutralize the nitric acid, so as to precipitate also the greater part of the bismuth still held in solution.

The following is the process of the German Pharmacopœia: 5 parts of nitric acid sp. gr. 1.20, are heated to 75°–90° C. (167°–194° F.), and to this is then added, small portions at a time, 1 part of coarsely-powdered bismuth, and solution facilitated by further application of heat. After several days of rest the clear solution is decanted, evaporated, and crystallized; the crystals are washed with water acidulated with nitric acid. 1 part of the crystallized bismuth nitrate is rubbed up into a uniform mixture with 4 parts of water, and the whole is then added to 21 parts of boiling water; the precipitate is separated by filtration, washed with an equal volume of cold water, and finally dried at 30° C. (86° F.). In this process the arsenic is gotten rid of as bismuth arsenate by allowing the first solution to subside for some days, and finally crystallizing the bismuth ternitrate, which salt is afterward decomposed by boiling water.

With the view of obtaining the salt of definite composition, Lalieu (1878) proposed its preparation from the well-washed and still moist oxide obtained from 200 Gm. of the metal by treating it with nitric acid equal to 48.5 Gm. of nitric anhydride, adding it in small quantities, and then heating until the mixture becomes limpid and white; after the addition of a little water the subnitrate is thrown upon a filter, washed with twice its bulk of water, expressed, and dried; the yield is 265 Gm.

Properties.—Bismuth subnitrate is a heavy white powder in minute crystalline scales and of a somewhat satiny appearance. It is not altered on exposure to air or light, is inodorous, has a faintly acid taste, and when moistened on litmus-paper has a slight but decided acid reaction. It is insoluble in water and alcohol, but dissolves completely and without effervescence in mineral acids. "When heated to 120° C. (248° F.) it loses between 3 and 5 per cent. of moisture, and at a red heat it gives off yellowish-red vapors and leaves between 79 and 82 per cent. of a yellow residue, which is soluble in nitric or hydrochloric acid, and is blackened by hydrogen sulphide."—*U. S.* The formula given above requires 76.5 per cent. of Bi_2O_3. This difference may be due to loss of water by drying at too high a temperature, but is usually owing to changes in its composition occurring during its preparation under the circumstances described above. The loss by ignition of these non-official oxynitrates ranges between 16 and 20 per cent.

Tests.—"On dissolving 3 Gm. of salt in 3 Cc. of warm nitric acid no effervescence should occur (absence of carbonate), and no residue should be left (absence of insoluble foreign salts). If this solution be poured into 100 Cc. of water, a white precipitate is produced, and, after filtering, evaporating the filtrate on a water-bath to 30 Cc., again filtering, and dividing the filtrate into portions of 5 Cc. each, these should respond to the tests for purity described under BISMUTHI SUBCARBONAS. When further tested as described under BISMUTHI SUBCARBONAS, the salt should be found free from alkalies and alkaline earths, and should give no reaction for ammonia. If 1 Gm. of the salt be heated in a porcelain crucible until nitrous vapors cease to be evolved, the residue, when cold, dissolved in 5 Cc. of stannous chloride test-solution, and a small piece of pure tin-foil added, no dark coloration or precipitate should be produced within fifteen minutes (limit of arsenic)."—*U. S.*

Bismuth and Bismuth Salts.—I. Bismuthum, *Br.*; Bismuth, *E., Fr.*; Wismuth, *G.* Symbol Bi. Atomicity trivalent and quinquivalent. Atomic weight 208.9.—The supply of bismuth is chiefly derived from the mines in Saxony, where it exists in the metallic state associated with cobalt, nickel, and silver ores. It is likewise found oxidized as *bismuth ochre*, in combination with sulphur and with tellurium, and in gold ores. Deposits of bismuth ore have been discovered in Hungary, France, Cornwall, and other parts of Europe, in Texas, California, Mexico, Bolivia, and other parts of America, and in Australia. Bismuth appears to have been first recognized as a distinct metal by Basilius Valentinus in the fifteenth century, but was afterward frequently confounded with antimony, tin, and zinc until Pott (1739), and afterward Bergmann, Davy, and others, proved its distinct properties. The metal is extracted by a simple process of smelting, advantage being taken of its low melting-point, and run into hot iron receiving-pots, where it congeals. The bismuth sulphide requires to be roasted; it is thus converted into oxide, which is reduced to the metallic state by being heated with charcoal. The crude metal thus obtained contains variable quantities of arsenic, copper, iron, and other metals.

BISMUTHUM PURIFICATUM, *Br.*—Purified bismuth.—Take of Bismuth 10 ounces; Potassium

Cyanide ½ ounce; Sulphur 80 grains; Potassium Carbonate and Sodium Carbonate, recently ignited, of each a sufficient quantity. Melt the bismuth in a crucible. Add the potassium cyanide and sulphur, previously mixed. Heat the whole to low redness for fifteen minutes, constantly stirring. Remove the crucible from the fire, and let it cool until the flux has solidified to a crust. Pierce two holes in the crust and pour the still fluid bismuth into another crucible. Remelt this partially purified bismuth with about 5 per cent. of a mixture of dried potassium and sodium carbonate, heating to bright redness and constantly stirring. Remove the crucibles from the fire, and pour out the bismuth into suitable moulds.

The flux of potassium sulphocyanate removes some of the impurities, while the remainder are removed by the alkali carbonates.

A method proposed by Mr. Mêhu (1873) aims at the formation of an alloy with potassium by heating to redness a mixture of powdered crude bismuth, potassium carbonate, charcoal, and soap under a layer of well-washed charcoal; the metallic button obtained at the end of an hour is then fused in a capsule, for the purpose of oxidizing the potassium to potassa, which is accomplished when a yellow-brown layer of bismuth oxide begins to form. It is claimed that arsenic and sulphur are completely removed by this process.

Properties.—Bismuth is a brilliant grayish-white metal with a distinct roseate tinge and a crystalline lamellate texture. When fused bismuth is cooled until a crust has formed, and the liquid portion is then poured out, the crucible will be found lined with rhombohedral crystals resembling cubes. Its specific gravity is 9.83, which is diminished by high pressure. It fuses at 268.3° C. (515° F.), and when congealing expands considerably, like water under similar circumstances, the density of the liquid metal being more than 3 per cent. greater than that of solid bismuth. It boils above 1100° C. (2012° F.), and may be distilled in a current of hydrogen. It is superficially tarnished at the ordinary temperature by exposure to the air, but at a red heat decomposes the vapor of water and burns in the air with a bluish flame to brown oxide, becoming yellow on cooling. It has the peculiar property of lowering the fusing-point of metals; an alloy of 2 parts of bismuth and 1 part each of lead and tin fuses at 93.75° C. (200.75° F.). It is but slightly attacked by boiling hydrochloric or dilute sulphuric acid; but nitric acid dissolves it readily, the solution on concentrating yielding crystals of bismuth nitrate (see Bismuthi Subnitras); the mother-liquor or the original solution in nitric acid, suitably diluted with water and separated from the white precipitate of subnitrate, should not yield a white precipitate with sulphuric acid (lead), or a blue one with potassium ferrocyanide (iron), or with the same reagent a reddish-brown one (copper). The presence of arsenic is ascertained by adding sulphuric acid to the solution, evaporating it to complete dryness, and applying Marsh's or Fleitmann's test (see pages 26 and 27). Silver, which is occasionally present, will be indicated by the white precipitate which takes place in the nitric-acid solution, previously diluted with water as much as possible, on the addition of hydrochloric acid. The fetid breath following the administration of bismuth preparations has been attributed by C. Ekin (1876) to the presence of some tellurium; but from observations made by Dr. Squibb (1882) this appears to be doubtful, or at least not the sole cause.

The *salts of bismuth* are colorless, except those formed with a colored acid or acidulous radical. The nitrate, sulphate, and chloride dissolve in a small quantity of acidulated water, but are decomposed by a large quantity of water, with the formation of insoluble basic salts. The solutions of bismuth salts yield with hydrogen sulphide a black precipitate insoluble in ammonium sulphide, with alkalies white precipitate insoluble in an excess, and with zinc, cadmium, or copper a dark-gray spongy mass consisting of metallic bismuth. The solutions give with potassium iodide a yellowish-brown precipitate, becoming red on the addition of water; this coloring being so intense that a minute quantity of bismuth may be detected in lead if the acetate is precipitated by an excess of potassium iodide and the mixture heated to boiling; on cooling, the golden-yellow color of the lead iodide will be tinged crimson, orange, or brown, according to the proportion of bismuth present (Field and Abel, 1877).

2. Bismuthi nitras s. ternitrate, Bismuthum trisnitricum.—Bismuth nitrate, Normal bismuth nitrate, *E.;* Azotate (nitrate) de bismuth neutre, *F.;* Wismuthnitrat, *G.* $Bi(NO_3)_3.5H_2O$. Mol. weight 584.37.—The manner in which this salt may be obtained free from arsenic has been described above. Normal bismuth nitrate crystallizes in large colorless prisms having a strongly acid taste, melting at about 80° C. (176° F.) in its water of crystallization, parting with a portion of its acid near 120° C. (248° F.), and with the whole of it at 260° C. (500° F.), leaving Bi_2O_3 behind. Water decomposes the salt, forming a basic nitrate. Mr. Balmanno Squire (1876) found the normal bismuth nitrate to be soluble in glycerin, and this solution, when recently made, is miscible with water without being precipitated. Mr. J. Williams observed that heat must be avoided in preparing the solution and after diluting it with water, and that potassa and soda cause in it a white precipitate, which is dissolved by an excess of the alkali, the alkaline solution being miscible with water, but not with alcohol. Mr. W. W. Moorhead (1877) proposed a *glycerite of bismuth nitrate*, using 2 troyounces of the crystals to sufficient glycerin to make 8 fluidounces. The salt may thus be prescribed in a perfect solution, which may be diluted by the patient when using it.

3. Bismuthi oxychloridum.—Bismuth oxychloride, Bismuthyl chloride, *E.;* Oxychlorure de bismuth, *Fr.;* Wismuthoxychlorid, *G.* BiOCl. Mol. weight 260.23.—It is prepared by slowly pouring a solution of bismuth in nitric acid into a solution of sodium chloride. It is a white powder known as *pearl white*, and in France, like bismuth subnitrate, as *blanc de fard*. When heated in closed vessels it turns yellow and melts without decomposition, but on being heated in

the air chlorine is thrown off and bismuthous oxide left. The salt is insoluble in water, but readily soluble in acid. It has occasionally been sold as oxide of bismuth.

4. Bismuthi subiodidum.—Bismuth subiodide, Bismuthyl iodide, *E.;* Oxyiodure de bismuth, *Fr.;* Basisches Wismuthjodid, *G.* BiOI. Mol. weight 351.39.—Bismuth subiodide is obtained when an aqueous suspension of bismuth subnitrate is boiled with potassium iodide, or when a solution of bismuth nitrate, in just sufficient water to prevent precipitation, is warmed with potassium iodide. In the first case the resulting compound will be of a crystalline character, while in the second it is obtained as a bulky amorphous powder. The exact composition of bismuth subiodide of course depends upon the method employed; Moerk claims to produce a pure article by boiling 20 Gm. of bismuth subnitrate with 200 Cc. of water and 1 Cc. of nitric acid (sp. gr. 1.42) for ten minutes, in order to convert all oxide present into subnitrate; then add 12 Gm. of potassium iodide dissolved in 100 Cc. of water; boil the mixture for half an hour, filter and wash until the washings cease to react with silver nitrate. Finally, dry below 100° C. (212° F.). Greene claims that by his method the powder obtained contains 99.44 per cent. of true bismuth subiodide and only traces of subnitrate; it is as follows: Dissolve 409 grains of bismuth subnitrate in 1 fluidounce of nitric acid with aid of heat, and dilute the solution carefully with water until a faint opalescence remains; add to this 221 grains of potassium iodide dissolved in 16 fluidounces of cold water; agitate well and apply heat, *but not to the boiling-point* (about 80° or 85° C.?); the precipitate formed is washed by decantation, drained, and dried at or below 100° C. (212° F.). Bismuth subiodide occurs as a bright-red or brownish-red powder, and is used either plain for dusting purposes or in form of an ointment.

5. Bismuthi phosphas.—Bismuth phosphate is prepared by dissolving 5 parts of the subnitrate in sufficient nitric acid, and pouring this solution slowly into a solution of 6 parts of sodium phosphate. It is a white powder, resembling the oxychloride.

6. Bismuthi lactas.—Bismuth lactate is prepared by boiling 10 parts of the subnitrate with an excess of caustic soda, washing the oxide well with water, and while still moist mixing it with 9 parts of lactic acid; the mixture is digested, and dried in the water-bath.

7. Bismuthi salicylas.—*Bismuth salicylate*, which was formerly prepared by precipitating a solution of bismuth nitrate in glycerin with a concentrated solution of sodium salicylate is best made, according to Nagelvoort, by following Duyk's process, slightly modified as to temperature: 500 Gm. of pure bismuth subnitrate are digested with 1000 Cc. of distilled water for two days, with frequent stirring, in a warm place; 50 Cc. of strong ammonia-water are now added, the liquid drawn off, and the residue, Bi_2O_3, washed until free from nitric acid; the moist oxide is transferred to a wide-mouthed bottle, a little distilled water and 125 Gm. of salicylic acid are added, and the mixture digested at ordinary room temperature, with frequent stirring, for at least forty-eight hours. The bismuth salicylate is then washed with small quantities of cold water until all free acid has been removed, and the product finally dried at a low temperature and kept in a dark place. As thus prepared the salt occurs as a cream-colored, odorless, and tasteless amorphous powder, free from uncombined salicylic acid and from bismuth subnitrate. It is a basic compound, having the composition $Bi(C_7H_5O_3)_3.Bi_2O_3$.

8. Bismuth subgallate (Dermatol) is prepared by dissolving 15 parts of bismuth subnitrate in 30 parts of glacial acetic acid, adding 200 to 250 parts of water, and filtering. To the filtrate add with constant stirring a warm solution of 5 parts of gallic acid in 200 or 250 parts of water. The resulting precipitate is separated by decantation and washed until free from nitric acid; it is then dried at 100° C. (212° F.). Bismuth subgallate occurs as an impalpable saffron-yellow, odorless powder, permanent in the air and insoluble in all ordinary solvents. It was introduced as a substitute for iodoform, and has been used as a dusting powder and in various forms of ointments alone or combined with zinc oxide.

9. Bismuthi tannas.—Bismuthum tannicum, Tannas bismuthicus.—Bismuth tannate, *E.;* Tannate de bismuth, *Fr.;* Wismuthtannat, *G.*—14 parts of crystallized bismuth nitrate are dissolved in the least possible quantity of nitric acid, previously diluted with half its weight of water; the solution is poured into an excess of solution of soda, the precipitate well washed with water until the washings cease to have an alkaline reaction, and the moist precipitate triturated with 20 parts of tannin diluted with water, strained through muslin, and dried with the aid of a moderate heat. This is Cap's process, proposed in 1860; in the first part of it bismuth hydroxide is formed from the nitrate by decomposing it with sodium hydroxide: the precipitate is then directly combined with tannic acid, with which it should be left in contact for an hour or two before being washed and dried. It forms a light-yellow powder which is insoluble in water and alcohol, and is entirely tasteless. When thoroughly dried its composition represents 53 per cent. of bismuth oxide and 47 of tannin.

10. Bismuthi valerianas.—Bismuthum valerianicum, Valerianas bismuthicus.—Bismuth valerianate, *E.;* Valérianate de bismuth, *Fr.;* Wismuthvalerianat, *G.*—A solution of bismuth nitrate in the smallest quantity of nitric acid, previously diluted with half its weight of water, is precipitated by a rather concentrated solution of sodium valerianate; the precipitate is washed with water, to which some valerianic acid has been added, until the washings, on evaporation, leave no residue, and afterward dried. Or 50 parts of bismuth subnitrate are digested for four hours with 150 parts of ammonia diluted with the same weight of water: the sediment, consisting of bismuth hydroxide, is well washed with water, drained, transferred to a mortar, and well triturated with 15 parts of concentrated valerianic acid, 30 parts of alcohol being gradually added during the trituration. It is afterward collected upon a filter and dried at the ordinary temperature. Prepared by either process, it is a white amorphous powder having a decided

odor of valerianic acid, insoluble in water and alcohol, soluble in nitric and in sulphuric acid; the latter solution does not acquire a black color on the addition of ferrous sulphate (absence of nitrate). Other impurities may be detected by the same tests as in the bismuth subnitrate.

Action and Uses.—There is no doubt that, practically, subnitrate of bismuth is insoluble in the gastro-intestinal juices. It appears to act upon the stomach and bowels simply by coating their mucous membrane with a virtually insoluble and at the same time perfectly unirritating substance, which protects it against the action of the contents of these viscera, and at the same time probably restrains their secretion and absorbs the excess of free acids present. Pure subnitrate of bismuth, taken internally, occasions no morbid symptoms, but confines the bowels and blackens and deodorizes the feces. It is not, properly speaking, an astringent, and it does not coagulate mucus. After death in persons who have been using it freely the gastric mucous membrane presents no peculiarities, but that of the small intestine is in parts bluish, and the colon and rectum are stained black by a reaction of the bismuth with the sulphurous compounds present.

Subnitrate of bismuth was originally employed to relieve certain chronic and painful affections of the stomach, which appear to have been *gastralgia* and *simple ulcer* of that organ. It is probable that the latter was the disease most commonly treated successfully, and that it was sometimes associated with neuralgia of the stomach. It is certain that pure gastralgia is not peculiarly benefited by bismuth, and that simple ulcer is signally improved by it. If the pain is greatest upon taking food, there is probably ulcer; if the paroxysms occur when the stomach is empty, they are probably neuralgic. Ulcerated *cancer* of the stomach is favorably influenced by subnitrate of bismuth, which, as in simple ulcer, forms a covering to the raw and irritable surface, and thereby lessens pain and vomiting. It is beneficial in cases of chronic *gastric catarrh* due to coarse food or excessive eating, and which are attended by a feverish condition, a coated tongue, and an enlargement of the papillæ. In almost every form of *diarrhœa* caused by irritation or ulceration of the intestinal coats this medicine is of the utmost service—in all cases, indeed, for which chalk has for a long time been employed. The premonitory diarrhœa of *cholera* is generally under its control when it is given in doses of not less than 30 or 40 grains, and the same is true of smaller doses in *cholera infantum*. There is no better agent for controlling the diarrhœa of *typhoid fever* when it becomes excessive at any period of the disease, but especially during its decline; and it is useful in *tuberculous diarrhœa*—provided that the doses of the medicine are large—and in all forms indeed of chronic diarrhœa and *chronic dysentery*. In *acute* as well as in chronic dysentery enemas composed of mucilage in which bismuth is suspended are very soothing to the inflamed and ulcerated bowel.

As a topical application subnitrate of bismuth is useful whenever a neutral protective and absorbent, and by the latter quality made somewhat astringent, powder is required. Nothing is superior to it as an application to superficial abrasions and ulcerations, as in *intertrigo*, slight and even blistered *burns*, confluent *variola*, *eczema*, *zona*, *fissures of the anus*, *prolapsus ani* or *p. vaginæ*, *chapped nipples*, *lips*, and *hands*, and *leucorrhœa*. The virtues exhibited by it in these affections has also been shown when it was used as a dressing for surgical and other *wounds*, for which purpose it was employed by Kocher in 1883, and afterward by Sée, Gosselin, Héret, and others (*Archives gén.*, Jan. 1886, p. 1). It was applied suspended in water or by insufflation as a dry powder, with the addition of the usual antiseptic dressing. But the cases of poisoning produced by it have caused this mode of treatment to be abandoned for large wounds. In vaginal leucorrhœa powdered bismuth on a roll of charpie should be introduced into the vagina through a speculum, and withdrawn after six or eight hours. *Cancrum oris* following an epidemic of measles was found to improve under the use of subnitrate of bismuth better than after any other topical measures (Macguire, *Med. Record*, xxxiii. 113), showing the advantage of a protective treatment. A similar result is stated to have attended this method in the management of recent wounds (Riedel, *Am. Jour. of Med. Sci.*, July, 1883, p. 250). It is an efficient remedy for acute *coryza* when repeatedly and thoroughly snuffed into the nostrils. Its efficacy may be increased by associating with it morphine and powdered gum arabic; *e. g.* muriate of morphine gr. j, powdered gum arabic ʒj, subnitrate of bismuth ʒiij. In chronic coryza the following powder has been strongly recommended as a snuff: subnitrate of bismuth 4 parts, liquorice-powder 8 parts, iodide of sulphur 30 parts. In most of these affections the cure will be hastened by associating with the bismuth oxide of zinc in the proportion of about one-fourth. In some cases of scrofulous *ozæna* cures have been effected by forcibly snuffing the finely-powdered subnitrate into the nostrils and daily cleansing the passages by means of the douche.

Sometimes it is topically applied suspended in water, which appears to be irrational; and sometimes in glycerin, which is less so, since the glycerin, if pure, tends to deprive the tissues of their moisture. The powdered salt is an efficient palliative of *excessive* or *fetid sweats* of the feet and other parts. A mixture of 2 parts of this preparation and 1 part of powdered benzoin has been proposed for the treatment of *whooping cough* by insufflation. Like other protectives and sedatives, it may lessen the frequency of the paroxysms when used in this manner.

A modification of Böttger's test for *diabetic sugar* has been proposed by W. L. Dudley, as follows: "Dissolve subnitrate of bismuth in the least possible quantity of chemically pure nitric acid, and add to it an equal amount of acetic acid of ordinary strength; dilute to eight or ten times its volume, and filter if necessary. To the solution to be tested add sufficient sodium hydrate to render it strongly alkaline, then add a drop or two of the bismuth solution; heat to boiling, and continue the boiling for twenty or thirty seconds. If sugar is present, the white flocculent precipitate which is formed on the addition of the bismuth solution to the alkaline liquid will become gray or black" (*Amer. Chem. Jour.*, 1880). Loewe employs the following formula for the test solution: "Subnitrate of bismuth 15 Gm.; dissolve in pure glycerin 30 Gm.; solution of sodium hydrate (sp. gr. 1.34) 60 to 70 Cem.; dilute with water 150 to 160 Cem.; heat to 212° F." (*Practitioner*, xxvi. 291).

The *dose* of subnitrate of bismuth varies from Gm. 0.20–0.25 (gr. iij–iv) in infantile cases to a teaspoonful for adults, but the average dose for adults may be stated at Gm. 0.60 (gr. x). It is best given with water alone and when the stomach is empty. Milk, soup, and similar liquids as vehicles tend to envelop the medicine, and to that extent neutralize its action.

Phosphate of bismuth has been proposed (by Tédenat) as superior to all the other bismuth compounds, because it is more insoluble than they are. It may be given in somewhat smaller doses than the subnitrate (*Bull. de Thérap.*, xcviii. 427).

Salicylate of bismuth has been credited not only with moderating and curing, but even with aborting, *typhoid fever* (Huchard), but upon insufficient grounds. No doubt it moderates the diarrhœa and corrects the fetor of the stools in this disease, and if largely given may reduce the temperature and pulse-rate; but that it shortens the disease or lessens its mortality no proof exists. It has also been lauded in various diarrhœal and painful disorders of the digestive tube by Solger (*Deut. med. Wochensch.*, No. 22, 1886; and Ehring, *Therap. Gaz.*, xii. 1840), but nothing has been adduced to show its superiority to the subnitrate.

Sub-benzoate of bismuth is stated to be a mild escharotic (*Med. News*, li. 653).

Subiodide of bismuth has been recommended by Dr. Reynolds (*Med. News*, xlix. 393), Chassaignac (*N. Orleans Med. and Surg. Jour.*, July, 1887), as an efficient substitute for the subnitrate in all of the affections mentioned in this article, and as of peculiar value in the treatment of chronic *ulcers*. A writer who claims that there is no danger from its absorption, because it is harmless even when taken by the mouth, overlooks the facts which have been established respecting the subnitrate. Anæsthetic virtues have been attributed to it.

Subgallate of bismuth (dermatol), like its congeners, has been found useful as an absorbent, protective, and astringent for many secreting surfaces, such as are presented in *eczema*, *herpes*, *ulcers*, *burns*, *wounds*, *abscesses*, etc., when their inflammatory stage has passed and the affected parts require only protection for their cure. It is non-poisonous and is entirely unirritating, and, like other salts of bismuth, has been found useful in chronic *diarrhœa* and *dysentery*. As an internal medicine its dose need not be strictly measured. (Compare Stone, *Med. Comment. Mass. Med. Soc.*, xv. 687.)

Tannate of bismuth is astringent, and was at one time used internally in *diarrhœa*, and topically in *gonorrhœa*, *leucorrhœa*, *ophthalmia*, etc. It is now very seldom employed.

There is not sufficient reason for believing that valerianate of bismuth is of the least therapeutical value.

BOLDUS.—Boldo.

Boldo, Fr., G.

The leaves of Peumus Boldus, *Molina*, s. Ruizia (Peumus, *Persoon*, Boldoa, *C. Gay*) fragrans. *Ruiz and Pavon.* Bentley and Trimen, *Med. Plants*, 217.

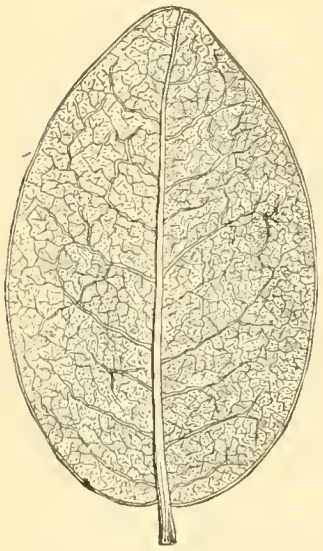
Nat. Ord.—Monimiaceæ.

Origin.—Boldo- or boldu-leaves are derived from a tall evergreen dioecious shrub which is a native of Chili, and is there frequently cultivated in gardens. It has lax cymes of sweet-scented, apetalous, greenish-yellow flowers, the pistillate ones producing about three yellowish drupes of the size of a pea and containing a single albuminous seed. The bark is used in tanning and the wood is esteemed for charcoal-making.

Description.—The leaves are opposite, on short petioles, coriaceous, about 5 Cm. (2 inches) long, broadly oval or oval-oblong, very obtuse at the apex, entire or somewhat undulate on the margin, rough on both sides, glossy above and pale and hairy beneath. The dried leaves are often reddish-brown, and have a fragrant odor and a refreshing aromatic pungent taste.

Constituents.—Claude Verne (1875) obtained from the leaves 2 per cent. of volatile oil, which after rectification is yellow, colored hyacinth-red by sulphuric acid, violet by nitric acid, red by potassa, and is decolorized by hydrochloric acid; it is freely soluble in alcohol, commences to boil at 185° C. (365° F.), and contains no aldehyde. Boldo-leaves also contain about $\frac{1}{10}$ per cent. of the alkaloid *boldine*, discovered by Bourgoin and Verne (1873); it is best extracted with acetic acid, imparts to water a bitter taste, is soluble in alcohol, ether, chloroform, benzene, and caustic alkalies, and is colored red by nitric and sulfuric acids. Besides some tannin and aromatic resinous compounds the other constituents do not possess any medicinal importance.

Fig. 40.



Boldo-leaf, natural size.

Pharmaceutical Uses.—Verne has proposed a *tincture of boldo*, made with 20 parts of the leaves and 100 parts of 60 per cent. alcohol; *wine of boldo*, made with 3 parts of the leaves and 100 of Madeira wine; an *aqueous* and an *alcoholic extract of boldo*, the latter prepared by evaporating the tincture.

Allied Plants.—Atherosperma moschata, *Labillardière*, an Australian tree, known there as *sassafras tree*, has in all parts an odor resembling somewhat that of nutmeg; the bark, which is used as an antiscorbutic and tonic, contains tannin and the bitter alkaloid *atherospermine*, which is a white amorphous powder readily soluble in alcohol and chloroform, but dissolving sparingly in ether; its colorless solution in sulphuric acid becomes green with potassium chromate (Zeyer, 1861). The allied South American genera, Citrosma and Laurellia, are highly aromatic. The bark of these trees is used for tanning.

Action and Uses.—Like all plants which contain an essential oil, boldo has been regarded as an active stimulant of the nervous and circulatory systems. Experiments upon himself by Verne (1882) showed that boldo affects neither the circulation, the temperature, nor the secretion of urine, but that it augments the discharge of urea (*Bull. de Thér.*, cii. 286).

Boldo has been recommended, in alcoholic or vinous solution, for *anæmia*, *dyspepsia*, and *general debility*, and the oil has been proposed for the relief of *catarrh*, especially of the urino-genital organs. The tincture has been prescribed in doses of Gm. 0.30–1.00 (♏ v–xv). Magnan and Juranville have alleged that in doses of Gm. 2 (gr. xxx) boldo or boldo-glucine occasions a tranquil sleep in persons of excited brain and in some cases of insanity (*Ther. Gaz.*, xii. 55); and Campenon attributes remarkable efficacy to it in cases of cirrhotic enlargement of the liver (*ibid.*, xiii. 756). But the evidence in all of these cases is very inadequate and lacks confirmation.

Atherospermia moschata.—According to Graves (*Lancet*, Feb. 1, 1862, p. 134), under the name of "native sassafras" it has long been used by the early settlers and Bushmen of Australia for making a sort of diet-drink in *rheumatic* and secondary *syphilitic* affections. He used it in his own person in *chronic bronchitis*, and in less than twenty-four hours his pulse fell from 120 to 80, and the expectoration from being excessive and difficult became moderate and easy. Other physicians employed it with equal advantage, and subsequently administered the oil in drop-doses as a sedative of excessive and irregular action of the heart. A decoction made with an ounce of the bark to a pint of water and boiled for ten or fifteen minutes was administered every three or four hours in doses of an ounce or two.

Daphnandra ripandula and D. mirantha have been studied by Bancroft. Their actions appear to be identical. The extract of the bark of the former plant is very poisonous. It furnishes an alkaloid which is, to some extent, antagonistic to strychnine. Applied topically, it paralyzes all muscles, voluntary and involuntary; it retards putrefac-

tion and deodorizes putrid meat; it checks the growth of Torula cerevisiæ and kills some water-plants (*Phar. Jour. and Trans.*, Oct. 1, 1887).

BOLUS.—Bole.

Bol, Fr.; *Bolus*, G.

Description.—This term is applied to certain native aluminum silicates, which are soft and unctuous to the touch, readily adhere to the moist tongue, and are easily scraped with the knife; they break with a conchoidal fracture, are insoluble in water, with which they gradually form a pasty mass, do not effervesce with acids, and for medicinal use are powdered and elutriated with water. They contain alumina and silica in the approximate proportion of 3 to 5. According to color they have been distinguished as—

Bolus alba, *P. G.*, known also as *Argilla* and *terra alba;* it is of a white color, and contains small quantities of magnesia and traces of iron.

Bolus armena, s. rubra, Argilla ferruginea, or *Armenian bole*, was formerly brought from Armenia, but is at present obtained in different parts of Europe. Its brown-red color is due to the presence of a considerable proportion of ferric oxide. *Terra lemnia*, formerly employed, differed from it merely in being of a yellowish color and containing less iron. After having been formed into flattish circular pieces and impressed with a seal these boles constituted the *terræ sigillatæ* which were formerly in high repute.

Creta rubra, Rubrica fabrilis, *red chalk* or *reddle*, is firmer than the preceding, contains more iron, and is used for marking on wood and stone.

Action and Uses.—Bole was very generally used in Greek and Roman medicine, and in Europe until a quite recent date, in numberless cases requiring astringent and absorbent medicines. Of internal affections for which it was employed may be mentioned *menorrhagia*, *hæmoptysis*, *chronic bronchitis*, *diarrhœa*, and *dysentery*. Topically, it was applied in *leucorrhœa*, *prolapsus ani*, *sore nipples*, *aphthæ*, *intertrigo*, *burns*, *ulcers*, *erysipelas*, etc. The small proportion of iron contained in it may have increased its efficacy. *Dose*, Gm. 0.30–0.60 (gr. v–x).

BORAGO.—Borage.

Bourrache, Fr.; *Borasch*, *Boretsch*, G.; *Borraja*, Sp.

Borago officinalis, *Linné.*

Nat. Ord.—Boraginaceæ.

Description.—Borage is an erect hispid annual indigenous to the Levant, but naturalized in Southern and Middle Europe and frequently cultivated in gardens. It has a white fleshy root and an erect branching stem .3–.6 M. (1 or 2 feet) high. The leaves are oval or obovate, alternate—the lower ones petiolate, entire, or wavy on the margin, the upper side and the veins beneath with stiff hairs. The flowers are in terminal racemes with ovate bracts, have a five-parted calyx, and a sky-blue or reddish corolla, which is rotate, closed in the throat by five emarginate appendages, and has five stamens. The fruit consists of four brownish-black ovate roughish nutlets, which are excavated at the base. The fresh plant has a slight cucumber-like odor and a saline taste. The herb is used as a salad and occasionally employed in medicine; the root and flowers have likewise been used.

Constituents.—Borage has been analyzed by Lampadius and Braconnot, who found considerable mucilage, a little resin, and potassium and calcium combined with organic and mineral acids. Braconnot obtained from the inspissated juice 30 per cent. of salts; Waltl (1829) from the dry herb 2 to 3 per cent. of potassium nitrate.

Allied Plants.—Cynoglossum officinale, *Linné.*—Hound's tongue, *E.;* Langue de chien, *Fr.;* Hundszunge, *G.*—A biennial European plant naturalized in North America. The stem is 2 feet (.6 M.) high; the leaves are hairy, elliptic, and petiolate, the upper ones lanceolate, sessile, and somewhat clasping; the flowers are brownish-red and have a short, white tube; the ovate nutlets are covered with short, hooked prickles. The fresh plant has a disagreeable odor; the taste is mucilaginous and slightly bitter.

Pulmonaria officinalis, *Linné.*—Lungwort, *E.;* Pulmonaire, *Fr.;* Lungenkraut, *G.*—A perennial European plant with a simple hairy stem and rough hairy entire leaves, often marked with white spots, and with reddish or purple nodding flowers. The radical leaves are ovate-cordate, pointed, and petiolate; the stem-leaves are spatulate or ovate, the upper ones sessile. The herb is inodorous, and has a mucilaginous somewhat astringent taste.

Mertensia (Pulmonaria, *Linné*) virginica, *De Candolle*.—Virginia lungwort, Cowslip, *E.*—It grows from New York westward, and southward to Texas, is a smooth herb 1 or 2 feet (.3 or .6 M.) high, and has obovate-oblong or elliptical sessile leaves, the lower ones narrowed into a petiole, and corymbose racemes of flowers, with a purple-blue or white corolla about an inch (25 Mm.) in length and four times as long as the calyx.

Echium vulgare, *Linné*.—Viper's bugloss, Blueweed, *E.*; Vipérine, *Fr.*; Natterkopf, *G.*—It is a common European perennial, and is naturalized in North America. It is rough-hairy, about 2 feet (.6 M.) high, and has linear-lanceolate leaves and showy blue flowers in axillary clusters, forming an elongated terminal raceme. It has very little odor and a mucilaginous taste. Both the herb and the long, nearly simple, brown, and internally white fleshy root have been employed.

Onosma echioides, *Lamarck*.—Lotwurz, *G.*—A perennial plant indigenous to Southern Europe. The stem is rough hairy and about 45 Cm. (1–1½ feet) high; the leaves vary from linear lanceolate to ovate-lanceolate, the latter being placed toward the top of the stem. The flowers are first white, and later yellow. The conical root is internally whitish, and the bark is dark-red, externally black. The root is used for coloring in place of alkanet.

Alkanna (Anchusa, *Linné*) tinctoria, *Tausch*.—Alkanet, *E.*; Orcanette, *Fr.*; Alkannawurzel, *G.*—This perennial herb, indigenous to Western Asia and South-eastern Europe, is about 30 Cm. (1 foot) high, has nearly sessile flowers with a whitish corolla-tube, purplish throat, and blue margin. The root as found in the market is 30 Cm. (a foot) or less in length, and about as thick as a finger, several-headed, and often crowned by whitish leaf-remnants. The soft bark easily separates into three layers, has a dark purplish color like the medullary rays, and covers a harder, yellowish, irregularly twisted, and spongy wood. It is principally used for coloring oils and pomades, due to the coloring-matter, anchusic acid, which it contains.

Anchusa officinalis, *Linné*.—Ox-tongue, Bugloss, *E.*—The plant is about 45 Cm. (1½ feet) high, rough hairy. The leaves are lanceolate to ovate-lanceolate, sessile or petiolate. The almost sessile flowers are arranged in a cyme and possess a purplish-blue corolla. The root resembles alkanet in shape, but is externally blackish-brown, internally white. The herb and root, which was formerly used medicinally, have an insipid, mucilaginous taste.

Lawsonia alba, *Lamarck* (Lythrarieæ), is the plant yielding the Oriental dyestuff alhenna. In Oriental countries an infusion of the broadly lanceolate or elliptical leaves is used for dyeing the finger- and toe-nails orange-red.

Action and Uses.—The virtues of borage, which are chiefly those of an emollient and protective, it owes to the mucilage it contains, while its saline elements render it somewhat diuretic when its infusion is freely used. In France especially it is much employed in acute *febrile* affections and in *pulmonary catarrhs*. The infusion is made with from Gm. 4–12 (ʒj–iij) in a pint of water. A decoction of the whole plant and a fomentation prepared with the flowers are used in local inflammations.

Cynoglossum in a fresh state gives off an exhalation which has produced acro-narcotic effects, and the leaves are a popular remedy for superficial *burns*, *bruises*, *abrasions*, etc., and for glandular and other local swellings. *Pulmonaria* is a lenitive and expectorant, and its dried leaves are somewhat astringent. It is extensively used in France as an ingredient of tisanes for coughs in various pulmonary affections. Its name is, indeed, derived from such uses of the plant. *Mertensia* has similar properties, and *Echium vulgare* is, at the same time, diuretic by means of its potassium and other salts.

Bugloss is said to have the same medicinal properties as borage (Borago officinalis), which are simply those of an emollient which becomes diaphoretic or diuretic according to the temperature and the quantity of the infusion in which it is administered. It is not used in this country. *Alkanet-root* has no medicinal virtues; its coloring matter is harmless.

BROMUM, *U. S., Br., P. G.*—Bromine.

Brominium.—*Brôme*, Fr.: *Brom*, G.

Symbol Br. Atomicity univalent. Atomic weight 79.76.

A liquid, non-metallic element obtained from sea-water and from saline springs.

Origin and Preparation.—Bromine was discovered by Balard (1826) in the mother-liquor obtained in the preparation of common salt from the water of the Mediterranean; he also investigated its chemical properties, and proved its close analogy to chlorine and iodine. Bromine does not exist in the free state, but is found widely distributed in nature, the bromides usually accompanying chlorides. It is more particularly found in sea-water, in the waters of Kreuznach, Kissingen, and other mineral springs, but is now obtained in considerable quantities from the mother-liquors of many salt-works in the United States and at Stassfurth, Germany. These mother-liquors, which have been freed by crystallization as much as possible from other salts, chlorides, and sulphates,

contain the bromine, usually in combination with magnesium or calcium. These compounds are decomposed either by heating their solution with black manganese oxide and hydrochloric acid, or by warming it to between 45° and 50° C. (113° and 122° F.) while chlorine gas is being passed into it; the bromides are at once decomposed; $MgBr_2 + Cl_2$ forms $MgCl_2 + Br_2$. The bromine volatilizes, and is condensed under a small quantity of water, which is contained in a deep Woulf's bottle kept cool by water, while that portion of bromine which escapes condensation is conducted into a solution of caustic potassa contained in an open bottle; this solution, when it has nearly lost its alkaline reaction, is subsequently utilized for the preparation of potassium bromide. The mother-liquors, as obtained in Western Pennsylvania and West Virginia, yield about ½ per cent. of bromine, or the brine about 1 pound of bromine to 13 bushels of salt. The production of the Ohio and Kanawha valleys amounts to about 130,000 pounds of bromine annually, in addition to which from 800 to 1000 pounds are manufactured in Pennsylvania (S. S. Garrigues, 1873). According to Wellcome (1877), about 1000 pounds are daily manufactured in the United States. W. J. M. Gordon (1883) gives the annual production in this country at between 450,000 and 500,000 pounds.

Properties.—It is a heavy, brownish-red, mobile and very volatile liquid, exhaling at the ordinary temperature deep orange-red vapors, which are highly irritating to the eyes and lungs, and on being conducted into a flame impart to it a green color. Its odor, which is suggestive of chlorine and iodine, is suffocating and disagreeable, hence its name (from βρῶμος, a stench). It boils at 63° C. (145.4° F.) (Pierre); Balard and others gave the boiling-point as low as 47° C. (117° F.). At 15° C. (59° F.) its specific gravity is 2.99, and at the freezing-point of water 3.187. It congeals at about −25° C. (— 12° F.), at the same time increasing its volume about 6 per cent. It destroys cork, wood, etc., bleaches litmus and other coloring principles, and alters or destroys most odorous organic compounds. It dissolves in 30 parts of water at 15° C. (59° F.), and in less of alcohol and ether, with gradual decomposition of these liquids, the brown-red, or if diluted brown-yellow, solutions are bleached rapidly in the sunlight, hydrobromic acid being formed. Potassium bromide increases the solubility of bromine in water. Carbon disulphide, benzene, and chloroform dissolve bromine freely with an orange-red color, and, like ether, take it up from the aqueous solution on being agitated with the latter. When in contact with water at a low temperature, bromine forms a deep-red hydrate, $Br_2.10H_2O$, crystallizing in octahedrons or in scales, which at 15° C. (59° F.) are decomposed into bromine and water. Bromine and its solutions color starch-paste brown-yellow.

Impurities.—Iodine does not now often form an impurity of bromine, but chlorine is frequently present, and causes a lowering of the boiling-point. Carbon bromide is occasionally present in crude bromine, and may be removed by careful rectification, its boiling-point being considerably higher than that of bromine.

Tests.—Bromine should completely volatilize by exposure to air or to heat (absence of salts, etc.). "If bromine be added to an excess of sodium hydroxide test-solution, it should combine to form a permanently clear liquid, without the separation of oily drops or the development of an odor resembling that of chloroform (absence of bromoform or other organic bromine compounds). If an aqueous solution of bromine be shaken with a slight excess of reduced iron until it becomes nearly colorless, the filtered liquid, on the addition of a small amount of ferric chloride and of starch test-solution, should not assume a blue color (absence of iodine). If 1 Cc. of a saturated aqueous solution of bromine be diluted with 9 Cc. of water, then mixed with 3 Cc. of ammonium carbonate test-solution and 5 Cc. of decinormal silver nitrate solution, and the whole actively shaken, the filtered liquid, when supersaturated with nitric acid, should not become more than opalescent, nor separate a flocculent precipitate within three minutes (absence of more than 3 per cent. of chlorine)." —*U. S.*

Pharmaceutical Uses.—In the manufacture of most of the medicinal bromine compounds free bromine is or may be employed.

Derivative Compounds.—Bromal, C_2HBr_3O. Mol. weight, 280.18. This compound resembles chloral in its chemical nature, and like it forms a hydrate when brought in contact with water or an alcoholate with alcohol. It is obtained when bromine is slowly added to absolute alcohol, the mixture kept cool, and after twenty hours distilled: bromal comes over between 172° and 180° C. (341.6° and 356° F.), and condenses as an oily liquid, which does not congeal at —20° C. (— 4° F.). It has a peculiar penetrating odor and a sharp, burning taste; its vapors are irritating to the eyes. On exposure to moist air it is converted into a white crystalline mass of bromal hydrate, $C_2HBr_3O.H_2O$, which can be obtained in large transparent crystals from its

solution in water; the hydrate has the odor and taste of bromal and fuses at 53.5° C. (128.3° F.). The alcoholate fuses at 44° C. (111.2° F.), is slightly soluble in water, and is decomposed by heat. Bromal is decomposed by alkali hydroxides, forming bromoform and alkali formate. A mixture of bromal hydrate and strong sulphuric acid separates oily bromal, but is not colored brown. Bromal hydrate forms with distilled water a clear solution which is not precipitated by silver nitrate.

Bromoform. Tribromomethane. $CHBr_3$. Mol. weight, 252.25.—This compound is analogous to chloroform, and is obtained when bromine is allowed to act on alcohol in the presence of alkalies or alkaline earths. It is now made almost exclusively by Denig's process, which consists in the action of sodium hypobromite on acetone; bromine is added to solution of sodium hydroxide, yielding sodium bromide and hypobromite; and when acetone is brought in contact with this mixture, reaction takes place (even in the cold), resulting in the formation of bromoform, together with sodium acetate and hydroxide. Bromoform is a clear colorless liquid of peculiar odor and sweetish taste; its spec. grav. is 2.9, and its boiling point 147–148° C. (296.6°–298.4° F.). It is sparingly soluble in water, but readily in alcohol, and must be kept protected against sunlight. Caution is necessary in the selection of this article: for medicinal use only that free from color and acid should be chosen. The chief value of bromoform has been as an abortive agent in the paroxysms of whooping cough, although it has also been used successfully by inhalation in the treatment of diphtheria. The usual dose for children is from 5 to 20 drops daily, preferably given in solution. Owing to the insolubility of bromoform in water, the following combination, suggested by Prof. Bedford, appears very desirable; each fluidrachm will contain about 3 drops of bromoform: Bromoform 16 minims, alcohol 2 fluidrachms, glycerin 12 fluidrachms, compound tincture of cardamom 2 fluidrachms; mix in the order named.

Bromol. Tribromophenol. $C_6H_2Br_3OH$. Mol. weight 330.06.—This is a well-known compound produced by the action of bromine upon phenol (carbolic acid) in aqueous solution. It occurs in the form of white crystals melting at 95° C. (203° F.), with an unpleasant odor and sweetish, astringent taste. It is soluble in alcohol, ether, chloroform, glycerin, and fixed and volatile oils, but is insoluble in water. Bromol possesses strongly antiseptic properties and is said to be non-toxic. It has been given internally in doses of $\frac{1}{10}$ to $\frac{1}{3}$ of a grain in cholera infantum; externally it is used in diphtheria in form of a 4 per cent. glycerin solution. *Bromol* must not be confounded with *Bromal* (which see above).

Bromine blocks for disinfecting purposes have been recommended by Frank (1882), and consist of a porous mass formed by incinerating a mixture of diatomaceous earth with crude tartar or with calcium saccharate; cut into cubes of 45 Cc., these weigh about 30 Gm. and absorb 100 Gm. of bromine, which is very gradually given off on exposure.

Action and Uses.—When dogs are confined in an atmosphere of bromine vapor they suffer a profuse secretion from the eyes, nostrils, and fauces, with cough, hoarseness, and dyspnœa. It is a corrosive irritant of the stomach, producing vomiting, pain, diarrhœa, and death by exhaustion. On dissection the mucous membrane of the stomach and bowels is found softened. Applied to the shaven hide, bromine acts as a caustic and produces gangrenous sores. As it is extremely volatile, care must be taken not to allow its vapor to reach the eyes, nostrils, or mouth. A case of death from bromidia is reported (*Med. News*, xlix. 305). The caustic action of bromine may be arrested by a 1–2 per cent. solution of carbolic acid (Schrwald, *Therap. Monatsh.*, iii. 384).

Formerly bromine was employed in the class of cases in which the use of iodine afterward became general—viz. glandular and other forms of *scrofula*, chronic diseases of the *skin*, constitutional *syphilis*, chronic enlargement of the internal *lymphatic* and *mesenteric glands*, the *liver*, *spleen*, *ovaries*, *uterus*, etc.—but in all of these uses it has been superseded by iodine. During the Civil War of the United States it was extensively applied to the treatment of *hospital gangrene*, according to the method of Dr. Goldsmith, which consisted essentially in cleansing the wound as far as possible of gangrenous tissue, and then applying pure bromine by means of a cotton or lint swab attached to a long wooden handle. Lint moistened with a weak solution of bromine in water was then laid on, covered with oiled silk or other impermeable tissue, and secured with a bandage. After a few hours a poultice was substituted, under which the eschar separated, leaving a healthy wound. The operation was severe, and the patient while undergoing it was etherized. According to Frank and others, bromine is one of the best agents for deodorizing and disinfecting the atmosphere of hospitals, etc. Berlin sanitary officials declare that three and a half ounces of bromine can disinfect a space of 918 cubic feet, and deodorize a space of 7000 cubic feet (*Med. News*, xli. 514). *Cancer* of different forms and of various external organs has been treated by tissue injections of a strong solution of bromine in alcohol, 1 part to 3; but owing either to its inefficiency or its painfulness the method does not appear to have been generally adopted. A weaker solution (1part in 8) has been used with some advantage as a local application to the skin for the purpose of allaying *pain*. Bromine is one of the numerous remedies proposed as specifics for poisoning by *Rhus radicans*.

Recently the topical use of bromine, which was advocated by Goldsmith in 1887 (*Med. Record*, xxxvii. 138), has been revived in the treatment of *diphtheria*. Hiller claims almost uniform success from pencilling the affected parts of the fauces with a solution of equal parts of bromine and bromide of potassium, Gm. 0.5–1 (gr. viij–xv) in Gm.200 (f℥vj.) of water. He also employs inhalations of bromine from a solution of 10 grains each of the two agents in from 10 to 15 ounces of water (*Centralbl. f. d. ges. Therap.*, i. 341). These results are confirmed by Hesse, who, moreover, warns against the use of bromine in laryngeal diphtheria and in bronchial and pulmonary disease (*Centralbl. f. Med.*, v. 86).

Bromal.—Bromal hydrate is a powerful and almost caustic irritant; applied to the skin in an ointment, it occasions redness and swelling, with subcutaneous infiltration, and therefore should not be used hypodermically. Unless greatly diluted it cannot be taken internally, and even then it soon gives rise to burning in the throat, vomiting, and diarrhœa. It has been tried in *epilepsy* ineffectually, and there is no reason why it should be used at all as a medicine.

Bromoform.—In 1884, V. Horoch inferred from his experiments with bromoform that it is anæsthetic and narcotic. In surgical operations on man the effects were the same. Its poisonous action is manifested by collapse and coma (*Therap. Monatsh.*, iv. 641; *Med. News*, lviii. 18). The compound appeared to possess antiseptic powers (*Centralbl. f. d. g. Ther.*, ii. 93). Bonome and Mazza substantially confirmed these results; they observed, however, that bromoform acted more slowly than either chloroform or ether, and was apt to irritate the eyes and nostrils. No excitement preceded its narcotic action (*Phila. Med. Times*, xv. 46). Stepp claimed for it remarkable efficacy in the treatment of *whooping cough*, giving to a child three or four weeks old one drop three or four times a day, and to older children proportionately larger doses. It was prescribed in water only, although it does not mix with this liquid. It tends readily to be decomposed, especially under the action of light (*Lancet*, Aug. 1889, p. 397; Dec. 1889, p. 1192). Neumann found it only a palliative of the disease (*Therap. Monatsh.*, iv. 321) while Fischer claims it to be "the best known remedy" (*Med. Record*, xxxviii. 257).

BRYONIA, *U. S.*—Bryonia, Bryony.

Bryone blanche, F. Cod.; *Couleuvrée*, F.; *Zaunrübe, Gichtrübe*, G.; *Brionia*, Sp.

The root of Bryonia alba, *Linné*, and Br. dioica, *Linné*.

Nat. Ord.—Cucurbitaceæ.

Origin.—Both plants are climbing monœcious and diœcious perennials and indigenous to Europe, Br. alba being more frequent in the northern, and Br. dioica in the southern section of that continent. They have rough, cordate, five-lobed, and toothed alternate leaves, and cymes of four to six small greenish-yellow flowers. Br. alba has black, Br. dioica red, globular berries, which are ¼ inch (6 Mm.) in diameter; hence the names *black* and *red bryony*. The root is collected in spring, and on drying loses from 85 to 88 per cent. in weight.

Description.—The roots are 18 inches to 2 feet (45 to 60 Cm.) long and 2 to 4 inches (5 to 10 Cm.) thick, nearly simple, in the fresh state fleshy and somewhat lactescent. Both are externally pale grayish-brown, transversely wrinkled, the root of Br. alba with numerous transversely elongated suberous warts or ridges. Internally they are white, have a thin bark, a brown cambium line, broad medullary rays, and numerous small narrow wood-bundles arranged between the medullary rays in radiating lines, and concentrically in circles separated by rather broad circles of parenchyma. This latter tissue shrinks considerably in drying, and, the root being usually dried in transverse slices, these show an irregular radiating and concentric arrangement from the projecting wood-rays. Dried bryony-root is inodorous and has a disagreeable bitter taste.

Constituents.—The bitter principle *bryonin* appears to have been first obtained pure by Walz (1859), though Schwerdtfeger had previously separated pearly crystals of a bitter and acrid taste, which, however, contained nitrogen. The aqueous solution of the alcoholic extract is precipitated by lead subacetate, the filtrate treated with hydrogen sulphide, neutralized with soda, and precipitated by tannin; this precipitate is dissolved in alcohol, the solution treated with lime, the filtrate decolorized with animal charcoal, evaporated, and washed with ether. Bryonin forms a white powder having the composition $C_{48}H_{80}O_{19}$, of an intensely bitter taste, insoluble in ether and soluble in water and alcohol. When boiled with dilute sulphuric acid, bryonin is split into glucose and amorphous *bryoretin* and *hydrobryoretin*, the former of which is soluble, and the latter insolu-

ble in ether. Bryony-root contains also starch, gum, sugar, albumen, waxy and fatty matter, malates and other salts.

Allied Plants.—Bryonia americana, *Lamarck*, and Br. africana, *Thunberg*, are employed in their native countries like European bryony. The former species is indigenous to the West Indies, the latter to Southern Africa.

Br. epigæa, *Rottl.*, of India has a mucilaginous and slightly bitter root, which is used by the natives as an alterative in syphilis and as a remedy in snake-bites.

Tayuya-root of Brazil, which has been recently recommended as a remedy for syphilis and scrofula, is said to come from a species of Bryonia.

Action and Uses.—The fresh plant applied to the skin produces vesication. Taken accidentally by man, bryony-root has occasioned profuse watery stools, violent colic and vomiting, collapse, and death. Three fatal cases of its use are referred to by Dixson, who also relates one in which grave symptoms were followed by recovery (*Therap. Gaz.*, x. 35).

In the Hippocratic writings bryonia-root prepared with wine was recommended for tetanus, prolapsus of the rectum, and uterine ulcers. Dioscorides in addition speaks of the young sprouts as purgative and diuretic, and of the root applied in poultices, etc. for the cure of various cutaneous eruptions, abscesses, etc. One species, the black, was especially recommended in affections of the spleen and kidneys and as a remedy for epilepsy. Later ancient writers speak of it as an emmenagogue and abortifacient, and as a remedy for the bites of venomous animals and insects. In modern medicine it has been principally employed as a hydragogue cathartic in *dropsy* in the same manner as jalap. In certain cases of *epilepsy* depending upon intestinal worms it has effected a cure. It has been used in chronic intermittent fever with enlargement of the *spleen*, and in chronic *bronchitis* with serous effusion in the air-tubes. It has also been recommended in the catarrhal stage of *whooping cough*. Externally, it has been employed as a rubefacient or vesicant in cases of *hydrarthrosis*, chronic articular and muscular *rheumatism*, and *glandular* engorgements. Slices of the fresh root have been applied behind the ears of children as a substitute for suppressed eruptions during dentition, and the juice has been used topically in *scabies*. A Roumanian physician claims for B. alba a decidedly *anti-hæmorrhagic* virtue, especially in post-partum hæmorrhage (*Annuaire de Thérap.*, 1888, p. 327).

The *dose* of the powder is from Gm. 0.60–4.00 (gr. x–lx). An infusion made with Gm. 8 in Gm. 250 of water (℥ij in Oss) may be prescribed in doses of a wineglassful.

Tayuya-root has been sufficiently tested in Europe to prove that it is a very feeble remedy for *syphilis* and *scrofula*. In a few cases only did it seem to be useful in superficial and glandular forms of either disease, and then only when reinforced by other medicines or a severe regimen.

BUCHU, *U. S.*—Buchu-leaves.

Buchu folia, Br.; *Folia bucco*, *Folia diosmæ*, *s. barosmæ.*—*Feuilles de bucco* (*booko*, *buchu*), Fr.; *Buckublätter*, *Buccoblätter*, G.

The leaves of—1. Barosma betulina (*Thunberg*), *Bartling et Wendland;* 2. Barosma crenulata (*Linné*), *Hooker.* Bentley and Trimen, *Med. Plants*, Pl. 45, 46.

Nat. Ord.—Rutaceæ.

Origin.—The three plants are shrubs attaining a height of several feet; the short-stalked or nearly sessile leaves are opposite or subalternate; the flowers, which are handsome, have the calyx deeply five-lobed; the five petals white or pinkish, longer than the calyx, and glandular punctate on the back, and the five hypogynous stamens alternating with the petals. The fruit consists of five carpels, which are united by the inner margin, are dehiscent above by their ventral suture, and contain each one smooth, glossy, and black seed. The shrubs are indigenous to the southern portion of Africa, more particularly to various parts of Cape Colony.

Much uncertainty has prevailed in relation to the diagnosis of the two first-named species, due to the great variation of the leaves. At the present time the following synonyms appear to be generally admitted:

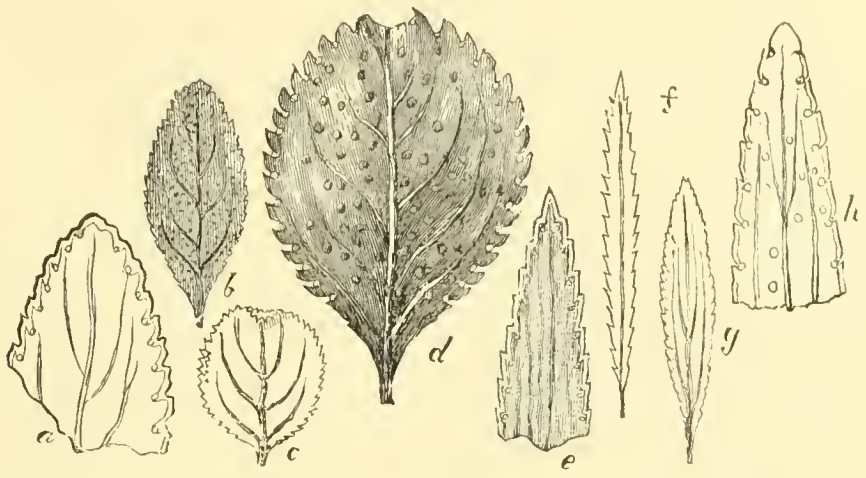
1. Barosma betulina, *Bartl.;* Diosma betulina, *Thunb.;* D. crenata, *D. C.*, *Lindl.*, and others; 2. B. crenulata, *Hook;* B. crenata, *Kunze;* D. crenata, *Lin.;* D. crenulata, *Lin.;* D. odorata, *D. C.;* D. latifolia, *Lodd.*

Description.—The leaves of the first species constitute most of the so-called *short buchu* of the market; they are 12 to 19 Mm. (½ to ¾ of an inch) long, obovate or

rhomboid-obovate, cuneate below, usually obtuse, and with the apex recurved; margin sharply serrate, each serrature containing a gland; base almost entire; texture cartilaginous.

The second species likewise contributes to the short buchu, the larger leaves being occasionally held as an *intermediate* variety between the short and the long. The leaves

Fig. 41.



Buchu-leaves: *a*, *b*, Barosma crenata, *Kze.*; *c*, *d*, Bar. betulina, *Bartl.*; *g*, *h*, Bar. serratifolia, *Willd.*; *e*, *f*, Empleurum serrulatum, *Ait.*—*b*, *c*, *f*, *g*, natural size.

vary between 19 and 31 Mm. (¾ and 1¼ inches) in length, and between oval and ovate or obovate in shape, obtuse above, margin serrulate or crenate, each crenature with a gland.

The leaves of Barosma serratifolia, *Willdenow*, differ materially in shape from the preceding; they constitute the *long buchu* of our commerce, are rather thinner than the two preceding kinds, 25 to 38 Mm. (1 to 1½ inches) long, linear-lanceolate in outline, tapering toward both ends, obtuse, margin serrulate, with a gland in each serrature, midrib prominent, with four lateral veins running nearly parallel to the margin.

Buchu-leaves are smooth, have a dull-green color, are paler on the lower surface, and have numerous large oil-cells, which render the leaves pellucid-punctate when held up to the light; they have a strong peculiar odor and a bitterish and aromatic taste. Prof. Flückiger (1873) has observed a layer of colorless cells between the epidermis of the upper side and the green tissue, which cells yield a large quantity of mucilage to water.

The leaves of Barosma Eckloniana, *Berg*, seem to be occasionally imported; they are nearly an inch long, oval, rounded at the base, strongly crenate, and grow from pubescent shoots (*Pharmacographia*).

Constituents.—The leaves of the first species yield from ½ per cent. (Flückiger, 1880) to 1.21 (Bedford, 1863) or 1.63 (Flückiger and Hanbury, 1874) per cent., those of the third species 0.66 per cent., of volatile oil (Bedford). The two oils agree with each other in sensible properties, and probably also in composition. In odor they resemble peppermint; exposed to a low temperature, they separate *barosma camphor* or *diosphenol*, a stearopten which, after recrystallization from alcohol, is in colorless needles which fuse at 83° C. (181.4° F.), sublime at the heat of a steam-bath, and boil at 233° C. (451.4° F.), but cannot be distilled without partial decomposition. Pure diosphenol has a slightly aromatic odor and a peculiar taste; its composition is $C_{14}H_{22}O_3$. Its alcoholic solution is colored dingy black-green by ferric chloride; its solution in alkalies is precipitated by carbon dioxide. It is probably this camphor which was described by Landerer (1844) as *diosmin*, and observed in a tincture of buchu three years old. The diosmin of Brandes was an extract-like body of a bitterish taste. Prof. Wayne (1876) obtained salicylic acid from the distillate of a lot of buchu-leaves; recent investigations having failed to detect this acid, its presence may probably be accounted for by an accidental admixture of the leaves. Buchu-leaves possibly contain a body similar to rutin (Flückiger). Besides the constituents mentioned, resinous, gummy, albuminous, and coloring matters and saline compounds have been observed. B. crenulata yields 4 to 5.4 per cent. of ash; B. betulina, 4.4 to 4.7 per cent.; and B. serratifolia, 5 to 5.5 per cent. (H. W. Jones, 1879).

Impurities and Substitutions.—The short buchu is sometimes mixed with the flowers and the non-aromatic capsules, which must be separated. The long buchu is

usually cleaner, but is occasionally mixed with or replaced by the leaves of Empleurum serrulatum, *Aiton*, nat. ord. Rutaceæ, indigenous to Southern Africa; they are 1 to 3 inches (25 to 75 Mm.) long, have a narrow linear shape, a serrulate margin, and an acute glandless apex; their odor is different from buchu. From other leaves buchu is readily distinguished by the characters given above.

Action and Uses.—Buchu excites a sense of warmth in the stomach which diffuses itself over the whole body. It quickens the appetite and digestion, and favors the secretion of urine, giving it a peculiar aromatic smell. Large doses excite vomiting and purging. The Hottentots, from whom a knowledge of this medicine was derived, employed an ointment made from it as a vulnerary, and a vinous tincture as a remedy for various disorders of the stomach and the urinary organs. It is chiefly in the last-named affections that it is used—viz. *chronic pyelitis*, *cystitis*, and *urethritis*. It is most commonly, perhaps, resorted to as a remedy for *catarrh of the bladder* caused by an extension of urethral irritation, but catarrh of the whole urinary passage is favorably influenced by it, as well as vesical tenesmus and atony of the bladder when they are attendant symptoms. Like other bitter plants containing a volatile oil, it may sometimes be useful in *feeble digestion* with flatulence. It may be administered in substance, Gm. 1.30–2.00 (gr. xx–xxx), or in the infusion or fluid extract. The former is prepared with Gm. 32 in Gm. 500 (℥j in Oj) of boiling water. *Dose*, Gm. 32–64 (℥j–ij). An infusion made with buchu and the analogous plant, uva ursi, is generally preferable to one containing either alone: ℞. Buchu, uvæ ursi, āā. Gm. 4–16 (℥j–iv); hot water, fl. Gm. 500 (Oj). Digest for half an hour in a covered vessel and strain. *Dose*, from ½ fluidounce to 2 fluidounces three times a day.

CACTUS.—Cactus.

Cactier, Fr.; *Kaktus*, *Fackeldistel*, G.

Nat. Ord.—Cactaceæ.

Description.—Of the numerous species of these American plants which are more or less medicinally employed in their native country the following has recently attracted attention:

Cactus (Cereus, *Miller*) grandiflorus, *Linné.*—Night-blooming cereus, *E.*; Cierge à grandes fleurs, *Fr.*; Königin der Nacht, *G.*—It is indigenous to tropical America, and frequently cultivated for ornament. The stem is weak, branching, fleshy, green, and five- or six-angled, the angles being beset with clusters of five or six short radiating spines. The numerous imbricate calyx-lobes are linear, acute, brownish, the inner ones yellow. The lanceolate petals are of a white color. The flowers, which open in the evening and wither by the following morning, are very fragrant and produce an orange-colored, interternally white, berry of the size of an egg. The fleshy branches, with the flowers, are imported preserved by alcohol. The juice has an acrid taste. The plant has not been analyzed.

Allied Plants.—Cactus (Cereus, *De Candolle*) fimbriatus, *Lamarck.*—The stem is erect, eight- to ten-angled, with clustered spines, and bears rose-colored flowers and red fruits. The juice is acrid; the berries are acidulous.

Cactus (Cereus, *De Candolle*) paniculatus, *Lamarck.*—It is tall, tree-like, with a quadrangular stem and numerous crenate and spiny branches. The large yellowish berries have a sweet and acidulous taste.

Cactus (Cereus, *Miller*) flagelliformis, *Linné.*—Stem and branches are weak, thin, several feet long, ten-angled, warty, spiny, and bear red flowers and small woolly berries. The acidulous juice is reputed to be anthelmintic. It contains, according to L. A. Buchner (1836), acid calcium malate, potassium acetate, albumen, mucilage, etc.

Opuntia vulgaris, *Miller*, s. Cactus Opuntia, *Linné.*—Prickly pear, *E.*; Figue de Barbarie, *Fr.*; Indische Feige, *G.*—It is indigenous to the West Indies and near the coast of North America northward to Massachusetts. The branches are broadly obovate, green, fleshy, bristly, and have small appressed subulate leaves, yellow flowers, and red bristly berries with an acidulous sweet pulp.

Mammillaria simplex, *Haworth*, s. Cactus mammillaris, *Linné.*—The stem is simple, obovate-oblong, about 8 inches (20 Cm.) high, mammilar-tuberculate, spiny, and produces small white flowers and bright-red berries.

Mamillaria simplex, *Haworth*, s. Cactus mamillaris, *Linné.*—The stem is simple, obovate-oblong, about 20 Cm. (8 inches) high, mammilar-tuberculate, spiny, and produces small white flowers and bright-red berries.

Anhalonium lewini, *Hennings.*—This plant is indigenous to Mexico, where it is used under the name of *muscale buttons* as a narcotic. The plant contains *anhalonine*, which seems to have physiological properties similar to those of strychnine (Lewin, 1889).

Melocactus communis, *Link et Otto*, s. Cactus Melocactus, *Linné*.—The stem is subglobular, about sixteen-furrowed, the ridges beset with clustered brown spines, flowers and berries red.

The succulent stems of the last-named three species and of many others are bruised and employed as discutient applications. The red-juiced berries when eaten are stated to color the urine red.

Mesembryanthemum crystallinum, *Linné* (nat. ord. Ficoideæ) (Ice-plant, Diamond fig, *E.*; Glaciale, Cristalline, *Fr.*; Eiskraut, *G.*), is well known under cultivation, is covered with glittering vesicles, has roundish ovate fleshy leaves, bears white or reddish odorless flowers, and has a saline taste. The juice contains oxalates and other salts. Brandenburg obtained from the dry plant 42 per cent. of ash, one-third being sodium salts; but H. Mangon (1882) found it to be very rich in potassium salts.

Action and Uses.—Long ago cactus (grandiflorus) juice was known to be extremely acrid, producing vesicles and pustules, and when taken internally causing vomiting, colic, and bloody stools. In substance and in tincture it was employed as a vermifuge (Richter, *Arzneimittellehre*, ii. 290). In 1868 it was stated that the tincture of the plant had been used advantageously by Rubini in functional *palpitation of the heart* (*Med. Record*, iii. 299); in 1879, Dr. N. S. Davis confirmed the earlier statement (*Phila. Med. Times*, x. 26); and in 1883, Dr. Byrd reported that it palliated the abnormal action and the pain in rheumatic disorders of the heart, and was even beneficial to the rheumatism itself (*ibid.*, xii. 811) The general agreement of opinion in recent years regarding it may be expressed as follows: Cactus, like digitalis, slows the heart, while increasing its energy and raising the arterial tension, but, unlike the latter drug, it displays no cumulative action, nor does it tend, like digitalis, to produce extreme contraction of the heart, resulting in sudden arrest of its action. As formerly pointed out, it is useful chiefly in functional disorders of the heart with or without simple dilatation, and occurring in exhausted states of the system. It fails when the feeble action of the organ depends upon extreme dilatation, and also in mitral obstruction, but is useful in aortic regurgitation. The medicine is usually employed as a tincture or fluid extract in the dose of Gm. 0.30–0.60 (♏ v–x) two or three times a day.

Opuntia vulgaris, cut transversely, is applied to swellings as a discutient. A decoction of it forms a mucilaginous drink (Porcher).

Anhalonium Lewinii, or "muscale buttons," has been studied by Lewin, who procured from it a basic substance named by him anhalonine. Experiments with it and with a watery extract of the plant showed that in the lower animals it occasioned a sedative or paralyzing action on the spinal cord, augmenting its reflex excitability even to the production of tetanus. Smaller doses caused only vomiting (*Therap. Gaz.*, xii. 231.) The fruit is reported to possess an exhilarating or intoxicating power whose effects last for several days. Its primary effect is to quicken the pulse- and respiration-rates, and is followed by unconsciousness and collapse (Briggs). An extract prepared from it is alleged to produce depression primarily, which is followed by excitement, and this in its turn by repose and sleep. A single drop of the fluid extract is said to relieve *dyspnœa* from various causes, and also the paroxysms of *angina pectoris* (Landry, *ibid.*, xiii. 16), besides exhibiting various incompatible virtues. Another reporter calls it "a heart-tonic, pure and simple" (Gregory, *Med. News*, liii. 682).

Mesembryanthemum is an obsolete medicine which once had a certain vogue in Europe, especially for the relief of disorders of the bladder attended with *dysury* or *incontinence* of urine. The expressed juice was used in the *dose* of Gm. 16 (a tablespoonful) daily.

CADMII IODIDUM, *Br. 1867.*—Cadmium Iodide.

Cadmium iodatum, Iodidum cadmicum.—Iodure de cadmium, Fr.; *Jodkadmium, Kadmiumjodür*, G.

Formula CdI_2. Molecular weight 364.56.

Preparation.—This salt is generally prepared by digesting an excess of metallic cadmium with iodine and water until a colorless solution is obtained, which is filtered and evaporated. It may also be obtained by dissolving 20 parts of potassium iodide and 15 parts of cadmium sulphate in water, evaporating the solution to dryness, exhausting the residue with warm absolute alcohol, and filtering and crystallizing (A. Vogel, 1863).

By the first process a direct combination of the metal and iodine is effected, while in the second process a mutual decomposition of the two salts takes place, with the formation of cadmium iodide and potassium sulphate. The latter, being insoluble in alcohol, remains upon the filter: $CdSO_4 + 2KI$ yields $CdI_2 + K_2SO_4$.

Properties and Tests.—Cadmium iodide exists in white, flat, micaceous crystals of a pearly lustre, inodorous, of a nauseous metallic taste, permanent in the air, soluble in alcohol and at the ordinary temperature in a little more than its own weight of water. Heated at about 310° C. (600° F.), it forms an amber-colored liquid, and at a dull-red heat is decomposed, vapors of iodine being given off. The aqueous solution, which reddens litmus, yields with hydrogen sulphide a yellow precipitate of CdS, which is insoluble in ammonium sulphide (differences from arsenic), and the filtrate from this precipitate is not affected by ammonia, ammonium sulphide or carbonate (absence of the metals of the zinc group and of the earths and alkaline earths), and after applying these tests leaves no residue when evaporated to dryness and ignited (absence of alkalies). The presence of heavy metals would be indicated by the brown or blackish discoloration in the yellow color of the precipitated sulphide. Ammonia would be detected by the odor given off on the addition of an excess of potassa solution. Most other cadmium salts differ considerably from the iodide in appearance. Their possible presence, however, may be inferred by applying the following test of the British Pharmacopœia: 10 grains dissolved in water, and silver nitrate added in excess, give a precipitate which, when washed with water and afterward with half an ounce of solution of ammonia, and dried, weighs 12.5 grains." Any deviation from this weight indicates the presence of foreign salts.

Action and Uses.—According to Garrod, it has the same action and may be employed in the same cases as yellow iodide of lead, particularly in *scrofulous* enlargement of the *glands* and chronic skin diseases. It does not stain the skin. An ointment may be used containing Gm. 4–32 (gr. lx–℥j) of lard.

CADMII SULPHAS.—Cadmium Sulphate.

Cadmium sulfuricum, *Sulfas cadmicus.*—*Sulfate de cadmium*, Fr.; *Schwefelsaures Cadmiumoxyd*, *Kadmiumsulfat*, G.

Formula $3CdSO_4.8H_2O$. Molecular weight 765.64.

Preparation.—This salt is readily prepared by dissolving 2 parts of metallic cadmium in 2 parts of sulphuric acid which has been diluted with 10 or 12 parts of water and mixed with 1 part or 1¼ parts of nitric acid. Cadmium dissolves slowly in diluted sulphuric acid, with the liberation of hydrogen, but in the presence of nitric acid it is readily dissolved, with the evolution of nitric oxide, according to the equation $3Cd_2 + 6H_2SO_4 + 4HNO_3 = 6CdSO_4 + 8H_2O + 4NO$. Sufficient heat will be generated to cause the reaction to proceed briskly. When it slackens heat is applied, and the whole evaporated to dryness to expel excess of acid; the residue is dissolved in three times its weight of water, the solution filtered, evaporated to one-half, and set aside to crystallize. The crystals are collected upon a filter and dried at a moderate heat. The mother-liquor may be made to yield more crystals by further evaporation. From the last portions the cadmium may be obtained by precipitation with zinc.

Properties and Tests.—Cadmium sulphate crystallizes in colorless rhombic prisms, which effloresce somewhat in the air, have an astringent and strongly metallic taste, and change the color of blue litmus-paper to red. It dissolves at 23° C. (73.4° F.) in 1.6 parts of water, is somewhat more soluble in hot water, and is insoluble in alcohol; at 100° C. (212° F.) it loses 11.8 per cent. (5 molecules) of water, and the remainder when heated to redness; at a full red heat one-half of the acid is also expelled. Its purity may be ascertained by precipitating the solution of 10 grains of the salt with dilute potassa solution, and after washing the precipitate igniting it; it should weigh 5 grains; or, 10 grains of cadmium sulphate dissolved in water, and barium nitrate added in excess, yield a precipitate which after washing and heating should weigh 9.1 grains.

Action and Uses.—Sulphate of cadmium is astringent and irritant, like sulphate of zinc, but is much more powerful. A grain taken internally has occasioned profuse salivation, vomiting, colic, diarrhœa, and tenesmus. Injected subcutaneously, it has caused giddiness, retarded pulse and respiration, fainting, and sometimes spasms. It has been chiefly used in *conjunctivitis*, ulcers and opacities of the *cornea*, *otorrhœa*, and *gleet*, in solutions containing from Gm. 0.06–0.50 (gr. j–viij) of the salt in Gm. 64 (2 ounces) of water. *Bromide of cadmium* is employed by photographers, and is sometimes found in commerce labelled bromide of ammonium. In a published case two ladies, misled by this error, took a small but uncertain dose of the former salt. It occasioned violent vomiting and a severe burning pain in the throat, œsophagus, and stomach, followed by purging and collapse. No cerebral symptoms were present. For several days

both patients were confined to bed and their stomachs continued irritable (Wheeler, *Boston Med. and Surg. Jour.*, Oct. 1876, p. 434). Roux employed it in epilepsy, but produced only excessive vomiting.

CADMIUM.—Cadmium.

Cadmium, Fr., G.; *Kadmium*, G.

Symbol Cd. Atomicity bivalent. Atomic weight 111.5.

Origin and Preparation.—This metal is found near Bishopstown, Scotland, in the form of sulphide as the mineral greenockite, but it is more frequently present in small quantities in some kinds of calamine, blende, and other zinc ores. It was discovered by Stromeyer and Hermann in 1817. Cadmium being more volatile than zinc, it is contained in the first portions o btained in the distillation of the latter metal, and its presence is indicated by the appearance of a brown flame (the so-called "brown blaze") before the greenish-white flame of burning zinc is noticed. To obtain cadmium the zinc, or the zinc oxide containing it, is dissolved in dilute sulphuric or muriatic acid, and the cadmium precipitated by metallic zinc; or the acid solution is treated with hydrogen sulphide to precipitate the cadmium as yellow sulphide, which is used as a pigment under the name of *cadmia;* the sulphide is dissolved in strong hydrochloric acid, the solution precipitated by an excess of ammonium carbonate to remove copper and traces of zinc, and the washed and dried precipitate mixed with lampblack and distilled.

Properties.—Cadmium is a malleable and ductile metal having the color of tin, and like the latter it emits a crackling sound when bent. It crystallizes readily in octahedrons, is superficially tarnished on exposure to the atmosphere, becomes brittle at 82° C. (180° F.), fuses near 315° C. (592° F.) (B. Wood, 1862), and volatilizes, according to Becquerel (1863), at 720° C. (1319° F.), and according to Deville and Troost at 860° C. (1580° F.). Its density varies between 8.60 and 8.69; its vapor is dark-yellow, has a nauseous taste, and burns with a dark-red flame to brown oxide. In the presence of acids cadmium slowly decomposes water, hydrogen being given off; but nitric acid dissolves the metal readily. The salts of cadmium are mostly white; those soluble in water have an acid reaction and a disagreeable metallic taste. Their solutions, treated with hydrogen sulphide or ammonium sulphide, afford orange-yellow precipitates of CdS, which is insoluble in an excess of the precipitant and in dilute acids and alkalies. Caustic alkalies produce white precipitates of $Cd(OH)_2$, which is soluble in ammonia, but not in potassa or soda. The soluble carbonates, phosphates, and oxalates and potassium ferrocyanide produce white precipitates.

Tests.—The impurities likely to be present in metallic cadmium are mainly zinc and copper, the former of which is recognized by precipitating the solution in nitric acid with hydrogen sulphide, when the filtrate from the bright orange-yellow precipitate will yield a white precipitate on the addition of ammonia and ammonium sulphide. When the solution in nitric acid is precipitated by slight excess of ammonium carbonate, the filtrate will have a blue color if copper be present.

CAFFEA.—Coffee.

Semen Coffeæ.—Café, Fr.; *Kaffee*, G.

The fruit of Coffea arabica, *Linné.* Bentley and Trimen, *Med. Plants*, 144.

Nat. Ord.—Rubiaceæ, Coffeineæ.

Origin.—Coffee is indigenous to tropical Africa, more particularly to Abyssinia; possibly also to Southern Arabia, but this is denied by some authors. It grows wild in Central Africa and on the coast of Mozambique, and was introduced into Java near the close of the seventeenth century, and into the West Indies and South America during the eighteenth century. At present it is very extensively cultivated in most tropical and subtropical countries. The Liberian coffee-plant is a distinct species, C. liberica, *Hiern* (1877), which seems to be less subject to disease, and has been successfully introduced in the East Indies. The seeds of several other species of Coffea are used in their native countries, but do not appear to be of commercial importance.

In its wild state the coffee tree attains the height of from 6 to 9 M. (20 to 30 feet), and has somewhat the aspect of a cherry tree, but its bark is whitish and furrowed and its numerous branches are opposite. In cultivation it is trimmed down to the height of 1.8 M. (about 6 feet). The smooth evergreen leaves are ovate-oblong, rather accuminate, 10 to 15 Cm. (4 to 6 inches) long, 37 to 50 Mm. (1½ to 2 inches) wide, dark-green and

glossy above, paler beneath, and somewhat glandular near the midrib. Flowers in clusters of three to five or seven, with a small five-lobed calyx, a white tubular five-lobed corolla, five stamens, and one pistil with a bifid style. The fruit is an oval, deep-purple, two-seeded drupe, the parchment-like endocarp enclosing two plano-convex seeds, which are placed together by their flat sides and constitute the raw coffee of commerce. The Liberian coffee-plant has the corolla six- to nine-lobed and the fruit globular.

When the berries are ripe they are gathered and freed from the pericarp and scanty pulp by suitable apparatus and washing; the seeds are then dried, and subsequently freed from the parchment-like testa by passing them between wooden rollers and by winnowing. The seeds constitute one-third the weight of the ripe berries.

The use of coffee as a beverage appears to have spread from Abyssinia first to Arabia early in the fifteenth century, to Constantinople in 1554, and to France and England after 1640. Until the beginning of the eighteenth century the supply was exclusively obtained from Arabia, where, in the district of Yemen, the plant is cultivated and yields the small seeds so highly valued as Mocha coffee. The East Indian coffees consist usually of the largest seeds; West Indian and South American coffees are generally intermediate between the two varieties previously named.

Description.—The seeds are oval, longitudinally grooved upon the flat side, usually almost completely deprived of the parchment-like, finely-wrinkled testa, fragments of which remain in the groove and sometimes upon the back. The horny albumen is of the shape of the seed, according to the variety of a yellowish, brownish, bluish, or greenish tint, and is folded, or rather rolled up, whereby the groove is produced. The embryo is situated under the convex side near one end, is slightly curved, and occupies about one-fourth the length of the seed. Raw coffee has a very faint odor and a sweetish, slightly astringent, and bitterish taste. The commercial varieties vary considerably in flavor, in size, and in the shade of color. On keeping, coffee loses during the first year about 8 per cent. in weight, principally moisture; during the second, 5 per cent., and during the third year 2 per cent., the flavor being at the same time greatly improved.

Constituents.—The sweetish pulp of the pericarp contains several sugars, of which Boussingault (1881) found 2.37 per cent. cane-sugar, 8.73 per cent. invert-sugar, and 2.21 per cent. mannit. According to Payen's analysis (1849), coffee contains 13 per cent. of fat, 15.5 of glucose, dextrin, and an undetermined vegetable acid, 10 of vegetable casein, 5 of chlorogenate of caffeine and potassium, 3 of nitrogenized principle, 0.8 of caffeine, 0.001 of solid volatile oil, 0.002 of liquid aromatic principle soluble in water, 6.7 of ash, and 12 of moisture, the remainder being cellulose. The fat consists of palmitin and olein. The acids contained in coffee have been the subject of repeated investigations. These render it probable that, besides a little citric acid, the principal one is *caffeo-tannic acid*, which, according to Rochleder, is Payen's *chlorogenic acid;* its precipitate with gelatin is soluble in the tannin solution; tartar emetic does not precipitate it, but it yields with lead salts and baryta solution yellow precipitates. Vlaanderen and Mulder (1858) separated this principle under the name of *caffeic acid*, and regard the other acids of coffee (*caffeanic*, *cœrulic*, and *caffeelic*) as products of oxidation; and they believe the various colors of raw coffee to be due to mixtures of these derivatives. They consider chlorogenic as a mixture of their caffeic and cœrulic acids; Rochleder's *viridinic acid* (1848) may be a similar mixture. The *caffeic acid* of Hlasiwetz (1867) is obtained by continued boiling of caffeo-tannin with excess of potassa solution and separation by sulphuric acid. When pure it has the composition $C_9H_8O_4$, is in straw-yellow crystals, forms mostly yellow-colored salts, and, like the amorphous gum-like caffeo-tannin, yields with fusing potassa protocatechuic acid, $C_7H_6O_4$. By dry distillation pyrocatechin is obtained. Zwenger and Siebert (1861) obtained from Java coffee 0.3 per cent. of kinic acid, which is most likely the coffeic acid of Stenhouse, obtained (1854) from coffee-leaves, and which readily yielded kinone when treated with manganic deutoxide and sulphuric acid. (For a description of *Caffeine* see below.)

The roasting of coffee, which is best accomplished at a temperature of about 250° C. (482° F.), renders the seeds pulverizable, and at the same time gives them a more agreeable taste and enables them to yield more of their constituents to water. The coffee thus acquires a chestnut-brown color and loses about 18 per cent. of its weight. The generation of gaseous compounds ruptures the cells, and a peculiar and agreeable aroma is produced, probably through the decomposition of the fat and tannin. But Payen's (as well as Rochleder's) investigations failed to point out the principle to which the changes are due. Very probably they depend upon the decomposition of several of the organic compounds, and unquestionably upon the production of a pyrogenated volatile oil, to

which the grateful aroma is due. Caffeine does not partake of these changes, except that it is slowly volatilized at the temperature stated; hence the roasting of coffee ought to be effected in closed vessels. Bernheimer (1880) found nearly one-half of the products of roasting to consist of palmitic acid, the remainder being acetic acid, carbonic acid, probably acetone, hydroquinone, pyrrol, methylamine, .18 to .28 per cent. caffeine, and .04 or .05 *coffeol*, $C_8H_{10}O_2$, to which the aroma of coffee is due; it is an oil boiling at 195° C. (383° F.), and is probably a methylether of saligenin.

Coffee yields 4 to 5 per cent. of ash—Mocha coffee as much as 7.84 per cent.—consisting chiefly of potassium, sodium, magnesium, and calcium carbonates and phosphates, the earth salts amounting to one-seventh or one-sixth of the weight.

Adulterations.—Inferior qualities of coffee are sometimes mixed with or sold for the better varieties, and the brown, yellow, or discolored seeds are occasionally artificially colored with indigo, Prussian blue, and other substances. These pigments usually adhere merely superficially, and may be removed by washing with water. Fictitious coffee-seeds, made of clay and other plastic material, are easily recognized by the absence of fragments of the testa and of the deep groove upon the flat side of the seed. Ground coffee is frequently adulterated with roasted amylaceous seeds and bitter roots, chiefly chicory and occasionally dandelion. Roasted coffee yields with cold water a brownish-yellow infusion, while that of the adulterants is dark-brown or red-brown. F. M. Rimmington (1880) suggests the following process for the detection of adulterations: The coffee is boiled with water and a little sodium carbonate, then washed with water and macerated in a weak solution of chlorinated lime for two or three hours, when the ground coffee will form a dark stratum and the ground chicory a nearly white layer; the microscope will reveal other admixtures.

The pericarp of coffee fruit, which has been recommended as a cheap substitute for coffee, is free from caffeine; but the pericarp of the seed (husks), which have to some extent been used under the name of *sultan coffee* and *sacca coffee*, and are said to improve the flavor of coffee, contain .082 per cent. of caffeine, according to Peckol. The roasted flattish ovate seeds of Cassia occidentalis, *Linné*, are used in the tropics as a substitute for coffee under the name of *negro coffee* or *Mogdad coffee*, and have been met with as an adulteration in Europe; they do not contain caffeine, and are best detected by the microscope. Mogdad coffee yields 4 to 5 per cent. of ash; roasted chicory, 10 to 11 per cent.; roasted rye and wheat, 2 to 3 per cent.

Caffeina, *U. S.*, *Br.*, *It.;* Coffeinum, *P. G.*—Caffeine, Caffeia, Theine, Guaranine, *E.;* Caféine, Théine, *Fr.;* Koffeïn, Kaffeïn, Theïn, *G.* Formula $C_8H_{10}N_4O_2.H_2O$. Mol. weight 211.68.—This, the most important constituent of coffee, is obtained by precipitating the decoction of coffee with lead acetate, removing the excess of lead from the filtrate by hydrogen sulphide, neutralizing by ammonia, evaporating, and recrystallizing (Garot). Prof. E. S. Wayne (1875) recommended the following process, which has been found very serviceable: 2 parts of powdered coffee or tea are boiled with 3 parts of levigated litharge and sufficient water; the acids combine with the lead; the nearly colorless filtrate is freed from lead by hydrogen sulphide, and on concentration will yield most of the alkaloid in colorless crystals; the yellowish mother-liquid requires to be treated with animal charcoal, when the remainder of the alkaloid is likewise obtained colorless. Good coffee yields between 0.8 and 1.0 per cent., coffee-leaves .3 per cent., maté or Paraguay tea and Chinese tea between 1.1 and 1.25, kolanuts 2.13, and guarana about 5 per cent. of caffeine. Caffeine crystallizes in colorless or white, flexible, silky needles or thin long prisms, which are inodorous, of a faintly-bitter taste, fusible, and sublimable without decomposition. It is soluble in 80 parts (*U. S.*, *P. G.*) of water, and in 33 parts (*U. S.*), about 50 parts (*P. G.*), of alcohol at 15° C. (59° F.); in 160 parts of absolute alcohol; in about 7 parts (*U. S.*), 9 parts (*P. G.*), of chloroform; in 9.5 parts (*U. S.*), 2 parts (*P. G.*), of boiling water. It is soluble in 555 parts of ether, slightly soluble in carbon disulphide, and dissolves freely in boiling alcohol. These solutions have a neutral reaction to test-paper. Benzene, chloroform, or amyl alcohol, when repeatedly agitated with its solution in acidulated water, dissolves the whole of the caffeine (Dragendorff). Crystallized from alcohol or ether, it is anhydrous; crystallized from water, it contains 8.5 per cent. (1 molecule) of water, with which it parts at above 100° C. (212° F.); when heated to 229° C. (444° F.) it melts to a colorless liquid, and when ignited burns without leaving any residue. The anhydrous crystals have the composition $C_8H_{10}N_4O_2$, and contain 28.8 per cent. of nitrogen. Caffeine, moistened with strong nitric acid or dissolved in chlorine-water and evaporated at the heat of a water-bath, leaves a reddish-yellow residue, which becomes purple by ammonia from the formation of *murexoin* (Schwarzen-

bach). "If a small quantity of caffeine is dissolved in about 1 Cc. of hydrochloric acid, a little potassium chlorate added, the whole evaporated to dryness on the water-bath and the capsule then inverted over a vessel containing a few drops of ammonia-water, the residue will acquire a rich purple color, which is destroyed by alkalies."—*U. S.* Concentrated aqueous solutions of caffeine give with silver nitrate a white granular, crystalline precipitate; with mercuric chloride, long needles soluble in hydrochloric acid; with palladium chloride, yellow scales; with picric acid, no precipitate; the alkaloid dissolves in sulphuric and in nitric acid, and the solution remains colorless for several hours (Dragendorff). On adding to a solution of a small quantity of caffeine in concentrated sulphuric acid a minute fragment of potassium dichromate, it will acquire a yellowish-green color, which gradually becomes green.

Caffeine is *methyl-theobromine*, and may be formed by heating theobromine silver with methyl iodide in sealed tubes. According to Mulder and Günther, it dissolves more or less readily in solutions of citric, tartaric, oxalic, and acetic acids, and on cooling caffeine crystallizes. Hager, and afterward Haaxman (1877), ascertained that commercial *citrate* and *valerianate of caffeine* consist merely of the alkaloid with some acid adhering. Lloyd (1881) and Biedermann (1882) showed that caffeine salts with organic acids may be obtained from chloroform, and that they are easily decomposed by water. Tanret (1882) regards the solutions of caffeine in sodium benzoate, cinnamate, and salicylate as definite compounds suitable for hypodermic use; these solutions may be made so as to contain in each Cc. (15 minims) 0.20 Gm. (3 grains) of caffeine, and with sodium salicylate 0.30 Gm. (4½ grains). The salts with mineral acids have an acid reaction to test-paper, and are decomposed by water or alcohol. Their concentrated solutions yield with mercuric-potassium iodide a precipitate which soon crystallizes in needles. Similar precipitates obtained with other alkaloids remain amorphous (Delffs, 1854). Diluted acidulated solutions of caffeine are not precipitated by mercuric-potassium iodide (Mayer's test).

When caffeine is heated with alcoholic potassa or with solution of barium hydroxide, water is assimilated, barium carbonate is precipitated, methylamine and a little ammonia are given off; and from the residue Strecker obtained (1861) a strong and uncrystallizable base, *caffeidine*, $C_7H_{12}N_4O$, which is easily soluble in water and alcohol, but to a slight degree in ether. The decomposition takes place mainly according to the equation $C_8H_{10}N_4O_2 + H_2O = C_7H_{12}N_4O + CO_2$. O. Schultzen (1867) and F. Rosengarten (1871) proved that by prolonged boiling a further decomposition takes place, affecting chiefly the caffeidine, and resulting in the production of sarkosine, formic acid, methylamine, and ammonia; thus: $C_8H_{10}N_4O_2 + 6H_2O = C_3H_7NO_2 + CH_2O_2 + 2CH_3H_2N + NH_3 + 2CO_2$.

Caffeine triiodide—or, properly speaking, caffeine diiodide-hydro-iodide—$(C_8H_{10}N_4O_2I_2\text{-}HI)_2.3H_2O$, forms long, dark-green prisms, which are readily soluble in alcohol, and is given in doses of 2–4 grains.

Allied Drug.—Semen (Nuces) colæ.—Cola-nut, Guru-nut, *E.*; Noix de cola, Noix de gouron, Café du Soudan, *Fr.*; Kolanuss, *G.*—The tree, Cola (Sterculia, *Beauvois*) acuminata, *R. Brown* (nat. ord. Sterculiaceæ), is indigenous to tropical Africa, and is also found in tropical America; the yellow flowers produce five follicles, each containing one seed. The latter in the fresh state are brown externally and purplish or violet-colored internally; after drying, reddish or brown, somewhat mottled on the surface. They are about 25 Mm. (1 inch) long, oblong-ovate, flattish on one side, and have a slight nutmeg-like odor and a mild somewhat aromatic taste; in the fresh state they are bitter. Daniell showed the presence of caffeine, and Attfield (1865) obtained 2.13 per cent. of this alkaloid, besides 1.5 fat and volatile oil, 42.5 starch, 10.7 sugar and gum, 6.3 protein compounds, and 3.2 ash. Heckel and Schlagdenhauffen (1882) obtained similar results, and found also .023 theobromine and 1.62 tannin. The seeds are said to be used for clearing muddy water.

Action and Uses.—Since coffee was introduced into Arabia from Africa in the fifteenth century numerous opinions have been expressed of its salutary and of its mischievous effects. The consequences of an abuse of tea were declared to be similar to those of coffee long before chemistry had demonstrated the identity of theine and caffeine. Among their evil effects were enumerated the following: indigestion, acidity, heart-burn, watchfulness, tremors, debility, irritability of disposition, and dejection of spirits. By some persons both tea and coffee were accused of producing paralysis. Most of these effects are more likely to follow the habitual use of tea than of coffee, perhaps because, as a general rule, more of the former than of the latter is consumed; and the spinal symptoms, such as painful muscular tension and cramp and persistent wakefulness, are more apt to be produced by tea (v. Thea). The habit of taking coffee at breakfast and

after dinner is explained by the stimulant action (whether direct or indirect) which it exerts not only upon the nervous system generally, but especially upon the stomach and bowels: there can be no doubt that it quickens gastric digestion and relieves the sense of plenitude in the stomach, stimulates the secretion of bile, and by augmenting the peristaltic action of the intestine promotes defecation. It is quite as certain that, used to excess, it paralyzes the digestive function in all its steps, and leads to further disorders, of which the chief are congestion of the liver, constipation, and hæmorrhoids. Whether these effects are to be ascribed to a power in coffee to produce contraction of the capillary blood-vessels may be uncertain, but their reality is beyond doubt. To such an operation has also been ascribed an aphrodisiac action of coffee which is alleged by Willis, Linnæus, and by numerous French writers, one of whom cites a Persian tale to the same effect. It would be singular if such were the case, when, as is well known, the consumption of coffee is greatest by the very nations most notorious for sexual excesses. It is not, however, without interest to remember that the use of coffee is universal and excessive in France, and that the smallness of the families of that country is quite exceptional.

The poisonous action of coffee may be illustrated by the following statements: Liell reports the case of a woman, thirty years old, who in the course of an hour and a half took 18 grains of citrate of caffeine. The leading symptoms were delirium, semi-consciousness, absence of headache; pulse 55 and irregular; cold extremities and general clammy perspiration, normal temperature (?); anæsthesia, slight paresis of hands and feet, rigid flexure of the muscles of the arms; cramps of the legs; tremor of the hands, feet, and tongue, and a reeling gait; convulsions followed of a tetanoid character; the pupils were normal, the vision dim; some vomiting took place; there was abdominal colic, but no opening of the bowels, and urination was frequent and copious (*N. York Med. Jour.*, Sept. 19, 1885). Curschmann (*Deutsch. Klinik*, 1873) reports that a woman who had taken a decoction of 8 ounces of coffee suffered chiefly from a sense of impending death and muscular weakness. The respiration was hurried (24–25 a minute) and the pulse 112, firm and strong. Subsequently diarrhœa occurred; the urine was frequently voided, its quantity increased, and its specific gravity 1014. These examples, as well as those that follow, demonstrate that the toxical effects of coffee and caffeine are far from uniform. Thoroughgood refers to a case in which, after 60 grains of nitrate of caffeine were taken by mistake, muscular tremors, vomiting, etc. were *relieved* by digitalis; in another instance a single grain of the same preparation relieved an attack of asthma, but "soon there came on a deadly faintness, from which the patient was with difficulty restored" (*Med. Press and Circular*, Oct. 1884, p. 348). In a third case a lady took 200 grains of this preparation. The chief symptoms were great depression, semi-consciousness, and somnolence, extreme pallor and muscular relaxation, a slow, soft pulse, and sighing respiration. Recovery occurred after vomiting induced by apomorphine (Geraty, *Lancet*, Feb. 1889, p. 219). Other cases are reported by Glogauer (*Therap. Monatsch.*, April, 1888), and by Cohn (*ibid.*, Mars, 1889, p. 139). Guilliot (*Med. News*, lii. 71) describes the effects of chronic coffee-poisoning as follows: The skin is pale or dusky, the expression is dull, and the features have the look of premature old age, and sometimes are slightly swollen. The flesh wastes, the eyes have a glassy look, the pupils are somewhat dilated, the lips and tongue are tremulous; the appetite is lost; there is insomnia or else disturbed sleep; dyspepsia accompanies constipation or diarrhœa; neuralgia affects the stomach and other parts; headache and vertigo are common, and spasms or general convulsions may occur. According to the same writer, habitual excess in coffee induces in men sexual apathy and even impotence, and in women leucorrhœa (*ibid.*, xlvii. 708). Sometimes it occasions *pruritus ani aut vulvæ*. Later illustrations have been furnished by Mendel (*Centralb. f. Ther.*, vii. 727). Lapicque and Parisot (*Annuaire de thérap.*, 1890, p. 36); Sée (*ibid.*, p. 126); Müller *Therap. Monatsch.*, iv. 314); Lüderitz (*Amer. Jour. Med. Sci.*, 1890, p. 66). The physiological action of coffee has been illustrated by Reichert (*Med. News*, lvi. 476; *Therap. Gaz.*, xiv. 294).

The mode in which coffee assists digestion has been described, and the popular use made of it to prevent or to relieve *indigestion;* but it is useful in other forms of the affection than are associated with exhaustion or debility, and which directly result from excesses in eating and drinking or depend upon weakness due to sedentary habits, acute disease, old age, etc. Gastro-intestinal atony may be associated on the one hand with *constipation*, or on the other with *diarrhœa*, and in either case pure strong coffee in small quantities will often afford relief. In constipation the coffee should be taken early in the morning before the first meal. Partly with a view to promote digestion,

coffee has been much used during *convalescence* from acute diseases; but in this condition, and also in acute febrile diseases of a *typhoid type*, it had long been employed with advantage before the present rationale of its operation was proposed, according to which it restrains tissue-change, and thus becomes a conservator of force. Caffeine is by no means an adequate substitute for strong coffee under such circumstances. Coffee may take the place of alcohol in the adynamic conditions for which that stimulant is prescribed, or may be associated or exhibited alternately with it. It has been found that in *typhus* fever coffee increases the elimination of urea, and in so far purifies the blood without increasing the destructive metamorphosis of tissue, and that it lessens coma and low delirium, which it possibly does by contracting the capillaries of the brain. In this and all other typhoidal conditions it appears to act immediately as a stimulant of the heart as well as a conservator of force. It has an advantage over alcohol in that it stimulates and sustains, as well as cheers, without inebriating. (Compare Huchard, *Bull. de Soc. de Ther.*, g. 1889 p. 145). Coffee, and also caffeine, have been used in the treatment of *intermittent fever*, and have cured it, as almost everything else has done, occasionally. The power of coffee to prevent and to moderate *alcoholic intoxication* is well known; one may drink more wine when taking coffee than without this association, and actual intoxication is often arrested by a cup of strong coffee. These effects tend to confirm what has been said above of the action of coffee on the brain. *Delirium tremens* is an indirect effect of alcohol, and comes on, it may be, days after intoxication has ceased, and involves an opposite state of the brain—one of anæmia, not of congestion. In this affection coffee is only an adjuvant; what good it does is through its primary stimulant impression upon the nervous system and the stomach, and perhaps by its limiting the waste which the exorbitant excitement and muscular effort attendant upon the disease entail. For these purposes it should be given in small and repeated doses. In *opium-narcotism* the condition is much the same as in acute alcoholic intoxication, and in it coffee is equally efficient in preventing coma and its consequences. Experiments upon animals have also shown that coffee and tea are direct physiological antidotes to morphine. Coffee should be given in the manner just recommended, and by the rectum as well as by the mouth, but not to the neglect of other stimulants of the nervous system, such as flagellation and electricity. "Fluid extract of coffee," and also "strong coffee," have been used hypodermically in cases of opium-poisoning. According to Litti, coffee is an antidote to *strychnine* in rabbits (*Med. Record*, xxviii. 264). The stimulant action of strong coffee sometimes prevails against obstinate *hiccup*. The utility of coffee in *spasmodic asthma* has long been established. A competent authority in regard to this disease (Salter) says: "I should think, from my own experience, that coffee relieves asthma in two-thirds of the cases in which it is tried. The relief is very unequal, often merely temporary, and sometimes very slight; sometimes it is complete and permanent." It should be given in a very strong and hot infusion, either an hour in advance of the paroxysm if it occurs periodically, or as soon as the first symptoms are felt. Its mode of action is not accurately known. It must be borne in mind, however, that the attack usually comes on at night, and especially during sleep—that is to say, at a time when all convulsive diseases except hysteria are most apt to break out—and that the action of coffee is directly opposed to sleep; that the paroxysm may be relieved either by stimulants or by sedatives (belladonna, lobelia); and therefore it seems probable that the cure of the attack depends upon the removal of the congestion of the nervous centre which was its immediate cause. A similar mode of action probably explains certain cases in which *chordee* and also *dysury* were terminated by the same means. Some forms of *nervous headache* are apt to be relieved by coffee, by tea, and by Paraguay tea. It would seem that the most appropriate cases are those in which the face is flushed and other signs exist of cerebral congestion; those, on the other hand, in which the face is pale and the pain appears to be simply neuralgic, and not congestive, are thought to be aggravated by the medicine. Caffeine in two-grain doses is sometimes used, but a well-prepared infusion of coffee is preferable. It has long been known that certain strangulated *hernias* have been reduced under the influence of coffee after the failure of the taxis. In many the reduction was spontaneous, in others easy. They were cases in which the protrusion was recent, and when there was no sign of gangrene or of inflammation in the hernial tumor. The mode of action may be inferred, from what was said above, to be, that coffee stimulates the intestinal muscles, by which the gas contained in the loop is expelled, and contracts the blood-vessels, by which the serous transudation is diminished. In favorable cases these two agencies suffice to lessen the bulk of the tumor and permit its reduction. Desprès has used strong coffee with decided benefit in uterine *hæmorrhage* occurring after delivery and also in the

form of *metrorrhagia* (*Bull. de Thérap.*, xcvi. 201). Pulverized roasted coffee is a familiar domestic *deodorizer*. When prepared from the half-carbonized seed it may be applied, like charcoal, to gangrenous and otherwise fœtid lesions.

In 1725, Zwenger recommended coffee as a remedy for dropsy (*Bull. de Thér.*, ciii. 146). It has been stated above that caffeine is a diuretic. Clinically, it has been proved by Gubler and others to act very promptly in this manner, and to reduce the pulse-rate simultaneously. These effects are ascribed to a direct action upon the nerves of the kidney. In several cases of cardiac *dropsy* "citrate of caffeine" in the dose of 3 grains three times a day promptly produced copious diuresis, even when digitalis had failed or ceased to have any effect (Shapter). The cases most benefited are those in which cardiac irregularity exists as an effect of muscular debility rather than of valvular obstruction. Leech, who found it useful as a diuretic in *cardiac dropsy*, judged that it exerted a direct action upon the kidneys, causing the elimination of water (*Practitioner*, vols. xxiv. xxv.); and Brakenridge, localizing its action still further, pronounced it to be "a stimulant of the renal glandular epithelium, and very slightly, if at all, a vascular diuretic" (*Edinburgh Med. Jour.*, xxvii. 4, 100). That coffee and caffeine are primary and direct stimulants of the whole nervous system seems proved by daily experience, and that their effects are comparable, not to those of digitalis, but rather to the action of alcohol. Unlike digitalis, which affects only certain involuntary muscles, caffeine, like alcohol, stimulates the entire muscular and vascular systems. It has been repeatedly said that caffeine and digitalis cannot be substituted therapeutically for one another—that the former acts where the latter ceases to act; and the explanation of this fact resides in their very dissimilar mode of action. When digitalis fails, it is because the heart is either positively or relatively incompetent to propel the blood, and the medicine has no power of strengthening except by tonically contracting it; but coffee or caffeine stimulates the nervous centres which are the source of the heart's power, and temporarily restores the regularity and efficiency of its function, and so permits the removal of the dropsies, etc. which immediately threaten the extinction of life. Cases illustrating this singular rescue from imminent death have been published by Milliken (*Phila. Med. Times*, xii. 344), Brakenridge, Huchard, and others, who agree that under the conditions mentioned the hypodermic administration of caffeine is the best remedy. The explanation given affords a satisfactory reason for the failure of caffeine in dropsy that is not due to cardiac disease. (Compare Lépine, Huchard, Dujardin-Beaumetz, *Centralblatt f. Thérapie*, i. 229.) We have nothing to modify in this explanation, offered some years ago, of the utility of caffeine in cardiac dropsy, but may confirm it by a reference to the cases of Bruen (*Med. News*, xlvi. 120) and Dumas (*Bullet. et Mém. Soc. de Thérap.*, Sept. 1886, p. 141). Sansom, however, maintains that it is most efficient in dropsy caused by mitral insufficiency (*Lancet*, March and April, 1886). Caffeine, and also strong coffee, have been found useful in atonic *diarrhœa*, "in melancholia, in the brain disorders of overworkers, in the sleeplessness and depression of spirits of drunkards, in asthenic mania" (Shapter, *Times and Gaz.*, July, 1881, p. 33), and as a means of curing the *opium* and the *alcohol habit*. This is only another form of the familiar fact that coffee tends to dispel intoxication caused by opium and alcohol, as well as the exhaustion or collapse that follows their abrupt withdrawal, as we have, indeed, already remarked. It is probable that the use of coffee in the southern and of alcohol in the northern countries of Europe shows that the one is better adapted to a dry and the other to a damp climate, and also that an intellectual stimulant is more grateful to the excitable nature of Southern, and one that blunts perception to the cooler temperament of Northern, races.

The *dose* of caffeine may be said to range from Gm. 0.016–0.20 (gr. ¼–2–3) in powder, mixed with sugar. Huchard maintains that the ordinary doses are too small. He begins with 5 or even 10 grains during a day, and then gradually increases the dose until 15 grains, or even two or three times that quantity, are taken in the same space of time. If, like coffee, it sometimes causes uncertainty of sight and gait, nausea, headache, palpitation, etc., the dose must be lessened. Owing to its imperfect solubility it should not be prescribed in pill, but it may be rendered more soluble by the addition of salicylate or benzoate of sodium or antipyrine. The most convenient mode of administering caffeine hypodermically is that proposed by Tanret, who has published the following formula: R. Benzoate of sodium, Gm. 3.60; Caffeine, Gm. 3; Distilled Water, q. s. to make 10 Ccm. Of this solution each Ccm. contains Gm. 0.30 (gr. v) of caffeine (*Med. Record*, xxiii. 440). The same solution, diluted and flavored, may be administered internally.

The so-called *valerianate of caffeine* appears in some cases to have been of service in

the treatment of *hysterical vomiting* and of *whooping cough*. In the latter disease it was given twice a day in doses of about Gm. 0.03 (gr. ½) to children of two years and upward. "*Citrate of caffeine*" appears to be a compound of variable and uncertain strength.

A derivative of caffeine, ETHOXY-CAFFEINE, seems to act on the brain and spinal cord, causing palpitation of the heart, flushing of the face, sweating, diuresis, somnolence, and even coma. Like caffeine, it may excite nausea and vomiting, to prevent which it has been given along with sodium salicylate or cocaine muriate. It has been found efficient in relieving neuralgic *headache*. It may be prescribed in divided doses amounting to from Gm. 0.25–1 (gr. iv–xv) a day.

KOLA or GOUROU NUT was thoroughly investigated by Heckel and Schlagdenhauffen (*Amer. Jour. Phar.*, March, 1884). It is used throughout Equatorial, and especially Western, Africa as a masticatory and in powder, in the belief that it renders the gums firm, strengthens the digestion, and, like coca, enables persons to endure prolonged exertion without fatigue. It is thought to cleanse foul waters and render tainted meat edible, and also to be aphrodisiac. Its qualities appear to be derived from the caffeine it contains. The above statements have been substantially confirmed by Barrickman (*Therap. Gaz.*, viii. 335), as well as by Smith (*Amer. Jour. Phar.*, lviii. 391), and by Firth (*Practitioner*, xliii. 27); the last of whom, however, denies the allegation of the first that kola, like coffee, dissipates alcoholic intoxication. Kola has been used by Monnet and others (*Bull. de Thérap.*, cviii. 12; *Dictionnaire de Thérapeutique*, art. "Kola") in the treatment of various states of *debility* due to nervous prostration or to exhausting discharges; to relieve *irregularity* of the *heart*, *neuralgia*, *migraine*, etc.; and, in a word, all the conditions for which coffee and caffeine are employed. The most efficient manner of using kola nut is by slow mastication and swallowing the saliva; but various pharmaceutical formulæ for its administration have been proposed, (See Monnet. *Therap. Gaz.*, ix. 223.)

CAFFEINA CITRATA, *U. S.*—CITRATED CAFFEINE.

Caffeinæ Citras, Br.; *Caffeine citrate*, E.; *Citrate de Caféine*, Fr.; *Koffeïn citrat*, G.

Preparation.—Caffeine, 50 Gm.; Citric Acid, 50 Gm.; Distilled Water, hot, 100 Cc. Dissolve the citric acid in the hot distilled water, add the caffeine, and evaporate the resulting solution on a water-bath to dryness, constantly stirring toward the end of the operation. Reduce the product to a fine powder and transfer it to well-closed bottles.—*U. S.*, The process of the British Pharmacopœia is equivalent to the above, the quantities, however, being expressed in parts.

Citrated caffeine is a white powder having a purely acid (slightly bitter, *Br.*) taste, and an acid reaction, readily soluble in a mixture of 2 parts of chloroform and 1 of rectified spirit. With 3 parts of water it forms a syrupy liquid, and this, when diluted, gives a precipitate (caffeine), which is redissolved when 25 (10, *Br.*) parts of water have been added.—*U. S.*

CAFFEINA CITRATA EFFERVESCENS, *U. S.*—EFFERVESCENT CITRATED CAFFEINE.

Preparation.—Caffeine, 10 Gm.; Citric Acid, 10 Gm.; Sodium Bicarbonate, 330 Gm.; Tartaric Acid, 300 Gm.; Sugar, in very fine powder, 350 Gm.; Alcohol, a sufficient quantity. To make 1000 Gm.

Triturate the solid ingredients, previously well dried, to a fine, uniform powder. Mix this with alcohol to a soft paste and rub it through a No. 6 tinned-iron sieve or enamelled colander. Then dry it, and reduce it to a coarse, granular powder. Keep the product in well-stoppered bottles.—*U. S.*

CAHINCA.—CAHINCA ROOT.

Radix caincæ, s. cainanæ.—*Cainça*, Fr.; *Caincawurzel*, G.

The root of Chiococca racemosa, *Jacquin.*

Nat. Ord.—Rubiaceæ, Coffeineæ.

Origin.—The plant is a native of Southern Florida, the West Indies, Central America, and a portion of South America. It is a shrub with opposite shining, oval, ovate-oblong, or elliptic leaves, racemes of fragrant yellowish flowers, and small white berries with flattish ovate seeds.

Description.—The woody root exists in pieces 7 to 15 Cm. (3 to 6 inches) long, about 2 to 6 Mm. ($\frac{1}{12}$ to $\frac{1}{4}$ inch) thick, more or less bent, externally blackish- or grayish-brown, finely wrinkled longitudinally, with narrow transverse corky ridges and fissures, with a thin brown bark of a resinous lustre internally, and with a whitish wood. It is usually mixed with portions of the lower stem, which are 12 to 25 Mm. ($\frac{1}{2}$ to 1 inch) thick, and have deep longitudinal furrows, with intervening rounded often very prominent ridges produced by separated wood-bundles which have not been developed into separate branches; the porous wood encloses a thin pith and is radiate by medul lary rays. The bark has a nauseous, bitter, and acrid taste.

The roots of Chiococca densifolia, *Martius*, and Ch. anguifuga, *Martius*, are of a reddish-brown color, often transversely fissured, and destitute of longitudinal ridges. The shrubs are indigenous to Brazil, and are known there as *cainana* or *caninana*.

Constituents.—The most important constituent of cahinca-root is *cahincin* or *cahincic acid*, which, according to Rochleder (1867), has the composition $C_{40}H_{64}O_{18}$. It exists in the root partly free and partly as a calcium salt (François, Pelletier, and Caventou, 1829), forms white, silky, very bitter needles, is soluble in about 600 parts of cold water and ether, and crystallizes from its solution in hot alcohol. When boiled with hydrochloric acid it is split into sugar and *cahincetin*, $C_{22}H_{34}O_3$, the alcoholic solution of which gelatinizes on the addition of water. Fused together with potassium hydroxide, cahincetin yields butyric acid and *cahincigenin*, $C_{14}H_{24}O_2$. Rochleder and Hlasiwetz (1851) regard the tannin of cahinca-root as being identical with *caffeo-tannic acid*.

Action and Uses.—When first introduced into American and European medicine cahinca was reputed to be an efficient diuretic, as well as a tonic, emmenagogue, and laxative. There is no doubt of its diuretic virtues in *dropsy* independent of acute renal disease. But it is now very rarely employed. By some it is stated to be a hydragogue cathartic. It is best administered in a decoction made with Gm. 8 (℥ij) of the root to a pint of water, or an electuary may be formed with powdered gum and syrup containing about Gm. 1 (gr. xv) of the powdered root.

CALAMUS, *U. S.*—Calamus.

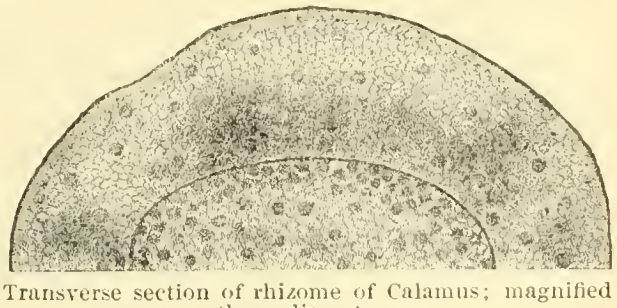
Rhizoma calami, P. G.; *Radix calami aromatici*, *Radix acori.*—*Sweet flag*, E.; *Acore vrai*, *Acore odorant*, Fr.; *Kalmuswurzel*, G.; *Acorro vero*, It.; *Calamo aromatico*, It., Sp.

The rhizome of Acorus Calamus, *Linné*. Woodville, *Med. Bot.* 248; Bentley and Trimen, *Med. Plants*, 279.

Nat. Ord.—Araceæ, Acoroideæ.

Origin.—An herbaceous perennial, with leaves resembling those of the flag (iris), and green triangular flowering stems terminating with a cylindrical spadix of small sessile flowers, and a long two-edged bract resembling the leaves. The plant is indigenous to North America and Northern Asia, but has spread throughout Central Asia to India, and throughout Europe to the Pyrenees. In Burmah and Ceylon it is cultivated. It grows in the muddy margins of streams and swamps.

Fig. 42.



Transverse section of rhizome of Calamus; magnified three diameters.

Description.—The rhizome grows to the length of several feet, is horizontal, subcylindrical, about 2 Cm. ($\frac{3}{4}$ inch) in diameter; reddish-brown, longitudinally wrinkled, distinctly annulate from the transverse and obliquely-directed leaf-scars, which are crowded near the over-ground stems; in other parts 9 to 12 Mm. ($\frac{3}{8}$ to $\frac{1}{2}$ inch) or more distant, and some of them fringed by projecting wood-bundles; the lower surface of the rhizome shows the circular root-scars arranged in a wavy single or sometimes double line, branching alternately to the right and left. It has a spongy texture, due to numerous air-passages, and breaks with a short corky fracture, showing a white or pale reddish-white color internally. Upon the transverse section a fine darker line (nucleus sheath) separates an elliptical central portion from an outer layer, the latter being in width about one-fifth the diameter of the rhizome. The wood-bundles are irregularly scattered, most numerous within the nucleus sheath; the oil-cells, which become more

conspicuous on being moistened by an alkali, are likewise scattered and more numerous in the outer portion.

Calamus has an agreeable aromatic odor, which is best preserved by keeping the rhizome unpeeled, as directed by the present Pharmacopœia. Peeled calamus when fresh is white, but turns pinkish on drying, and is less aromatic and bitter than the unpeeled. It should be collected early in spring, and deprived of the far less aromatic and bitter rootlets, which are 10 to 15 Cm. (4 to 6 inches) long, unbranched, but near the tip beset with soft thin fibres. On drying it loses from 70 to 75 per cent. in weight. It is not subject to adulteration, and cannot easily be confounded with other rhizomes.

Constituents.—The rootlets contain little of the volatile oil; the rhizome yields from 1½ to 2 per cent.; Bartels obtained from the fresh-peeled rhizome ¼ per cent., Martius 1 per cent. from the peelings. The yellowish or brown-yellow oil (Oleum calami, *P. G.*) has an agreeable odor, turns red-brown by ferric chloride, and contains, according to A. Kurbatow (1873), a hydrocarbon, $C_{10}H_{16}$, of a terebinthinate odor, boiling at 159° C. (318.2° F.), and yielding with chlorine a crystalline mass which melts at 65° C. (149° F.). The portion boiling at a higher temperature is of a deep-blue color, and not of a constant boiling-point. Faust (1867) named the bitter principle *acorin*. It was obtained from the concentrated decoction by precipitating it successively with alcohol and lead acetate and subacetate, removing the lead by hydrogen sulphide, neutralizing with soda, and agitating with ether, which leaves it as a soft brown-yellowish mass, soluble in ether and alcohol, having a faint alkaline reaction, and being precipitated from its solution in hydrochloric acid by tannin, sodium phosphomolybdate, and potassium iodohydrargyrate. It contains nitrogen, and when boiled with dilute sulphuric acid or baryta-water yields sugar and a resin-like body. Flückiger obtained a small quantity of crystals from its tannin precipitate by treatment with lead oxide and chloroform. Thomas (1887) purified the acorin as obtained by Faust by shaking the aqueous solution with freshly-burned animal charcoal, then washing and drying this and extracting it with 90 per cent. alcohol. This was recovered, remnants of volatile oil being removed on a water-bath; the liquid was shaken with ether, and on evaporation this left the acorin entirely free from nitrogen. By long boiling with dilute acids or alkalies an odor of ethereal oil becomes perceptible; this formed in larger quantity by heating acorin with aqueous soda solution in a current of hydrogen. This oil consists of two bodies, one boiling at 158°–159°, as above, and the other between 255° and 288°, and is blue in color, but becomes colorless on boiling with sodium metal. This reaction also yields sugar; if carried on in the air, a resin-like body, *acoretin*, appears, which by reduction in alkaline solution yields ethereal oil and sugar. Trommsdorff obtained from the fresh drug 1.6 of starch, 5.5 of gum, 2.3 per cent. of soft resin, and 21 per cent. of cellulose.

Pharmaceutical Uses.—Tinctura calami.—Digest 1 part of bruised calamus with 5 parts of alcohol spec. grav. .892 for eight days; express and filter. It has a brownish-yellow color.—*P. G.*

Extractum calami.—Bruised calamus is exhausted by digestion with a mixture of 3 parts of water and 2 parts of alcohol, and the filtered tincture evaporated to the consistence of a thick extract.—*P. G.*

Action and Uses.—Calamus excites a sense of warmth in the stomach, promotes the appetite, and improves the digestion. It is said to quicken the pulse and increase the secretion of urine and perspiration. In excessive doses it may cause headache. It is added to bitter tonic infusions in atonic *dyspepsia* and other disorders producing abdominal flatulence. It may be used for the relief of flatulent *colic* and as a very mild stimulant in some cases of the *typhoid condition*. It is often eaten prepared with sugar as a conserve, and it may be habitually chewed to relieve slight dyspeptic disorder. It is said to be used for *coughs* by the Indians of the Hudson's Bay territory (*Amer. Jour. Phar.*, lvi. 617). An infusion made with Gm. 32 (℥j) of calamus and Gm. 500 (Oj) of hot water may be prescribed in the dose of a wine-glassful.

CALCII BROMIDUM, *U. S.*—Calcium Bromide.

Calcium bromatum.—Bromure de calcium, Fr.; *Bromcalcium, Calciumbromid*, G.

Formula $CaBr_2$. Molecular weight 199.43.

Preparation.—Calcium bromide is readily prepared by dissolving pure calcium carbonate in hydrobromic acid and evaporating the solution. Bödeker has used a method which was described by Faust (1867), and is based upon the decomposition of sulphur

bromide, SBr_6, by lime, whereby calcium bromide and sulphate are formed; $SBr_6 + 4Ca(OH)_2$ yields $3CaBr_2 + CaSO_4 + 4H_2O$. 20 parts of sulphur are dissolved in 240 parts of bromine (300 parts are required by calculation), and the solution added to thin milk of lime, which contains 140 parts of pure lime. After the mixture has become colorless the liquid is filtered, treated with carbon dioxide, and heated to remove excess of lime; the filtrate is concentrated, mixed with twice its bulk of alcohol to precipitate calcium sulphate, is again filtered, and evaporated.

Properties.—Thus obtained, calcium bromide is a whitish, granular, or pulverulent, neutral, very deliquescent salt, having a pungent bitter and saline taste. It is freely soluble in alcohol (1 part, *U. S.*) and water, the latter solution yielding with difficulty colorless needles. According to Kremers (1857, 1858), 1 part of the salt dissolves at 0° C. (32° F.) in .80 parts, at 20° C. (68° F.) in .70 parts, at 40° C. (104° F.), in .47 parts, and at the boiling-point 105° C. (221° F.) in .32 parts of water, and solutions having at 19.5° C. (67° F.) the specific gravity

	1.044	1.089	1.139	1.194	1.252	1.315	1.385	1.461	1.594	1.641
contain	5	10	15	20	25	30	35	40	45	50 per cent. $CaBr_2$.

The salt melts at a red heat, giving off bromine; treated with strong sulphuric acid, hydrobromic acid is evolved, afterward bromine and sulphur dioxide. The aqueous solution yields with ammonium oxalate a white precipitate insoluble in acetic acid, but soluble in hydrochloric acid; with silver nitrate, a curdy precipitate insoluble in nitric acid and in diluted ammonia-water; and with a few drops of chlorine-water liberates bromine, which dissolves in carbon disulphide with a yellow or brown-yellow color free from violet tint.

The solution left in contact with lime forms calcium oxybromide, which has a strong alkaline reaction, and on evaporation is left behind as a very white salt.

Tests.—The neutral reaction of the salt and its ready solubility in water and alcohol exclude most impurities. "If to 5 Cc. of a 5 per cent. aqueous solution, slightly acidulated with hydrochloric acid, an equal volume of hydrogen sulphide test-solution be added, neither coloration nor turbidity should be perceptible (absence of arsenic, lead, etc.). The addition of ammonium sulphide test-solution to the aqueous solution should not produce any color or turbidity (absence of iron, aluminum, etc.). If 5 Cc. of the aqueous solution (1 in 20), slightly acidulated with acetic acid, be completely precipitated with ammonium oxalate test-solution, the filtrate should, on evaporation, leave not more than a trace of fixed residue (limit of magnesium and alkalies). If diluted sulphuric acid be dropped upon the salt, the latter should not at once assume a yellow color (absence of bromate). If to 5 Cc. of the aqueous solution (1 in 20) a few drops of starch test-solution be added, and then chlorine-water, drop by drop, no blue color should appear (absence of iodide). No turbidity should be produced if 0.2 Cc. of barium chloride test-solution be added to 5 Cc. of the aqueous solution (absence of sulphate). If 1 Gm. of the salt be mixed with 0.5 Gm. of iron filings and 0.5 Gm. of powdered zinc, and heated in a test-tube with 5 Cc. of sodium hydrate test-solution, no ammoniacal vapors should be evolved (absence of nitrate or nitrite). If 0.25 Gm. of the well-dried salt be dissolved in 10 Cc. of water, and 2 drops of potassium chromate test-solution added, it should require 25. Cc. of decinormal silver nitrate solution to produce a permanent red color (corresponding to 99.7 per cent. of the pure salt, a greater amount indicating presence of chloride, a smaller amount other impurities)."—*U. S.*

Action and Uses.—In 1871 this salt was stated by Dr. Hammond to produce the characteristic effects of the bromides more promptly than the analogous compounds, and also to induce sleep where they failed to do so. He regarded it as peculiarly appropriate for relieving the *insomnia* caused by mental labor or excitement, and the exhausted and irritable states of the nervous system met with in *hysterical* women, and accompanied by headache, vertigo, insomnia, and extreme mental excitability. He also found that it cured *epilepsy* in very young infants when bromide of potassium failed. The best mode of administering was said to be according to the following formula: R. Calcii bromid. ʒj; Syrupi calcis lactophos. fʒiv.—M. S. A teaspoonful three times a day in a little water in epileptic cases. As a hypnotic for adults the dose is from Gm. 1.30 to 2.00 (gr. xx–xxx).

It has been objected to this as well as to the other bromine salts that their sedative action is due not to the bromine they contain, but to their alkaline or earthy bases. This strange notion is sufficiently condemned by the fact that uncombined bromohydric acid produces the same effects as its salts.

Iodobromide of calcium is reported to have maintained in quiescence the distressing symptoms of a case of *exophthalmic goitre*, and at last reduced the thyroid gland to its natural size.

CALCII CARBONAS PRÆCIPITATUS, *U. S.*—Precipitated Calcium Carbonate.

Calcii carbonas præcipitata, Br.; *Calcium carbonicum præcipitatum*, P. G.; *Calcaria carbonica præcipitata*, *Carbonas calcicus præcipitatus*, *Creta præcipitata.—Precipitated carbonate of lime*, E.; *Carbonate de chaux précipité*, *Craie précipitée*, Fr.; *Calciumkarbonat*, *Präcipitirter kohlensaurer Kalk*, G.; *Carbonato di calcio precipitato*, It.; *Carbonato de cal*, Sp.

Formula $CaCO_3$. Molecular weight 99.76.

Preparation.—Take of Calcium Chloride 5 ounces; Sodium Carbonate 13 ounces; boiling Distilled Water a sufficiency. Dissolve the calcium chloride and sodium carbonate each in 2 pints of the water; mix the two solutions and allow the precipitate to subside. Collect this on a calico filter, wash it with boiling distilled water until the washings cease to give a precipitate with silver nitrate, and dry the product at the temperature of 100° C. (212° F.).—*Br.*

In this process a mutual decomposition of calcium chloride and sodium carbonate takes place, resulting in the formation of sodium chloride, which remains in solution, and calcium carbonate, which precipitates. The decomposition is illustrated by the equation $CaCl_2 + Na_2CO_3 = 2NaCl + CaCO_3$. The precipitate retains, even after prolonged washing, a small portion of sodium salt; made with ammonium carbonate, it is much more readily freed from the latter by washing. If calcium carbonate is precipitated in the cold, it is flocculent and quite voluminous, and with difficulty deprived of the mother-liquor by washing; hence it is advisable to heat the solutions before mixing them.

Properties.—Thus prepared, it is a white, impalpable, inodorous, and tasteless powder consisting of microscopic rhombohedric crystals, but entirely free from grittiness. It has the specific gravity 2.72, is without action upon moistened test-paper, and is not altered in the air, but above 400° C. (752° F.) begins to evolve carbon dioxide, and at a red heat is entirely converted into calcium oxide. "The salt is nearly insoluble in water; the solubility is increased by presence of ammonium salts, and especially by carbonic acid; alkali hydroxides diminish it. It is insoluble in alcohol, but dissolves without residue in dilute hydrochloric, nitric, or acetic acid, carbon dioxide being copiously given off.—*U. S.*

Tests.—"For applying tests of identity and purity, boil 6 Gm. of calcium carbonate with a mixture of 50 Cc. of diluted acetic acid and 50 Cc. of water; allow the liquid to cool, and filter. In this solution ammonium oxalate test-solution produces a white precipitate insoluble in acetic, but soluble in hydrochloric acid. If from 20 Cc. of this solution the calcium be completely precipitated by a slight excess of ammonium oxalate test-solution, the filtrate should, on evaporation, leave only a trace of fixed residue (limit of magnesium and alkalies). If 10 Cc. of the solution be slightly acidulated with acetic acid, no immediate turbidity should be produced by the addition of 0.5 Cc. of barium chloride test-solution (limit of sulphate). If to 10 Cc. of the solution, slightly acidulated with nitric acid, 0.1 Cc. of silver nitrate solution be added, and the precipitate, if any, removed by filtration, the filtrate should remain perfectly clear upon addition of more silver nitrate solution (limit of chloride). Addition of ammonia-water should not produce any turbidity in the solution (absence of iron, aluminum, phosphate, etc.). If to the solution, slightly acidulated with acetic acid, an equal volume of hydrogen sulphide test-solution be added, neither color nor turbidity should be produced (absence of arsenic, lead, etc.). If 1 Gm. of the salt be agitated with 50 Cc. of water, the filtrate should not show an alkaline reaction with litmus-paper, and, on evaporation, should not leave more than a trace of fixed residue (limit of soluble impurities)."—*U. S.*

A substitution of calcium sulphate for the carbonate, wholly or partly, has been occasionally observed; this will not readily dissolve in diluted hydrochloric acid, with little or no effervescence; boiled with distilled water and allowed to cool, then filtered, a liquid will be obtained giving a white precipitate with barium chloride.

Action and Uses.—This preparation differs in no essential particular from prepared chalk (*v. Creta præparata*).

CALCII CHLORIDUM, *U. S., Br.*—Calcium Chloride.

Calcium chloratum, Calcaria muriatica, Chloridum calcicum.—Chlorure de calcium, Fr.; *Chlorcalcium, Calciumchlorid*, G.; *Cloruro di calcio*, It., Sp.

Formula $CaCl_2$. Molecular weight 110.65.

Calcium chloride deprived of its water by fusion at the lowest possible temperature. It should be preserved in a well-stopped bottle.

Preparation.—This compound is a by-product in many chemical processes, among others that for solution of ammonia. It may be formed by neutralizing hydrochloric acid with marble or other calcium carbonate; $CaCO_3 + 2HCl$ yields $CaCl_2 + CO_2 + H_2O$. Iron being usually contained in these native carbonates, it is removed by digesting the solution with chlorinated lime and slaked lime, by which the iron is first converted into ferric chloride and then precipitated as ferric hydroxide. The filtrate, which will be found to have an alkaline reaction, is neutralized with hydrochloric acid, evaporated, and dried at a temperature of 200° C. (392° F.). The whole of the water of crystallization is expelled at 200° C.; the Br. P. directs the salt to be dried at 204.5° C. (400° F.), and regards its composition to be $CaCl_2.2H_2O$ (mol. weight 146.57).

Properties.—Calcium chloride is in white, dry, but very deliquescent inodorous masses, and has a hot, saline, and bitterish sharp taste. When the salt is overheated in fusing, a small quantity of chlorine is expelled as hydrochloric acid; hence the anhydrous salt usually has a faint alkaline reaction, which is increased at a red heat. According to Kremers (1858), 1 part of the anhydrous salt dissolves at 10° C. (50° F.) in 1.58 parts, at 15° C. (59° F.) in 1.46 parts, at 20° C. (68° F.) in 1.35 parts, at 40° C. (104° F.) in .83 part, at 60° C. (140° F.) in .72 part of water; the solution, saturated at 15° C. (59° F.), has the specific gravity 1.41104. The concentrated solutions, exposed to a low temperature, deposit transparent crystals of the salt containing $6H_2O$, and these melt in the neighborhood of 30° C. (86° F.); when evaporated to dryness at a temperature not exceeding 150° C. (302° F.) a crystalline powder, $CaCl_2.2H_2O$, is obtained, which, on being mixed with two-thirds its weight of snow, produces a temperature of —45° C. (—49° F.). The anhydrous salt dissolves in about 8 parts of cold absolute alcohol, and at 78.3° C. (174° F.) in 1.43 parts; it is more freely soluble in alcohol containing water. These solutions are precipitated by an excess of ether, and on concentration and cooling yield soft white crystals of calcium chloride, combined with alcohol ($2C_2H_5OH$) or with alcohol and water. The aqueous solution yields with ammonium oxalate a white precipitate insoluble in acetic acid, but soluble in hydrochloric acid, and with silver nitrate a white precipitate readily soluble in ammonia and reprecipitated by nitric acid.

Tests.—"The aqueous solution (1 in 20) should remain clear upon addition of ammonia-water (absence of iron, aluminum, etc.), or of barium chloride test-solution (absence of sulphate). If from 20 Cc. of the solution the calcium be completely precipitated by ammonium oxalate test-solution, the filtrate should, on evaporation, leave not more than a trace of fixed residue (limit of magnesium and alkalies). If 5 Cc. of the aqueous solution, acidulated with hydrochloric acid, be mixed with an equal volume of hydrogen sulphide test-solution, neither color nor turbidity should appear (absence of arsenic, lead, etc). No turbidity should be produced by the addition of 0.5 Cc. of potassium dichromate test-solution to 5 Cc. of the aqueous solution (absence of barium)."—*U. S.*

Pharmaceutical Uses.—Calcium chloride is used for the drying of gases and certain liquids and in the preparation of various calcium salts. For the latter purpose it is directed only in the process for Calcii carbonas præcipitata.

Liquor calcii chloridi, *Br.*—Dissolve calcium chloride 88 grains in distilled water 1 ounce. Spec. grav. 1.145.

Action and Uses.—Chloride of calcium is an active irritant, and in excessive doses may occasion gastro-intestinal inflammation. In medicinal doses it is supposed to have a special action upon the glandular system, increasing secretion, removing infarctions, etc. It has been used very successfully to reduce *scrofulous* swellings of the external lymphatic glands, of the mesenteric glands, etc., and in strumous *diseases of the skin*, particularly *lupus*. In the latter cases it should be associated with iodine, applied locally. Some attempts have been made to revive this method. In 1885 (*Practitioner*, xxxv. 160) Dr. Crighton claimed for it curative powers "in *glandular enlargements* of the neck in children, where the glands seem massed together and are almost of a stony hardness;" in similar cases in which suppuration had occurred; in *tabes mesenterica*; and in *scrofulous caries*. Similar results were reported by Mr. Davies (*ibid.*, xxxvi. 12). The dose

employed by Crighton was Gm. 0.60–1.30 (gr. x–xx), or more, of the crystallized chloride of calcium for adults, and Gm. 0.13–0.20 (gr. ij–iij) for children. Davies found that very much larger doses, such as Gm. 2.50 (gr. xl) three times a day, could be taken beneficially. It is said to exhibit peculiar virtues in the *dyspeptic* disorders to which scrofulous children are subject, and which are popularly supposed to be of verminous origin, such as restless sleep, capricious appetite, irregular stools, foul breath, and enlarged tonsils. (For full details see W. Begbie, *Works*, Sydenham Soc. ed., p. 307.) Physicians of authority have affirmed its curative power in cases of *uterine* and *ovarian tumors*. The only "tumors" which contract under this or any other medicinal treatment are the so-called muscular tumors, which may be reduced by the loss of their liquid constituents. The use of the medicine is not unattended with risk. If persisted in for a length of time, it is apt, according to Wells, to bring about calcareous degeneration of the arteries generally. Whatever action it may possess in arresting the growth of fibroids probably depends upon this property. *Dose*, from Gm. 0.60–1.20 (gr. x–xx), taken in milk or dissolved in a large quantity of water. The old "solution of muriate of lime" (*Ph. Edin.*) contained 8 ounces of the crystallized salt in 12 fluidounces of water. *Dose* for an adult, from 20 to 50 minims, in water or milk. A syrup has been prepared which contains 5 ounces of the crystallized salt in 12 fluidounces of the excipient. *Dose*, a teaspoonful.

CALCII HYPOPHOSPHIS, *U. S., Br.*—Calcium Hypophosphite.

Calcium hypophosphorosum, *Calcaria hypophosphorosa*, *Hypophosphis calcicus.*—*Hypophosphite of lime*, E.; *Hypophosphite de chaux*, Fr.; *Calciumhypophosphit*, *Unterphosphorigsaurer Kalk*, G.

Formula $Ca(H_2PO_2)_2$ or $CaH_4(PO_2)_2$. Molecular weight 169.67.

Preparation.—Calcium hypophosphite is obtained by heating phosphorus with milk of lime, inflammable hydrogen phosphide being given off—namely, $3Ca(OH)_2 + 6H_2O + 4P_2$ yields $3Ca(H_2PO_2)_2 + 2PH_3$. Proctor (1858) uses a deep boiler, in which a uniform milk is made with 4 pounds of burned lime and 5 gallons of water; 1 pound of phosphorus is added, and the whole boiled, boiling water being added from time to time to preserve the measure, until the phosphorus has been all oxidized and the strong odor of hydrogen phosphide has disappeared. The mixture is filtered, the residue washed with water, the mixed filtrate evaporated to 6 pints, filtered from the calcium hydroxide and carbonate, and again evaporated and crystallized or granulated. Nearly half the phosphorus is oxidized to phosphoric acid, probably by the decomposition of water, since the escaping gas contains free hydrogen (Wurtz) and remains with the excess of lime as calcium phosphate. E. Scheffer (1858) succeeded in avoiding much of this loss by using phosphorus which had been previously burned under water by passing atmospheric air into it, whereby it assumed a spongy appearance. It unites then with the lime even at the ordinary temperature, but more readily at 55° C. (about 130° F.), and very little spontaneously inflammable gas is generated. The salt is prepared on the large scale by adding granulated phosphorus to milk of lime and exposing the mixture to the air, and agitating frequently until the phosphorus has disappeared. A small portion of hydrogen phosphide is evolved (Gmelin-Kraut's *Chemie*). It is well to precipitate the dissolved lime by passing carbon dioxide through the warm filtrate and by filtering again. The observation previously made by Wurtz, that hypophosphites boiled with an excess of alkali are decomposed into hydrogen and phosphite or phosphate, has been recently confirmed by W. F. Short (1882) for the calcium salt prepared by boiling with excess of lime.

Properties.—Calcium hypophosphite crystallizes in transparent, thin, flexible scales composed of flat monoclinic prisms, but is usually met with as a white crystalline powder with a pearly lustre, of neutral or slightly alkaline reaction, inodorous, and of a bitter, nauseous taste. In the dry state it is permanent in the air, but when dissolved in water it is gradually oxidized to calcium phosphate. Heated to redness in a retort, it decrepitates, evolves water, spontaneously inflammable hydrogen phosphide, and a little phosphorus, and leaves nearly 80 per cent. of a reddish residue containing a little amorphous phosphorus and calcium pyrophosphate. The salt dissolves in 6 parts (6.8 parts, *U. S.*) of cold and in a slightly less amount of boiling water; it is insoluble in strong and but slightly soluble in dilute alcohol (H. Rose). The solution yields white precipitates with silver nitrate and with mercuric chloride, both turning dark when heated, from a reduction to the metallic state. Metallic gold is precipitated from the chloride, and the soluble copper salts yield with the solution, particularly on heating, metallic

copper. Ammonium oxalate produces in the solution a white precipitate which is insoluble in acetic acid, but dissolves in hydrochloric acid.

Tests.—"If 1 Gm. of the salt be dissolved in 20 Cc. of water, no insoluble residue should be left (absence of phosphate, sulphate, and other insoluble impurities). In this solution no precipitate should be produced by the addition of lead acetate test-solution (absence of soluble phosphate); nor after acidulation with hydrochloric acid, by barium chloride test-solution (absence of soluble sulphate); or by an equal volume of hydrogen sulphide test-solution (absence of arsenic, etc.). On adding to 5 Cc. of the solution (1 in 20) 1 Cc. each of ammonium chloride test-solution and ammonia-water, and 3 Cc. of ammonium carbonate test-solution, applying a gentle heat for a few minutes, and then filtering, not more than a very slight turbidity should be produced by the addition to the filtrate of a few drops of sodium phosphate test-solution (limit of magnesium). If 0.1 Gm. of calcium hypophosphite be dissolved in 10 Cc. of water, then mixed with 10 Cc. of sulphuric acid and 50 Cc. of decinormal potassium permanganate solution, and the mixture boiled for fifteen minutes, it should require not more than 3 Cc. of decinormal oxalic acid solution to discharge the red color (corresponding to at least 99.68 per cent. of the pure salt)."—*U. S.*

In the official volumetric test for the quality of the salt the potassium permanganate converts the hypophosphite into an acid phosphate, according to the equation $5CaH_4(PO_2)_2 + 8KMnO_4 + 12H_2SO_4 = 5CaH_4(PO_4)_2 + 4K_2SO_4 + 8MnSO_4 + 12H_2G$; the excess of permanganate solution added is determined by oxalic acid, and hence the exact quantity consumed by any sample of hypophosphite is readily ascertained. Each Cc. decinormal permanganate solution corresponds to 0.0021209 Gm. calcium hypophosphite; and as each Cc. decinormal oxalic acid solution will exactly decolorize 1 Cc. of the permanganate solution, the Pharmacopœia really demands $50 - 3 = 47$ Cc. of decinormal permanganate solution for the oxidation of 0.1 Gm. calcium hypophosphite, 47 Cc. = (0.0021209×47) 0.0996823 of calcium hypophosphite, which is equal to 99.68 per cent.

Pharmaceutical Uses.—Syrupus calcii hypophosphitis. Calcium hypophosphite 1 ounce; Water 9½ fluidounces; Sugar 12 ounces; Essence of Vanilla ½ fluidounce. Dissolve and mix (Procter).

Action and Uses.—On theoretical grounds the combinations of phosphorus with lime have been supposed to possess a power of stimulating and regenerating the nervous system and those tissues which contain phosphorus and lime. The experiments of Perl (*Virchow's Archiv*, lxxiv. 54) led him to conclude that the soluble salts of lime are in a slight degree absorbable, and therefore capable to that extent of acting therapeutically when the normal lime compounds of the body are deficient. According to Dysart, the lacto-phosphate is the only salt of lime that is readily appropriated by the economy (*Practitioner*, xxii. 375). These views have led to the use of the lime salts in *anæmia*, *scrofula*, *caries*, *tuberculosis*, and other cachectic conditions; in *chlorosis* and *menorrhagia;* in *fractures* uniting slowly or imperfectly; in *rickets* and in *Pott's disease;* and in various chronic *profluvia* connected with a feeble and often strumous state of the system. The claims made for these preparations, independently of other and more efficient medicines (iron, cod-liver oil) and hygienic influences, consist largely of assertion without evidence, and are too slender to be seriously entertained. Nevertheless, as the preparations of lime in question are innocuous, there is no reason why the degree of benefit they confer, however slight, should not be taken advantage of in the various cachexiæ mentioned. *Dose*, Gm. 0.30–0.40 (gr. v–vj) or more at meal-times. The syrup of the hypophosphite of calcium may be used in doses Gm. 4 (fʒj).

CALCII IODAS.—Calcium Iodate.

Iodate de chaux, Fr.; *Jodsaurer Kalk*, G.

Formula $Ca(IO_3)_2.6H_2O$. Molecular weight 496.49.

Preparation.—The following process was proposed by W. Flight (1864): An alcoholic solution of iodine is gradually mixed with an excess of a filtered aqueous solution of chlorinated lime, care being taken to prevent the increase of temperature, so that the formation of iodine chloride shall not be permitted. The chlorinated lime oxidizes the iodine, calcium iodate being precipitated, while calcium chloride and hydrochloric acid remain in solution; $5Ca(ClO)_2 + 2I_2 + 2H_2O$ yields $2Ca(IO_3)_2 + 3CaCl_2 + 4HCl$. Reichardt (1874) directs the use of iodine with an excess of chlorinated lime diffused in water. After decolorization the mixture is slightly acidulated with hydrochloric acid, heated to boiling, and the filtered solution crystallized.

Properties.—Calcium iodate crystallizes from water in flat, colorless, shining needles, which are slowly efflorescent on exposure, require at 15° C. (59° F.) about 300 parts of water for solution, and are nearly insoluble in alcohol. The aqueous solution yields a white precipitate with ammonium oxalate, and liberates iodine on the addition of sulphurous acid.

CALCII IODIDUM.—Calcium Iodide.

Calcium Iodatum.—Iodure de calcium, Fr.; *Jodcalcium, Calciumjodid*, G.

Formula CaI_2. Molecular weight 292.97.

Preparation.—The salt is obtained on dissolving slaked lime in hydriodic acid and evaporating; or, 3 parts of iodine are digested with sufficient iron and water until a green solution of ferrous iodide is obtained. The liquid is filtered and mixed with 1 part of iodine, and after this has been dissolved it is boiled with milk of lime prepared with 1 part of burnt lime, until the iron has been precipitated; the liquid is then filtered and evaporated.

Properties.—Calcium iodide is a white salt which crystallizes with difficulty in pearly scales. It is freely soluble in alcohol and water, and is very deliquescent. 100 parts of water dissolve at 0° C. (32° F.) 192, at 20° C. (68° F.) 204, and at 92° C. (197.6° F.) 435 parts of the salt. On exposure to the air the solution is partly decomposed, calcium carbonate being precipitated. The solution yields a white precipitate with ammonium oxalate, and a bright red one with corrosive sublimate.

Tests.—On mixing the solution with sulphurous acid and cupric sulphate in excess and heating the mixture, a grayish precipitate of cuprous iodide is produced, and the filtrate yields no precipitate on the addition of silver nitrate (absence of chloride and bromide).

Action and Uses.—Experiments seem to show that this salt arrests putrefactive fermentation, deodorizes fecal matter, and acts as an irritant upon the living tissues. Given internally, in doses of from Gm. 0.06–0.20 (gr. j–iij) three times a day, it is alleged to arrest *erysipelas*, diminish and deodorize *suppurative discharges*, and promote the cure of *scrofulous ulceration*. These statements call for confirmation, and even more do its claims to extraordinary efficacy in pulmonary *phthisis*.

CALCII PHOSPHAS PRÆCIPITATUS, *U. S.*—Precipitated Calcium Phosphate.

Calcii phosphas, Br.; *Calcium phosphoricum*, P. G.; *Calcaria phosphorica, Phosphas calcicus præcipitatus.—Precipitated phosphate of lime*, E.; *Phosphate de chaux hydraté*, Fr.; *Calciumphosphat, Phosphorsaure Kalkerde*, G.

Formula $Ca_3(PO_4)_2$. Molecular weight 309.33.

Preparation.—Take of Bone-ash 4 ounces; Hydrochloric Acid 6 fluidounces; Water 2 pints; Solution of Ammonia 12 fluidounces or a sufficiency; Distilled water a sufficiency. Digest the bone-ash in the hydrochloric acid, diluted with a pint of water, until it is dissolved; boil for a few minutes; filter; add the remainder of the water, and afterward the solution of ammonia, until the mixture acquires an alkaline reaction; and, having collected the precipitate on a calico filter, wash it with boiling distilled water as long as the liquid which passes through occasions a precipitate when dropped into solution of nitrate of silver acidulated with nitric acid. Dry the washed product at a temperature not exceeding 100° C. (212° F.).—*Br.*

The process of the U. S. P. 1370 was identical with the above. By dissolving the bone-earth in hydrochloric acid, acid calcium phosphate, $CaH_4(PO_4)_2$, and calcium chloride, $CaCl_2$, are formed; on the addition of ammonia the result is ammonium chloride, water, and tricalcium phosphate, the latter of which precipitates; $CaH_4(PO_4)_2 + 2CaCl_2 + 4NH_4OH$ yields $4NH_4Cl + 4H_2O + Ca_3(PO_4)_2$. The ammonium chloride is removed by washing with water. If the precipitation is effected in the cold the calcium phosphate is very voluminous and the washing is quite difficult. The calcium phosphate of the German Pharmacopœia is prepared by precipitating a solution of calcium chloride with sodium phosphate, has the composition $CaHPO_4.2H_2O$, is more readily soluble than the above salt, and when heated to redness loses 26 per cent. of water.

Properties and Tests.—This preparation is often called *bone phosphate* to distinguish it from other calcium phosphates; it forms a light white, amorphous, permanent powder, which at an intense white heat fuses without decomposition and on cooling yields

a porcelain-like mass. When fused with sodium carbonate or digested with a solution of this salt it is partly decomposed, with the formation of calcium carbonate. It is insoluble in water and other simple solvents; almost insoluble in acetic acid, but somewhat soluble in solutions of sodium chloride and other neutral alkali salts. Continued boiling with water induces decomposition, with the formation of basic phosphate, $Ca_5(PO_4)_3OH$, and of hydrophosphate, $CaHPO_4$. "When moistened with silver nitrate test-solution a yellow color is assumed by the salt either before or after ignition (distinction from acid calcium phosphate, which, after ignition, remains white when moistened with silver nitrate). For applying tests of identity and purity, shake 2 Gm. of the salt with 20 Cc. of water, and add nitric acid, drop by drop, until solution is effected; then add water to make the liquid measure 40 Cc. No effervescence should occur on adding the acid (absence of carbonate). From a portion of this solution the salt is precipitated unchanged by a slight excess of ammonia-water. From another portion ammonium molybdate test-solution precipitates yellow ammonium phosphomolybdate; the reaction is accelerated by a gentle heat. If to 5 Cc. of the solution, acidulated with nitric acid, 0.5 Cc. of silver nitrate test-solution be added, not more than a slight turbidity should result (limit of chloride). The clear solution should not be rendered turbid by barium chloride test-solution (absence of sulphate); nor by potassium sulphate test-solution (barium); nor by an equal volume of hydrogen sulphide test-solution (arsenic, lead, etc.); nor should it be colored blue by potassium ferrocyanide test-solution (iron). If 5 Cc. of the solution be mixed with 1 Cc. of sodium acetate test-solution, and then with ammonium oxalate test-solution, until the calcium is completely precipitated, the filtrate should not be rendered very turbid by adding ammonia-water in slight excess (limit of magnesium)."—*U. S.*

Pharmaceutical Uses.—SYRUPUS CALCII PHOSPHATIS. 1 troyounce of calcium phosphate dissolved with sufficient hydrochloric (or preferably phosphoric) acid, avoiding excess of acid, and sufficient syrup to make 1 pint (Wiegand, 1854). The syrups of chlorhydrophosphate and of acid calcium phosphate, as used in France, are little more than one-fourth the strength of the preceding.

Action and Uses.—If this compound and its preparations possess medicinal virtues, they are chiefly those of the hypophosphite of lime, which is treated of elsewhere. There is, however, sufficient reason for believing that they are not assimilated at all. Yet they have been used with reputed advantage in *mollities ossium*, and also to promote the consolidation of *fractures* in which the formation of callus is slow or imperfect. The *dose* of the phosphate is from Gm. 0.60–1.60 (gr. x–xxx), and may conveniently be given in carbonic-acid water. Phosphate of lime has also been used to check the colliquative *sweats* of *phthisis* (*Amer. Jour. Med. Sci.*, Apr. 1887, p. 530), and topically for the treatment of *tubercular disease* of the joints (*Centralbl. f. M.*, v. 383–385).

"Physiological phosphate of lime" is the name given to the residue of bones when their animal matter has been removed by caustic soda. Reduced to a fine powder and mixed with bread in the proportion of 1 per cent., it has been thought useful in the conditions above named.

CALCII SULPHAS EXSICCATUS, *U. S.*—DRIED CALCIUM SULPHATE.

Calcii sulphas, Br.; *Calcium sulfuricum ustum*, P. G.; *Dried gypsum*, *Plaster of Paris*, E.; *Plâtre*, Fr.; *Gebrannter Gyps*, G.

A powder containing about 95 per cent. of calcium sulphate ($CaSO_4$, mol. weight 135.73) and about 5 per cent. of water.—*U. S.*

Preparation.—Native calcium sulphate is carefully heated until about three-fourths of its water has been expelled.—*U. S.*

It should be preserved in well-closed vessels, to prevent the gradual absorption of moisture from the atmosphere.

Properties.—"Dried gypsum occurs as an amorphous white powder, without taste or odor, and when mixed with half its weight of water it forms a smooth paste which rapidly hardens. It is soluble at 15° C. (59° F.) in about 410 parts of water, at 38° C. (100.4° F.) in 388 parts, and at 100° C. (212° F.) in 476 parts. It is insoluble in alcohol, but dissolves readily in diluted nitric or hydrochloric acid, also in saturated solutions of potassium nitrate, sodium thiosulphate, and of various ammonium salts. Heated to above 204° C. (399.2° F.), dried gypsum becomes anhydrous, and loses the property of forming a paste with water and hardening rapidly. Its saturated solution in water should be neutral to litmus-paper, and forms white precipitate with alcohol and

with solutions of ammonium oxalate and of barium chloride. The addition of diluted acids to dried gypsum should not cause effervescence (absence of carbonate)."—*U. S.*

CALCII SULPHAS.—Native calcium sulphate. $CaSO_4 + 2H_2O$. Mol. weight 171.65. Gypsum, *E.;* Solfate de chaux, *Fr.;* Calciumsulfat, Schwefelsaurer Kalk, Gyps, *G.*— This compound is met with in nature in the form of transparent prisms known as *selenite*, and in semi-opaque masses which are called *alabaster* and *gypsum*. The same compound is precipitated on adding sulphuric acid or a sulphate to a solution of a calcium salt. It is a white, crystalline powder, insoluble in alcohol, but soluble in 380 parts of cold or 450 parts of boiling water.

Surgical Uses.—Plaster of Paris is used for making casts of deformities and surgical injuries, and as one of the articles adapted for applying the so-called immovable apparatus intended to retain broken bones in a fixed position. "A roller of coarse, soft muslin must have dry plaster of Paris thoroughly rubbed into its meshes; some cold water is then to be poured upon either end of it, so as to moisten it through. A dry roller having been previously applied to the limb, the wetted plaster bandage must be smoothly rolled upon it, the surgeon taking care that no reverses are made. . . . . It hardens in the course of a few minutes, and as it dries forms a solid, hard, and light casing to the limb. It has the advantage over the starch apparatus of being lighter, and especially of drying and hardening quickly" (Erichsen). Some surgeons recommend "crinoline," and others "cheese-cloth," in preference to muslin as a material for the bandages, on account of the larger meshes of their web; and it is suggested to impregnate the fabric with the powdered plaster of Paris by passing it through a box containing this substance (*Boston Med. and Surg. Jour.*, Sept. 1887, p. 204). To render the plaster less brittle it is sometimes mixed with mucilage, which however, causes it to dry more slowly. The chest-bandage may be converted into a jacket by cutting it, when dry, down the middle of the front and finishing the edges with eyelet-holes and lacings. (See *Med. Record*, xvi. 487).

This bandage has been regarded as peculiarly suited to the treatment of simple, compound, and comminuted *fractures* of the limbs, ribs, and pelvis, and of Pott's *disease of the spine*. It is employed by surgeons as the best form of immovable apparatus, provided that it be judiciously and skilfully applied; but some object that, owing to the concealment of the seat of injury, cures with shortening, deformity, etc. are more common with the use of the immovable than with other apparatus. In treating angular curvature of the spine the patient is partially suspended by the head and shoulders, or is lying prone in a canvas hammock, while the bandage is applied. But full extension is held to be dangerous. It is used in *lateral curvature* also, in the various deformities of the *ankle* and *knee-joints*, and to sustain the dressings after Pirogoff's *amputation*. (For further information compare *Med. Record*, xxi. 11, xxvi. 428; *Med.-Chir. Trans.*, lxiv. 295; *Therap. Gaz.*, xvi. 297).

CALCII SULPHIS.—Calcium Sulphite.

Sulfite de chaux, Fr.; *Schwefligsaurer Kalk*, G.

Formula $CaSO_3.2H_2O$. Molecular weight 155.69.

Preparation.—4 parts of slaked lime are intimately mixed with 1 part of water; the mixture is spread out in thin layers, and sulphur dioxide passed into the vessel or chamber as long as it is absorbed; or the gas is passed into milk of lime and the resulting precipitate dried.

Properties.—Calcium sulphite is a white powder requiring 800 parts of cold water for solution: it dissolves readily in aqueous sulphurous acid, and crystallizes from this solution in hexagonal prisms. It has a slight sulphurous taste, and on exposure is gradually converted into calcium sulphate.

Action and Uses.—The local action of this sulphite appears to be very slight, since when administered to dogs in very large doses it does not occasion any signs of gastro-intestinal irritation. This fact is referable, in part at least, to the great insolubility of the compound. It appears to be absorbed and excreted without change in the urine. It limits *fermentation* and *putrefaction* in the digestive organs, like other compounds of sulphurous and hyposulphurous acids (see Acidum Sulphurosum), and may be applied externally for the same purposes and to stimulate indolent *ulcers*, etc. The very large quantities which are considered necessary for securing its effects render its internal administration as difficult as it is indeed superfluous, considering the number of soluble sulphites and hyposulphites available.

CALENDULA, *U. S.*—Calendula.

Marigold, E.; *Souci, Fleur de tous les mois*, Fr.; *Ringelblume, Todtenblume*, G.

The florets of Calendula officinalis, *Linné.*

Nat. Ord.—Compositæ, Cynareæ.

Origin.—The garden marigold is an annual plant, a native of Southern Europe and the Levant, and is frequently cultivated for ornament. It has a spreading somewhat angular and roughish-hairy stem, 3 to 6 M (a foot or two) high, and alternate, sessile, rather fleshy, hairy, and entire or few-toothed leaves, of which the lower ones are spatulate or obovate, and the upper ones varying between oblanceolate and lance-oblong. The flower-heads are terminal, about 5 Cm. (2 inches) broad, have a flattish, hemispherical involucre, with two rows of nearly equal linear-lanceolate scales, enclosing a flat receptacle without chaff, one or several rows of ray-florets, varying in color from light-yellow to orange, and numerous disk-florets, which are tubular, five-cleft, yellow, staminate, and barren. The akenes are strongly incurved or coiled, and more or less muricate, those of the outer row distinctly winged, those of the inner rows with slight or no wings. The fresh plant has a rather strong and heavy somewhat narcotic odor and a bitter somewhat saline taste. After drying the plant has but little odor and a weaker taste.

Description.—The florets as found in commerce are about 12 Mm. (½ inch) long and 3 Mm. (⅛ inch) wide, and are the ray florets of the flower-heads. They are linear and strap-shaped, three-toothed above, and possess a delicate longitudinal venation. The florets contain in the short hairy tube remnants of a filiform style, which is terminated by two elongated branches. In color they vary from yellow to orange, but on exposure to sunlight they become of a whitish tint. The taste is somewhat bitter and slightly saline, and the odor is slight and somewhat heavy.

Substitution.—In 1867 we called attention to the fact that the flower-heads of Tagetes erecta, *Linné*, were sold as calendula, and we believe that much of the *fluid extract of calendula* at present in the market is really obtained from the species named and from Tag. patula, *Linné.* These two plants are indigenous to Mexico and tropical America, but are often cultivated under the names of *French* or *African marigold.* They have pinnatifid leaves and showy flowers, with the scales of the involucre united to form a tube, the receptacle naked, and the ray-florets broadly ligulate, toothed, light or deep orange-colored, sometimes (T. patula) striped with red; the akenes are flattish, slender, and crowned with a few chaffy or awned scales.

Composition.—Calendula was analyzed by Geiger (1818), who, besides the usual constituents of herbs, found in it an amorphous bitter principle and *calendulin*, which is yellowish, tasteless, insoluble in ether, soluble in alcohol, and swelling with water into a transparent jelly.

Action and Uses.—The leaves and the unexpanded flowers were at one time supposed to possess stimulant and resolutive virtues, and were used in congestions of the *liver, jaundice, amenorrhœa, scrofula*, and even in *typhoid* febrile states. Both internally and externally marigold was employed in the treatment of *cancer*, and was thought to dispose cancerous ulcers to heal. A solution of the extract and a decoction of the herb were employed for this purpose. A saturated tincture of the flowers is said to promote the cure of *contusions, wounds*, and simple *ulcers;* but alcohol under various forms has done the same. A tincture of calendula has (1881) been recommended in suppurative *otitis*, but as it was mixed with boracic acid, which was alone competent to the cure, the efficacy of the tincture may be doubted (*New York Med. Record*, xx. 729). The extract is alleged to have been very efficient in allaying chronic *vomiting*, as well as for the purposes above enumerated. It was given in doses of Gm. 0.10 (gr. ij) several times a day.

CALLITRICHE.—Water-Starwort.

Callitriche verna, *Linné.*

Nat. Ord.—Haloragеæ.

Description.—The plant is a native of Europe, and of North America from Pennsylvania and New Jersey northward. It grows in stagnant waters, and sluggish rivulets, has a stem .3 to .6 M. (1 or 2 feet) long, radiating at the nodes, and nearly sessile, obovate, entire, and three-nerved floating leaves, which are crowded in a tuft and about 8 Mm. (⅓ inch) long; the submerged leaves are longer and linear, the flowers monœcious and inconspicuous.

A closely-allied species, Call. heterophylla, *Pursh*, which is common in the Southern United States, has broadly spatulate and petiolate floating leaves, and is used for the same purpose as the Northern water-starwort.

Action and Uses.—Water-starwort is esteemed in the Southern States as a diuretic in *dropsy*, and is administered in the form of a tincture or in spirits saturated with the plant. In decoction it is given to horses to promote diuresis.

CALUMBA, *U. S.*—Calumba.

Calumbæ radix, Br.; *Radix colombo*, P. G.; *Radix columbo.—Columbo*, E.; *Colombe*, Fr., Sp.; *Kolombowurzel*, G.; *Colombo*, F. It.

The root of Jateorrhiza palmata (*Lamarck*) *Miers*, s. Cocculus palmatus, *De Candolle. Bot. Mag.* 2970, 2971; Bentley and Trimen, *Med. Plants*, 13.

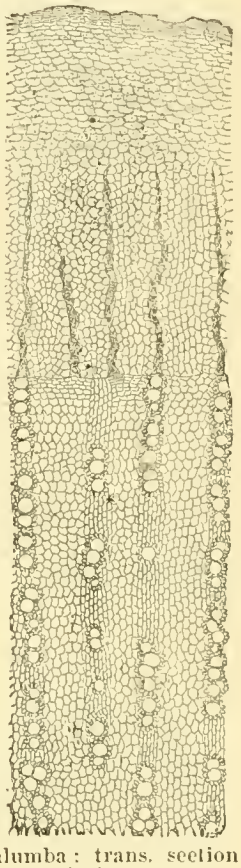
Nat. Ord.—Menispermaceæ.

Origin.—Besides the plant named above, Jateorrhiza Calumba, Miers, s. Cocculus palmatus, Wallich, has been named as the source of the drug. The distinctive characters, supposed to depend upon the shape of the basal lobes of the leaves and the presence or absence of hairs in the male inflorescence, were proven by Hanbury to be unimportant and to exist on the same stem; hence he suppressed the name of a supposed species, retaining that of J. palmata. Bentley agrees with these views, but retains the name of J. Calumba. The name is derived from *kalumb*, the African name of the root.

The plant is indigenous to the forests of Mozambique, in the southern portion of Eastern Africa, quite abundant along the lower Zambesi River, and cultivated in some African and East Indian islands. It is a hairy perennial climber, which reaches the summits of lofty trees, has large nearly orbicular, cordate, and palmately-lobed leaves, and diœcious flowers. It grows from a short, thick, and irregular rhizome, and this gives off numerous fusiform roots, which are the portion collected during the dry season, cut into transverse slices, and dried in the shade.

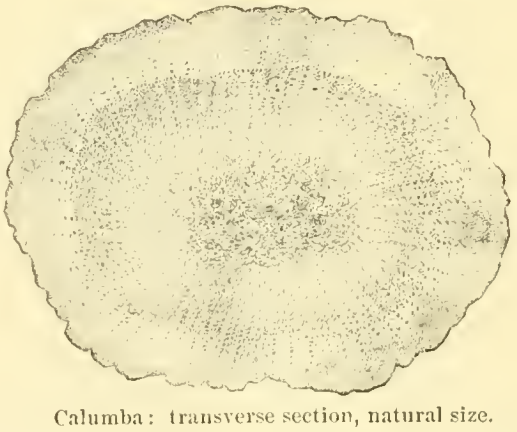
Description.—Columbo-root exists in commerce in nearly circular disks, having a diameter of 25 to 63 Mm. (1 to 2½ inches), and a thickness of about 6 to12 Mm. (¼ to ½ inch). From the considerable shrinking of the parenchyma the central portion is quite depressed, but the meditullium shows two or three circles of projecting and radiating vascular bundles, and upon a fresh section the dark-colored cambium line becomes plainly discernible, together with the numerous radiating dark-colored and narrow bast-wedges. The fresh section is of a light or grayish-yellow color, more yellowish-brown in the outer bark, which externally shows a gray-brown cork. The root breaks very readily in all directions with a short and mealy fracture; its odor is slight, more prominent and characteristic on powdering or moistening; the taste is slightly aromatic, persistently bitter, and at the same time mucilaginous. As imported it is often more or less worm-eaten.

Fig. 44.



Calumba: trans. section through the outer portion; mag. 25 diam.

Fig. 43.



Calumba: transverse section, natural size.

Colombo-root enters commerce directly from Zanzibar or through Bombay and other Indian ports. 38,115 pounds were received in the United States in 1882; during the preceding year only 8336 pounds.

Constituents.—Columbo-root has been analyzed by Planche, Wittstock, Buchner, Lebourdais, and Boedeker. *Columbin* was obtained by Wittstock (1830) by evaporating the ethereal tincture of the root. Boedeker (1849) prefers to obtain it by shaking the turbid aqueous solution of the alcoholic extract with ether. It forms colorless, inodorous, and very bitter prisms and needles, and is soluble in alkalies and hot alcohol, and in acetic acid, less so in cold alcohol and ether, and nearly insoluble in water. Boedeker found the yellow color of the cell-walls due to *berberine*, which exists probably in combination with the straw-yellow bitter *columbic acid;* the latter is almost insoluble in cold water, sparingly soluble in cold ether, freely in alkalies and alcohol; the last two principles are probably formed from the first. Columbin is $C_{42}H_{44}O_{14}$; the addition of ammonia, NH_3, may result in the formation of berberine, $C_{20}H_{17}NO_4$, columbic acid, $C_{22}H_{24}O_7$, and $3H_2O$. Buchner (1831) found in columbo-root also 35 per cent. of starch, 17 of pectin, 4.7 of gum, 5 of yellow resin, and a little wax. The root yields about 6 per cent. of ash.

Substitutions.—The roots of bryonia and of Frasera Walteri, which have been occasionally sold as columbo, have scarcely any resemblance to it, and are readily distinguished by their color and by the absence of the dark cambium zone and radiating lines.

Action and Uses.—Colombine is said, in small doses, to augment the secretion of the liver and gastro-intestinal glands, but in large doses to act as an emeto-cathartic (Roux). Calumba is a pure stimulant stomachic tonic, increasing the appetite and improving the digestion, It does not constipate. The experiments of Tschelzoff led him to conclusions regarding the action of vegetable bitters, including calumba, which are opposed to universal experience (*Bull. de Thérap.*, cxi. 90). He found that they lessen the secretion of the gastric juice as well as its digestive power; that they have no influence on the secretion of bile; that they rather promote than restrain gastric fermentation, etc. These conclusions have been corroborated by the careful experiments of Reichmann, who, however, concluded that bitters are especially indicated when the secretion of the gastric juice is diminished (*Archives gén.*, Nov. 1888. p. 614), but they do not seriously impair the value of the opposite testimony of physicians in every age. In India calumba has long been used in the treatment of *diarrhœa*, *cholera morbus*, and *dysentery*, and in Europe it has been found an efficient remedy for the *vomiting* and *purging* incident to teething, for atonic *dyspepsia*, the vomiting of pregnancy, etc. Its special mode of action appears to depend chiefly upon its constitutent, berberine (see Berberis), although the associated colombine, which is intensely bitter, probably enhances the tonic power of the medicine. In order to preserve the infusion it may be prepared as follows: Take 1 ounce of powdered columbo, ½ ounce of powdered orange-peel, 2 ounces of brandy, and 14 ounces of water. Macerate for twelve hours and filter. Or it may be prepared more quickly by displacement. If a laxative operation is desired, rhubarb may be added to the materials. The dose of columbo in powder is from Gm. 0.60–2.00 (gr. x–xxx). In this form it may be associated with carbonate of iron and a little ginger or orange-peel. The simple infusion, which is no longer officinal, is made with Gm. .16 (½ troyounce) of columbo to Gm. 250 (a pint) of water. *Dose*, Gm. 32–64 (f℥j–ij).

CALX, *U. S., Br.*—Lime.

Calcaria usta, P. G.; *Calcii oxidum*, *Calcaria*, *Calx viva*, *Calx usta*, *Oxydum calcicum*. —*Burned lime*, E.; *Chaux*, *Chaux vive*, Fr.; *Kalk*, *Aetzkalk*, *Gebrannter Kalk*, G.; *Ossido di calcio*, It., Sp.

Formula CaO. Molecular weight 55.87.

Lime prepared by burning white marble, oyster-shells, or the purest varieties of natural calcium carbonate. It should be kept in well-closed vessels in a dry place.—*U. S.*

Preparation.—Lime is an alkaline earth which is obtained by calcining native calcium carbonate, such as chalk, limestone, or marble, by which carbon dioxide is given off, calcium oxide remaining behind; $CaCO_3$ is decomposed into $CO_2 + CaO$. Prepared on the large scale from native carbonates, it contains also the impurities naturally existing therein, such as magnesia, ferric oxide, alkali salts, silica, and clay. If the latter is present in sufficient quantity, it will slake feebly or not at all, and is then called *poor* or *over-burnt*. To obtain pure lime, pure calcium carbonate should be employed, and if the calcining has been done in a crucible the resulting mass should be moistened with water and again calcined to expel the carbon dioxide completely. The same effect is produced on the large scale by constructiug the lime-kiln in such a manner that the products of combustion pass over the limestone.

Calcii hydras, *Br.;* Calcaria hydrica.—Slaked lime, Calcium hydroxide, Calcium hydrate, *E.;* Chaux éteinte, Chaux hydratée, *Fr.;* Kalkhydrat, Gelöschter Kalk, *G.*—Formula $Ca(OH)_2$. Molecular weight 73.83.

The British Pharmacopœia gives the following directions for preparing it: Take of Lime 2 pounds; Distilled Water 1 pint (Imperial). Place the lime in a metal pot, pour the water upon it, and when the vapor ceases to be disengaged cover the pot with its lid and set it aside to cool. When the temperature has fallen to that of the atmosphere, put the slaked lime on an iron wire sieve and by gentle agitation cause the fine powder to pass through the sieve, rejecting what is left. Put the powder into a well-stopped bottle and keep it excluded as much as possible from the air. Slaked lime should be recently prepared.

Properties.—Burnt lime is in hard white or grayish-white, porous masses of the specific gravity 3.1 to 3.2. It is fusible with difficulty only before the oxyhydrogen blowpipe, giving off a splendid red light, but is not otherwise altered. It is inodorous, and has an alkaline reaction and a caustic, burning taste. When mixed with about one-half its weight of water it absorbs the latter, the air being at the same time expelled from the pores with a hissing noise; it then becomes heated and is converted into slaked lime, particles of this being mechanically carried up by the vapors; moistened with a small quantity of water, lime becomes luminous in the dark. At 15° C. (59° F.) it requires about 750 parts of water for solution, but at 100° C. (212° F.) over 1300 parts are necessary; hence a solution of lime saturated in the cold becomes turbid on being heated. Exposed to the air, it absorbs water and carbon dioxide and is converted into calcium hydroxide and carbonate.

Slaked lime forms a soft white powder of spec. grav. 2.08 and of a strong alkaline taste and reaction. It does not part with its water at 100° C. (212° F.), and becomes completely anhydrous only at a dull red heat, without melting previously. On exposure to the air it is converted into calcium carbonate. When lime is slaked, or slaked lime is mixed with about 3 or 4 parts of water to form a thin magma, the mixture is called *milk of lime.*

Tests.—"If 1 part of lime be slaked, and then thoroughly mixed with 50 parts of water, and the greater portion of the milky liquid decanted, no hard, gritty particles should be found in the residue, nor should the addition of hydrochloric acid to this residue cause much effervescence (limit of carbonate) nor leave more than a slight, insoluble residue. If the decanted portion be dissolved in acetic acid and filtered, if necessary, a portion of the filtrate should not be rendered turbid by potassium dichromate test-solution (absence of barium). In another portion of the filtrate the addition of ammonia-water should not produce more than a slight turbidity (limit of aluminum, etc)."—*U. S.*

Salts.—Slaked lime decomposes most of the alkali and metallic salts by combining with their acids and forming *calcium salts*, which are colorless unless the acid be colored, have a neutral reaction upon test-paper, and impart to the flame of the blowpipe a yellowish-red color. Lime salts soluble in water are not precipitated by ammonia, but yield white precipitates with ammonium carbonate, phosphate, and oxalate, and with sulphuric acid, the latter precipitate being soluble in a large quantity of water, and the former ones in acetic acid, with the exception of the oxalate. Those salts which are insoluble in water are dissolved by dilute hydrochloric acid, and this solution is not disturbed (that of calcium oxalate excepted) when solution of sodium acetate is added in excess; but if to this liquid a solution of ammonium oxalate is added, all the calcium will be precipitated as calcium oxalate.

Pharmaceutical Uses.—On account of its affinity for water, lime is employed in preparing absolute alcohol and strong ether; its affinity for acids renders it useful in the preparation of alkalies (ammonia, potassa, soda), alkaloids (quinine, strychnine, etc.), and certain organic acids and allied compounds (santonin). It is employed in preparing precipitated sulphur, in the manufacture of chlorinated lime and potassium chlorate, and in many other chemical processes.

Action and Uses.—Owing to its strong affinity for organic elements, unslaked lime causes the decomposition of organized matter, and thus favors the solution of the animal and vegetable constituents of soils. With albumen it forms a horny mass. In like manner it is employed to arrest putrefactive fermentation in the stools of infective diseases, such as *cholera*, *typhoid fever*, and *dysentery;* in cesspools, sewers, slaughter-houses, dissecting-rooms, etc. It is used by tanners to remove the hair and cuticle from hides. It has a less affinity for water than the alkalies, and is therefore a less energetic

caustic, but in forming a hydrate it evolves a large amount of heat, so that when taken internally in large doses it inflames the mucous membrane of the throat, œsophagus, etc., and even causes ulceration and gangrene of these organs and of the stomach, and death, As a caustic, quicklime has been employed from time immemorial. It was usually mixed with sulphuret of arsenic in the treatment of indolent and unhealthy *ulcers* and for removing superfluous *hair* from the skin. Quicklime may also be used to destroy *nævi* and to establish *issues*, for which purposes a fragment of freshly-prepared lime should be laid upon the skin, protected by adhesive plaster with a proper opening in it, and moistened with a few drops of water. The heat produced is estimated at 350° F., and so rapidly destroys the organization of the skin that the lime ought to be removed before it is entirely exhausted in order to prevent too deep an eschar. Mixed with wood-ashes, it has been employed in the treatment of *favus*, and in an ointment containing 1 part of lime to 20 or 30 of lard for the cure of *psoriasis* and indolent *ulcers*. The caustic action of lime may be limited by vinegar or other dilute vegetable acid.

CALX CHLORATA, *U. S.*—Chlorinated Lime.

Calx chlorinata, Br., U. S. 1870: *Calcaria chlorata*, P. G.; *Chloris calcicus, Chloruretum calcis, Calcii hypochloris.—Chloride of lime, Calcium hypochlorite, Bleaching-powder*, E.; *Chlorure de chaux, Poudre de Tennant ou de Knox*, Fr.; *Chlorkalk, Bleichkalk*, G.

A compound resulting from the action of chlorine upon calcium hydroxide, and containing at least 35 per cent. *U. S.* (33 per cent. *Br.*, 25 per cent. *P. G.*) of available chlorine. Chlorinated lime should be preserved in well-closed vessels in a cool and dry place. This preparation is often improperly called "Chloride of Lime."

Preparation and Composition.—Chlorinated lime was first prepared on an extensive scale by C. Tennant and Knox of Glasgow in 1799, and is manufactured in essentially the same manner at the present time, the improvements introduced at various times consisting in perfecting the apparatus and the production of chlorine. Well-slaked lime, free from dampness, is rubbed through a sieve, and the powder thus obtained is spread upon shelves which are placed in several tiers in boxes or chambers, into which dry chlorine gas is conducted from the top as long as it is absorbed, care being taken to regulate the current of gas in such a manner that the temperature within the chambers does not rise higher than 25° C. (77° F.), in order to avoid the formation of calcium chlorate. According to Lunge (1881), in the presence of an excess of about 4 per cent. of moisture, in the calcium hydroxide, and at a temperature of about 40° C. (104° F.), a product containing 43 per cent. of available chlorine may be obtained.

The oldest view concerning the composition of chlorinated lime admits of a direct combination and the formation of $CaOCl_2$, and since the whole amount of slaked lime cannot be thus converted, a portion of it was supposed to form a double compound with it, having the composition $2(CaOCl_2.H_2O) + Ca(OH)_2$. But it is now generally admitted that a decomposition takes place, the precise nature of which is, however, by no means fully established. It has been assumed that the reaction occurs between two molecules each of calcium hydroxide and chlorine. $2Ca(OH)_2 + 2Cl_2$ may form $CaCl_2 + Ca(ClO)_2 + 2H_2O$; that is, calcium chloride, calcium hypochlorite, and water, which have been by some supposed to be merely mixed together; but since alcohol does not dissolve one-half of the chlorine as $CaCl_2$, others have regarded them to be combined, forming $CaCl_2.Ca(ClO)_2.2H_2O$. Schorlemmer (1873) adopted the view previously suggested by Odling, that chlorinated lime is calcium hypochlorite, in which 1 ClO is replaced by Cl; that its formula is therefore Ca(ClO)Cl, and that with water this compound yields calcium hypochlorite and chloride. If either of the above be the true composition of chlorinated lime, it should contain about 49 per cent. of available chlorine, while in fact it contains much less. This deficiency has been ascribed to various causes, but mainly to the difficulty or impossibility of exactly forming calcium hydroxide without excess or deficiency of water, both of which causes act injuriously; the formation of some calcium chlorate under certain circumstances likewise accounts for a part of the loss. Fresenius and F. Rose (1861) regarded dry chlorinated lime as a compound of calcium hypochlorite and oxychloride with $4H_2O$, formed according to the equation $4Ca(OH)_2 + 2Cl_2 = Ca(ClO)_2.Ca_3O_2Cl_2 4H_2O$, and that this compound is decomposed by water into calcium hypochlorite, chloride, and hydroxide. C. Stahlschmidt (1876) expressed the view that chlorinated lime may be considered as a calcium hydroxide in which 1 atom of hydrogen is replaced by Cl, and that its formation is explained by the equation $3Ca(OH)_2 + 2Cl_2 = 2CaHClO_2.CaCl_2.2H_2O$, which requires an amount of active chlorine equal to nearly 39

per cent. of the product; which result may be attained in practice. In certain cases, however, nearly 43 per cent. of chlorine has been reached, and this is accounted for by the presence of some moisture, by which the above calcium chlorohydrate, as it may be called, is decomposed into calcium hypochlorite and hydroxide, $Ca(ClO)_2 + Ca(OH)_2$, the latter of which, with more chlorine, yielding again chlorohydrate; but to complete the conversion into calcium hypochlorite (and chloride) a much larger amount of water seems to be necessary than could be retained by dry chlorinated lime. That aqueous solutions of chlorinated lime contain calcium hypochlorite was proven by Kingzett, who obtained this salt from concentrated solutions of the former placed in a freezing mixture or evaporated in a vacuum over sulphuric acid. Schorlemmer, Lunge, and others have shown that with nitric or sulphuric acid carefully added, avoiding excess, a distillate containing hypochlorous acid is obtained; that carbonic acid liberates in the solution hypochlorous acid; and that, after exhausting chlorinated lime with little water, the subsequent solutions contain calcium and chlorine uniformly in the proportion required by the formula Ca(ClO)Cl.

Properties.—Chlorinated lime is a white or whitish powder or in friable lumps, dry or but slightly damp, with a feeble odor of chlorine and a disagreeable bitter and saline taste. Under various circumstances it may undergo decomposition on keeping, either with the evolution of oxygen or by conversion into a mixture of calcium chloride and chlorate. On exposure to the air it absorbs and combines with carbon dioxide and becomes moist. It has an alkaline reaction, but finally bleaches test-paper. It is partly soluble in water and in alcohol, wholly soluble in dilute acetic acid (not more than a trifling residue of insoluble matter should be left, *U. S.*), with the evolution of chlorine and the production of calcium chloride; $2Ca(ClO)Cl$ or $Ca(ClO)_2.CaCl_2 + 4HCl$ yields $2Cl_2 + 2CaCl_2 + 2H_2O$. If chlorinated lime contains a larger percentage of calcium chloride than is indicated by one of the above formulas, its chlorine will not be liberated, and is therefore not *available chlorine* for bleaching purposes. The same decomposition is effected by an excess of all acids except carbonic, which liberates hypochlorous acid. The solution in diluted acetic acid shows the presence of lime by yielding with ammonium oxalate a white precipitate soluble in hydrochloric acid. The aqueous solution, mixed with manganese dioxide, mercuric, ferric, and other oxides, evolves oxygen (Mitscherlich), and if ammonium sulphate be added nitrogen is given off (Calvert, 1870). The solution in the presence of carbonic or other acid rapidly destroys vegetable colors, and this property finds extensive application in the arts. Distilled with alcohol, wood-spirit, some volatile oils, etc., chlorinated lime generates chloroform, and when it is mixed with certain organic substances in the dry state a gradual decomposition and development of heat take place, and may result at last in an explosion. The spontaneous explosions of chlorinated lime which are on record may probably be referred to such a cause.

Tests.—The solution of chlorinated lime in diluted hydrochloric acid may be tested for impurities in the same manner as a solution of calcium carbonate. The most important determination, however, is that of the amount of available or active chlorine present, and depends upon its oxidizing power. The methods in use are oxidation of arsenous oxide or of ferrous sulphate or of sodium thiosulphate, in the last case preceded by the liberation of iodine. The process adopted is as follows: "If 0.35 Gm. of chlorinated lime be thoroughly triturated with 50 Cc. of water and carefully transferred, together with the washings, into a flask, and then 0.8 Gm. of potassium iodide and 5 Cc. of diluted hydrochloric acid added, the reddish-brown liquid, to which, toward the end of the titration, a few drops of starch test-solution are added, should require, for complete decoloration, not less than 35 Cc. of decinormal sodium thiosulphate solution (each Cc. corresponding to 1 per cent. of available chlorine)."—*U. S.* "10 grains, mixed with 30 grains of potassium iodide and dissolved in 8 fluidounces of water, produce, when acidulated with 2 fluidrachms of hydrochloric acid, a reddish solution which requires for the discharge of its color at least 934 grain-measures of the volumetric solution of sodium thiosulphate, corresponding to not less than 33 per cent. of chlorine."—*Br.* "If 0.5 Gm. of chlorinated lime be triturated with 20 Cc. of water, and to this liquid be added 1 Gm. of potassium iodide, 20 drops of hydrochloric acid, and a little starch solution, the mixture should require for decoloration at least 35.2 Cc. of decinormal solution of sodium thiosulphate."—*P. G.* In the first part of these processes iodine is liberated from the potassium salt, thus causing the red color of the solution or a blue color in the presence of starch; the addition of the thiosulphate causes the formation of sodium tetrathionate and iodide, the red or blue color disappearing as soon as all the

free iodine has been converted into the latter salt. By a slight modification the test may be used to ascertain the true percentage of available chlorine.

Pharmaceutical Uses and Preparations.—Chlorinated lime is largely employed in the arts for bleaching purposes; it is used in preparing chloroform and Liquor sodæ chlorinatæ, *U. S.;* as Vapor chlori, *Br.*, it is used in the moist condition; and Liquor calcis chloratæ, *Br.*, is a solution of it in water.

Fumigatio chlori, P. G. 1872. For *stronger* fumigation use a mixture of table-salt and manganese dioxide, each 1 part, sulphuric acid 2 parts, previously diluted with 1 part of water. The *milder* fumigation is made of chlorinated lime mixed with water to a soft mass, vinegar being afterward added.

Action and Uses.—The action of chlorinated lime resembles that of chlorine, with a superadded causticity derived from the lime in its composition. In moderate doses it appears sometimes to act as an irritant of the stomach and bowels, and if the quantity taken be large it produces heat in these organs, nausea, vomiting, and diarrhœa. If used in a mouth-wash, it removes acid, bitter, or metallic tastes. Externally, it is an active irritant, and is sometimes moderately caustic. It dries suppurating surfaces and prevents gangrenous ulceration.

In solutions of the strength of Gm. 1.50 (gr. xx), or more, to the ounce of water, it has been regarded as a useful stimulant in purulent *ophthalmia*. This solution on lint is efficacious in *frost-bite* and also as an injection in *gonorrhœa*. In various forms of *ulceration of the mouth*, scorbutic, gangrenous, or arising merely from debility, chlorinated lime promotes cicatrization, and is useful for this affection in scarlatina. Indolent and specific *ulcers* of other parts, and *burns*, are favorably modified by its use. It may be included among the means of curing *itch* when applied on cloths in a solution containing from $\frac{1}{60}$ to $\frac{1}{40}$ part of chlorinated lime. But care must be taken lest it irritate the skin unduly.

In *typhus fever* it has been thought to moisten and cleanse the tongue, allay delirium, and revive the functions of the skin. It tends to reduce excessive mucous secretions, and has been used with marked advantage in the treatment of *phthisis* and *chronic bronchitis* with profuse purulent expectoration. When this is fetid the action of the medicine is peculiarly efficient; and it may be prescribed in atomized inhalations as well as by the stomach. It has been used with success in the treatment of *scrofulous glands*, both internally and in an ointment. Even in some cases of enlarged mesenteric glands its action has appeared to be salutary.

As a *disinfectant* chlorinated lime has been employed under a great variety of circumstances to suspend the decomposition of organic matter and neutralize the resulting foul effluvia. Besides being used for this purpose in privies, close-stools, dissecting-rooms, sewers, etc., it has proved to be very efficacious in correcting the *foul odors* connected with putrefaction in the living body, as in cases of *retained placenta* or uterine clots, *cancer of the uterus* and of other parts, *ozæna*, *mercurial salivation*, *foul breath* due to the decomposition of glandular secretions in the fauces, the fetor exhaled by the *armpits*, *feet*, etc. A false anology led to its use for preventing contagion by the sick and by infected fomites, but there is no reason to believe that its influence exceeded that of the various measures of purification which were associated with it. Chlorinated lime decomposes hydrosulphuric acid, hydrosulphuret of ammonia, sulphuret of potassium, and hydrocyanic acid, and may therefore be used as a chemical *antidote* to these *poisons*. Persons *poisoned* by privy and by sewer gases have been restored by holding a cloth wet with a solution of this substance before the nostrils. A similar expedient has been used to protect persons in an atmosphere saturated with *sulphuretted hydrogen*.

The *dose* of chlorinated lime is from Gm. 0.06–0.30 (gr. j–v) in solution. From Gm. 0.50–4.00 (gr. x–lx), dissolved in from 4 to 8 ounces of water and filtered, may be given in twenty-four hours. As a mouth wash 1 part dissolved in 100 of water may be used. For external use the most energetic form of the preparation is that of a semi-fluid paste; the feeblest, to be at all useful, may contain Gm. 4 (℥j) of chlorinated lime in Gm. 250 (8 ounces) of water. An ointment for dry atonic ulcers may be made with equal parts of this preparation and lard; for enlarged glands, etc. the proportion of Gm. 4 (℥j) to Gm. 32 (℥j) of lard is sufficient.

CALX SULPHURATA, *U. S., Br.*—Sulphurated Lime.

Calcaria sulfurata, Hepar sulphuris calcareum, Hepar calcis.—Crude calcium sulphide, E.; *Sulfure de chaux*, F.; *Kalkschwefelleber*, G.

A mixture containing at least 60 per cent. of calcium monosulphide [CaS = 71.89], together with unchanged calcium sulphate [$CaSO_4$ = 135.73], and carbon, in varying proportions.—*U. S.*

A mixture containing not less than 50 per cent. of calcium sulphide (CaS).—*Br.*

Preparation.—Dried gypsum, in fine powder, 70 Gm.; Charcoal, in fine powder, 10 Gm.; Starch, 2 Gm. Mix them thoroughly, pack the mixture lightly into a crucible, cover this loosely, and heat it to bright redness until the contents have lost their black color. Allow the crucible to cool, reduce the product to powder, and at once transfer it to small, glass-stoppered vials.—*U. S.*

In place of metric weights the following proportions may be used in avoirdupois weight: dried gypsum 3½ ounces, charcoal ½ ounce, starch 44 grains.

The reaction taking place when the mixture is heated consists in the oxidation of the charcoal at the expense of the calcium sulphate, a part of the latter being converted into calcium sulphide, $CaSO_4 + C_3 = CaS + CO_2 + 2(CO)$; the resulting carbon monoxide and dioxide pass off as gases. The starch assists in the reduction.

The Br. process is very similar: Calcium sulphate (nearly anhydrous) 7 oz., wood-charcoal 1 oz., both in fine powder; mix thoroughly; heat to redness in an earthen crucible until the black color has disappeared; cool, and at once place the whitish residue in a stoppered bottle.

Properties.—Sulphurated lime is a pale-gray powder, gradually altered by exposure to the air, exhaling a faint odor of hydrogen sulphide, having an offensive alkaline taste and an alkaline reaction, very slightly soluble in water and insoluble in alcohol; boiling water partially decomposes it. On dissolving sulphurated lime with the aid of acetic acid, hydrogen sulphide is abundantly given off and a white precipitate (calcium sulphate) is thrown down. The filtrate yields, with test solution of ammonium oxalate, a white precipitate soluble in hydrochloric, but insoluble in acetic acid.—*U. S.*

Tests.—"If 1 Gm. of sulphurated lime be gradually added to a boiling solution of 2.08 Gm. of cupric sulphate in 50 Cc. of water, the mixture digested on a water-bath for fifteen minutes and filtered when cold, no color should be imparted to the filtrate by 1 drop of test solution of potassium ferrocyanide (presence of at least 60 per cent. of pure calcium monosulphide)."—*U. S.* The equation, $CuSO_4.5H_2O + CaS = CuS + CaSO_4 + 5H_2O$, shows that 248.8 parts of cupric sulphate require 71.89 parts of calcium sulphide for complete decomposition and 2.08 Gm. will therefore require 0.601 + Gm., which is practically 60 per cent. of 1 Gm.

Allied Compounds.—Calcii sulphidum, s. sulphuretum, s. sulfuratum.—Calcium sulphide, *E.;* Sulfure de calcium, *Fr.;* Schwefelcalcium, *G.* Formula CaS. Mol. weight 71.89.—Nearly pure calcium sulphide is obtained by intimately mixing 12 parts of powdered gypsum with 3 or 4 parts of lampblack or powdered charcoal, and heating the mixture in a covered crucible as long as gas is given off. The charcoal, combining with the oxygen of the calcium sulphate, escapes as carbon monoxide or dioxide, and leaves calcium sulphide, CaS, having a grayish, yellowish, or reddish color from impurities naturally present. It is inodorous, has an alkaline and a sulphurous taste, dissolves completely in 500 parts of water, and is gradually decomposed by water into calcium hydroxide and hydrosulphide.

Calcii oxysulphuretum, known in France as *sulfure de calcium* or *foie de soufre calcaire.* Mix sulphur 100 parts; slaked lime 300 parts; water 500 parts; boil, stirring frequently, until a portion when dropped on a cold slab will solidify; then pour out on a marble slab, and when cold keep the mass in well-stopped bottles.—*F. Cod.* It has a gray or greenish-gray color, and is a variable mixture of calcium oxysulphide and thiosulphate or sulphate.

A solution known in France as *sulfure de chaux liquide* is made by boiling for an hour 2 parts of lime previously slaked, 5 of sublimed sulphur, and 20 of water, water being added to preserve the original amount; the filtrate has the density 1.16.

A soft mass, containing calcium hydrosulphide, Ca2HS, and used as a depilatory, is prepared from 2 parts of slaked lime and 3 of water by passing into the mixture hydrogen sulphide as long as it is absorbed. The mass, known as *Martin's depilatory*, has a strong sulphurous odor, and on standing separates into two portions, which are to be mixed when used; if properly prepared, an application for eight or ten minutes is sufficient for removing the hair.

Phosphorescent Powder or Paint. Calcined oyster-shells or cuttlefish-bone 100 parts; caustic lime 100 parts; calcined sodium chloride 25 parts; mix and thoroughly incorporate from 20 to 25 per cent. (about 55 parts) of sulphur and from 3 to 7 per cent. (about 8 to 18 parts) of calcium, barium, strontium, or magnesium sulphide; the luminosity may be increased

by adding incinerated marine algæ. The powder is rendered adhesive by means of varnish, collodion, etc. After exposure to the sunlight it will be luminous in the dark. A similar compound is *Canton's phosphorus* (1768), prepared from burnt oyster-shell 2 parts and sulphur 1 part.

Action and Uses.—Sulphurated lime acts as an irritant and corrosive, and is seldom, if ever, used internally. It is decomposed in the stomach, liberating sulphuretted hydrogen gas. The *dose* of it internally is variously stated to be from Gm. 0.006–0.03 (gr. $\frac{1}{10}$–$\frac{1}{2}$) and from Gm. 0.20–0.40 (gr. iij–vj). Externally, it is sometimes employed in baths containing from Gm. 32–128 (℥j–iv) of the salt in the treatment of *itch* and certain obstinate scaly *diseases of the skin*. (See SULPHUR.) It has also been used in an ointment (1 to 10 parts in 15 parts of lard) for similar purposes, and as an ingredient of depilatory preparations.

CALCIUM SULPHIDE has been used, like potassium sulphide, in local and general baths for chronic diseases of the *skin*, chronic *rheumatism*, etc., and internally for chronic *bronchitis*, and even in pulmonary *phthisis*. It was given internally in doses of one-tenth of a grain, gradually increased to a grain (Gm. 0.004–0.06), in the treatment of *acne*, and with alleged success. But as milk of sulphur and other topical applications, as well as other internal treatment, were employed at the same time, the share of the sulphide in the result may have been, and probably was, very small. Its use in the treatment of *scabies* is described under SULPHUR; and the same preparation is said to be an efficient remedy for *ringworm* (*Tricophyton tonsurans*).

In 1869, Dr. Ringer claimed for the sulphides generally, but especially for this preparation, the power of arresting suppuration (*Therapeutics*, p. 48; *ibid.*, 1888, p. 94), directing 1 grain of calcium sulphide to be dissolved in half a pint of water, and a teaspoonful of the solution to be taken every hour. Thus, to one-sixty-fourth of a grain of this compound, so administered, was ascribed the cure of scrofulous and tuberculous abscesses! After years of oblivion this method was revived by Dr. F. N. Otis (*New York Med. Jour.*, May, 1880), who claimed for it the power of arresting the suppuration of *buboes*, *furuncles*, and other *abscesses;* and a case was published in which the cure was attributed to it of a gastro-pulmonary fistula (*Phila. Med. Times*, xi. 73). Ultimately, a much more moderate estimate of its virtues was furnished in a report to the Therapeutical Society of New York. It concluded "that in many cases of suppurative affections, ranging from the small pustules of acne to extensive suppurating surfaces, an appreciable, and often a very marked, benefit is derived from the use of calcium sulphide. . . . . At the same time, its action is not uniform, and in many apparently favorable cases it will fail entirely. It is somewhat prone to irritate the stomach." One-tenth of a grain every two hours, it is stated, is the full dose, although some patients will bear a grain three or four times a day. "It will occasionally produce headache and more or less eructation of sulphuretted hydrogen" (*Amer. Jour. Med. Sci.*, July, 1882, p. 268). More recently it has been vaunted as a remedy for *leucorrhœa*, *rhinitis*, and *glandular enlargements* (*Therap. Gaz.*, xii. 366); and the prompt cure of *diphtheria* has even been attributed by Hubbard to the use of a spray from a solution made from lime, 1 part; sulphur, 2 parts; water, 20 parts. Slake the lime with part of the water, add the remainder and the sulphur; boil to 12 parts, and filter (*Med. Record*, xxxiv. 703).

CAMBOGIA, *U. S., Br.*—GAMBOGE.

Gambogia, U. S. 1870; *Gutti*, P. G.; *Gummi-resina guttæ*, *s. gutti*, *Gutta gamba*, *Cambodia.*—*Gutte*, *Gomme-gutte*, Fr.; *Gummigutt*, *Gutti*, G.; *Gomma gotta*, F. It.; *Goma guta*, *Guta gamba*, Sp.

A gum-resin obtained from Garcinia Hanburii, *Hooker filius*. Bentley and Trimen, *Med. Plants*, 33.

Nat. Ord.—Guttiferæ (Clusiaceæ).

Origin.—A medium-sized tree with glossy laurel-like leaves and small yellow diœcious flowers, the pistillate ones being on short pedicles. It was formerly regarded merely as a variety (pedicellata) of Garc. Morella, *Desrousseaux* (s. G. pictoria, *Roxburgh;* G. Gutta, *Wight;* G. cambogioides, *Royle;* Hebradendron cambogioides, *Graham*), and is indigenous to Siam, Cambodia, and Cochin China. Flückiger and Hanbury observed that the yellow milk-juice is secreted in unbranched ducts, which are principally located in the middle bark, and to a less extent in the dotted vessels of the alburnum, in the pith, leaves, flowers, and fruit. Gamboge is obtained by incisions made into the bark, the latex being collected in the joint of a bamboo, occasionally also in other vessels, where it is allowed to harden.

Description.—Gamboge is in cylindrical, either solid or hollow, straight or bent, sticks, 15 to 20 Cm. (6 to 8 inches) long and 25 to 50 Mm. (1 to 2 inches) in diameter, called "pipes;" the surface is striated longitudinally from impressions of the bamboo, and occasionally contains some splinters of it. Gamboge breaks easily with a flattish conchoidal, smooth fracture of a a deep orange-red tint and in a waxy, somewhat resinous lustre; thin splinters are slightly translucent. It yields a bright-yellow powder, and on being triturated with water a uniform bright-yellow emulsion is readily obtained. This emulsion forms with ammonia-water a clear deep-red afterward brown solution, and with potassium or sodium hydrate an orange-red solution, the liquid becoming colorless on the addition of acids, the yellow resin being precipitated. Gamboge is inodorous, but the dust is sternutatory, and it has a disagreeable acrid taste. Inferior qualities of pipe gamboge are of a brown or gray tint, harder, of a dull earthy or irregular fracture, and less inclined to produce a uniform emulsion.

Cake gamboge has been collected in flat vessels, and is met with in irregular lumps, which otherwise resemble pipe gamboge, but are more liable to be adulterated.

Constituents.—Aside from accidental impurities, like cellular tissue, gamboge contains about 4 per cent. of moisture, the remainder being resin, and 16 to 20 per cent. of gummy matter, which is not identical with gum-arabic. The resin is called *cambogic acid*, is soluble in alcohol, ether, and with a deep-red color in dilute alkalies, and from the latter solution is precipitated unaltered by acids; its solutions yield a yellow precipitate with lead acetate, and brown ones with iron and copper salts. By fusing it with caustic potassa, Hlasiwetz and Barth (1866) observed the disengagement of vapors having the odor of lemon and melissa, and found in the residue, besides acetic and volatile fatty acids, also *phloroglucin* and *pyrotartaric* and two other acids. Gamboge is free from starch, and if adulterated with it an emulsion made with hot water will turn green by solution of iodine, or it may be recognized in the residue left after treatment with alcohol and cold water.

Action and Uses.—In man, applied to the raw skin, gamboge acts as an irritant. Internally, in small doses, it appears to increase the glandular secretions, but in large doses causes vomiting, colic, and tenesmus. But there is no evidence of its increasing the secretion of bile. In doses of Gm. 0.20–0.25 (gr. iij–iv) it occasions liquid stools, with little or no colic. Rutherford's experiments led him to conclude that gamboge is not a cholagogue, although it violently irritates not only the duodenum, but the whole of the small intestine. He remarks that colchicum, which is equally irritant, is decidedly cholagogue, and infers, therefore, that duodenal irritation alone is not sufficient to increase the excretion of bile. The purgative virtue of gamboge appears to reside in its resinous element. When given in small and repeated doses it is said to cause diuresis. There is no evidence of its ever having produced fatal effects.

Gamboge is seldom employed unless associated with other purgatives. It is reputed to be well adapted for relieving such congested states of the *liver* as arise from malarial causes. In these cases it is usually associated with calomel. As a *hydragogue*, acting by the kidneys as well as the bowels, its merits appear to be well established. For this purpose it should be given in small and repeated doses, such as Gm. 0.01 (gr. $\frac{1}{6}$) every hour, dissolved in sweetened water. It is often associated with jalap and with bitartrate of potassium. Its want of taste fits it for use by children. It is sometimes employed as a *vermifuge*, and is then usually prescribed with vermicide medicines.

Gamboge is administered in substance in the average *dose* of Gm. 0.06–0.30 (gr. j–v). It is most efficient when mixed with water and sugar. A convenient formula is the following: ℞. Gamboge gr. x; Carbonate of potassium ʒj; Cinnamon-water fʒij.—Mix. S.—30 drops three times a day in water.

CAMPHORA, *U. S., Br., P. G.*—Camphor.

Camphre, Fr.; *Kampfer*, *Campher*, G.; *Canfora*, F. It.; *Alcanfor*, Sp.

Formula $C_{10}H_{16}O = C_8H_{14}.CH_2.CO$. Molecular weight 151.66.

A stearopten or concrete volatile oil, having the nature of a ketone, obtained from Cinnamomum Camphora, *F. Nees et Ebermaier*, s. Laurus Camphora, *Linné*, s. Camphora officinarum, *C. Bauhin*, and purified by sublimation. Bentley and Trimen, *Med. Plants*, 222.

Nat. Ord.—Laurineæ.

Origin.—The camphor laurel is a handsome tree 7.5 to 9 M. (25 to 30 feet) high, with thin reddish or yellowish branches, and alternate evergreen, smooth, and shining

leaves, which are glaucous beneath. The flowers are small, yellowish, in pedunculate axillary cymes, and produce oblong-globular dark-purple berries about ⅓ inch (8 Mm.) long and containing a single seed. It is indigenous to Eastern and South-eastern Asia from Cochin China north through China, and in Japan and Formosa. It grows very readily in tropical and subtropical countries, and is cultivated in Italy as an ornamental tree. All parts of the tree have a camphoraceous odor and taste, but the camphor is obtained from the root, trunk, and branches by chipping the wood, and either boiling it with water in an iron vessel which is covered with a rude earthen or wooden head lined on the inside with straw, in which the camphor condenses, or as in Formosa, where the chips are merely exposed to the vapor of water, which is boiled in a wooden trough, lined on the outside with clay, earthen pots, ten in number, serving as the heads of the rude still. The camphor is scraped out from time to time, placed in suitable vats to drain off much of the adhering oil, and then packed. Camphor appears to have been used as a medicine in Europe in the twelfth century. The kind first known was Dryobalanops camphor, which is now seen only as a curiosity outside of Southern Asia.

Commerce.—*Japan* or *tub camphor*, formerly also called Dutch camphor, is imported in tubs containing about 125 pounds, covered by matting and surrounded by another tub. It is in white granular masses, usually with a reddish tint and dry to the touch. *Formosa* or *Chinese camphor*, generally imported in lead-lined chests, is occasionally as handsome in appearance as the preceding, but frequently is in smaller granules, darker, sometimes even blackish in color, or damp from adhering oil or moisture. Crude camphor dissolves completely in alcohol, with the exception of from 1 to 5 or 6 per cent. of foreign matters, sand, etc. In the fiscal year 1866–67, 432,075 pounds of crude and 30,526 pounds of refined camphor passed through the custom-houses of the United States. Since 1876 very little refined camphor has been imported, it varying between 208 pounds in 1877 and 11 pounds in 1882, while in the same period the importation of crude camphor fluctuated between 986,292 pounds in 1879 and 2,542,830 pounds in 1880.

Refining.—This was formerly done exclusively in Europe, but it has for some years been successfully carried on in the United States. It is stated that the apparatuses used in Europe are still the old-fashioned *bombaloes*, large somewhat depressed glass globes with a short neck and an aperture through which the watery vapors find egress; some charcoal or lime is introduced with the crude camphor into the vessels, which are placed in a sand-bath, and this is rapidly heated, first to expel the water, after which the sand is lowered and the heat gradually increased to between 200° and 205° C. (392° and 401° F.); after the camphor has sublimed and condensed at the top the vessels must be broken in order to recover the purified camphor. Similar subliming-vessels are in use in the United States, but they are so arranged that they can be taken apart and used over again, and provision has even been made by a firm in Philadelphia to recover the volatile oil contained in the camphor. The operation requires a careful regulation of the heat for subliming and judicious provision for cooling the top, so as to obtain the camphor in solid crystalline cakes. Another Philadelphia firm sublimes the crude camphor slowly from retorts and condenses the vapors in a large chamber, whereby the camphor is obtained in a fine crystalline powder, which is afterward, by hydraulic pressure, formed into solid cakes, thus lessening the surface of exposure and the rapidity of evaporation.

Properties.—Refined camphor forms orbicular slightly convex cakes, with a circular hole in the centre, corresponding to the aperture of the subliming-vessel. It is white, translucent, crystalline in texture, fissured in the interior, tough, and not pulverizable, except after moistening it with alcohol, ether, chloroform, or a volatile oil. It evaporates slowly at the ordinary temperature, and condenses in partly-filled bottles in the form of glossy hexagonal plates or prisms. Various contrivances have been suggested to keep camphor in the powdered condition, such as precipitation by water in the presence of magnesia, trituration with a fixed oil, glycerin, or sugar; but the most satisfactory method appears to be that proposed by J. C. Lowd (1871), of condensing the hot camphor vapors in a large chamber. The powder thus obtained, which has been called *flowers of camphor*, may be preserved for some years if kept in a cool place, and even if it should cake together may readily be reduced to the pulverulent condition. Another method is that proposed by Dr. Bruno Hirsch, pouring a hot concentrated alcoholic solution of camphor into ten times its volume of distilled water, stirring constantly, collecting the precipitate on a strainer, and after it has drained drying it over lime, calcium chloride, or sulphuric acid, without subjecting the powder to any pressure.

Camphor fuses at 175° C. (347° F.), boils at 204° C. (399° F.), sublimes without leaving any residue, and when ignited burns with a luminous sooty flame; its specific gravity

at 15° C. (59° F.) is 0.990; its solutions are dextrorotatory. It is sparingly soluble in water (see AQUA CAMPHORÆ), dissolves at 15° C. (59° F.) in 0.7 parts of alcohol, and is freely soluble in ethers, chloroform, glacial acetic acid, wood spirit, acetone, carbon disulphide, benzene, benzin, and volatile and fixed oils; its solutions in alcohol and ether increase the solubility of corrosive sublimate, and the presence of this salt renders camphor more soluble in these liquids. (See HYDRARG. CHLOR. CORROS.) Camphor dissolves by trituration in 10 parts of milk, and the solution may be diluted with water without causing precipitation. When rubbed together with powdered chloral or resins the mixtures gradually become soft or liquid, and in the fused state resins dissolve a considerable proportion of camphor. It has a peculiar penetrating odor and an aromatic somewhat cooling taste. The odor of camphor is destroyed by Tolu balsam, asafetida, and similar umbelliferous resins. Thrown upon water, camphor shows a peculiar rotatory motion, which is probably caused by its rather rapid evaporation and slow solubility.

Its composition is represented by the formula $C_{10}H_{16}O$. When distilled with zinc chloride or phosphoric anhydride it is gradually converted into cymene, $C_{10}H_{14}$, and by oxidation with nitric acid into *camphoric acid*, $C_{10}H_{16}O_4$, and finally into *camphoronic acid*, $C_9H_{12}O_5$. Schwanert's *camphresinic acid* (1863) is a mixture of these two. *Nitroso-camphor*, $C_{10}H_{15}O.NO$, was prepared by Claisen and Manasse (1889) by treating camphor and amyl nitrite, dissolved in ether, with sodium ethylate; it melts at 153° C., and is readily soluble in water, alcohol, ether, and chloroform. By the action of hypochlorous acid on camphor, Wheeler (1868) obtained several chlorine substitution-products, and by acting upon these with alcoholic solution of potassa, *oxycamphor*, $C_{10}H_{16}O_2$, is formed, which crystallizes in needles, has the odor and taste of camphor, and sublimes without change, but melts at 137° C. (278.5° F.). Camphor combines and forms also substitution-compounds with iodine and bromine.

Other Camphors and Camphor Oils.—The crystallizing stearoptens of volatile oils are sometimes designated as camphors.

OLEUM CAMPHORÆ, U. S. 1870.—Oil of camphor, Camphor oil of Formosa, *E.;* Huile volatile de camphre, *Fr.;* Flüchtiges Kampferöl, *G.*—The oil is obtained in the preparation of crude camphor, and a portion also in refining this product. It is a dark wine-yellow or yellowish-brown liquid, having a camphor-like odor and taste and the specific gravity .940. At a low temperature it deposits a considerable quantity of camphor in the form of crystals, and at about 180° C. (356° F.) it begins to boil. It turns the plane of polarized light to the right. By careful fractional distillation a considerable portion of camphor is left in the retort, but cannot be completely removed by this means. The liquid distillate has, according to Martius, the odor of camphor and cajeput, and, according to Mulder, is a solution of laurel camphor, $C_{10}H_{16}O$, in a hydrocarbon of the composition $C_{10}H_{16}$; the latter, according to Lallemand (1859), resembles oil of lemon in its chemical behavior.

SUMATRA, S. BORNEO CAMPHOR, or BARUS CAMPHOR, is found in fissures of the wood of Dryobalanops Camphora, *Colebrook* (D. aromatica, *Gaertner*). Nat. Ord. Dipterocarpaceæ. Its odor is somewhat different from that of ordinary camphor; its crystals are slightly heavier than water, and but sparingly volatilized at ordinary temperatures. It is *borneol* or *camphyl alcohol*, $C_{10}H_{18}O$, and by treatment with nitric acid it is converted into ordinary camphor. The stately tree yielding this drug is indigenous to Sumatra and Borneo, and requires cutting down to obtain the camphor, which in the East is sold at a high price, and therefore never enters commerce at large. This camphor is dextrogyre.

CAMPHOR OIL OF BORNEO is obtained from the same tree by tapping or felling it. It is a rather viscid brown-yellow or reddish oil, which is a solution of resin and a little borneol in a hydrocarbon, $C_{10}H_{16}$; the latter has a terebinthinate odor, and is identical with the hydrocarbon of oil of valerian; hence the names *borneene* and *valerene*. Lallemand (1859) could not obtain borneol, but isolated two terpenes boiling respectively at 180° and 255° C. (356° and 491° F.). The crude oil is dextrogyre, begins to boil at about 175° C. (347° F.), and deposits little or no camphor when placed in a freezing mixture. It is rarely, if ever, met with in commerce.

NGAI CAMPHOR is obtained in Burmah and China by the distillation of Blumea balsamifera, *De Candolle:* Nat. Ord. Compositæ—a tall weed of South-eastern Asia, and commands there a higher price than ordinary camphor. It has the composition of the Borneo camphor, $C_{10}H_{18}O$, but turns polarized light to the left, and yields with nitric acid a camphor having the composition of ordinary camphor, but levogyre in optical behavior. It was examined in 1874 by Hanbury, Plowman, and Flückiger.

VINUM CAMPHORATUM, *P. G.*—Wine of camphor, *E.;* Vin camphré, *Fr.;* Kampferwein, *G.*—Dissolve camphor 1 part in alcohol 1 part, and add gradually and with agitation mucilage of acacia 3 parts and white wine 45 parts. It is a whitish, turbid liquid, which requires to be well shaken when dispensed.—*P. G.*

CAMPHORA CARBOLISATA, S. PHENOLATA.—Camphorated phenol, Phenol-camphor, *E.;* Camphre phenolé, *Fr.;* Phenolkampfer, *G.*—Camphor 2 parts; carbolic acid 1 part;

allow to liquefy (Bufalini, 1875). Camphor 100 parts, carbolic acid 36 parts, alcohol 4 parts; dissolve (Hager). A colorless or oily liquid having the odor of camphor, soluble in fixed oils, alcohol, and ether, nearly insoluble in water and glycerin.

Camphora salicylata.—Salicylated camphor, *E.*; Camphre salicylé, *Fr.*; Salicylirter Kampfer, *G.*—Camphor 84 parts, salicylic acid 65 parts; heat in a water-bath to 90° C. (194° F.) until liquefied (Prota Giurleo, 1881). A colorless oily liquid, solidifying to an opaque crystalline mass, becoming unctuous on being triturated; slightly soluble in water and glycerin, more soluble in fats and volatile oils, and crystallizing from hot benzol.

Action and Uses.—The local action of camphor upon the living tissues is that of a stimulant and irritant. A piece of it held in the mouth irritates, and may even ulcerate, the lining membrane; the same effect is possible in the stomach. Internally, its action varies with the dose. In large doses it causes a burning pain along the œsophagus and at the pit of the stomach, vomiting, diminished frequency and force of the pulse, followed by its intermission, by giddiness, dimness of vision, muscular debility, paleness and coolness of the skin, with a cyanotic hue in grave cases, spasms and ridigity of the muscles, and general convulsions. These phenomena, which show that camphor in such doses is a direct and powerful sedative, are followed by a reaction in which there is more or less excitement and fever. A man swallowed two pieces of camphor, each as large as a nutmeg, and presented the characteristics just described (*Bull. de Thér.*, cix. 563). In no instance does camphor seem to have directly caused the death of a healthy adult. As supplementary to the cases referred to in the previous edition of this work the following may be cited: 150 grains of camphor dissolved in oil occasioned in a healthy adult general convulsions with stupor, followed by confusion of mind. Dr. Brothers, the reporter of this case, referred to several others, including one of a female who took 200 grains of camphor in alcohol, became convulsed and comatose, but was convalescent on the following day; and also five fatal cases, all but one of which occurred in children. The exception was a pregnant woman, who swallowed 184 grains of camphor, aborted, and died (*Med. Record*, xxxii. 734). The fatal result cannot fairly be attributed to the camphor alone. In another case a girl said to have been in the habit of eating camphor was found unconscious, and so died (*Med. News*, liii. 241). In this case the meagerness of the details forbids a positive judgment as to the cause of death. In medicinal doses Gm. 0.12 to 1.0 (gr. ij–xv) camphor stimulates the nervous and vascular systems, and through them all the functions; the pulse becomes stronger and more frequent, the skin grows warmer and moister, and there is a consciousness of more or less exhilaration. Such effects are of short duration, and are not succeeded by exhaustion or depression. Small doses appear to irritate the genital organs, but full medicinal doses allay morbid excitement in them. It appears, then, that camphor stimulates in small and depresses in large doses, and that its operation is very transient—almost as much so as that of alcohol, which in some other respects it resembles. According to physiological experimenters, the spinal cord is not influenced by camphor, for convulsions do not occur after the separation of the medulla oblongata from the medulla spinalis. Owing to the rapid disappearance of the smell of camphor from the urine and feces of animals poisoned by it, it is held that the drug is decomposed in the organism.

The ancients do not appear to have used camphor in febrile affections, but in the eighteenth century it acquired a reputation in the treatment of *typhoid conditions* which it has never lost. It was held to be less heating than ammonia, less stupefying than opium, and, along with the latter, to act as a powerful sudorific. It was considered—and is, in fact—an appropriate remedy for the condition which includes exhaustion, stupor, and nervous derangement, shown by muscular trembling and subsultus and low delirium, the phenomena belonging to the malignant or typhoid state in which the nervous system tends to collapse because the blood has become impure. In this condition stimulants sustain nervous power until the depuration and reorganization of the blood are accomplished; and camphor in small and repeated doses has the advantage, over some other appropriate remedies, of inducing no injurious secondary effects. The typhoid state, it should be remembered, may be an incident of inflammatory affections as well as of idiopathic fevers. A French army surgeon claims that in the treatment of an epidemic of typhoid fever marked by unusual ataxia he was very successful after he began the administration of enemas containing 8 grains of crystallized carbolic acid, 15 grains of camphor, 1 ounce of alcohol, and about 6 ounces of water (*Bull. de Thérap.*, ciii. p. 465). The share of the carbolic acid in the result may perhaps be disregarded. In *spasmodic diseases* camphor has been largely employed in whooping cough, chorea, and

even epilepsy, but its power in these affections is of very subordinate importance. In *typhoid states* of continued fevers and of inflammations its hypodermic use has been found useful when the drug was dissolved in almond oil, and injections, each containing 2 or 3 grains of camphor, were administered every two to four hours. The same method has been employed successfully in *poisoning by illuminating gas*. In minor disorders of the nervous class, such as *headache*, *palpitation*, *hiccup*, spasmodic *dysphagia*, etc., camphor in small and repeated doses shows the same power as other nervous stimulants. In small doses, and even as a topical application, it seems to afford marked relief in that distressing occipital headache which arises from severe and prolonged mental strain. In full sedative doses it has proved an antidote to *strychnine*. The Arabians and their followers in Europe were familiar with the power of camphor in large doses to repress *sexual excitement*, and they, as well as nearly all successful imitators of them, prescribed from 20 to 60 grains a day. The doses of 2 or 3 grains sometimes directed for this purpose are worse than useless. They are perhaps more efficient in certain cases of genital excitement produced by local irritation—by cantharides, for example. It is usual to incorporate powdered camphor with blistering plasters to prevent *strangury*, but the evidence of the efficiency of this expedient is not very strong. A poultice saturated with camphor and applied to the perineum will relieve this symptom, and also prevent *chordee*. In some cases of *mania* large doses of camphor have proved efficient, particularly in the puerperal form; it very probably would be more eligible than the excessive doses of opiates which are sometimes employed. It is stated that equal parts of chloral hydrate and camphor form a much more powerful sedative and soporific than a like dose of either substance alone (Simmons, *Amer. Jour. of Med. Sci.*, Jan. 1880, p. 89). Camphor has been employed to expel *lumbricoid worms*, and by enema to destroy *ascarides* of the rectum. It has been resorted to internally and locally with good effect in hospital *gangrene*. *Ulcers* that are slow to heal, owing to a depressed state of the system, are benefited by camphor in powder; the same may be said of specific ulcers of the genitals. Camphor dissolved in ether or chloroform, or even alcohol, and applied on cotton within the cavity of a carious tooth, mitigates *toothache* materially. This is one of the most ancient uses of the medicine. Snuffed into the nostrils, the fumes of camphor, like other local irritants, will sometimes arrest a forming *coryza*. They may be employed by simply smelling a lump of camphor, or they may be disengaged from camphor mixed with hot water in a vessel and conveyed to the nostrils through a funnel. In an ointment or liniment it forms one of the best cures for *scabies*, and is said to prevent the maturation of *variolous* pustules.

Camphor may be administered in substance in the pilular form when the dose is small, but larger doses are best given in emulsion, which should be flavored with the extract or the syrup of liquorice. As a stimulant the *dose* is from Gm. 0.06–0.30 (gr. j–v), repeated every three or four hours in mild cases, but in low fevers it should be from Gm. 0.60–1.30 (gr. x–xx), and repeated according to the indications. In maniacal nervous excitement not less than Gm. 1.30 (gr. xx) should be given, and repeated as often as may be required. In cases of *poisoning* by camphor alcohol may be administered in small and repeated doses.

Carbolized or phenol camphor has been applied with a brush to the false membranes of *diphtheria*, and is stated to have caused a rapid subsidence of the inflammatory swelling and a removal of the exudation (*Bull. de Thérap.*, xciv. 18; xcviii. 529). In 1885 it was stated by Schaeffer to be a local anæsthetic in *toothache* from caries and for the pain of ingrown toe-nail (*Boston Med. and Surg. Jour.*, Jan. 1885, p. 32). In 1887, Cochran applied it to the treatment of *herpes*, of *wounds*, *boils*, *ulcers*, and uterine *leucorrhœa*. Dissolved in olive oil, it is alleged to have not only palliated but arrested *erysipelas*. He also found it useful in *gastric catarrh*. He stated that in 10-drop doses it occasioned a not unpleasant sense of warmth in the stomach, and that upon the skin or applied hypodermically it caused anæsthesia of the immediate neighborhood (*Therap. Gaz.*, xi. 805). In a word, its action is principally due to the carbolic acid in its composition.

Salicylated camphor, mixed with from 10 to 20 parts of vaseline, with the addition of paraffin, can be made into suppositories. It is stated to exhibit remarkable healing powers when applied to phagedenic and atonic *ulcers*, especially those of a syphilitic nature (*Bull. de Thérap.*, xcvii. 143.)

Wine of camphor is used for the same purposes as spirit of camphor.

Camphoric acid has been alleged by Reichert (*Therap. Gaz.*, xii., 632), Mosler (*Med. News*, lii. 558), and Nussel (*Am. Jour. Med. Sci.*, Dec. 1888, p. 641) to be a

profitable application to the larynx in *phthisis*, and to the skin in *eczema* and *acne*, etc., but the clinical proofs of its value are defective. Mosler did not find it superior to the more usual remedies in *laryngitis* and *bronchitis*, but recognized its virtues in chronic *cystitis*, when used as an injection as well as when given by the mouth. He, and also Fürbinger, found it efficient in the *night-sweats* of phthisis. As a gargle or lotion a ½–1 per cent. solution in water or glycerin may be used. To check night-sweats it was given in the dose of Gm. 1–2 (15 to 30 grains).

CAMPHORA MONOBROMATA, *U. S.*—Monobromated Camphor.

Bromated camphor, E.; *Camphre monobromé*, Fr.; *Monobromkampfer*, G.; *Canfora monobromata*, F. It.; *Bromuro de alcanfor*, Sp.

Formula $C_{10}H_{15}BrO$. Molecular weight 230.42.

Preparation.—Laurent obtained (1840) camphor dibromide, $C_{10}H_{16}OBr_2$, by uniting bromine with camphor, and stated that on distillation it afforded bromine, camphor, a little hydrobromic acid, and a bromated oil. Swarts (1861) heated camphor dibromide in sealed tubes and obtained monobromated camphor. W. H. Perkins (1865) subjected the oily bromide of Laurent to distillation, and found the distillate, collected above 265° C. (509° F.) after crystallization from alcohol, to be monobromated camphor. We have found (1872) the following process to give satisfactory results: Break 13 ounces of camphor into small pieces; put these into a quart retort, first filling the neck; raise the latter somewhat, and then introduce through the tubulure, by means of a funnel-tube, 4 ounces of bromine, washing the last down with 20 or 30 minims of alcohol. A brisk reaction will commence in about fifteen or twenty minutes; after it has subsided and the retort has become cool introduce 8 to 9 ounces of bromine in four portions, waiting after each addition until the reaction has ceased. The addition of alcohol is not requisite, but facilitates the reaction, and the bromine may be added in larger quantities if provision be made for condensing the vaporized bromine and returning it to the retort. This is now slowly heated to about 132° C. (270° F.), allowed to cool, the contents dissolved in warm petroleum benzin, the solution allowed to crystallize, and the crystals purified by recrystallization from hot alcohol or petroleum benzin. On evaporating the mixed mother-liquors an oily mass is obtained, which, heated to 260° C. (500° F.), becomes black, and contains monobromated camphor, to be obtained by recrystallization as before. Gault (1874) heats at first in a water-bath, crystallizes from strong alcohol, and heats the oily mass contained in the mother-liquor to not over 220° C. (428° F.). A similar process is recommended by Dubois, who states that by confining the heat to 100° C. no by-products of any consequence are formed. J. U. Lloyd (1875) recommends the camphor dibromide to be heated with water in a retort placed in a sand-bath, and the product to be crystallized from alcohol. T. C. Linthicum (1876) considers the reaction very unsatisfactory at 100° C.

In the above processes camphor dibromide, $C_{10}H_{14}OBr_2$, is first formed, and this, on being heated, is decomposed into hydrobromic acid, HBr, and monobromated camphor, $C_{10}H_{15}BrO$, the latter representing a molecule of camphor in which 1 atom of hydrogen is replaced by 1 of bromine. During the operation one-half of the bromine used is given off as hydrobromic acid, and may be collected in water or combined with a base.

Properties.—Monobromated camphor crystallizes from alcohol in thin white or colorless prisms and needles, and from petroleum benzin in long flat prisms or glossy scales. It has a weak but persistent camphoraceous odor, a mild camphoraceous taste, and a neutral reaction. It is permanent in the air and not affected by direct sunlight. It is insoluble in water, slightly soluble in glycerin, freely soluble in alcohol, ether, chloroform, fixed oils, and in less than its own weight of hot petroleum benzin, from which solution the greater part crystallizes on cooling. It melts at 76° C. (168.8° F.), and evaporates slowly with the vapors of boiling water, condensing in fine white interlaced needles; at 274° C. (525° F.) it boils and volatilizes completely, with partial decomposition. It dissolves without decomposition in cold sulphuric acid, and is again precipitated by water. When boiled with silver nitrate and nitric acid it is decomposed, and yields 81.2 per cent. of silver bromide. Heated with zinc chloride to near 160° C. (320° F.), it yields a hydrocarbon, C_8H_{16}, and liquid thymol, $C_{10}H_{14}O$ (Schiff, 1880).

Pharmaceutical Uses.—If a liquid preparation is desired, monobromated camphor is conveniently given in the form of emulsion, after dissolving it in six or eight times its weight of expressed oil of almond or other bland oil. Monday (1877) proposed

an *elixir of monobromated camphor* containing 1 per cent. by weight of the latter, by dissolving with the aid of a gentle heat 3 Gm. of it in a mixture composed of 120 Gm. of 90 per cent. alcohol, 80 Gm. of water, and 100 Gm. of glycerin.

Action and Uses.—From a number of experiments upon animals Bourneville drew the following conclusions: 1. Monobromated camphor diminishes the number of the heart-beats and contracts the blood-vessels of the ears and eyelids. 2. It renders the inspirations less frequent. 3. It lowers the temperature steadily, and in fatal cases until death; in those animals which recover the temperature rises to its original point, but more slowly than it fell. 4. It is unquestionably hypnotic, and seems to act chiefly upon the brain. 5. It does not appear to induce tolerance, and cats and guinea-pigs lose flesh rapidly while using it. The experiments of Mr. Lawson upon man tend to confirm the conclusions of Bourneville in regard to its influence upon the pulse and temperature, both of which were depressed under the action of the compound, but in doses of 10 grains it did not show any soporific influence. In subsequent trials of the medicine he found that its great liability to produce gastric irritation, and the excitability and wasting following thereon, formed a strong objection to its use.

Monobromated camphor may take the place of camphor alone in the *ataxic* forms of the *typhoid state*. It has been used with alleged advantage in *epilepsy*, not only in the convulsive form of the disease, but in epilepsia minor and in cases of epileptic delirium in females. But, according to Dr. Gowers, it in his hands produced no good results. It has appeared to arrest *convulsions* depending upon dentition. In several cases of inveterate *chorea* and of *paralysis agitans* it is reported to have mitigated the convulsive movements in a notable degree, and to have controlled the excitement of *hysteria* and also of *delirium tremens*. In *insomnia* connected with cerebral hyperæmia or with heart lesions it has proved beneficial, and *palpitation* of the heart due to either cause has been relieved by it. The same is true of its use in *headache* occasioned by over-stimulation of the brain by mental excitement. It has also palliated *nervous cough* and nocturnal *incontinence of urine*, relieved anal and vesical *tenesmus*, especially when this symptom depended upon nervous irritability and not upon substantial disease of the affected organs, and it has also subdued *priapism*. It will be observed that all these affections are such as are apt to be benefited by the alkaline bromides; and it is more than probable that a solution of one of them in camphor-water, if not in simple watery solution, would answer the same, if not a better, purpose. After a sufficient trial of the preparation, Dr. Lawson concluded (*Practitioner*, xiv. 262) that its insolubility and the gastric derangement it causes render it ineligible as a medicine, and that its therapeutic value does not entitle it to rank with the other soporific and calmative medicines which are analogous to it. It has usually been administered in sugar-coated pills, and in doses of from Gm. 0.10–0.30 (gv. ij–v), repeated several times a day or oftener. Its insolubility and unpleasant taste and smell render any other liquid vehicle than oil inappropriate for its administration. A formula for an elixir is given above.

CANELLÆ CORTEX, *Br.*—Canella-Bark.

Canella.—Canelle blanche, Fr.; *Weisser Zimmt, Weisser Canel*, G.; *Canela blanca*, Sp.

The bark of Canella alba, *Murray*, s. Winterania Canella, *Linné*, s. Canella Winterana, *Gaertner*. Woodville, *Med. Bot.* 237; Bentley and Trimen, *Med. Plants*, 26.

Nat. Ord.—Canellaceæ.

Origin.—The *white wood* or *wild cinnamon* tree is indigenous to many of the West Indian islands and the southern section of Florida. It grows to about 12 M. (40 feet), has evergreen, blunt, lanceolate leaves, pale violet-colored, highly aromatic flowers in terminal corymbs, and bluish-black subglobular berries, about 1 Cm. ($\frac{2}{5}$ inch) long, and containing two to four angular and roundish reniform seeds. The silver-gray corky layer of the bark is mostly removed by beating, and subsequent cutting before the bark is collected. The drug became first known in Europe in 1605.

Description.—The bark is in quills or half-quills, varying in length from a few decimeters to .6 or .9 M. (2 or 3 feet), and in diameter from 6 to 38 Cm. ($\frac{1}{4}$ to $1\frac{1}{2}$ inches). The external surface is of a pale yellowish-red color, with transversely elongated scars of the suberous warts, and occasionally with fragments of the gray corky layer and with whitish patches of the inner bark laid bare by the removal of the reddish layer; inner surface white, finely striate; fracture short, white, with numerous bright orange-yellow

dots of resin-cells. The odor is agreeably aromatic, cinnamon-like; the taste aromatic, somewhat bitter, and biting.

Substitutions.—The bark of Cinnamodendron corticosum, *Miers* (Bentley and Trimen, *Med. Plants*, 27), a small tree of the same natural order as the preceding, is indigenous to Jamaica, and is there employed like Canella alba. It has oblong-lanceolate, acute leaves and red flowers in axillary clusters of two to four. The bark is of a ferruginous gray-brown, darker upon the outer surface, spotted by scars of the nearly circular suberous warts, smooth and finely striate upon the inner surface, and agreeing in odor and pungent taste nearly with the preceding. Both barks have been frequently sold as Winter's bark. Cinnamodendron macranthum, *Baillon*, of Porto Rico, yields a similar bark.

Constituents.—The analyses of Henry (1821) and of Petroz and Robinet (1822) proved the existence of volatile oil, resin, bitter principle, mucilage, starch, albumen, and salts. The *canellin* of the last-named chemists is identical with mannit, according to Meyer and Von Reiche (1843), who obtained 8 per cent. of it, and separated from the volatile oil eugenol, an oil having the odor of cajuput, and another fraction not further examined. From 0.5 to 0.94 per cent. of volatile oil and about 6 per cent. of ash, consisting mainly of calcium carbonate, have been obtained from the bark. The bitter principle has not yet been isolated. The cinnamodendron-bark has probably similar constituents, but contains in addition some tannin, which is not present in Canella alba.

Action and Uses.—Canella is tonic and stimulant, and may be employed to relieve simple gastric debility. It is seldom used alone, but rather along with bitter tonics and with purgatives that tend to debilitate, as scammony and jalap, or that have a local action which it is designed to increase, as in the case of aloes when given for *uterine disorders;* it is also used in chlorotic *menorrhagia* and *metrorrhagia* following parturition or depending upon cancer of the uterus. It is a constituent of *pulvis aloes cum canella*, long a valued remedy for *amenorrhœa*, and formerly an officinal preparation. The *dose* in powder is from Gm. 0.60–2.50 (gr. x–xl.)

CANNABIS INDICA, *U. S., Br.*—Indian Cannabis.

Hemp, E.; *Chanvre*, Fr.; *Hanf*, G.; *Cañama*, Sp.

Cannabis sativa, *Linné.* Bentley and Trimen, *Med. Plants*, 231.

Nat. Ord.—Urticaceæ, Cannabineæ.

Official Kinds.—1. Cannabis Indica, *U. S., Br.;* Herba cannabis Indicæ, *P. G.*—Indian cannabis, Indian hemp, *E.;* Chanvre indien, *Fr.;* Indischer Hanf, *G.*—The flowering tops of the female plant of Cannabis sativa, grown in the East Indies.—*U. S.*

2. Cannabis americana, *U. S.* 1880.—American cannabis, American hemp, *E.;* Chanvre américain, *Fr.;* Amerikanischer Hanf, *G.*—Cannabis sativa, grown in the Southern United States, and collected while flowering.

Origin—The hemp-plant is indigenous to Asia, from India north to Western China and the Caspian Sea; it grows likewise in tropical Africa. Having been cultivated from a very early period for its textile bast-fibres and its oily fruit, the cultivation has extended to most civilized countries. The plant grows spontaneously in Europe and North America, and has been naturalized in some parts of Brazil. It is an annual, with an angular roughish stem, 1.2, 2.4, and 3 M. (4 to 8 and even 10 feet) high, with opposite or the upper ones alternate petiolate and digitate leaves, composed of five to nine lanceolate or linear-lanceolate, acute, and serrate leaflets, and with diœcious flowers. The Indian plant has the lower leaves alternate, the stem is more branched, and the bast-fibres are coarser; but the characters vary and are not sufficiently important to constitute it a distinct species. The plant richest in resin grows at an altitude of 1800 to 2400 M. (6000 to 8000 feet).

Description.—The Indian hemp found in the market is that known in India as *gunjah* or *ganja*, and in London and elsewhere as *gauza;* as collected it consists of the tops of branches, which are 50 to 75 Mm. (2 to 3 inches) long, compressed, of a brownish-green color, with few leaves, a large number of female flowers, and some ripe or nearly ripe fruits, the whole more or less agglutinated by resin, but nevertheless quite brittle; odor narcotic, not unpleasant; taste bitter and slightly acrid. In

the bazars it is also seen in bundles, which are composed of the upper branches, .6 to .9 M. (2 to 3 feet) long, several inches in diameter, and showing more or less of the resinous exudation.

Another form is used in India under the name of *bhang* or *siddhi*, the *hashish* of the Arabs, which consists of leaves and small stalks coarsely broken and mixed with few fruits; it is smoked with or without tobacco, and is chiefly employed in the preparation of various electuaries and beverages. The resin is collected in India in a very primitive manner and impure condition, and is known as *charas* or *churrus*. It is either the dusty powder obtained on storing the dry plant, or by rubbing the fresh tops between the hands and scraping off the adhering resin, or by removing it from the leather garments of men who run through the hemp-fields brushing against the plants. The plants grown at an altitude of from 6000 to 8000 feet are stated to produce this resin, while those grown in the plains yield little or none.

The American hemp consists usually of the barren plant, which has the character given above; the staminate flowers are in loose pedunculate, axillary panicles crowded near the summit, and composed of clusters of pedicillate greenish flowers having a deeply five-cleft perianth. The fertile plant has the pistillate flowers single or in pairs, sessile, bracteate, and with slender protruding stigmas, the inflorescence forming erect, short, and compact spikes. The odor of the dry plant is heavy, the taste bitter and somewhat acrid.

Fructus cannabis.—Hempseed, *E.*; Semences de chanvre, Chénevis, *Fr.*; Hanfsamen, *G.*—It is an akene, about 3 Mm. (⅛ inch) long, ovate, somewhat flattened, and somewhat two-edged; the pericarp is thin, hard, smooth, greenish or brownish, delicately veined, and contains a single greenish seed, the embryo of which has the radicle bent upon one of the cotyledons. The fruit is inodorous, and has an unpleasant, sweetish, and oily taste. By trituration with water it yields an emulsion.

Constituents.—G. Martins (1856) obtained from this plant, besides gum and sugar, nitrate of potassium and other salts and resinous matter; dried at 100° C. (212° F.), the herb yielded 18 per cent. of ash containing silica and phosphates as the main constituents. European hemp had been previously examined by Schlesinger and Bohlig (1840); both found considerable malic acid, and the latter 0.3 per cent. of a yellow aromatic oil having faintly narcotic properties. Personne (1857) claimed the volatile oil obtained from Indian hemp to be the sole active principle; he separated it into liquid *cannabene*, $C_{18}H_{20}$, and solid *cannabene hydride*, $C_{18}H_{22}$. According to Bohlig, the essential oil contains oxygen. After rectification over sodium it was found by L. Valente (1881) to have the spec. grav. .9292 at 0° C., to boil at 256° to 258° C. (493° and 496.4° F.), to be readily soluble in alcohol, and to be violently acted upon by bromine. The *hashiscin* of Gastinel is merely the alcoholic extract of gunjah deprived of the principles soluble in water. The *cannabin* of T. and H. Smith (1846) is much purer; it is obtained by exhausting the gunjah with water and solution of sodium carbonate, then washing the residue with water, drying, exhausting with alcohol, treating the tincture with milk of lime, precipitating the lime with sulphuric acid, treating the filtrate with animal charcoal, filtering, concentrating, and precipitating by water; it constitutes a brown amorphous resin which burns without leaving any ash. Procter (1864) observed that the resin is converted by hot nitric acid into an orange-red substance resembling gamboge, and Bolas and Francis (1871) obtained from this residue *oxycannabin*, $C_{20}H_{20}N_2O_7$, which crystallizes from methylic alcohol in large prisms. Preobraschensky (1876) claimed to have obtained *nicotine* from Bucharian hashish and from gunjah. Siebold and Bradbury (1881) failed, like other investigators, to obtain nicotine, but isolated from 10 pounds of gunjah about 2 grains of a volatile alkaloid, *cannabinine*, which forms a varnish-like mass of a coniine-like but less nauseous odor, sparingly soluble in water, and in this solution yielding with chlorine-water a white turbidity. Matthew Hay (1883) showed that Cannabis indica contains several alkaloids; the sulphate of one of these is soluble in alcohol. The alkaloid itself is easily soluble in water and in alcohol, more slowly soluble in chloroform and ether, and from the latter solution obtainable in needles. It does not show the color-reactions of strychnine, but resembles it in its physiological effects; hence the name *tetanocannabine* is proposed for it.

The analysis of Bucholz, and the later one by Anderson (1855), failed to find in hempseed any other constituents than those common to oily seeds. The small quantity of resin has not been further examined; the protein compounds amount to 22 or 24 per cent. and the fixed oil to about 30 per cent. Berjot (1860) obtained 28, Cloëz (1865)

31.5, and Münch (1866) 35.5 per cent. of oil. *Oil of hempseed* is a drying oil, and has a greenish- or brownish-yellow color, a peculiar odor, and a mild taste; it is readily soluble in boiling alcohol, and when heated with one-fifth of its measure of soda solution spec. grav. 1.34 it acquires a yellowish-brown color and a thick consistence.

Extractum cannabis americana, Extract of American hemp. An alcoholic tincture of American cannabis evaporated to the consistence of an extract, *U. S. P.* 1870.

Cannabine tannate, for which no formula has been published, is a yellowish-brown permanent powder, insoluble in water and ether, slightly soluble in alcohol, of a not unpleasant odor, and of a bitterish astringent taste; it is stated to be the tannate of a glucoside.

Action and Uses.—The action of cannabis upon man varies with the individual's temperament. Some it inspires with pugnacity, and others it inclines to dreamy contemplation, to motiveless merriment, or to maudlin sensibility; some it makes unnaturally active and restless, and plunges others in a drowsy stupor; but more than any other agent, not even excepting belladonna, it perverts the natural perception of objects and their normal condition and relations. At the same time it dilates the pupils. During its influence the physical condition of the experimenter exhibits changes in the rate and rhythm of the pulse, warmth of the skin, restless muscular movements, more or less insensibility to touch and pain, and sometimes impaired power of locomotion, the limbs feeling as if weighted with lead. In one reported case a diffused vesicular eruption was attributed to this medicine (Hyde). It does not increase, but, on the contrary, impairs, the venereal propensity and power. One of its immediate sequences is a voracious desire for food. A vivid and detailed description of the effects of this preparation upon himself is furnished by Dr. Beane (*Ther. Gaz.*, viii. 278). Among them he notes a sinking feeling at the præcordium, a sensation of spasmodic contraction of all the blood-vessels, and a rapid action of the heart. The cardiac oppression and rapid pulse have been noted by others (*ibid.*, ix. 18; x. 618; *Centralbl. f. d. ges. Ther.*, iv. 449; *Med. Record*, xxviii. 55). But in the case of a consumptive patient "the pulse was full, regular, and not noticeably accelerated" (*Times and Gaz.*, June, 1885, p. 817.) The varying action of the drug upon the same person is exhibited by Mr. Fielde in his vivid narrative of the experiments tried upon himself in China (*Therap. Gaz.*, xii. 449). Its stimulant action is illustrated by its influence upon a Persian sect, Haschischin (whence the French and English word assassin), who, under its influence, ran amuck, slaying or wounding all they met (Stillé, *Therapeutics*, 4th ed. i. 956). Similar occurrances even now occasionally take place in India (*Boston Med. and Surg. Jour.*, Sept. 1885, p. 239). The habitual use of cannabis in excessive doses causes the face to become bloated, the eyes injected, and the limbs weak and tremulous; the mind grows imbecile, and ultimately death by marasmus is apt to occur. Acute poisoning by large doses is marked by various and dissimilar symptoms in different cases. In some there is loss of consciousness, with collapse or stupor, insensible pupils, a pale, clammy, and insensible skin, extreme debility, and a small, feeble pulse. A case in which the drug was taken with a suicidal intent presented the grave symptom of paralysis of the respiratory muscles of the thorax, and the patient's recovery was attributed to the use of the electrical battery (*Therap. Gaz.*, viii. 514). But it does not appear that cannabis has unequivocally caused death in any case. In other cases a cataleptic condition, spasms, or convulsions occur, and in all there is marked anæsthesia. The last-named effect led to the use of cannabis by the Chinese in certain surgical operations. (For a fuller account of its effects, see Stillé, *Therapeutics*, 4th ed. i. 958.)

The effects of cannabis as just described would not suggest its employment in *tetanus*, and yet in the traumatic variety of a disease notoriously of fatal issue its virtues have been demonstrated by physicians entirely competent to test them. In India it has been successfully employed by causing the patient to smoke *gunja*, or else the dried leaves of cannabis, almost continuously. It is of comparatively little use in *neuralgia*, *rheumatism*, *epilepsy*, or *chorea*. Yet in the first of these affections its efficacy is claimed by several recent authors, including Hare, McConnell (*Practitioner*, xl. 95), Reynolds (*loc. inf. cit*). In a case of chorea following concussion of the spine it seemed to promote the cure (Siegfried, *Hygien. and Med. Rep. U. S. Navy*, 1879). Its anæsthetic virtues are shown by its allaying the intense *itching* of *eczema*, so as to permit the patient to sleep; it is said to have been used with advantage to diminish *hallucinations* of sight and hearing in certain forms of *insanity* and in *delirium tremens;* but in such sensorial aberrations its action is by no means uniform. Its use in the treatment

of the *morphine habit* has furnished some encouraging results. It is alleged that extract of cannabis, used habitually in the dose of one-third of a grain twice a day, will prevent or greatly mitigate recurrent *headache* or *migraine*. During the attacks the dose should be increased to Gm. 0.03 (gr. ½) or more. Among the later reporters of its success in this disorder are MacKenzie (*Practitioner*, xxxviii. 294) and Greene (*ibid.*, xli. 35), who agree that the medicine should be continued for several months in doses of Gm. 0.02–0.03 (gr. ⅓ to ½) three times a day, and gradually increased, while its action is kept within the physiological limit. It seems to be peculiarly efficient in various conditions of the brain involving a positive or relative anæmia of that organ, such as *delirium* during *fever* and in *delirium tremens*, and *sleeplessness after fever*, *softening of the brain*, *thickening of the meninges*, *obstinate nervous vomiting*, etc. Reynolds (*Lancet*, March, 1890, p. 637) has furnished the special indications for the medicine in several of these diseases: viz. senile insomnia, *facial neuralgia*, *locomotor ataxia*, chronic *spasms* (not epileptic); and Germain Sée has recommended it in various forms of *gastric irritation* of an atonic character and attended with flatulence, and vomiting, giddiness, migraine, palpitation, etc. (*ibid.* Sept. 1890, p. 631). He suggests doses of ⅓ grain three times a day. Cannabis appears capable, directly or indirectly, of causing uterine contraction, as in many cases of *uterine hæmorrhage*; and it is also said to provoke this act during *labor* with as much energy as ergot, but that its effects are less persistent. Maeconnell attributes to it the virtue of overcoming anorexia following exhaustive fevers and other diseases, and states that in India those who use it habitually have voracious appetites. He also speaks of its control over *dyspeptic diarrhœa* (*lientery*), and in this connection refers to the constipating effect of its habitual use (*Practitioner*, xl. 95). Bond and Edwards had previously written of its value in diarrhœa (*ibid.*, xxxix. 8), and Rennie in *dysentery* (*Therap. Gaz.*, xi. 196), but, as they associated with it morphine or astringents, the part played by cannabis in the treatment does not appear to be very definite. Birch has reported cases of the *chloral habit* and of the *morphine habit* which were successfully treated by extract of cannabis (*Lancet*, March, 1889, p. 625). The *dose* of extract of cannabis is from Gm. 0.013–0.06 (⅕ to 1) grain, but since this preparation is often quite inert, none should be used medicinally that has not previously been tested. It should also be remembered that the susceptibility to its action is very unequal, and that therefore the primary should be a minimum dose. Lemon-juice is said to neutralize its effects, and tobacco and coffee to increase them; but, on the other hand, coffee has been recommended as an antidote, and so have ammonia, strychnine, and even atropine. There is no clinical evidence in favor of those last named. Fronmüller alleges that *tannate of cannabine* is a reliable hypnotic in the dose of from 2 to 10 grains; and this statement is repeated by Pusinelli and Findler, but is questioned by Ewald, Leyden, and others. It seems to be agreed that the hypnotic effect of the drug is manifested chiefly when wakefulness is due to mental excitement, and especially in persons of a nervous temperament, and also when it is caused by long confinement without due exercise. The dose varies from 5 to 15 grains. Dr. H. C. Wood, however, reports that he gave Merck's tannate of cannabine to a number of patients in doses of 20 grains a day, and produced no distinct effect beyond a slight drowsiness (*Therap. Gaz.*, ix. 379). Richter pronounces this preparation uncertain and untrustworthy, and a similar judgment has been given by Prior (*Centralbl. f. Therap.*, vi. 607).

Cannabinon.—At a meeting of the Berlin Society for Psychiatry and Nervous Diseases (*Centralbl. f. d. g. Therap.* iii. 94), Richter stated that in doses of 1½ grs. this preparation acts like cannabis, but may induce collapse; Vogelgesang had given it to insane patients in 6–8-grain doses, but with little advantage, for its benefits were very transient, and sometimes it brought on a semi-paralytic attack; Blumenthal had seen analogous effects from doses of 1½–3 grains, and in one instance from the smaller dose; Gnauk had a similar experience where 5 grains of the medicine had been taken, and with 2 grains he failed to secure sleep. Mendel noted dryness of the throat and vomiting among its effects, and Roux, after an elaborate experimental study of the subject (*Bull. de Thérap.*, cxi. 492), declared the preparation unsafe as well as uncertain.

CANTHARIS, *U. S., Br.*—Cantharides.

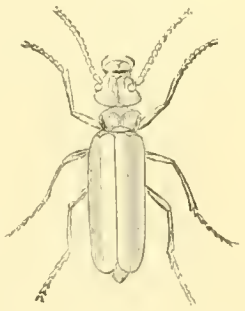
Cantharides, P. G.; *Muscæ Hispanicæ.*—*Spanish flies*, E.; *Cantharides*, Fr.; *Spanische Fliegen*, *Canthariden*, *Kanthariden*, G.; *Cantaride*, *Cantarella*, *Mona di Spagna*, It.; *Cantaridas*, Sp.

Cantharis vesicatoria, *De Geer* (*His. des Insectes*), s. Lytta vesicatoria, *Fabricius*, s. Meloe vesicatorius, *Linné*. The beetle collected chiefly in Hungary and Southern Russia.

Class Insecta; Order Coleoptera—Beetles.

Description.—The so-called Spanish fly is indigenous to Southern and Central Europe, and is found eastward as far as Western Asia; it frequents chiefly trees and shrubs of the Oleaceæ and Caprifoliaceæ, such as the ash, lilac, elder, and honeysuckle. The beetle is from 15 to 30 Mm. ($\frac{3}{5}$–$1\frac{1}{5}$ inch) long and 5 to 8 Mm. ($\frac{1}{5}$ to $\frac{1}{3}$ inch) broad, flattish cylindrical in shape, of a shining brass or copper-green color above and below, and finely punctate above. Head obtusely triangular and subcordate, with a longitudinal furrow; eyes two, lateral; antennæ filiform, of eleven joints, the lowest three green, the upper black; thorax of the same width as the head, obtusely quadrangular, longitudinally channelled; wing-cases covering the body, with two fine longitudinal ridges; wings ample, membranous, brownish-transparent; tarsi of the hinder legs with four, and of the others with five, joints; claws bifid. Cantharides have a strong and disagreeable odor and a slight taste becoming strongly acrid. They yield a brown-gray powder intermixed wih green shining particles.

Fig. 45.



Cantharis vesicatoria.

Collection and Commerce.—Cantharides are collected early in the morning by spreading cloths under the trees and shrubs, which are then shaken or beaten with poles; the insects are plunged into hot water, afterward spread out and dried. A better method for killing them is by means of a little chloroform, ether, oil of turpentine, or carbon disulphide after enclosing them in a tight vessel. They are collected for exportation in Spain, Italy, Hungary, and Southern Russia, and packed in boxes and casks. Those coming from Russia are of a copper color, larger than those of Western Europe, and are most esteemed. 6000 pounds of cantharides were imported in the year 1867, and 5000 pounds in 1879, but the importation usually reaches 14,000 to 19,000 pounds per annum, including Chinese blistering-beetles.

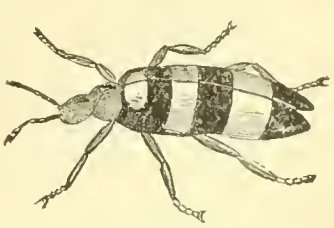
Allied Species.—Several of the American species allied to the Spanish flies have been found to possess efficient vesicating properties, and among these may be mentioned: *Cantharis vittata*, or potato-fly, which has a black thorax and wing-cases, with three yellow stripes upon the former, and the latter margined with yellow and with a yellow stripe down the middle; *C. cinerea*, black, closely punctured, and covered with ash-gray hairs; *C. marginata*, elytra black, with the margin ash-colored; *C. atrata*, only about $\frac{1}{3}$ inch long, uniformly black. Attention has also been called among others to *C. Nuttalli*, which resembles the Spanish fly, but has golden-purple wing-cases striped with green; it is very abundant in Kansas and Colorado. (An interesting paper, treating of many of the North American blistering-beetles and of the development of Meloe, by Mr. W. Saunders, may be found in the *Proceedings of the American Pharmaceutical Association*, 1876, p. 505.)

Mylabris cichorii, *Fabricius*, and M. phalerata, *Pallas*, two vesicating insects indigenous to Eastern and Southern Asia and to some parts of Africa, have recently been imported as *Chinese blistering-flies*: the insects are black, with two orange-colored bands and two spots of the same color upon the wing-cases. They yield a blackish-gray powder destitute of the green glossy particles observable in powdered cantharides, and are quite efficient as a vesicant. The East Indian Lytta Gigas, *Fabricius*, which is longer than cantharides and of a purplish-blue color, has likewise been occasionally met with in commerce.

Fig. 46.

Cantharis vittata.

Fig. 47.



Mylabris cichorii.

Preservation.—All blistering-beetles should be kept in a well-dried condition and in close vessels, the drying to be effected at a temperature not exceeding 40° C. (104° F.), so as to avoid loss of cantharidin. If they cannot be kept in this condition, they may be protected from the attacks of mites and of small beetles and their larvæ by the addition of a little camphor, ether, chloroform, oil of turpentine, benzene, or carbon disulphide. W. E. Saunders (1883) finds the vapors of chloroform to afford better protection than camphor. The blistering principle resides mainly in the soft parts of cantharides; the idea which has been sometimes advanced, that they increase in strength when thus attacked, is erroneous.

Adulterations.—Cantharides are occasionally mixed with beetles of a similar color

which have been collected with them, but evidently not for fraudulent purposes. The shape and color of the insects prevent them from being adulterated. But powdered cantharides are said to be sometimes ground together with euphorbium. Adulterations are best recognized by determining the amount of cantharidin by the modifications of Procter's process mentioned below, sometimes also by the amount of ash. "When incinerated, cantharides should yield not over 8 per cent. of ash."—*P. G.*

Constituents.—Robiquet's analysis (1810) indicated the presence of cantharidin, free acetic and uric acids, fatty matters (stearin, palmitin, and olein, according to Goessmann), yellow viscid matter soluble in water and alcohol, a yellow substance soluble in ether and alcohol, black extractive, and magnesium and calcium phosphates. E. Dietrich (1883) found also notable quantities of formic acid. Pocklington (1873) regards the green coloring matter as chlorophyll. *Cantharidin*, $C_{10}H_{12}O_4$, is most readily obtained by Procter's process (1851), as modified by Mortreux (1864) and Fumouze (1867): this method consists simply in exhausting the powder with chloroform, evaporating spontaneously, and freeing the residuary crystals from fat and coloring matter by washing them with bisulphide of carbon. Galippe (1875) recommends the substitution of acetic ether for the chloroform. Beguin gives preference to the same menstruum, and believes that the solvents mentioned completely extract the cantharidin, and that therefore it cannot be contained in the beetles partly in combination, as was stated by Bluhm (1865), Rennard (1871), and others. But Dragendorff (1867, 1872) showed that the yield of cantharidin may be increased by treating the powder first with an alkali, and supersaturating afterward with hydrochloric acid before exhausting the cantharidin; and E. Dietrich (1880) found it of advantage to subject the alkaline liquid to dialysis. The experiments of R. Wolff (1877), made with Lytta aspersa of South America, indicate that ammonium compounds may be present and gradually increase in quantity through the agency of moisture and the magnesium salts of the beetles, whereby sparingly soluble compounds are formed; all of which, as far as examined, are decomposed by acetic ether, with the liberation of cantharidin; hence the larger yield when old cantharides are treated with this menstruum. The amount of cantharidin found by different authors in cantharides varies between 0.17 and 0.57. Boiraux and Léger (1875) obtained as much as 1 per cent. by using hot coal-oil (boiling between 80° and 120° C.). W. R. Warner (1856) obtained from C. vittata 0.40, L. Fahnestock (1879) from the same species by Dragendorff's method 1.3 per cent.; R. Wolff from Lytta aspersa 0.85, Prestat (1876) from Mylabris interrupta of Algiers 0.858, Maisch (1872) by Fumouze's process from Chinese beetles 1.016 per cent., and L. Fahnestock (1879) 1.25 per cent. from the same lot of beetles after they had been kept for six years, and with the use of Dragendorff's process; Warner obtained only 0.43 per cent. That cantharidin is with difficulty obtained pure from old cantharides was also shown by Fahnestock (1879). According to Nentwich (1871), full-grown cantharides only are vesicating.

Cantharidin crystallizes in colorless prisms and scales, and is soluble in alcohol, methylic alcohol, ether, chloroform, acetic ether, glacial acetic acid, and fixed and volatile oils, but insoluble in carbon disulphide and in petroleum benzin. Dietrich considers formic acid the best solvent, and states that cantharidin dissolved in this acid may be distilled. It is rendered soluble in water through the yellow viscid matter in cantharides (Robiquet), which we find to be partly precipitated by basic lead acetate and mercuric chloride. But, according to Rennard, hot and cold water dissolves nearly $\frac{1}{3}$ and $\frac{1}{5}$ per cent. of cantharidin, and this vaporizes when distilled with water, more particularly with the first portions—with chloroform even at 60° C., and in the dry state at and above 85° C. (185° F.). When dry it fuses near 210° C. (410° F.), and sublimes more freely at that temperature, condensing again in glossy prisms or needles. It unites with bases after assimilating H_2O, forming salts, *cantharidic acid* having the composition $C_{10}H_{14}O_5$, but on being decomposed by an acid cantharidin is again separated (Dragendorff, 1867). Krafft (1877) gives the formula $C_{20}H_{24}O_8$ to cantharidin, and states that the latter, heated with hydriodic acid spec. grav. 1.8, is gradually converted into the monobasic *cantharic acid*, which has the same composition, is crystalline, soluble in 120 parts of cold and 12 of boiling water, sparingly soluble in ether, and not vesicating when its glycerin solution is applied to the skin.

Pharmaceutical Uses.—Linimentum Cantharidis, U. S. 1880. Digest 15 parts of cantharides in No. 60 powder with 100 parts of oil of turpentine in a close vessel by means of a water-bath for 3 hours; strain and add enough oil of turpentine through the strainer to make the liniment weigh 100 parts. Oleum Cantharidatum, P. G.—Digest 3 parts of coarsely-powdered cantharides in 10 parts of olive oil for 10 hours and filter.

Other Insects.—Only two insects are now officinal in the U. S. and British Pharmacopœias, Cantharis and Coccus. Some European pharmacopœias recognize also the *red ant*, Formica rufa, *Linné*, which belongs to the order Formicidæ, and is used in preparing a spirit (see ACIDUM FORMICICUM) and a tincture. The latter, *tinctura formicarum*, is made by digesting 2 parts of fresh and bruised ants in 3 parts of alcohol, and has a brown color.

Recently an insect of the order Orthoptera has been recommended—BLATTA (PERIPLANETA, *Burmeister*) ORIENTALIS, *Linné;* Cockroach, *E.;* Bête noir, Panetière, Cafard, *Fr.;* Schabe, *G.*—It is a native of Asia, but now found in most parts of the civilized world. It is dark-brown, about 1 inch (25 Mm.) long, has a flat broad body, the extremity of which is furnished with two conical appendages; the antennæ are long and filiform, the legs thin but strong, and the wings lie straight on the back, covering the greater part of the body of the male, but being quite short in the female. The cockroach is nocturnal in its habits and has a disagreeable sickening odor. Bogomolow (1876) announced the isolation of the active principle *antihydropin* in a crystalline form, but has not published the process for obtaining it.

Action and Uses.—Internally, if the quantity be large, cantharides occasion a burning heat in the throat, stomach, and bowels, cause nausea and vomiting, often of blood, and produce fibrinous and sometimes bloody stools, griping, and tenderness of the abdomen. With such symptoms death may take place. If there is time for the absorption of the cantharidin, there is also strangury, with burning pain in the kidneys and bladder; the urine may at first be increased, but soon grows scanty, albuminous, or bloody; the local irritation is apt to occasion erection of the penis: sometimes, though rarely, erotic excitement and seminal emissions occur, and in the female genito-urinary excitation, which may induce abortion. Gangrene sometimes attacks the genitals. It is said that venereal excitement is more apt to follow the action of cantharides in substance than that of cantharidin, and the difference is ascribed to an essential oil which the former contains, and which gives them their characteristic nauseous and pungent odor. The general symptoms of cantharidal poisoning consist of a frequent and small pulse, hurried breathing, vascular injection of the face, heat of skin, thirst, pain in the head, delirium, trembling, tetanic spasm, and coma. The smallest fatal dose of cantharides on record is 24 grains, but the patient was a pregnant female, who aborted. An ounce of the tincture has been fatal to a boy of seventeen. Camba relates that several members of a family were poisoned by eating small birds in whose alimentary canal were found fragments of Spanish flies (*Therap. Monatsheft*, iii. 186). After death from cantharides the gastro-intestinal and urinary mucous membranes are congested, bloody, inflamed (with exudation), or gangrenous. The kidneys are sometimes enlarged and engorged, and offer the signs of parenchymatous and desquamative nephritis, but chiefly of the latter (Eliaschoff, *Virchow's Archiv*, xciv. 323; Aufrecht, *Pathologische Mittheil.*, ii. 32; E. Lahousse, 1885). The Malpighian bodies, the secreting tubules, and the interstitial tissue are involved; the blood-vessels become choked with blood-cells; albuminous exudations into the tubules take place, forming casts; and the cells of the uriniferous canals perish. The bladder contains blood, while its lining membrane is red, and presents blebs, pseudo-membranes, and sometimes ulcers. Applied to the skin in cerates, ointments, etc. or as cantharidin, this agent produces a stinging and burning pain, with redness, followed by vesication. The serum contained in the elevated cuticle is pale yellow, alkaline, and albuminous; the chorion is pale red, and its papillæ are prominent, or, if the action has been energetic, the chorion is highly inflamed and may be coated with a fibrinous layer. When a blister is very large and long applied, it is apt to produce strangury, and the urine is then covered with an albuminous pellicle. It may also cause general nervous excitement and fever, inflammation of the lymphatics and their glands, or a diffuse erythema, and even gangrene of delicate parts or of such as are weakened by blood diseases. Hence a blistering plaster of large size should rarely be kept upon the skin until complete vesication occurs. Cantharidin does not appear to cause toxical effects as readily as cantharides, yet it is estimated (Ewald) as being 200 times stronger.

Cantharides in the form of the tincture have been given in low forms of *fever*, and in cases of exhaustion from protracted *hectic*, with alleged advantage, but there is nothing to render this method eligible. The same is true in regard to *dropsy* and chronic *bronchitis*. In scaly *diseases of the skin* they have been found very useful, and should not be forgotten when arsenic and the application of tar, etc. have failed. In various forms of *debility of the bladder*, such as produce *incontinence of urine* in children and old men, and in the latter *dysury*, this medicine has been often efficient. Sometimes, indeed, when directly injected into the urethra, long-standing *gleets* have been cured by it, and also by its internal administration. In chronic *vesical catarrh* it deserves more confidence than it is apt to receive. *Diabetes insipidus* has been arrested by it. In all of

these cases, except the last, it acts by producing a substitutive irritation. Before the pathological conditions which produce *dropsy* were recognized a certain number of cases of this affection were recorded as having been cured by cantharides. Richter restricted the use of the medicine to cases distinguished by a torpid state of the system; Ferrier applied it to the cure of scarlatinous dropsy; and it was recommended by Lieutaud and by Blackwall (STILLÉ, *Therapeutics*, 4th ed. i. 427). More recently, Grainger Stewart (1871) mentioned the tincture of cantharides as a good stimulant diuretic in the later stages of the inflammatory form of Bright's disease; but Dickinson (1868) spoke of it unfavorably. E. Wagner (1882) referred to it, along with sabina, as possibly dilating the renal capillaries. In 1884, Dr. Bruen claimed that the tincture of cantharides acts favorably in chronic catarrhal nephritis combined with some interstitial process and associated with more or less cardiac hypertrophy, especially when given along with digitalis. He also stated that in several cases of *cardiac dropsy* "it very constantly increased the urinary secretion, forming a valuable adjuvant to digitalis" (*Phila. Med. Times*, xiv. 275). These statements are confirmed by Fifield in relation to complete suppression occurring in a hard drinker with albuminous urine. The tincture of cantharides was given hourly in drop doses (*Boston Med. and Surg. Jour.*, Mar. 1884, p. 271). It has usually been held that digitalis is not adapted to the treatment of cardiac hypertrophy, except when it is associated with predominant dilatation. The irritant action of cantharides upon the pelvic organs is illustrated by its use in *amenhorrhœa* depending upon atonic conditions, and in passive *seminal emissions* of the same nature. The old but long obsolete use of cantharides for *hydrophobia* has been proposed anew, but upon no substantial ground (*Med. News*, xlix. 596).

In 1891, Liebreich was led by experiments on animals with *cantharidin* to conclude that if this substance could in due proportion be introduced into the blood it might bring about the elimination of *tuberculous* deposits. He accordingly, in certain cases of *tubercular laryngytis*, injected into the back 1 cc., containing $\frac{2}{10}$ of a milligram ($\frac{1}{350}$ gr.), but thought that $\frac{1}{2}$ decimilligram ($\frac{1}{700}$ to $\frac{1}{1400}$ gr.) in most cases sufficient when given every other day. The rapidity of its action he described as extraordinary (*Amer. Jour. Phar.*, lxiii. 295). These statements were in a degree confirmed by Germonic, but Forlanini and Devoto failed to do so (*Therap. Gaz.*, xv. 483, 763), and this *a-priori* remedy for phthisis failed, as others had done before.

Externally, the uses of cantharides, especially in blisters, are very numerous. They are employed —1st, to stimulate the whole or a particular part of the system; 2d, to promote the absorption or prevent the accumulation of inflammatory exudations; 3d, to recall suppressed discharges; 4th, to act as a depletory; 5th, to promote the cure of internal diseases by counter-irritation of the skin. Their direct remedial influence by stimulation is seen in cures of indolent *ulcers*, *fistulæ*, and several inveterate diseases of the skin, as *lepra*, *psoriasis*, *alopecia furfuracea*, and *lupus*, and even of certain acute ones, as *zona* and *erysipelas*. Liniments containing tincture of cantharides are among the best means of curing *alopecia*. Blisters have been used with striking effect to prevent the increase and hasten the cure of *boils* and *carbuncles*, by applying them so as to cover the whole indurated spot and allowing them to vesicate fully. To be successful this method must be employed early. The revulsive operation of blisters is the one most usually invoked, and, on the whole, the most useful. Wherever there is a local tendency to congestion the timely and due application of a blister modifies and may arrest it; thus it may prevent serious *congestion of the brain*, or its increase if already existing, or its consequences through effusion if this have occurred, by depleting the neighboring skin, and probably by a reflex action upon the vaso-motor nerves. These consequences include *paralysis* and other effects of *congestion*, *hæmorrhage*, and allied conditions of the brain and spinal cord. Evidently, vesication should not be made in their acutest stage, and its benefits are relatively small when the state has become chronic; in the former it overstimulates, in the latter its stimulation is useless. Harkin claims to have frequently cured nocturnal *enuresis* by blistering the upper part of the back of the neck (*Jour. Am. Med. Assoc.*, viii. 266). Many cases of *dropsy of the brain* have been palliated by blistering the scalp; many of *general dropsy* by blisters cautiously applied to the legs; many also of *hydrocele*, of *hydrarthrosis*, and, most of all, of *chronic pleurisy*, in which no medical means are more efficient than a succession of large blisters. A similar action is no doubt exerted by blisters when applied along the under surface of the penis for *gleet* and to the sacrum for *leucorrhœa*, to prevent *abortion*, to relieve *dysmenorrhœa*, and to hinder the suppuration of deep-seated *buboes* and other glandular inflammations. In the last-mentioned cases, if the inflamed organ is very superficial or the action of the blister

is deep, suppuration will be hastened. *Abscesses* of various sorts may be conveniently evacuated by blistering, and especially cold abscesses, if the skin over them is already thin.

The action of blisters in *fevers* is probably both stimulant and revulsive, and to a certain extent depletory. The clinical facts of the matter are simply these: that blisters, especially on the nape of the neck, are generally useful in *typhus* and *typhoid* fevers, whether the condition be one of excitement or of coma or denote a tendency to the one or the other state. They are not equally beneficial under analogous conditions in scarlatina or variola, or during acute inflammation of the lungs, heart, or bowels. Their stimulant action is the one most frequently sought—*i.e.* when the symptoms are moderately comatose—in which case the vesicant should not remain applied longer than from two to four hours, its fuller effect being secured by a dressing of simple ointment or a poultice. In cases of profound stupor a more sustained operation is necessary. When coma is due to an *apoplectic* condition, whether hæmorrhagic or only congestive, the active depletory operation is to be secured by a more prolonged application of the blister, and, if necessary, to the scalp as well as to the back of the neck. In such cases also the discharge should be maintained by means of stimulant dressings. In all forms of inflammation of the *eyes* blisters are invaluable as revulsives, applied to the nuchæ, behind the ear, or on the forehead. The utility of blisters in *acute* inflammation of the pleura and of the lungs (*pleurisy* and *pneumonia*) depends upon their being applied long enough only to vesicate superficially and so as to cover a large portion of the affected lung. Smaller blisters may relieve a stitch in the side, but will not so distinctly influence the progress of the inflammation within, as denoted by a diminution of the cough, oppression, and fever. Small blisters are of essential use in those limited pleurisies which occur during chronic phthisis, and they should not be disregarded in analogous pneumonias. In *pericarditis* blisters should seldom be omitted; they allay pain, probably limit the effusion, and certainly promote its absorption. The revulsive action of blisters is also a precious resource in the treatment of *phlegmasia alba*, of *phlebitis*, and especially of *chronic fluxes of the bowels*. Nothing is more efficient in the last than a succession of large and superficial blisters. The treatment of acute articular *rheumatism* by blisters applied upon the affected joints has been attended with a large degree of success, but it is doubtful whether the benefit is due so much to a revulsive or counter-irritant operation as to the alkalinity of the secretions induced by blistering. As the use of alkalies internally and locally usually cures acute articular rheumatism, it does not seem worth while to employ a remedy which accomplishes no more than they, while it inflicts much pain. In cases of retrocedent rheumatism or gout it has been advised to blister the joints last affected, but less severe revulsives are doubtless as useful. Of all the local methods of treating *neuralgia*, that by blisters is the most efficient. It consists in applying small blisters over the superficial portions of the affected nerves, especially where they emerge from bony or tendinous openings or distribute their terminal branches to the skin. The vesication should be slight when the nerves are superficial, energetic when the trunks lie deep. The nerves of the head, face, and chest require the former method—the sciatic nerve the latter. In cases suitable for superficial vesication the operation should be repeated as often as the skin heals if the pain continues to return; when the nerves lie deep, the discharge from the blistered surface should be constantly maintained until the cure is perfect. *Spinal irritation*, so called, is most frequently a true neuralgia, but is sometimes also a constant aching of the muscles along the spine, produced by nervous exhaustion. It may be relieved by superficial blistering, and by other local stimulants, including electricity, provided a suitable regimen by rest and nutritious food are at the same time employed. The revulsive action of blisters is also employed in *convulsive disorders* for the purpose of reducing the morbid irritability of the cerebro-spinal centres. It has long been used upon the spine in *tetanus*, and with unequivocal advantage, and in all diseases attended with tetanoid rigidity or convulsions. Its advantages are hardly inferior in all cases of *paralysis* that depend upon congestion or inflammation of the spinal cord or its membranes. It is notably a valuable element of the treatment in *epidemic meningitis* when the phenomena dependent upon nervous disorder exceed those which depend upon alterations of the blood. The blisters should cover the occiput and extend along the spine to the end of the cervical vertebræ at least, and should vesicate thoroughly. *Spasms* of particular muscles may be moderated by blistering the affected part, as in *scrivener's spasm*, and the nutrition of *wasting muscles* after rheumatism, injuries, etc. is generally improved by a course of blistering. *Vomiting* is often arrested by blistering the epigastrium.

A blister should, in general, be applied as near as possible to the part which it is intended to benefit. It is usually undesirable to allow it to remain upon the skin until vesication has been accomplished. *Usually from three to six hours, or until vesication commences, will be long enough.* It will act more promptly if the part has first been cleansed with warm water and soap and bathed with vinegar. Fever renders the action of blisters more rapid, and coldness and nervous insensibility of the skin retard it, and so, too, does a perspiring skin. They act more promptly when the skin is delicate, hence more so in children and females than in other persons; consequently, especial care should be used to prevent their excessive action in such patients, either by diluting the blistering cerate or by interposing a piece of tissue-paper or fine muslin between the plaster and the skin. If it is desired to heal a blister soon, the raised cuticle should be cut freely, so as to evacuate the serum, and a dressing of absorbent cotton applied and secured with a roller. If it is intended to maintain the discharge, the cuticle should be removed, and a dressing, first of simple cerate, and within twenty-four hours one of basilicon ointment, applied. Under such stimulation the discharge grows purulent, and may be maintained by savine cerate or mezereon ointment. As a general rule, blisters should be very cautiously employed in old and in young persons; in the former they act slowly and often leave intractable sores; in the very young they are prone to excite excessive reaction and occasion gangrene. During epidemics of diphtheria blisters are very apt to become covered with false membrane; during other epidemics they are likely to be attacked with erysipelas or with gangrene, or to be followed by abscesses or by an eruption of boils. To prevent the strangury which plasters of cantharides frequently cause, the most usual method is to sprinkle the surface of the plaster with finely-powdered camphor or to brush it over with tincture of camphor. The efficacy of this method is very doubtful. It has been alleged that if the plaster be sprinkled with bicarbonate of sodium mixed with coarsely-powdered cantharides, the apprehended effect will not take place. Blisters should never be used when the urine is albuminous. For internal administration the tincture is the only preparation of cantharides which it is prudent to use.

Poisoning by cantharides recently taken should be treated by a vegetable emetic, with copious draughts of warm water, and afterward by the free use of mucilaginous or albuminous liquids. But chloroform and the fixed oils, which dissolve the active principle of cantharides, should not be administered. General warm baths and emollient cataplasms on the abdomen should be used, and opiate enemata.

Mylabris bifasciata, M. lunata, M. cicorii, and other species of Mylabris all contain cantharidin, and differ from the officinal insects chiefly in the amount they furnish of the vesicating principle. Mylabris cichorii is now believed to represent the medicinal cantharis of the ancients (Adams, *Paulus Œgineta*, iii. 154), by whom several species or varieties of it were employed in medicine, which all owe their virtues to cantharidin. It is said to have been regarded by the inhabitants of Salamis as a specific for *hydrophobia* (*Dublin Quart. Jour.*, March, 1862, p. 193).

Blatta orientalis, or common cockroach, was anciently employed in medicine. An oily decoction of these insects was used to cure warts, scaly eruptions, indolent ulcers, contusions, boils, etc. Internally, they were given along with resin for the relief of dyspnœa (Pliny). Quite recently (1878) in Russia they have been employed in *albuminuria*. They are said to diminish the quantity of albumen, increase the perspiration and urine, remove the attendant dropsy, and neither to impair the digestion nor irritate the kidneys. In other forms of dropsy they are reported to have exhibited remarkable diuretic powers. More recent statements of the use of this agent in Russia appear to confirm the belief in its diuretic powers in dropsy (*Med. Record*, xvii. 682). But Paul, having fully tested it clinically, concluded that it has no medicinal effect whatever (*Bull. de Thérap.*, xcvi. 429, 473). Stanislas Martin endeavored to discern in the insect the cause of the virtues attributed to it, but he could extract from it only a stinking fat (*Bull. de Thérap.*, xcii. 168). The daily dose was from Gm. 0.25–0.30 (gr. iv–v) of the powder obtained from the dried insect.

Ænas afer, a coleopterous insect that abounds in Spain, is claimed to possess over cantharides the following advantages: it is cheaper; it acts without appreciable pain; it is equally powerful, and does not irritate the urinary organs (*British Med. Jour.*, May 20, 1882).

Red ants were formerly used medicinally. A large number of them, enclosed in a linen bag, were infused in boiling water, which, with the bag, was then added to local or general baths in the treatment of chronic gout and rheumatism. The affected foot or hand was sometimes subjected for several hours to the action of the ants by being thrust

into their hills. Internally, a tincture of domestic manufacture was given, and which was made by the prolonged infusion of a large amount of ants in an equal quantity of brandy. An officinal *spiritus formicarum* was formerly in common use, and was retained in the German Pharmacopœia for 1890. It was given internally, in doses of from 20 to 50 drops, in nervous and paralytic affections, and also applied by friction. An oil made by macerating living ants in almond oil was used for similar external purposes.

CAPPARIS.—Caper.

Câprier, Fr.; *Kapper*, G.; *Alcaparro*, Sp.

Capparis spinosæ, *Linné.*

Nat. Ord.—Capparideæ.

Origin and Description.—The caper-bush is indigenous to the countries near the Mediterranean and eastward, and is cultivated for its flower-buds, which, preserved with salt and vinegar, constitute the commercial *capers* (Câpres, *Fr.;* Kappern, *G.;* Alcaparra, *Sp.*). The buds are of the size of a pea, have 4 sepals, 4 petals, numerous stamens, and a stalked ovary, are of a gray-green color, and have a pungent taste. The *leaves* are roundish-oval, entire, bluish-green, and rather fleshy, and have a bitter and acrid taste, which is stronger in the bark, particularly in the thick *root-bark*. The oval fruit is of the size of a plum, and contains a number of flattish bitter seeds.

Constituents.—The buds contain a volatile oil having an alliaceous odor, and a yellow coloring matter identical with *rutin*. (See Ruta.) The pungent principle of the root-bark is a saponin-like body (Rochleder). The tannin and bitter principle have not been examined.

Allied Plants.—Capparis cynophallophora, C. ferruginea, *Linné*, and other West Indian species, have vesicating root-barks, which are also employed for their diuretic properties; their fruit is antiscorbutic, and all parts are regarded as possessing more or less anthelmintic and antihysteric properties. C. coriacea (Simulo), C. Ægyptiaca, *Lamarck*, and many other Eastern species are similarly employed.

C. lodada, *R. Brown.* The fruit is used like pepper in Africa. Many other species yield similar fruits.

Polanisia graveolens, *Rafinesque*, a North American annual, clammy-pubescent, with trifoliate leaves, small whitish flowers, and linear-oblong, many-seeded pods, has an unpleasant odor and is pungent and irritant.

Gynandropsis pentaphylla, *De Candolle*, an East Indian plant, naturalized in the Southern United States, has whitish flowers with long-clawed petals, and stalked linear capsules with many seeds; odor unpleasant. The seeds have been used in the place of mustard.

Reseda odorata, *Linné* (Nat. Ord. Resedaceæ'), is the well-known mignonette, cultivated for its sweet-scented flowers. Its root contains allyl sulphocyanate (oil of mustard).

Reseda luteola, *Linné.*—Dyer's weed, Weld, *E.;* Herbe jaune, Gaude, *Fr.;* Wau, Gelbkraut, Harnkraut, *G.*—It has been naturalized to some extent in the eastern part of the United States. Its conical root has a radish-like odor and taste. The leaves are oblong-lanceolate, the upper ones sessile. The flowers are in dense racemes, and have four pale-yellowish narrow petals. The ovate capsule terminates with four short horns. The herb has a persistently bitter taste, and contains *luteolin*, $C_{20}H_{14}O_8$, yellow, silky, volatile needles of a faintly bitter and slightly astringent taste, sparingly soluble in water and ether, more soluble in alcohol; acetate of lead precipitates it yellow, and ferric chloride is colored by it green, and afterward red-brown. Fused with potassium hydroxide, it yields phloroglucin and protocatechuic acid. The seeds contain a green drying oil.

CAPSICUM, *U. S.*—Capsicum.

Capsici fructus, Br; *Fructus capsici*, P. G.; *Piper Hispanicum.—Capsicum fruit, Cayenne (African or Pod) pepper*, E.; *Capeique, Piment des jardins, Piment rouge. Poivre de Cayenne*, Fr.; *Spanischer Pfeffer, Schlotenpfeffer*, G.; *Chile, Pimiento*, Sp.

The dried fruit of Capsicum fastigiatum, *Blume.* Woodville, t. 80; Bentley and Trimen, *Med. Plants*, 188, 189.

Nat. Ord.—Solanaceæ.

Origin.—Several species have long since been cultivated in tropical countries, and since the early part of the sixteenth century also in Europe; they are supposed to be indigenous to South and Central America, and to have been introduced into the East Indies by the Portuguese; also in Africa. The plants of this genus are herbaceous or shrubby, have the leaves alternate or on the flowering branches sometimes opposite, petiolate, entire or wavy-margined, and produce from the forks of the branches from one to three pedunculate flowers with a rotate, five-lobed, yellowish, whitish, or reddish corolla,

and yielding an incompletely two- or three-celled berry containing numerous flat seeds. In the course of time many varieties have been produced through cultivation. The average annual importation into the United States during seven years ending 1882 was 81,977 pounds of the fruit and 13,295 pounds of powdered capsicum, the highest being of the former 353,683 pounds in 1876, and of the latter 25,352 pounds in 1881.

Description.—C. FASTIGIATUM, *Bl.*, is a small shrub bearing in each fork two or three fruits which are 12 to 18 Mm. ($\frac{1}{2}$ to $\frac{3}{4}$ inch) long, about 5 Mm. ($\frac{1}{5}$ inch) thick, of a conical-oblong shape, supported by a flattish cup-shaped five-toothed calyx, bright-scarlet in color; become shrivelled on drying, and consist of a thin, translucent, and fragile pericarp enclosing two cells containing, attached to the thick central placenta, numerous flat reniform, yellowish seeds, which are about 3 Mm. ($\frac{1}{8}$ inch) in diameter and have a semicircular embryo enclosed in a fleshy albumen. The odor of the fruit is peculiar, its taste extremely hot and biting. This kind is known in commerce as *African* or *bird pepper*, and in Great Britain as *chillies* and *Guinea pepper*. It is the only kind permitted by the British and the U. S. Pharmacopœia.

C. FRUTESCENS, *Linné*, has a similar fruit, which is ovate-oblong, 8 to 12 Mm. ($\frac{1}{3}$ to $\frac{1}{2}$ inch) long and 3 or 4 Mm. ($\frac{1}{8}$ or $\frac{1}{6}$ inch) thick.

C. ANNUUM, *Linné*, is an herbaceous annual, and is extensively cultivated in the temperate zone. The fruit grows singly in the forks of the stem, is much larger than the preceding, and varies in shape between straight or curved, conical, erect, or pendulous, and more or less globular; it attains a length of 5 to 10 Cm. (2 to 4 inches), a thickness of 25 to 38 Mm. (1 to $1\frac{1}{2}$ inches), is sometimes yellow, but generally red, and after drying brownish; otherwise it resembles the preceding. The fruit is known in England as *pod pepper*, but also sold as *chillies*, and is the kind recognized by the German Pharmacopœia.

C. LONGUM, *Fingerhuth*, C. grossum, *Willdenow*, C. cordiforme, *Miller*, and other nominal species, are now usually regarded as varieties. Some cultivated varieties, like much of the *paprika* used in Hungary, were shown by H. B. Brady (1880) to be almost destitute of pungency.

The fruits of C. cerasiforme, *Willdenow*, of the size and shape of a cherry, and of C. chlorocladum, *De Candolle*, small and oblong, are occasionally, though not often, met with.

The outer layer of the pericarp of capsicum-fruit consists of several rows of tangentially elongated cells with irregularly thickened walls, and containing the granular red or yellow coloring matter. This is followed by a thicker layer of thin-walled parenchyma and thin spiral vessel, and by the inner membrane, consisting of a single row of flat irregularly thick-walled cells.

Powdered capsicum is of a dark orange-red color, is very sternutatory and irritating, and, particularly when prepared from the second species, is not unfrequently attacked by insects.

Constituents.—Since the analysis made (1816) by Bucholz and Braconnot the name of *capsicin* has been given to various liquid or soft preparations, all of which were more or less impure, though containing the fiery principle, which at last was isolated by J. C. Thresh (1876), who found it to be a crystallizable body which has been called *capsaicin*, is with difficulty obtained pure, and, according to Dr. Buri, has the composition $C_9H_{14}O_2$. A. Meyer (1889) isolated capsaicin from Capsicum annuum by extracting with boiling ether, evaporating, and taking up the residue with oil of sweet almonds. This was then extracted with 70 per cent. alcohol, evaporated, and the residue dissolved in solution of potassium hydroxide which was free from carbonate, filtered, and the solution saturated with carbon dioxide. After standing some days the capsiacin crystallized; it was then washed with cold water and cold benzin. It is present in small quantities only, and intimately associated with a red fatty matter which consists chiefly of palmitic acid. Buchheim's *capsicol* (1873) is a red oily liquid containing the active principle, which may be isolated by treating the oleoresin prepared with ether or benzin with weak potassa solution, passing carbon dioxide through the watery liquid, and purifying the precipitate by recrystallization. Capsaicin is colorless, melts at 59° C. (138.2° F.), volatilizes at 115° C. (239° F.) with extremely irritating vapors, and dissolves in alcohol, fixed oils, ether, amylic alcohol, benzene, and alkalies, but slowly in turpentine, carbon disulphide, and petroleum. It yields crystalline compounds with barium, calcium, and mercury, and when oxidized with nitric acid produces an oily body, oxalic and succinic acids, and another crystalline acid whose nature has not been determined. The red coloring matter of capsicum is but slightly soluble in boiling alcohol, but dissolves read-

ily in oils, carbon disulphide, petroleum, amylic alcohol, ether, and chloroform. Felletár (1868) isolated from capsicum a volatile alkaloid which has the odor of coniine, but was found to differ from this alkaloid by Dragendorff (1871) in the different shape of the crystals of its hydrochlorate, and from lobeline in not being colored by Fröhde's reagent. The odor of capsicum is in part due to a volatile oil consisting chiefly of stearopten and having a parsley-like odor; from 100 pounds of capsicum Flückiger obtained only .02 Gm. (*Pharmacographia*).

INFUSUM CAPSICI.—Infusion of capsicum, *E.;* Tisane de capsique, *Fr.;* Spanischpfeffer-Aufguss, *G.*—Macerate for two hours capsicum, 240 grains in boiling water a pint, and strain.—*U. S.* 1870.

Action and Uses.—Capsicum is an irritant and a local stimulant. Applied to the skin, it causes redness, and if continuously applied may ultimately produce vesication. In proper quantities it excites a grateful warmth in the throat and stomach and quickens the appetite and digestion. It tends to prevent the flatulence occasioned by vegetable food, and for this purpose is largely used as a condiment in hot climates. In large doses it causes a general glow, with thirst, but does not raise the temperature or accelerate the pulse. If too lavishly used, it sometimes brings on torpor of the digestive functions, but often it seems not to be injurious.

Capsicum is of use by enabling feeble stomachs to digest food, as is shown by its efficacy in atonic *dyspepsia*. Freely taken, it is said to cure *hæmorrhoids*, as black pepper and still other stimulants are known to do. It perhaps sometimes cures *intermittent fever*, and in obstinate cases is a good stimulant to conjoin with quinine. Chéron attributes to capsicum the power of controlling *menorrhagia*. In common with other agents of the same nature, it tends to prevent or to relieve *sea-sickness*. In *delirium tremens* it is beneficial by enabling the patient to retain and digest food; indeed, we have seldom in this disease found it necessary to employ other internal remedies than a strong soup well seasoned with red pepper. As a local stimulant it is particularly efficient in *tonsillitis*. The simple form may sometimes be arrested in its first stage by a capsicum gargle; and in the sore throat of *scarlet fever* and in *diphtheria* no application is so efficient as a strong gargle or wash made with this substance.

The *dose* of powdered capsicum is from Gm. 0.30–0.60 (gr. v–x). An infusion is made by adding Gm. 2.50 (gr. xl.) of capsicum to half a pint of boiling water; of this a tablespoonful may be given at a dose. An infusion used with remarkable success in an epidemic of *angina maligna* (diphtheria?) is thus described: Take 2 tablespoonfuls of red pepper and the same quantity of fine salt; beat them into a paste, and add half a pint of very sharp vinegar. Of this the dose for an adult is said to be a tablespoonful every hour. It is excessively acrimonious, but it is alleged to hasten the separation of the false membranes and sloughs from the fauces. Tincture of capsicum is a familiar addition to liniments used to relieve muscular *rheumatism*, *neuralgia*, nervous *headache*, flatulent colic, etc., when applied on cloths or by friction. A plaster made of Burgundy pitch (or the officinal capsicum plaster), with which powdered capsicum or its oleoresin has been incorporated, is a very efficient stimulant in cases of chronic *lumbago* and other forms of muscular *rheumatism*, *neuralgia*, etc. Analogous to this is an "extract of red pepper" mixed with resin plaster and spread upon paper. These preparations excite a sense of warmth in the skin, and redden but do not vesicate it.

CARBO ANIMALIS, *U. S., Br.*—ANIMAL CHARCOAL.

Carbo ossium, Ebur ustum, Spodium.—Boneblack, Ivory black, E.; *Charbon animal, Noir d'os*, Fr.; *Thierkohle, Knochenkohle, Beinschwarz*, G.; *Carbone animale, Nero di ossa*, It.; *Carbon de hueso*, Sp.

Charcoal prepared from bone.

Preparation.—Boneblack of commerce is obtained by roasting bones deprived of fat in iron cylinders until vapors cease to be given off, when charcoal is left intimately mixed with about ten times its weight of the inorganic constituents of bone, and containing a little nitrogen, probably as nitrogen carburet. The volatile products of the dry distillation are various gases, an ammoniacal aqueous liquid called *bone-spirit*, and a blackish-brown tar called *bone-oil*.

CARBO ANIMALIS PURIFICATUS, *U. S., Br.*—Purified animal charcoal, *E.;* Charbon animal purifié, *Fr.;* Gereinigte Knochenkohle, *G.*

Animal Charcoal, in No. 60 powder, 100 Gm.; Hydrochloric Acid, 300 Gm.; Boiling Water, a sufficient quantity. Introduce the animal charcoal into a capacious flask, add

200 Gm. of hydrochloric acid and 100 Cc. of boiling water, and connect the flask with an upright condenser. By means of a sand-bath keep the mixture gently boiling during eight hours. Then add 500 Cc. of boiling water, transfer the mixture to a muslin strainer, and when the liquid has run off return the charcoal to the flask. Add to it 100 Cc. each of hydrochloric acid and of boiling water, boil for two hours, again add 500 Cc. of boiling water, transfer the whole to a plain filter, and, when the liquid has run off, wash the residue with boiling water until the washings give only a faint cloudiness with silver nitrate test-solution. Dry the powder in a drying-oven and immediately transfer it to well-stoppered vials.—*U. S.*

The process of the British Pharmacopœia is very similar to that given above, 16 ounces of boneblack, 10 fluid-ounces of hydrochloric acid, and 20 fluidounces of water being used.

Carbo carnis, or meat charcoal, is prepared by cutting 3 parts of veal freed from fat in small pieces, mixing it with 1 part of small bones, and roasting in a covered vessel until inflammable vapors cease to escape; the residue when cold is powdered.

Properties.—Boneblack, like purified animal charcoal, is a dull black, rather dense, inodorous, and nearly tasteless mass, which for uses in the arts is either granulated or powdered. It is entirely insoluble in all simple solvents; the purified animal charcoal also in hydrochloric acid, which dissolves a portion of the boneblack. The compounds removed in its purification are the inorganic constituents of the bones, and consist mainly of calcium phosphate, with some calcium carbonate and magnesium compounds. When ignited with free access of air, boneblack leaves a white ash, amounting to at least 86 per cent. of the original weight, which should be completely soluble in hydrochloric acid with the aid of heat. It has the remarkable property of removing organic coloring matters from their neutral or somewhat acid solutions, and is employed for that purpose in the refining of sugar and in many chemical operations, for many of which its previous purification is requisite to avoid contamination with earthy matters which would be dissolved by the organic acids.

Tincture of litmus diluted with twenty times its bulk of water, agitated with purified animal charcoal and thrown upon the filter, passes through colorless.—*Br.* When ignited at a high temperature with a little red mercuric oxide and free access of air, purified animal charcoal leaves not more than about 2 per cent. of residue (*Br.*). If 1 part of it be digested with 2 parts of hydrochloric acid and 6 parts of water, no effervescence should take place (absence of carbonates), and the filtrate should not yield a precipitate on being supersaturated with ammonia (absence of earthy phosphates); boneblack yields a voluminous white or whitish precipitate. The clear ammoniacal liquid or filtrate should not be precipitated by solution of barium chloride or test-mixture of magnesium (absence of alkali sulphate and phosphate), and on being evaporated to dryness and ignited should leave no fixed residue (absence of potassium and sodium salts). "If 2 Gm. of the powder be ignited at a red heat with free access of air in a broad shallow porcelain or platinum dish, it should not leave a residue weighing more than 0.08 Gm. or 4 per cent. of the original weight (limit of silicates and other fixed inorganic matter). If 1 Gm. be boiled with a mixture of 3 Cc. of potassium hydroxide test-solution and 5 Cc. of water for several minutes, the filtrate should be colorless (evidence of complete carbonization)."—*U. S.*

Purified animal charcoal removes from their aqueous solutions tannin, alkaloids, bitter principles, basic lead and other metallic salts, iodine, lime, etc.—a property which it shares more or less with boneblack, and which was first observed by Figuier (1810). This property is due to the finely-divided state of the carbon and the surface attraction resulting therefrom, and may be imparted to wood charcoal if, previous to charring, the vegetable substances are intimately mixed with flint, lime, or other earthy matters; a mixture of 10 parts of pipe-clay, 50 parts of finely-powdered coal, and 2 of tar yields, after carbonization, a charcoal possessing excellent decolorizing properties, depending in part upon the presence of alumina. By reheating purified animal charcoal with potassium carbonate its decolorizing power, which was impaired by the treatment with acid, is greatly increased, and similar active charcoals are obtained from blood, horn, leather, etc. by mixing them with the salt mentioned, carbonizing the mixtures, and exhausting the residues with water.

The value of animal charcoal as a decolorizer is best ascertained by treating known weights of it with diluted solutions of indigo or litmus, and ascertaining the bulk which may be completely decolorized by slow percolation. Corenwinder (1853) proposed treatment of the charcoal with diluted solutions of lime and sugar, and determining by titra-

tion the amount of lime remaining in solution. The decolorizing property, however, does not appear to be strictly proportional to the lime- or salt-absorbing power of animal charcoal. When the decolorizing power of the charcoal has been exhausted it cannot be restored by heating to redness, because a dense charcoal, resulting from the absorbed substances, will then be deposited in the pores; but if allowed to ferment this substance will be destroyed, and by washing the charcoal with water, drying, and igniting it becomes again a good decolorizer. Pelouze (1854) proposed to effect the revivification of spent animal charcoal by treating it with caustic alkalies or alkaline carbonates; according to Renner (1862), the process is a tedious one. Placing the decolorizing power of bone-black = 1, Bussy ascertained that of purified animal charcoal to be = 1.6; purified animal charcoal ignited with potassium carbonate = 20; blood ignited with potassium (or calcium) carbonate = 20; glue ignited with potassium carbonate = 15.5.

Composition.—Animal charcoal consists of amorphous carbon intimately mixed with the inorganic compounds of bone (see Os), chiefly calcium phosphate and carbonate, which are partly or wholly removed in purification with hydrochloric acid.

CARBO LIGNI, *U. S., Br.*—Charcoal.

Carbo ligni pulveratus, P. G.; *Carbo præparatus, Carbo e ligno, Carbo vegetabilis.*—*Wood charcoal*, E.; *Charbon végétal*, Fr.; *Holzkohle, Präparirte Kohle*, G.; *Carbone di legno*, It.; *Carbone vegetal*, Sp.

Charcoal prepared from soft wood and very finely powdered.—*U. S.*

Preparation.—Wood heated to about 300° C. (572° F.) leaves charcoal as a residue. On a large scale this is effected in iron cylinders (see Acidum Aceticum Pyroligneosum), in closed chambers of brick, or by the method of pile-burning, in which the heat developed by the combustion of a portion of the wood effects the charring of the rest. Two, and sometimes three, stacks of billets of wood of even length are piled up around some stakes driven into the ground until a flattish cone of from 30 to 70 feet in diameter has been formed, which is covered by sod and earth, openings being left near the base for the escape of the water which is at first expelled. After the heap has been kindled in the centre the top opening is closed, and when the wood has become perfectly dry the open space at the base is likewise closed and the pile left to smoulder for several weeks. The charcoal is finally withdrawn and extinguished by water, dry sand, or charcoal-dust. The yield varies with the kind and dryness of the wood. Karsten found that a wood which lost at 100° C. 57 per cent. and at 150° C. (302° F.) an additional 10 per cent. of its weight, would yield only 14 per cent. of charcoal, while the same wood dried yielded 25 per cent. The difference is explained by the formation of carburetted hydrogen on the passing of aqueous vapors over red-hot charcoal, and the same cause accounts for the smaller yield in the dry distillation of wood when the cylinders are rapidly heated, so that the wood near the iron is charred while the pieces in the centre still contain water.

Properties.—Charcoal has the shape and shows the texture of the wood from which it was obtained; it is black, inodorous, tasteless, very porous and brittle, insoluble and infusible. Alcohol in which charcoal has been digested should not become colored, and on evaporation should leave no residue. When charcoal is heated in the air it is converted into carbon monoxide or dioxide, but it should not burn with flame (absence of organic compounds). Ordinary wood charcoal is usually incompletely carbonized, and requires to be again ignited in nearly-closed vessels until it ceases to give off inflammable vapors, and to be reduced to a uniform, fine, non-gritty, dull-black powder before it is adapted for medicinal use. "If 1 Gm. of charcoal be boiled with a mixture of 3 Cc. of potassium hydroxide test-solution and 5 Cc. of water for several minutes, the filtrate should be colorless or nearly so (evidence of complete carbonization)."—*U. S.* Prepared by pile-burning, charcoal is considerably denser than when obtained in retorts; the latter kind is therefore preferable, particularly that made from soft wood, which is more porous than that obtained from hard wood. Charcoal made from young shoots of the willow, poplar, or linden is for these reasons most esteemed. It contains the inorganic constituents present in the wood, and these amount in well-prepared charcoal to about 1 per cent.

Like other porous bodies, wood charcoal possesses the property of absorbing gases; this was first observed (1777) by Fontana and by Scheele, and Lowitz (1785) discovered the clarifying and decolorizing property of wood charcoal, in consequence of which it was used in the refining of sugar until animal charcoal was found to be better adapted for this purpose. The volumes of gases absorbed by recently-ignited wood charcoal are not

uniform, but vary with the nature of the gas and of the charcoal, as was shown by Morozzo (1783), the absorbing power being for oxygen 10, for carbon dioxide 35, for hydrogen sulphide 55, and for ammonia about 100 volumes, to 1 of the charcoal. Considerable heat is generated thereby, as also by the oxidation of some of the gases by the absorbed oxygen, and may increase to spontaneous ignition; and the increase in weight of pile-burned charcoal may amount to from 10 to 15 per cent. by absorption of watery vapors. This property explains the uses of charcoal as a deodorizer, for which purpose it should be freshly burned or reheated to expel the gases condensed in its pores. Odorous principles are not only absorbed by it from the atmosphere, but likewise from solutions in water and weak alcohol; its employment for the removal of the fusel oil from spirits is well known. (See ALCOHOL.) It acts in a manner similar to animal charcoal in precipitating from their aqueous solutions metallic salts, or even the metals, most bitter principles, and coloring matters; but for the latter purpose is much inferior to the former.

Composition.—Wood charcoal is amorphous carbon mixed with the inorganic constituents of the wood from which it has been prepared. If insufficiently burned it is also contaminated with empyreumatic products resulting from the partial decomposition of the organic principles.

Pharmaceutical Uses.—Wood charcoal is an ingredient of certain dentifrices, and is employed in some chemical processes for its deoxidizing action, as in the preparation of sulphurous acid and in the reduction of bromates and iodates to bromides and iodides. It is used in making Cataplasma carbonis, *Br.*

CARBONEUM, Carbonium.—Carbon, *E.*; Carbone, *Fr.*; Kohlenstoff, *G.*—Symbol C. Atomicity quadrivalent or bivalent. Atomic weight 11.97.—Carbon is extensively diffused in nature; combined with oxygen as carbonic anhydride, CO_2, usually called carbon dioxide, it exists to a small extent as a constant ingredient of the atmosphere; it is found in the mineral kingdom in the free state as well as in various combinations, most notably as carbonates; and it is invariably present in all organized beings and organic compounds, which, when heated with a limited access of air, usually become black from carbonization—*i. e.* the separation of carbon.

Carbon exists in the following three allotropic modifications:

1. DIAMOND is found chiefly in India near Golconda, Borneo, Southern Africa, and Brazil, and is in colorless and variously colored octahedrons of 3.5 to 3.6 specific gravity. It is a non-conductor of electricity and the hardest substance known. Lavoisier proved it to be pure carbon; when burned it usually leaves between 0.05 and 0.2 per cent. ash; amorphous diamond, which is used for polishing the crystalline, may leave up to 2 per cent. The value of crude diamonds exported in 1881 from the Cape of Good Hope is estimated to exceed £4,500,000.

2. GRAPHITE, Plumbago or black lead (Plombagine, Crayon noir, *Fr.*; Wasserblei, Reissblei, *G.*) has been found in many countries, crystallizes in hexagonal plates varying in specific gravity between 1.8 and 2.5, is of a black-gray color, fatty to the touch, quite soft, and a good conductor of electricity, and leaves between 0.2 and 5 per cent., occasionally even as much as 46 per cent., of ash.

3. AMORPHOUS CARBON exists in nature as *coal*, of which there are three principal varieties—namely, *lignite*, *bituminous coal*, and *anthracite* (*lithanthrax*)—which contain respectively about 66, 80, and 90 per cent. of carbon, partly in the form of organic compounds. Artificially prepared, it constitutes *wood charcoal*, *animal charcoal*, *coke*, and *lampblack*, the latter being obtained by the incomplete combustion of resinous matters; after it has been heated in covered vessels to expel the volatile organic compounds it constitutes a nearly pure carbon.

Coke is the residue left from the dry distillation of coal, and consists of amorphous carbon contaminated with the mineral constituents of the coal.

When burned with an insufficient supply of oxygen, carbon is converted into *carbon monoxide*, CO; with a full supply of air it yields *carbon dioxide*, CO_2. The chemistry of carbon in its various combinations constitutes what is known as organic chemistry.

Action and Uses.—Charcoal in the stomach absorbs more or less of the gases and liquids contained in that organ. Unlike alcohol, salt, and some other substances, it does not retard—but, on the contrary, hastens—the decomposition of organic matter, while it renders latent the gases evolved during the process. That a portion of this action is owing to the minute subdivision of the charcoal is shown by the analogous effects of dry earth, sand, and gravel upon decomposing organic matters; and whether the action is due to any other cause is more than doubtful. It is not determined absolutely whether charcoal derived from ivory or bone or box-wood, or that which is prepared from poplar or other light porous wood, is the more efficient, but it is certain that charcoal of any kind is most active when freshly made.

For all forms of *flatulence* charcoal is one of the most certain remedies, and at the same time for those other *dyspeptic* phenomena which sometimes attend it, particularly nausea, fetid breath, foul taste in the mouth, constipation, palpitation of the heart, etc.

It is remarkable that charcoal does not tend to produce *constipation*, but rather to moderate it when it exists. The cases in which it is said to accumulate in the bowels and obstruct them are not well authenticated. If, however, an obstruction already exists, charcoal by accumulation will aggravate it. (Comp. Richardson, *Asclepiad*, Oct. 1884.) Its power of relieving flatulence is not confined to that of the stomach and small intestine; it has proved efficient when the colon was alone distended and a stricture existed near the sigmoid flexure. It has seemed to be a remedy for intestinal *worms* in some cases of intestinal indigestion with colic, flatulence, and irregular stools. Jules Guérin, Maurel, and others (*Bull. de Thérap.*, xcviii. 279; xcix. 274) found finely-powdered charcoal a very efficient remedy for choleriform *diarrhœa* both in adults and children. It was administered with milk diluted with water and sweetened. In epidemic *dysentery* it has proved very serviceable when administered by the stomach and also by the rectum, allaying the tormina and tenesmus and correcting the fetor of the stools, while it lessened their frequency and rendered them more feculent. It has been recommended for lessening *tympanites* in typhoid fever, but its administration does not produce this result, and has occasioned intestinal hæmorrhage. If this objection to its use did not exist, it would be found one of the best internal remedies for the *fetor of the stools* in that disease. As an application to *gangrenous* and foul *ulcers*, incorporated largely in a poultice made with flaxseed, bread-crumb, or yeast, it is very efficient in correcting the smell and hastening a separation of the dead tissue. As an ingredient of dentifrices for cleansing the *teeth* and purifying the breath the use of charcoal is familiar. Its deodorizing power has caused it to be employed in the arts and for sanitary purposes, as for preventing the generation of *putrid gases* in graves, vaults, sewers, privies, and innumerable analogous places, and notably for the filtration of *foul drinking-water*, which it not only deprives of its smell, but also of its organic constituents, and renders it pure and clear.

The *dose* of charcoal is one or more teaspoonfuls. It should be as freshly prepared as possible. If intended to correct digestive fermentation, it should be taken directly after meals, and is best administered in water, the portion adhering to the mouth being washed down by a mouthful of water alone. It has been prepared and given in gelatin capsules. This method ensures a more active preparation than one which has been exposed to the air.

CARBONEI DISULPHIDUM, *U. S.*—Carbon Disulphide.

Carboneum sulfuratum, P. G.; *Alcohol sulfuris*, *Carbonei bisulphidum*.—*Carbon bisulphide*, E.; *Sulfure de carbone*, Fr.; *Schwefelkohlenstoff*, *Schwefelalkohol*, G.; *Sulfuro di carbonio*, It.

Formula CS_2. Molecular weight 75.93.

Origin.—Scheele (1777) noticed the production of a very fetid gas on heating a mixture of sulphur and charcoal, but Lampadius (1796) by accident first obtained the compound in a liquid state. Clément and Désormes (1802) elaborated a process for its preparation, and stated it to be a compound of carbon and sulphur; its exact composition, however, was first proven by Vauquelin (1811) and by Berzelius (1812).

Preparation.—Carbon disulphide is made on the large scale by heating in a cylinder fragments of charcoal or coke to redness and adding through a tube, near the bottom, pieces of sulphur, which is vaporized and unites with the red-hot charcoal. The condensed liquid contains sulphur in solution, from which it is freed by distillation in a water-bath, and the compounds, having a disagreeable odor, are removed by prolonged agitation with milk of lime, litharge, chlorinated lime, powdered corrosive sublimate, or copper sulphate, decanting, adding about 2 per cent. of a bland fixed oil or beeswax, and rectifying in a water-bath. E. Allary (1881) uses for the same purpose water and potassium permanganate, the latter added in small quantities, until after agitation the liquid retains its violet color; redistillation is not necessary. Carbon disulphide should be kept in well-stopped bottles in a cool place, remote from lights or fire.

Properties.—Thus obtained, it is a very mobile colorless liquid having a high refracting power, and when quite pure a rather agreeable ethereal odor and a pungent aromatic and cooling taste; but often it is of a more or less fetid odor from the presence of other volatile compounds. It has the specific gravity 1.290 at 0° C. (32° F.) and 1.268–1.269 at 15° C. (59° F.), *U. S.* It boils at 46° or 47° C. (114.8° or 116.6° F.), *U. S.* It evaporates rapidly at the ordinary temperature, and on passing a rapid current of dry air over its surface partly congeals. It is very inflammable—more so than ether—and burns with a blue flame, yielding sulphur dioxide and carbon dioxide or monoxide. It requires about 1000 parts of water for solution, is soluble in almost all

proportions of absolute alcohol, ether, chloroform, and fixed and volatile oils, and in 1½ to 2 parts of official alcohol. It dissolves freely phosphorus, sulphur, bromine, iodine, fats, volatile oils, caoutchouc, and other compounds, and unites with some of the sulphur bases, forming *sulphocarbonates*, which correspond to the carbonates, containing sulphur in place of oxygen. Dissolved in alcohol and heated in the presence of ammonia, *ammonium sulpho-cyanate* and hydrogen sulphide are produced; $CS_2 + 2NH_3$ yields $NH_4CNS + H_2S$.

Tests.—Carbon disulphide should not change the color of moistened litmus-paper (absence of sulphurous acid), and when agitated with solution of lead acetate should not produce a brown or black color (absence of hydrogen sulphide). A portion evaporated spontaneously in a glass or porcelain vessel should leave no solid residue (absence of sulphur).

Uses.—In the arts it is largely employed for the extraction of fats and in the vulcanization of caoutchouc, and has been proposed as a solvent for obtaining the delicate perfumes of flowers.

Potassium sulphocarbonate, K_2CS_3, is prepared by agitating potassium monosulphide, K_2S, with carbon disulphide, and evaporating at about 30° C. (86° F.). It forms yellow deliquescent prisms, which are sparingly soluble in alcohol, have a peppery and sulphurous taste, and above 60° C. (140° F.) are converted into the red-brown anhydrous salt. A solution containing also potassium carbonate, but sufficiently pure for destroying the *phylloxera* and other insects, is made by agitating potassa solution with carbon disulphide as long as the latter is dissolved; and if alcohol be present *potassium xanthogenate*, $K(C_2H_5)CS_2O$, is also formed. Both salts are slowly decomposed in the soil, with the liberation of carbon disulphide.

Action and Uses.—Bisulphide of carbon was described in 1826 by Lampadius, who discovered the compound in 1796. He noted its rubefacient and also its refrigerant action upon the skin, and recommended its vapor in syncope, and the use of liniments containing it for frost-bite, rheumatism, and local paralyses, as well as its internal administration. Mansfield and others employed it in gouty and rheumatic disorders and for quickening uterine contractions. Pellingahr wrote of it as a cardiac stimulant, diuretic, and emmenagogue, but found it useless in gout and rheumatism (Richter, *Ausfurlich. Arzneimittel.*, iii. 464; Supl. Bd., p. 457). Tiedemann described its effects upon animals, and Kaaf upon himself, confirming the observation of Pellingahr (Strumpf, *Arzneim.*, ii. 533). Krimer used it to produce cold by evaporation in the reduction of strangulated herniæ. Turnbull employed a sponge saturated with the liquid and contained in a wide-mouthed bottle, which he applied over indurated lymphatic glands. Page of Boston found that its vapor relieved local pains; and Schiel of St. Louis used it in a liquid form with alcohol in similar cases, and especially in neuralgia (*U. S. Dispensatory*, 1830). A similar application of it was made by Nessley of Ohio in 1872. Michaelson applied it to burns on cotton wadding. It appears to have been first used as a general anæsthetic by Harold Tanlow in 1848 (Guibert, *Nouveaux médicaments*, p. 604), and soon afterward it was tried on man by Dr. Simpson of Edinburgh, and by Snow on mice (Pereira, *Mater. Med.*, 1848, Amer. ed., i. 377). Simpson described it as a very rapid and powerful anæsthetic, but in several instances it produced depressing and disagreeable visions, and was followed by headache, giddiness, and obstinate vomiting. It rendered the pulse very frequent. Its anæsthetic effect also was very transient; and another objection to its use was found in its very unpleasant odor, which was compared to that of putrid cabbage. When pure it loses this peculiarity. Applied topically, it blunts the sensibility of the skin.

This anæsthetic has been found useful for producing insensibility of the skin in limited surgical operations, such as *opening abscesses*, the *evulsion of nails*, etc. It has also been applied locally for the relief of *headache*, *neuralgia*, and *toothache*. It has been found to relieve the neuralgic pains of *locomotor ataxia* when applied along the spine; and Sanders (*Med. News*, xl. 371; xlii. 201) has stated that he found it very efficient as a topical remedy in pure *neuralgia*, especially of the occipital, cervical, intercostal, and sciatic nerves. In other words, its action, like that of chloroform, is counter-irritant and anæsthetic. It has been made use of, but not very successfully, to lessen the swelling of enlarged *lymphatic glands*, of *goitre*, and of *lupoid* and *syphilitic* growths. For the latter purposes it may be applied in an ointment containing 1 part of the preparation to from 5 to 10 of lard. It has been used with alleged benefit in *elephantiasis Arabum*, (*Brit. Med. Jour.*, Dec. 24, 1887). For producing local anæsthesia it may be employed as an atomized vapor, and as a local anodyne the lotion described below may be employed. It is alleged to be a

very efficient application for indolent *ulcers* when slightly brushed over their surface, which should then be dusted with subcarbonate of bismuth and supported by a bandage. The liquid causes severe pain for a few moments. Tincture of iodine is said to correct its objectionable odor when mixed with it in the proportion of one-fourth. The mixture may also be scented with mint, bergamot, etc. Bisulphide of carbon may be administered internally in doses of from 2 to 6 or more drops. It may be taken in an alcoholic liquor, in mucilage, or in milk.

Dujardin-Beaumetz and some other physicians have exalted the antiseptic and rubefacient and anodyne action of this preparation, For the latter purposes it may be applied on a wad of cotton covered with oiled silk. In half a minute severe pain is produced, but it rapidly subsides on the removal of the dressing. For the former object it has been used in the treatment of *typhoid fever*, and has been thought to prevent the absorption of the septic products contained in the intestine. It certainly deodorizes, and perhaps disinfects, the stools. The following is the mode of administration recommended: R. Pure bisulphide of carbon, Gm. 25 (fʒvj); Spirit of peppermint, 50 drops; Water, Gm. 500 (1 pint). Keep in a well-stoppered bottle of the capacity of a pint and a half, agitating occasionally, and renew the water as often as the solution is used. It is given in tablespoonful doses mixed with milk or wine and water. Its influence on the course and issue of the disease has not been demonstrated. (Compare *Lancet*, Mar. 1889, p. 596.)

CARBONEI TETRACHLORIDUM,—Carbon Tetrachloride.

Carbonii tetrachloridum, *Carboneum chloratum*.—*Chlorocarbon*, *Tetrachlor-methane*, E.; *Bichlorure de carbone*, *Formène perchloré*, Fr.; *Chlorkohlenstoff*, G.

Formula CCl_4. Molecular weight 153.45.

Preparation.—Chlorocarbon was discovered by Regnault in 1839, and is produced by the action, in sunshine, of chlorine upon marsh-gas, CH_4, or upon chloroform, $CHCl_3$, hydrochloric acid being also formed in both cases. It is best prepared by passing well-dried chlorine gas through carbon disulphide, and afterward through a porcelain tube wrapped in sheet copper and filled with fragments of porcelain maintained at a red heat, whereby carbon tetrachloride and sulphur chloride are produced; $CS_2 + 3Cl_2$ yields $CCl_4 + S_2Cl_2$. The vapors are condensed by the aid of ice or a refrigerating mixture, and the liquid thus obtained is slowly added to an excess of potassa solution or milk of lime, whereby the sulphur chloride is decomposed and dissolved. The chlorocarbon separates at the bottom and is purified by distillation.

Properties.—It is a colorless, thin, oily liquid of an agreeable aromatic odor, insoluble in water, soluble in alcohol and ether, and not decomposed by contact with aqueous solution of potassa, which, however, will remove any carbon disulphide that may be present. Chlorocarbon has the spec. grav. 1.599, and boils at 77° C. (170.6° F.). Geuther (1858) observed that by the action of nascent hydrogen it is gradually converted into hydrochloric acid and chloroform or dichlor-methane, CH_2Cl_2, according to the temperature at which the reaction takes place.

It is regarded as a chlorinated derivative of marsh-gas (see Methyleni Bichloridum); according to its elementary composition it is carbon tetrachloride, or, according to the old notation, *bichloride of carbon*, CCl_2 or C_2Cl_4, which name is still occasionally used.

Allied Compound.—Carbon trichloride, Hexachloretiiane, C_2Cl_6. Mol. weight 236.16.—It is prepared by passing, in sunshine, dry chlorine gas into ethyl chloride or ethydene chloride (see page 139) until the liquid congeals, when the mass is recrystallized from alcohol. Carbon trichloride forms colorless or white rhombic prisms, is brittle and easily pulverizable, has an aromatic camphoraceous odor, and is nearly tasteless. Its specific gravity is about 2.0. It is insoluble in water, freely soluble in alcohol, ether, fats, and volatile oils, burns in the presence of alcohol with a red flame, melts at 160° C. (320° F.), boils at 182° C. (359.6° F.), subliming in crystals, and volatilizes slowly at ordinary temperatures.

Action and Uses.—When inhaled by man it produces a sense of coolness in the fauces and of general warmth, followed promptly by anæsthesia and a complete return of consciousness. It has been used with success in relieving *neuralgia* and various local pains, including *dysmenorrhœa* and the throes of *parturition*. As its primary, or at least proximate, action is upon the heart, and as several deaths are laid to its charge, it ought never to be employed internally. The experiments of Regnauld and Villejean in 1866 also led them to conclude that this anæsthetic is "extremely dangerous" (*Bull. de Thérap.*, cx. 490).

CARDAMOMUM, *U. S., Br.*—Cardamom.

Cardamomi semina, Br.; *Fructus* (*semen*) *Cardamomi* (*minoris*), P. G.; *Cardamomum minus*, s. *Malabaricum.—Malabar cardamoms*, E.; *Cardamomes*, Fr.; *Cardamomen, Kleine Kardamomen*, G.; *Cardamomo menor*, Sp.

The fruit of Elettaria repens, *Baillon*, s. E. Cardamomum, *Maton*, s. Amomum repens, *Sonnérat*, s. Alpinia (Amomum, *White*, Matonia, *Smith*, Renealmia, *Roscoe*) Cardamomum, *Roxburgh*. Bentley and Trimen, *Med. Plants*, 267. The dried ripe seeds kept in their pericarps, *Br.*

Nat. Ord.—Scitamineæ.

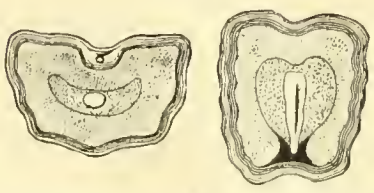
Origin.—This perennial plant is indigenous to Hindostan, more particularly to the mountainous region of the Malabar coast, where it is also extensively cultivated in clearings made in the forests, so that the plants will enjoy sufficient shade, or in the betel-nut plantations, as in Mysore. It grows to the height of 1.8 to 3 M. (6 to 10 feet) from a thick horizontal rhizome, has lanceolate leaves which are .3 to .6 M. (1 to 2 feet) long, and almost sessile upon the long hairy sheaths, and produces three or four nearly horizontal scapes which bear several short racemes of greenish-white flowers. It flowers during the rainy season, and the inferior capsules are collected from and after October, before they are quite ripe, to avoid their splitting, and dried by artificial heat. The drug is exported in chests from Bombay, Madras, and other East Indian ports. 29,000 pounds of cardamom were imported into the United States in 1876, and 65,000 pounds in 1880.

Description.—Cardamom-fruits vary in length from 1 to 2 Cm. ($\frac{2}{5}$ to $\frac{4}{5}$ inch), and are commercially divided into *shorts* and *short-longs* or *mediums* and *longs*. They are ovoid or oblong, obtusely triangular, rounded at base, beaked above, of a pale-buff color, longitudinally striate, and three-celled. The capsular integuments are thin, leathery, the three cell-partitions starting from the centre of the valves. The seeds are attached to a central placenta in two rows, brown, slightly glossy, about 5 Mm. ($\frac{1}{5}$ inch) long, and 3 Mm. ($\frac{1}{8}$ inch) broad, angular, transversely rugose, with a depressed hilum and a channelled raphe on one side, and contain a club-shaped embryo, the radicle projecting toward the hilum, and the upper part completely surrounded by the horny endosperm, and this by a thicker saccate layer of granular perisperm. Each seed is enclosed in a thin membranous nearly colorless arillus. The integuments are nearly inodorous and tasteless; the seeds have an agreeable odor and a warm aromatic and pungent taste. The seed-coat consists of three distinct layers, each one formed of a single thickness of cells, those of the outer layer being brownish, rather thick-walled, and upon transverse section square in outline and small; those of the second layer, much larger, thin-walled, square; and those of the inner layer, radially elongated, dark-brown, and with a small cavity near the outer end. The outer albumen contains minute starch-granules and crystalloid proteids; the inner albumen and embryo are filled chiefly with fixed oil and mucilage; the volatile oil is mostly contained in the large thin-walled cells of the testa.

Fig. 48.

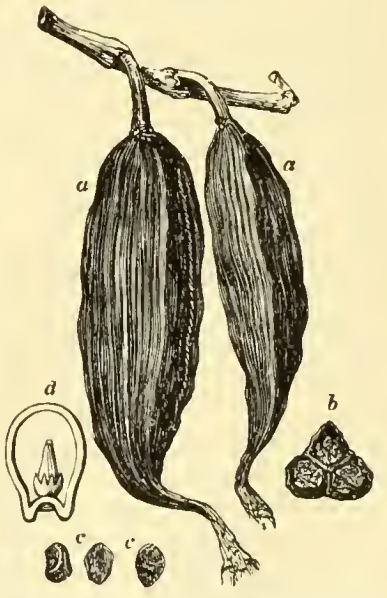
Malabar Cardamom: *a*, short; *b*, medium; *c*, long.

Fig. 49.



Cardamom-seed; transverse and longitudinal section; magnified 5 diameters.

Fig. 50.



Ceylon Cardamom: *a*, capsules; *b*, transverse section of capsule; *c*, seeds; *d*, section of seed with embryo; magnified.

Good cardamoms should be full and plump, and yield 75 per cent. of their weight in seeds. Malabar and Aleppy cardamoms are usually ovoid and have a short beak; Madras cardamoms are more oblong and acuminate.

Other Varieties of cardamoms are used in the East Indian islands and China, but are rarely met with in our commerce. The *Ceylon* or *long cardamoms* are occasionally seen in commerce; they are obtained from Elettaria major, *Smith*, which is now usually regarded as a variety of the officinal plant, and is indigenous to Ceylon. The fruit is about 4 Cm. (1½ inches) long, lanceolate oblong, acutely triangular, with flat sides and a long, attenuated apex. It is usually of a darker color, and the seeds are less agreeable in odor and taste. The *round cardamoms* of Siam, Java, and other islands are the fruits of Amomum cardamomum, *Linné*, of the size of a cherry, globular or somewhat ovate in shape, the three sides convex; the taste of the seeds is more camphoraceous. The *Bengal cardamoms*, obtained from Am. aromaticum, *Roxburgh*, are an inch long, oblong or oval, rounded below, terminated by a short nipple, and near the apex provided with nine wings. Similar in appearance, but terminating above in a long beak-like calyx, is the *Nepal cardamom*, the origin of which is not known. The *large* or *winged Java cardamom* is the nearly globular capsule of Am. maximum, *Roxburgh*, about 25 Mm. (1 inch) long, obtusely triangular, each side provided with three or four firm, short membranaceous wings, which are best observed after soaking the fruit in water. The *round Chinese cardamoms*, which are rounded on the side, are probably produced by Am. globosum, *Loureiro*.

Constituents.—Trommsdorff (1834) obtained 4.8 per. cent. volatile oil, 10.4 fixed oil, and smaller quantities of starch, malate (?) of potassium, gummy extractive, and coloring matter. The volatile oil has a spec. grav. of .93 to .94 and the odor and taste of the seeds, is colorless or yellowish, dextrogyre, and contains oxygen. Flückiger (1872) found nearly 11 per cent. of moisture and 15 per cent. of ash in air-dry Ceylon cardamoms, and in the ash 0.79 per cent. of manganese, which he also observed to be present in the leaves and fruits of other Zingiberaceæ. Warnecke (1886) obtained 6.12 per cent. of ash from air-dry cardamoms.

Action and Uses.—Cardamom is a warm and agreeable carminative and stomachic. It may be added to tonic and stimulant preparations. An infusion made with Gm. 4.00 (3j) of the bruised seeds in half a pint of boiling water may be given in doses of a wineglassful. The officinal tinctures are more commonly employed.

CARDUUS BENEDICTUS.—Blessed Thistle.

Herba cardui benedicti, P. G.—*Chardon bénit*, Fr.; *Benedictendistel*, G.; *Cardo benedetto*, It.; *Cardo santo*, It., Sp.

The leaves and flowering tops of Cnicus benedictus, *Gaertner*, s. Centaurea benedicta, *Linné*.

Nat. Ord.—Compositæ, Cynareæ.

Description.—The "blessed thistle" is an annual woolly plant which is indigenous to Western Asia and South-eastern Europe, and has been naturalized in other parts of Europe, and sparingly so in the United States. It is about 45 Cm. (18 inches) high, has a reddish angular branching stem, and alternate, oblong or ovate-lanceolate, sinuately pinnatifid, and dentate leaves, each tooth bearing a soft spine. The lowest leaves are 20 Cm. (8 inches) or more long, and narrowed into an angular winged petiole; the upper ones are smaller, sessile, and somewhat decurrent. The flower-heads are terminal, ovate in shape, about 31 Mm. (1¼ inches) long, surrounded by large bracts, have the imbricate scales of the involucre prolonged into a yellowish spine, and contain numerous tubular yellow florets and terete many-ribbed akenes, which are crowned with ten short teeth and with a pappus consisting of ten long and ten alternate short bristles, the latter forming an inner row. The leaves and flowering tops are collected mostly from cultivated plants, and lose on drying about 75 per cent. The dry leaves have a grayish-green color. The taste is saline and strongly bitter. In Mexico, Circium mexicanum, *De Candolle*, is employed.

Constituents.—Analyzed by Morin, the widely-diffused constituents of herbs were found associated with a brown-yellow amorphous bitter principle. The latter was obtained pure by Nativelle (1839), and ascertained by Seribe (1842) to be present in allied plants. This *cnicin* is prepared like salicin, crystallizes in colorless needles, is very bitter, freely soluble in alcohol and wood-spirit, slightly so in cold water and ether, and dissolves in strong hydrochloric acid with a green, and in sulphuric acid with a red, color.

Pharmaceutical Uses.—The *Extractum cardui benedicti* of European pharmacopœias is made by exhausting the herb with hot water and evaporating.

Allied Plants.—Centaurea calcitrapa, *Linné.*—Star-thistle, *E.*; Chardon étoilé, *Fr.*; Stern-distel, *G.*—A European annual which is sparingly naturalized in some places of the United States near the coast. The pinnately-lobed leaves have the teeth prolonged into a thin spine, the involucre is spinous in the middle, the flowers are tubular and purple, and the akenes without pappus; the herb has a bitter taste.

Centaurea cyanus, *Linné.*—Bluebottle, *E.*; Bluet, *Fr.*; Kornblume, *G.*—A European annual somewhat naturalized in North America, also cultivated. It has a globular involucre, with appressed fringed scales and bright blue-colored tubular florets, the marginal ones being largest. The nearly tasteless florets are employed in fumigating-powders.

Action and Uses.—The "blessed thistle" was anciently, and even until quite recent times, held in high esteem as a remedy for all manner of diseases, including fevers and pulmonary, urinary, hepatic, and digestive disorders. It appears to have acted mainly as a bitter tonic, but in large doses it produced nausea, vomiting, and diarrhœa. Its active principle, cnicin, in the dose of 5 or 6 grains, causes a burning sensation and constriction in the pharynx and œsophagus, warmth in the stomach, and sometimes nausea, vomiting, colic, and diarrhœa. It has really no virtues differing materially from those of numerous other bitter tonics, and it most nearly resembles dandelion and colombo in its operation. It may be used in atonic *dyspepsia*—preferably, perhaps, in cases attended with hepatic congestion. The infusion is prepared with from Gm. 15–30 (℥ss–j) of the herb to Gm. 250 (f℥viij) of water. The decoction is apt to nauseate. An extract has been employed in doses of from Gm. 0.05–1 (gr. v–xv). *Star-thistle* has virtues similar to those of "blessed thistle," and blue-bottle (corn-flower) florets are slightly astringent and have been used in collyria. *Milk-thistle* (Carduus marianus) is alleged to have arrested hæmoptysis (*Med. Record*, xxii. 625), but the evidence in its favor is inadequate. A writer in the *Edinburgh Med. Journal* (xxix. 284) identifies "Carmedik" with Kardenbenedikt, or "blessed thistle," stating that the popular name is a corruption of the Dutch botanical title. It is an aromatic bitter, which possesses also a slight degree of astringency. (See Carthamus.) Cnicin has been given in doses of from Gm. 0.30–0.60 (gr. v–x) as an antiperiodic.

Cynara scolymus, or burr artichoke, anciently used as a salad, and reputed even in modern times to be a purifier of the blood, has been extensively employed in South Carolina as a diuretic and also in jaundice (Porcher, *Resources of the Southern Fields, etc.*, p. 470).

CAROTA.—Carrot.

Carotte, Fr.; *Möhre, Gelbe Rübe*, G.; *Zanahoria*, Sp.

The fruit of Daucus Carota, *Linné.* Woodville, t. 50; Bentley and Trimen, *Med. Plants*, 135.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—A biennial plant indigenous to Northern Asia and the greater part of Europe, and naturalized in this country, growing in dry fields and along roadsides, and cultivated to a considerable extent for its fleshy root. The furrowed stem is bristly, 30 to 90 Cm. (1 to 3 feet) high, branching; the leaves are bi- or tri-pinnatifid, the segments with lanceolate or linear incisions; the involucre consists of nine to twelve long pinnatifid leaves; the umbels are on long naked peduncles, at first level, finally concave; the flowers are white or whitish, the central one dark-purple, and commonly sterile, except in the first umbel, which, according to Meehan (1882), usually has a fertile central flower; the fruit is very hispid.

Description.—*The fruit* (*Fructus dauci, s. carotæ*), which for medicinal purposes is collected from the wild plant, is about 3 Mm. (⅛ inch) long, oval, dorsally compressed, and gray-brownish; each mericarp has five hispid filiform primary ribs, two of which are lateral, the remaining three upon the back; between these are four secondary ribs, two lateral and two upon the back, each beset with long spiny bristles, and covering one small oil-tube, two additional oil-tubes being upon the nearly flat face. The fruit has a slight, aromatic odor and a pungent aromatic taste.

The root (*carotte*, F. Cod.) of the wild plant is thin, spindle-shaped, woody, white, of an aromatic odor and a pungent bitter taste; but cultivated it becomes conical, thick, fleshy, red or yellow, and acquires an agreeable odor and a pleasantly sweet taste.

Constituents.—The fruit contains a small quantity of oxygenated volatile oil; 324 grains of it were obtained from 100 pounds of the fruit. The root has been analyzed by Vauquelin, Wackenroder, and C. Schmidt, who found a little volatile oil (0.011 per cent.), uncrystallizable sugar, mannit, starch, pectin, albumen, fixed oil, malic acid, and a coloring principle named *carotin*, which exists in the root in red crystals, is tasteless, insoluble

in water, slightly soluble in alcohol, ether, and chloroform, freely soluble in carbon bisulphide, benzene, and the fixed and volatile oils; its formula is $C_{18}H_{24}O$. Husemann (1860) found it to be accompanied in the root by *hydrocarotin*, $C_{18}H_{30}O$, which is colorless, tasteless, and obtained from boiling alcohol in silky crystals.

Action and Uses.—Carrot-fruit is diuretic and stimulant, and has long been used for exciting the *menstrual* flow, for the cure of *dropsy*, and for the relief of *strangury*. Its medicinal properties appear to depend upon its volatile oil. The fresh root, reduced to a pulp by scraping or grating, forms a clean and stimulating poultice for indolent, gangrenous, and cancerous *ulcers*. The juice, used as a wash, is said to relieve *itching* in several *diseases of the skin*. The powdered fruit may be given in the *dose* of from Gm. 2–4 (gr. xxx–lx). Gm. 32 (an ounce) of the bruised fruit to a pint of hot water forms an infusion which may be taken within twenty-four hours.

CARTHAMUS.—Safflower.

Flores carthami.—African or dyer's saffron, False (American) saffron, E.; *Carthame*, Fr.; *Saflor*, G.; *Cartamo, Azafrancillo, Alazor*, Sp.

The florets of Carthamus tinctorius, *Linné*.

Nat. Ord.—Compositæ, Cynareæ.

Origin.—An annual plant which is indigenous to India and extensively cultivated there, in Eastern and Western Asia, Northern Africa, and Southern and Central Europe. It is about 60 Cm. (2 feet) high, with sessile or clasping spinulous leaves, and rather large ovate flower-heads terminating the branches. The florets are collected after the shedding of the pollen and are freed from the ovaries.

Description.—The florets of safflower are about 2 Cm. ($\frac{4}{5}$ inch) long, tubular, with the limb divided into five nearly linear lobes; the tube of the anthers is about 5 Mm. ($\frac{1}{5}$ inch) long, protrudes from the throat, and is surmounted by the long filiform yellow style. The florets are at first yellow, but become red, and after drying of a brown-red color. They have a faint, peculiar, rather disagreeable odor and an insipid bitterish taste.

Constituents.—The analysis of Dufour and Salvétat proved the presence of the usual constituents of plants, and in addition a yellow and a red coloring principle, the former being exhausted by water, after which the latter is obtained in solution by treatment with solution of sodium carbonate and precipitated by acids. Schlieper (1846) gives to this *carthamin* or *carthamic acid* the formula $C_{14}H_{16}O_7$. The value of safflower as a dyestuff depends upon the carthamin, which in the dry state is red-brown, has a green metallic lustre, is insoluble in ether, but dissolves in alcohol with a handsome purple color, the solution becoming yellow by heat. The alkaline solutions of carthamin decompose and decolorize rapidly.

Action and Uses.—Safflower passes for being diaphoretic if administered in a warm infusion made with Gm. 8 (ʒ ij) of the flowers and a pint of boiling water. It may be used to dissipate commencing *catarrh* and muscular *rheumatism*, and to favor the efflorescence of *eruptive fevers*. In large doses it is said to be laxative. Its action and uses closely resemble those of chamomile. Carmedik, from the Cape of Good Hope, is said to be closely related to Carthamus tinctorius, but, unlike it, is extremely bitter as well as aromatic and astringent. It is used at the Cape as a stomachic bitter, infused in water or in brandy (*Edinb. Med. Jour.*, xxviii. 1073).

CARUM, *U. S.*—Caraway.

Carui fructus, Br.; *Fructus carvi*, P. G.—*Caraway-fruit (seed)*, E.; *Carvi, Cumin des prés*, Fr.; *Kümmel*, G.; *Alcaravea*, Sp.

The fruit of Carum Carvi (Carui), *Linné*. Woodville, *Med. Bot.*, Plate 45; Bentley and Trimen, *Med. Plants*, 121.

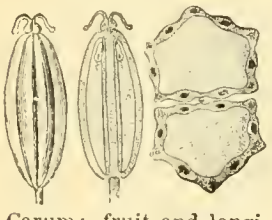
Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—A biennial plant which is indigenous to the Western Himalayas and the Caucasus, and is found throughout Siberia and the greater portion of Europe, but is scarce in the southern part of that continent. It is extensively cultivated in Norway, Russia, Germany, Holland, England, Morocco, and also in the United States; the yield of fruit per acre is between 8 and 10 cwt. The hollow cylindrical stem is 30 to 90 Cm. (1 to 3 feet) high, branched; the leaves bi- and tri-pinnate, with the ultimate divisions linear; involucre filiform; involucel none; umbels numerous; flowers small, white. The fruit is oblong, laterally compressed, splits when mature into the two mericarps, and finds its way into commerce from the countries named above. During the fiscal year 1866–67,

216,000 pounds of caraway were imported into the United States; at present about 1,000,000 pounds, including coriander, are annually imported.

Description.—The half-fruits are from 3 to 4 Mm. ($\frac{1}{8}$ to $\frac{1}{6}$ inch) long, brown and smooth, somewhat curved, slightly narrowed at both ends, with a rounded stylopod above five pale-colored filiform ridges, and between them on the back four grooves of a dark-brown color, which contain four large oil-tubes, two additional vittæ being on the flat face. Mogador caraway corresponds with this description, except that it is larger, attaining a length of fully 6 Mm. ($\frac{1}{4}$ of an inch). Caraway has an agreeable aromatic odor and a sweetish and spicy taste.

Fig. 51.



Carum: fruit and longitudinal section, 3 diameters; transverse section, 8 diameters.

Constituents.—Besides volatile oil (see Oleum Carui), Trommsdorff found in caraway a green fixed oil, a little wax, resin, sugar, mucilage, and some tannin, the latter being particularly present in the green fruit. The medicinal properties are due to the volatile oil.

Action and Uses.—Anciently, caraway was held to be diuretic and carminative. It is used at present chiefly to expel wind and allay pain in the flatulent *colic* of infants. An infusion is prepared with Gm. 4–8 (ʒj–ij) of the bruised seeds and half a pint of boiling water, of which the dose is a teaspoonful for infants and a tablespoonful for adults.

CARYOPHYLLUS, *U. S.*—Cloves.

Caryophyllum, Br.; *Caryophylli*, P. G.; *Caryophylli aromatici.*—*Girofle*, *Gérofle*, *Clous aromatiques*, Fr.; *Gewürznelken*, *Nägelein*, G.; *Clavos de especia*, Sp.; *Garofani*, It.

The unexpanded flowers of Eugenia aromatica, *O. Kuntze*, s. Eug. caryophyllata, *Thunberg*, s. Eug. aromatica, *Willdenow*, s. Myrtus Caryophullus, *Sprengel*, s. Caryophillus aromaticus, *Linné*. *Bot. Mag.*, vol. liv., plates 2749, 2750; Woodville, *Med. Bot.*, 193; Bentley and Trimen, *Med. Plants*, 112.

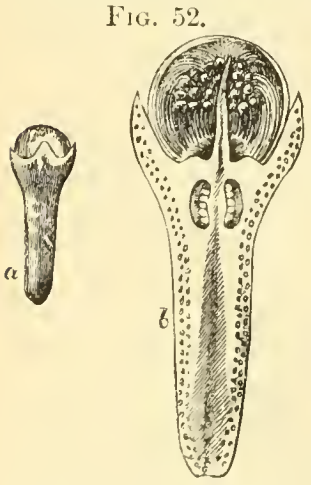
Nat. Ord.—Myrtaceæ.

Origin.—This handsome evergreen tree is supposed to have been indigenous only to the five small islands near the island of Jilolo, to which the name of Molucca or Clove Islands was formerly exclusively applied. The tree has been entirely destroyed there, but it is now cultivated in many of the islands of the Indian Ocean, in tropical Africa, Brazil, and the West Indies. It attains a height of 9 or 12 M. (30 or 40 feet), and is considerably branched, the branches forming an elegant pyramidal crown, and being terminated by cymes composed of fifteen to twenty-five flowers producing berry-like fruits.

Collection.—As soon as the buds change in color from green to red they are either picked by hand or detached from the trees by beating the branches with long bamboos, the buds being gathered upon cloths spread beneath the trees; they are afterward dried by exposure to the sun, whereby the color changes to brown. Between 1,000,000 and 1,500,000 pounds of cloves are annually consumed in the United States.

Description.—Cloves consist of a dark-brown, solid, nearly cylindrical calyx, somewhat tapering below, and above divided into four ovate lobes; these lobes clasp the four lighter-colored arched and imbricate petals, which form a globular head and cover the numerous bent stamens. The ovary is contained in the upper part of the adherent calyx, is divided into two cells, each containing about twenty ovules, and is crowned by a quadrangular disk, in the centre of which the simple style is placed. Cloves are $\frac{1}{2}$ to $\frac{2}{3}$ inch (12 to 16 Mm.) long, and, as obtained from different localities, vary somewhat in the shade of their brown color; the large, plump, and deep-brown cloves, as obtained from the Moluccas, Zanzibar, etc., are preferred, the smaller, shrivelled, and light-colored varieties, such as are often exported from Cayenne and the West Indies, being considered inferior. Cloves have a somewhat fatty appearance, a strong and highly aromatic odor, and a very pungent, warm, and aromatic taste. A large number of oil-cells are observed in the petals and in the outer tissue of the calyx; the latter are placed in two or three irregular circles beneath the epidermis, and yield some of their oil upon pressure with the finger-nail. Cloves partly deprived of their volatile oil are said to be occasionally used for adulteration; they are quite moist and usually without heads.

Fig. 52.



Clove: *a*, natural size; *b*, longitudinal section, magnified.

Other Parts.—Clove-stalks (Griffe de girofle (*Fr.*); Nelkenstiele, Nelkenholz (*G.*); Festucæ caryophyllorum, s. Fusti) are sometimes met with, and consist of the branching flower-stalks, about 2 Mm. ($\frac{1}{12}$ inch) in thickness, which are of a light-brown color, and have a distinct though not strong odor and taste of cloves; they contain 4 to 5 per cent. of volatile oil, and are sometimes employed for adulterating powdered cloves and sometimes for distilling the volatile oil. The importation of clove-stalks into this country has increased from 15,128 pounds in 1877 to 184,464 pounds in 1880.

Fig. 53.

Mother Clove.

Mother Cloves (Méres de girofle, Clous matrices (*Fr.*); Mutternelken (*G.*); Anthophylli) are the clove-fruits, generally collected before they are quite ripe; they are about 25 Mm. (1 inch) long, oval, crowned with the four-lobed calyx, have one or two seeds in each cell, and resemble cloves somewhat in appearance and properties, but are thicker, lighter, and weaker in odor.

Constituents.—Trommsdorff found in air-dried cloves 18 per cent. of volatile oil, 13 of tannin (which has not been further investigated), 13 of gum, 18 of water, 6 of tasteless resin, and 4 of extractive. Bonastre (1833) obtained from the watery distillate *eugenin*, in white pearly scales of a slight clove odor, having the composition $C_{10}H_{12}O_2$, and which is colored red by nitric acid. Ostermeyer isolated a green wax, and Lodibert (1825) inodorous and tasteless silky needles, *caryophyllin*, of the composition $C_{10}H_{16}O$, which are deposited from the concentrated tincture of cloves; they are colored blood-red by cold sulphuric acid, and, according to Mylius (1873), yield with fuming nitric acid crystals of *caryophillinic acid*, $C_{20}H_{32}O_6$. (For the composition of oil of cloves see Oleum Caryophylli.)

Action and Uses.—Cloves are general stimulants. They were formerly described as emmenagogue and aphrodisiac, and as suitable for expelling wind, allaying vomiting, and assisting digestion. They continue to be used for most of these purposes, but less as a medicine than as a condiment that promotes the digestion of fatty and crude food. Clove tea, made by infusing Gm. 8–12 (ʒij–iij) of bruised cloves in half a pint of boiling water, may be given in tablespoonful doses for the relief of *colic*. Powdered or bruised cloves wet with alcohol may be applied between cloths upon the epigastrium to allay *nausea* or *vomiting* and expel *flatus*, and upon the abdomen to relieve *colic*; but for these purposes the aromatic powder is preferable.

CASCARILLA, *U. S.*—Cascarilla-bark.

Cascarillæ cortex, Br.; *Cortex cascarillæ*, P. G.; *Cortex eluteriæ, s. thuris.—Sweetwood bark*, E.; *Cascarille, Ghacrille, Écorce éleuthérienne*, Fr.; *Kaskarillrinde*, G.; *Cascarilla*, G., It., Sp.

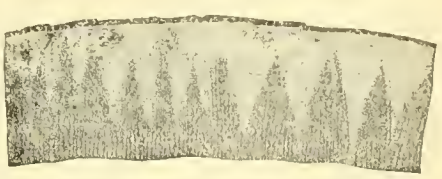
The bark of Croton Eluteria, *Bennett*, s. Clutia Eluteria, *Linné*. *Jour. Proc. Lin. Soc.*; *Pharm. Jour.*, 2d ser. vol. iv. p. 150; Woodville, *Med. Bot.*, 223; Bentley and Trimen, *Med. Plants*, 238.

Nat. Ord.—Euphorbiaceæ.

Origin.—This plant is a low or even a tree-like shrub with alternate, ovate-lanceolate, on the lower surface bronzed-silvery, leaves, and producing small white, monœcious, highly-odorous flowers in terminal and axillary spikes. The fruit is globular-ovate, scaly, silvery-gray, three-furrowed and three-celled, each cell containing a glossy orange-brown seed. The plant is indigenous to the Bahama Islands, where also Croton Cascarilla, *Bennett* (s. Clutia Cascarilla, *Linné*), and some other species of the same genus are met with, the barks of which may possibly sometimes be collected and sold as cascarilla. It is shipped in bags from Nassau, Bahamas, and has been known in Europe since the latter part of the seventeenth century.

Description.—It is in quills or channeled pieces 25 to 75 Mm. (1 to 3 inches) in length, about 12 Mm. ($\frac{1}{2}$ inch) in diameter, and about 2 Mm. ($\frac{1}{12}$ inch) thick, mostly, however, in small fragments. It is covered with a thin, grayish, easily-detached corky layer, upon which are smaller or larger white patches of a minute lichen (Verrucaria albissima, *Acharius*), the perithecia of which appear as black dots; the external layer, particularly of the older barks, is longitudinally and transversely fissured, presenting rectangular spaces with elevated edges, or is partly wanting. The inner bark is somewhat thicker, and has a brownish color and a smooth, brown-gray, inner surface. The bark breaks with a short somewhat resinous or horny fracture,

Fig. 54.



Cascarilla-bark: transverse section, magnified.

exhibiting in the outer layer some scattered oil- or resin-cells, and presenting a radially striate bast-layer in which but very few true bast-fibres are observed. It is rather fragrant when examined in bulk, but emits a strongly aromatic somewhat musk-like odor when burned; its taste is warm, aromatic, and very bitter.

Constituents.—Trommsdorff obtained from cascarilla 1.6 per cent. of volatile oil, 15.1 per cent. of resin, besides gum, potassium chloride, etc. The volatile oil consists of a hydrocarbon, $C_{19}H_{16}$ (Gladstone, 1872), and of an oxygenated portion. The resin is partly soluble in alkalies. Duval (1845), who isolated the bitter principle, *cascarillin*, in a crystalline state, announced also the presence of a little tannin, pectin, wax, fat, starch, and albumen. Cascarillin is obtained by concentrating the filtrate from the precipitate which is produced in an infusion by sugar of lead; it forms colorless needles or scales, is inodorous, bitter, fusible at 205° C. (401° F.), not precipitated by lead salts or tannin, freely soluble in ether and hot alcohol, sparingly soluble in cold alcohol and chloroform, and very sparingly in water; nitric acid converts it into a yellow resinous mass; sulphuric acid gives a red solution, from which water precipitates green floccules. C. and E. Mylius observed it (1873) in an extract separated in granules, and give its composition as $C_{12}H_{18}O_4$.

Allied Barks.—Malambo-bark is obtained in Venezuela from Croton Malambo, *Karsten*. It is in quills 12 to 25 Mm. ($\frac{1}{2}$ to 1 inch) in diameter and 15 to 20 Cm. (6 to 8 inches) long. It has a thin, soft, whitish, longitudinally-fissured cork, which is easily removed, exhibiting a brown surface with fine transverse furrows; the inner surface is gray-brown, finely striate, the fracture short-splintery, the odor aromatic, and the taste unpleasantly aromatic and bitter, resembling that of cascarilla.

Copalchi-bark is obtained from Croton Pseudochina, *Schlechtendal* (C. niveus, *Jacquin*), indigenous to Mexico. It resembles the preceding, is about 5 Mm. ($\frac{1}{5}$ inch) thick, hard and dense, has a grayish or yellowish corky layer, and beneath this is transversely fissured; the bast is reddish-brown, is coarsely striate in a radial direction, and breaks with a short, irregular fracture.

Barks differing considerably from those described, which are occasionally found in commerce as malambo- and copalchi-bark, are obtained from different plants. The composition of both barks is probably similar to that of cascarilla. Holmes (1874) described a bark which was probably derived from Croton lucidus, *Linné*, and was found as an admixture in cascarilla; it had a fawn-colored, firmly-adhering corky layer, was reddish and closely ridged upon the inner surface, had an astringent, slightly bitter taste, and yields a darker-colored tincture and infusion than cascarilla.

Pharmaceutical Preparations.—Extractum cascarillæ, P. G. The coarsely-powdered bark is exhausted by digestion with hot water and the infusion evaporated. When prescribed in mixtures, Mylius recommends the extract to be dissolved in a little hot alcohol and the solution to be added to the watery liquid, whereby the cascarillin becomes finely divided and remains in suspension.

Action and Uses.—Cascarilla is stimulant rather than tonic, and its fumes when inhaled are intoxicating. The infusion occasions a sense of warmth in the stomach, but in excessive doses nauseates and purges. Cascarilla was originally used to enhance the febrifuge power of cinchona, and independently in the *typhoid state* of various diseases, especially epidemic *dysentery*. It is now chiefly employed in the treatment of *dyspeptic* conditions due to gastric or intestinal atony and attended with flatulence or vomiting. The *dose* in powder is about Gm. 2 (gr. xxx). The infusion, made with an ounce of cascarilla to a pint of water, is preferable. It may be given in wineglassful doses.

Malambo-bark, says Strumpf, resembles Winter's bark in its action. In its native country it is used in atonic dyspepsia and in dysentery. The natives of Brazil have a superstition that the tapir cures itself of diarrhœa by eating this bark. It is also used by these people in asthma, spasms, and rheumatism, intermittent and yellow fevers, trismus nascentium, and worms. *Copalchi-bark*, according to the same authority, is employed as an antiperiodic-fever remedy, and tends to confine the bowels as well as to oppress the stomach. It is said to partake of the qualities of quassia, valerian, and menyanthis.

CASSIA FISTULA, *U. S.*—Purging Cassia.

Fructus cassiæ fistulæ.—Casse officinale, Casse en batons, Fr.; *Purgircassie, Fistelkassie, Röhrencassie*, G.; *Cassia*, It.; *Caña fistula*, Sp.

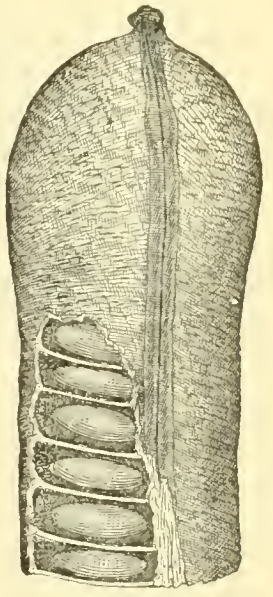
The fruit of Cassia Fistula, *Linné*, s. Cathartocarpus (Bactyrilobium, *Willdenow*) Fistula, *Persoon*. Woodv. t. 260; Bentley and Trimen, *Med. Plants*, 87.

Nat. Ord.—Leguminosæ, Cæsalpineæ.

Origin.—A tree 9 to 15 M. (30 to 50 feet) high, with large pinnate leaves appearing simultaneously with the long pendulous racemes of fragrant, golden-yellow, dark-veined flowers. Indigenous to the East Indies, it is now met with, spontaneously and under cultivation, in Egypt and other parts of Africa, the West Indies, and Brazil.

Description.—The fruit is an indehiscent, nearly cylindrical, woody legume, 45 to 60 Cm. (1½ to 2 feet) long and nearly 25 Mm. (an inch) thick, blackish-brown, with fine transverse veins and two bands running from the short thick stalk to the blunt apex. These bands are 3 to 4 Mm. (⅛ to ⅙ inch) broad, somewhat paler in color, smooth, and correspond to the dorsal and ventral sutures, the former being marked by a fine ridge, the latter by a shallow groove in the centre of the bands. The seeds are numerous, 8 to 10 Mm. (⅓ to ⅖ inch) long, flattish, ovate or oval, orange-brown, glossy, with a long filiform funiculus, a firm albumen, and fleshy-veined cotyledons; each seed is imbedded in a blackish-brown sweet pulp, and separately enclosed in a cell, the thin woody dissepiments being formed by the transverse distension of the placenta after fructification. The odor suggests that of prunes.

Fig. 55.



Cassia fistula: part of pod, natural size.

Other Varieties.—A lighter-colored purging cassia is occasionally met with, which is from 30 to 45 or 50 Cm. (12 to 18 or 20 inches) long, about 12 Mm. (½ inch) in diameter, slightly pointed, and has a reddish-brown sweet and somewhat astringent pulp, but otherwise resembles the official drug. It is usually referred to Cassia bacillaris, *Linné filius* (Cathartocarpus bacillus, *Persoon*), a tree indigenous to Surinam: but Hanbury's investigations (1863) render it certain that it is partly if not wholly obtained from Cassia moschata, *Kunth* (Cathartocarpus moschatus, *Don*), a tree found in Panama and the northern part of South America.

Cassia brasiliana, *Lamarck* (C. mollis, *Vahl*, C. grandis, *Linné filius*, Cathartocarpus, *Persoon*), yields a large purging cassia, sometimes known as *horse cassia*, which is 60 Cm. (2 feet) and more long, often curved, laterally compressed 38 Mm. (1½ inches) broad, rather coarsely veined, and has the dorsal suture indicated by one convex band and the ventral suture by two prominent obtuse ridges.

Constituents.—Purging cassia, treated with water, should yield about 30 per cent. of pulp, which, according to the analyses by Vauquelin and Henry, consists principally of sugar (about 60 per cent.), with some mucilage, pectin, salts, etc. In view of this composition it is difficult to understand why the drug should be unfit for medicinal use when the pulp has become dry and the seeds remain loose in their cells; it would seem, however, to be not indispensable.

Pharmaceutical Preparations.—Cassiæ pulpa, *Br.*—Cassia-pulp, *E.;* Pulpe de casse, Casse mondé, *Fr.;* Cassienmus, G.—It is extracted from the fruit by diffusing the pulp in water, straining, and evaporating. Cassia-pulp of British commerce, which has been imported from the East Indies, usually contains the seeds and dissepiments, and requires to be purified by softening with water and straining. It is blackish-brown, viscid, sweet, and of a somewhat sickly odor.

Confection of cassia, made by mixing cassia-pulp 100 Gm., syrup of violets 75 Gm., and sugar 20 Gm., evaporating to the consistence of a soft extract, and flavoring with a drop of oil of neroli, is known in France as *Casse cuite.*

Allied Drug.—*Fructus ceratoniæ, Siliqua dulcis.*—St. John's bread, *E.;* Carouge, Caroube, *Fr. Cod.;* Johannisbrot, Karobe, *G.;* Algarroba de Valencia, Garrobo, *Sp.*—Ceratonia siliqua, *Linné*, is a medium-sized evergreen tree, grows in the basin of the Mediterranean, and bears purple-colored racemes of polygamous apetalous flowers. The fruit is 10 to 20 Cm. (4 to 8 inches) long, nearly 25 Mm. (1 inch) broad, about 3 or 4 Mm. (⅛ or ⅙ inch) thick, obtuse, linear, much flattened, and with somewhat elevated edges, causing the transverse section to be narrowly and obtusely rectangular. The epicarp is leathery, brown, glossy, finely striate, and encloses a light-brown softer sarcocarp of a pleasantly sweet taste. The seeds, six to twelve in number, are flattish ovate and polished brown, and are contained in separate transverse cells formed by the papery inner layer of the pericarp. The fruit contains 40 to 50 per cent. of cane- and grape-sugar, besides mucilage, protein compounds, a little tannin, and butyric acid, to which the odor is due. The presence of free butyric acid was observed by Redtenbacher (1846). St. John's bread is frequently used in Southern Europe as an addition to expectorant and demulcent medicines.

Action and Uses.—Anciently used as a laxative to which special cooling virtues were attributed, and as a cleansing gargle for ulcerated sore throat, purging cassia is still esteemed as a mild and certain *laxative*, tending to promote the secretion of bile. It

gives a brownish or greenish tint to the urine. It is seldom used alone, owing partly to its tendency to occasion colic and flatulence. With manna it forms an active but mild laxative, and in hot climates and seasons it is usefully associated with tamarinds or with mild salines, especially in the treatment of *bowel complaints*. As a laxative the *dose* is from Gm. 4–8 (ʒj–ij); as a purgative, Gm. 30–60 (ℨj–ij). The sweet and acidulous pulp of the seeds of Ceratonia siliqua is used as a laxative in bronchitis and in the gastric and biliary derangements that are common in the south of Europe.

CASTANEA, *U. S.*—Chestnut.

Folia castaneæ.—Feuilles de châtaignier, Feuilles de marronier, Fr.; *Kastanienblätter*, G.; *Castaño*, Sp.

The leaves of Castanea dentata (*Marshall*), *Ludworth*, s. C. vesca, *Gaertner*, (C. vulgaris, *Lamarck*, C. sativa, *Miller*, Fagus Castanea, *Linné*), collected in September or October while still green.

Nat. Ord.—Cupuliferæ.

Origin.—A stately tree 24 to 30 M. (80 to 100 feet) high, indigenous to Western Asia, Southern Europe, and to the United States from Maine to Michigan southward. The wood, though light, is very durable. The whitish staminate flowers, which appear in May and June, form slender, pendulous aments 15 to 20 Cm. (6 to 8 inches) long; the pistillate flowers form clusters of three or four in an ovoid involucre, which finally becomes globose and covered with sharp prickles, and encloses two or three one-seeded nuts. These *chestnuts* (châtaignes, *F.;* Kastanien, Maronen, *G.;* castanas, *Sp.*), are flattish-hemispherical or somewhat triangular, brown, glossy, silky-pubescent at one end, and contain a firm white embryo having a sweet taste. American chestnuts are smaller and sweeter than those of Southern Europe.

Description.—The leaves are from 15 to 25 Cm. (6 to 10 inches) long, about 5 Cm. (2 inches) wide, upon petioles less than 25 Mm. (1 inch) in length, oblong-lanceolate, acuminate, mucronate, sinuate-serrate, smooth throughout, shining above, neatly feather-veined beneath. The leaves of the American chestnut (Cast. americana, *Rafinesque*) differ from those of the Oriental only in being rather acute at the base. They are nearly inodorous and have a somewhat astringent taste. They should be collected in the fall, in September or October, while still green; on drying they lose from 50 to 60 per cent. in weight.

Constituents.—Chestnut-leaves, examined by J. B. Turner (1879) and L. J. Steltzer (1880), were found to have the ordinary constituents of leaves—chlorophyll, fat, a little resin, gum, albumen, and extractive; the tannin, which gives a green-black precipitate with iron, was estimated at 9 per cent. by weighing the gelatin precipitate. The ash amounts to 5 or 6 per cent., and consists of carbonate, phosphate, and chloride of potassium, magnesium, calcium, and iron. The fruit contains nearly 50 per cent. of water, the remainder being starch 30 to 40, proteids 3 to 4, fat about 2, sugar ½ to 1 or 2 per cent., some mucilaginous matter and organic acids, and in the integuments resin, tannin, and bitter principle.

Allied Plant.—Castanea (Fagus, *Linné*) pumila, *Michaux*, is indigenous to the United States, from Southern Pennsylvania and Ohio to Florida and Eastern Texas. It is shrubby, or in the Southern States a tree 12 or 15 M. (40 or 50 feet) high. The leaves are oblong or somewhat obovate, acute, pointedly serrate, and white-downy beneath. The prickly involucre contains a single ovoid, acute, and dark-brown nut, called *chinquapin*, which is smaller than the chestnut and very sweet. The bark, like that of the chestnut, is astringent.

Action and Uses.—Judging from its apparent action in *whooping cough*, its sedative influence upon the respiratory nerves may be inferred. In the disease just mentioned it appears to control the paroxysms in a remarkable manner, in some cases suspending them entirely after the lapse of a few days. It may be given without limit in the form of an infusion made with Gm. 30 (ℨj) of the dried leaves in a pint of boiling water, or, more accurately, in the dose of from Gm. 2–4 (fʒss-j) of the fluid extract every three or four hours. Its taste is not unpleasant, and its administration requires no special circumspection.

CASTOREUM.—Castor.

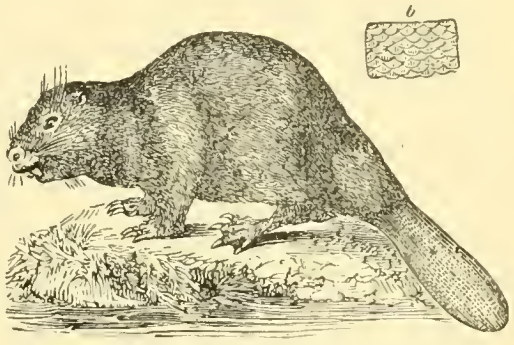
Castoréum, Fr.; *Bibergeil*, G.; *Castoreo*, It., Sp.

The dried preputial follicles and their secretion obtained from the beaver, Castor Fiber, *Linné* (Castor americanus, *Cuvier*, s. C. canadensis, *Kuhl*), and separated from the somewhat shorter and smaller oil-sacs which are frequently attached to them.

Class Mammalia. Order Rodentia.

Origin.—This animal inhabits the continents of the northern hemisphere between 33° and 68° N. lat., but is disappearing in the southern parts of those regions. It is from 60 to 75 Cm. (2 to 2½ feet) long, with horizontally-flattened tail, which is about 25 Cm. (10 inches) long and 7 to 10 Cm. (3 to 4 inches) wide, hairy at the base and scaly above. The head resembles that of a rat, with no canine teeth, but with two incisors, and on each side four molars in the upper and lower jaw. The fur consists of two kinds of hair—one rather bristly, the other denser and downy; its color is brown, but black, white, and spotted beavers are also met with. The feet have five toes, the anterior being short and close, the posterior longer and palmated; the hind feet are webbed close to the toes. Anus, genitals, and follicles communicate in both sexes with one canal or cavity located near the tail. In the male a pair of oil-sacs, containing the formerly official *axungia castoris*, terminates in the cloaca; the castor-sacs, located near the former, open by a common aperture in the preputial canal. The female has the castor-sacs below the os pubis on each side of the vagina. The European and Siberian beaver closely resembles the American in appearance and habits, but is somewhat larger and has a paler-colored fur.

Fig. 56.



Castor Fiber, *Linné*: *b*, scales of the tail.

The beaver feeds on roots and barks, and builds houses about 3 M. (10 feet) wide and 1.8 M. (6 feet) high, the entrance being under the water, the depth of which is increased by the building of dams composed of billets of wood and earth; in more densely-populated districts, where they are disturbed, the beavers burrow on the banks of rivers and creeks.

Description.—When fresh, castor-sacs are flesh-colored, soft, more or less pyriform; they are dried by being suspended over fire, when they become brown. They consist of four distinct coats: the outer one is cellular, resembles hog's bladder in texture, and encloses a fibrous layer, which is followed by a vascular, and this by an iridescent glandular coat, with many folds and numerous semilunar scales upon the inner surface, the whole being covered by a thin epithelium. According to E. H. Weber (1849), castor is mainly secreted by the prepuce of the penis and clitoris, but J. Fuchs (1881) states that it is altogether separated from glands contained in the inner coat of the sac. The contents of the recent follicles are an unctuous, yellowish, odorous mass, which, after drying, becomes brown and friable, but is not fusible. Castor is commercially distinguished by the countries from which it is obtained, the most highly valued being obtained from Russia and Siberia.

Castoreum sibiricum, s. Castoreum moscoviticum, rossicum, germanicum, europæum. The sacs are oval or globular pyriform, united at the narrowed end in pairs, the contents of a dull rather light-brown color and a strong peculiar odor. The sacs vary in weight from about 3 to 8, or occasionally even 14, ounces, and if not too dry the two outer coats may be readily separated. This kind is mostly collected in Siberia and Eastern Russia, the sacs from Western Russia and Germany being usually smaller and rarer. It is now rarely met with in commerce.

Castoreum canadense, s. castoreum americanum, anglicum. This is the variety generally met with in commerce. The sacs are more elongated, flatter, and usually more wrinkled and folded, than those of the preceding; they vary from club-shaped to narrow pyriform, are united in pairs, mostly between 1 and 4 ounces (rarely 8 ounces) each in weight; the outer coats adhere pretty firmly; the contents are often slightly glossy; the odor is aromatic, but weaker than the preceding; the taste about the same, pungent, bitter, and rather nauseous.

Russian and American castor are distinguished from each other by the characters indicated; the former yields 60 to 68 per cent. of its weight to alcohol, the latter between

45 and 50 per cent. The tincture of the former yields with much water a milky mixture, which becomes nearly clear on the addition of ammonia. The mixture obtained from the tincture of American castor is brownish, the precipitate being only partly soluble in ammonia.

Adulterations.—Castor is said to be occasionally adulterated with artificial mixtures of blood and earthy and resinous matters enclosed in some animal tissue; such substitution is easily detected by the absence of nearly all the characters described above.

Constituents.—The numerous older investigations have not thrown much light upon the composition of castor. The *volatile oil* of castor, present to the extent of 1 to 2 per cent., has the odor of that substance, and is of a pale-yellow color; according to Woehler (1844), it contains *carbolic acid*. The same chemist noticed also (1848) the presence of *salicin* and *benzoic acid*. Pereira (1851) believes the volatile oil to be mainly derived from the salicin, and observed that distilled castor-water gradually acquired the odor of salicyl-aldehyde (oil of Spiræa ulmaria). The bitter and acrid taste of castor is due to a dark-brown *resinous substance* which is insoluble in water and ether, but readily soluble in alcohol; it has not been further investigated. A peculiar crystalline body, *castorin*, was obtained by Bizio on cooling the strong alcoholic decoction. Valenciennes (1861) prepared it by boiling castor with milk of lime and treating the dried precipitate with hot alcohol; it forms colorless, readily fusible needles having a slight odor of castor and little taste; it volatilizes slowly with boiling water, is soluble in concentrated potassa, ether, benzin, and hot olive oil and oil of turpentine. Lehmann believes that the carbolic acid, if present, is obtained only from the smoke of the fire by which castor is dried; he found also *derivatives of bile*, *chlolesterin*, and a *protein compound*, the last two of which had already been obtained by Brandes. The inorganic constituents are carbonates, with some phosphates and sulphates of calcium, magnesium, potassium, and ammonium. Pereira obtained from Canadian castor 3.6 per cent. of ash. Castor-sacs containing a large proportion of calcium carbonate have been sometimes met with, and are said to be obtained from diseased animals.

Action and Uses.—It seems doubtful whether castor, any more than musk, has a definite action upon the healthy nervous system, but both are certainly stimulants of the nervous system disordered through exhaustion, direct or indirect. *Hysterical spasms*, those associated with *uterine colic*, *scanty menstruation*, and *tympanites*, and the muscular twitchings, tremblings, etc. which occur in the *typhoid state*, are palliated by this medicine. But for all purposes it is less efficient than musk, and scarcely superior to valerian, camphor, ammonia, ether, and some forms of alcohol. The *dose* of castor varies from Gm. 0.60 (gr. x) to ten times that amount, according to the strength of the preparation employed. The variable quality of the drug restricts its use.

CATALPA.—Bean Tree.

Catalpa, Fr., G., Sp.

Catalpa bignonioides, *Walter*, s. Bignonia Catalpa, *Linné*.

Nat. Ord.—Bignoniaceæ.

Description.—The tree is indigenous to the southern portion of the United States from Georgia and Florida westward, and is cultivated or wild farther north. It attains a height of 9 to 15 M. (30 to 50 feet), produces a light, close-grained, and very durable wood, and has spreading branches, large heart-shaped leaves, and compound racemes of showy flowers, which have the calyx two-lipped, the corolla bell-shaped, white, and in the throat dotted with purple and yellow. The fruit is capsular, nearly cylindrical, about 30 Cm. (12 inches) long, longitudinally striate and two-celled, and contains numerous very thin, long, and flat seeds which are enclosed in a delicate silky envelope, prolonged at both ends into finely-fringed wings. The bark, fruit, and seeds have been employed. The bark is externally gray-brown, smooth, somewhat glossy, with numerous small circular warts; in the middle layer green, and in the thick, tangentially arranged bast-layer white, becoming yellowish on drying; the inner surface is smooth. The bark of the trunk is about 6 Mm (¼ inch) thick, one-half consisting of the scaly cork, the other half of the bast-layer. It has a strongly bitter taste. The catalpa of the Western States is regarded as a distinct species, Catalpa speciosa, *Warder;* it is found in Southern Indiana and Western Kentucky, westward and south-westward, and has a rather heavier but equally durable wood.

Constituents.—The bark was analyzed by E. A. Rau (1870), who ascertained the presence of tannin in it. On dissolving the ethereal extract of the alcoholic extract in

diluted alcohol, and boiling with lead oxide, the liquid retained an amorphous bitter principle in solution, and hot alcohol dissolved from the lead precipitate a principle having an intensely nauseous, bitter taste, and crystallizing in micaceous scales, which were very soluble in ether, chloroform, and hot alcohol. Sugar and tasteless resin were also found.

The seeds were examined by F. K. Brown (1887), and yielded, besides tannin, fixed oil, resin, and sugar, two crystalline bodies. These latter were obtained by extracting the seeds with a mixture of ether, alcohol, and ammonia.

Allied Plants.—Bignonia capreolata, *Linné*, a native of the Southern United States, is a tall, climbing shrub, with orange-colored, bell-shaped, and somewhat two-lipped flowers, which are about 5 Cm. (2 inches) long. The root and stem have been used in place of sarsaparilla. A transverse section of the stem shows the wood in the shape of a cross. This plant, like the closely-allied Tecoma radicans, *Jussieu*, which bears large scarlet flowers, is known as *trumpet creeper*.

Several East Indian species of Bignonia are medicinally employed in their native country.

Action and Uses.—This is rather an ornamental tree than one useful in medicine. The bark, indeed, is said to be vermifuge, the wood emetic, and the leaves emollient and anodyne, yet the emanations of the tree are reported to be poisonous. A decoction of the pods, and the dried seeds also, have been used with alleged advantage in chronic *bronchitis* and in nervous *asthma*, especially when associated with senega; of which latter statement there need be no serious doubt. The juice of the root is also stated to be an efficient local remedy for chronic scrofulous *ophthalmia*.

"The root and vine of Bignonia capreolata in infusion or decoction answer the purpose of sarsaparilla. They are detergent and alterative, diuretic and sudorific, used in syphilis, chronic rheumatism, and in derangements arising from impurities of the blood" (Porcher, *Resources of the Southern Fields and Forests*). *Catalpa speciosa* has been alleged to exert a sedative action on the heart, slowing the pulse and weakening it (*Med. News*, lvi. 624), but the evidence in favor of this statement is inadequate.

CATAPLASMATA.—Cataplasms.

Poultices, E.; *Cataplasmes*, Fr.; *Umschläge*, *Breiumschläge*, G.

These are topical applications, of a soft, pasty consistence which are prepared from coarse or fine powders, mixed with water, various solutions, or fixed oils. In this country the ingredients are usually furnished by the pharmacist, but the poultice is prepared for use at the patient's house.

CATAPLASMA CARBONIS, *Br.*—Charcoal Poultice.

Cataplasme au charbon, Fr.; *Kohlenumschlag*, G.

Preparation.—Take of Wood Charcoal in powder ½ ounce; Crumb of Bread 2 ounces; Linseed Meal 1½ ounces; Boiling Water 10 fluidounces. Macerate the bread in the water for 10 minutes near the fire, then mix, and add the linseed meal gradually, stirring the ingredients, that a soft poultice may be formed. Mix with this half the charcoal, and sprinkle the remainder on the surface of the poultice.—*Br.*

Medical Uses.—Charcoal poultice is used as an emollient and disinfecting application to *gangrenous* and *fetid sores*.

CATAPLASMA CONII, *Br.*—Hemlock Poultice.

Cataplasme avec la ciguë, Fr.; *Schierlingumschlag*, G.

Preparation.—Take of Juice of Hemlock 1 fluidounce; Linseed Meal 4 ounces; boiling Water 10 fluidounces. Evaporate the juice to half its volume, add this to the linseed meal and water previously mixed, and stir them together.—*Br.*

Medical Uses.—Hemlock poultice is employed especially to relieve the pain of *cancerous* and other *sores*. Extract of conium may be substituted for fresh hemlock-leaves in its preparation.

CATAPLASMA FERMENTI, *Br.*—Yeast Poultice.

Cataplasme avec le levûre de bière, Fr.; *Hefenumschlag*, G.

Preparation.—Take of Beer Yeast 6 fluidounces; Wheaten Flour 14 ounces; Water

heated to 100° F. 6 fluidounces. Mix the yeast with the water, and stir in the flour. Place the mass near the fire till it rises.—*Br.*

The rising of the mass takes place in consequence of fermentation, which speedily commences, and whereby carbon dioxide is generated.

Action and Uses.—Yeast poultice or fermenting poultice is of great service to unhealthy, and especially gangrenous, *ulcers*, whether of a cancerous nature or not, in preventing fetor and hastening the removal of devitalized tissues. Its activity is indicated by the pain it sometimes causes.

CATAPLASMA LINI, *Br.*—Linseed Poultice.

Cataplasma emolliens s. communis.—Flaxseed poultice, E.; *Cataplasme de farine de lin, Cataplasme simple (commun)*, Fr.; *Leinsamen-Umschlag*, G.

Preparation.—Take of Linseed Meal 4 ounces; boiling Water 10 fluidounces. Mix the linseed meal gradually with the water with constant stirring.—*Br.*

The linseed meal of the British Pharmacopœia of 1867 was the *cake meal* of American commerce, and in preparing with this the linseed poultice the addition of ½ ounce of olive oil was deemed necessary. In the present Pharmacopœia the meal contains all the oil of the seed, and the further addition of oil is therefore not required. A mixture of ground flaxseed and cake meal is sometimes preferred for poultices.

Action and Uses.—Linseed or flaxseed poultice is usually employed in hospital practice as an emollient and protective to *inflamed* and *painful parts*. Owing to its tendency to ferment, it is apt to occasion an eruption of vesicles or pustules, and more than any other poultice to render the skin white, wrinkled, and sodden. To prevent these effects and preserve its moisture, its surface should be covered with fresh lard, sweet oil, linseed oil, or glycerin, or else one or the other of these articles should be mixed with the poultice.

CATAPLASMA SINAPIS, *Br.*—Mustard Poultice.

Sinapismus; Cataplasma rubefaciens.—Sinapisme, Cataplasme de moutarde, Cataplasme rubéfiant, Fr.; *Senfteig*, G.

Preparation.—Mix Mustard in powder 2½ ounces with 2 to 3 ounces of lukewarm Water; mix Linseed Meal 2½ ounces with 6 to 8 ounces of boiling Water; add the former to the latter and stir them together.—*Br.*

Mix recently prepared black mustard meal, 200 Gm., with scarcely tepid water in sufficient quantity to obtain a mass of the consistence of a poultice.—*F. Cod.*

Mustard of the British Pharmacopœia is a mixture of ground black and white mustard seeds, though the proportion of the two is not indicated. It is now very properly mixed with lukewarm water, but on incorporating this with the hot flaxseed poultice a portion of the rubefacient volatile oil is necessarily volatilized.

Action and Uses.—This poultice is convenient for maintaining a moderately stimulant action upon the skin, and at the same time protecting it. It is very useful in local muscular *rheumatism*, in thoracic and abdominal *inflammations*, in *colic*, and for exerting a derivative action upon the feet in congestive affections of the *head*. The preparation and uses of the preparation usually called sinapism or mustard *plaster* are described under Sinapis.

CATAPLASMA SODÆ CHLORINATA, *Br.*—Chlorine Poultice.

Cataplasme chloriné, Fr.; *Chlornatron-Umschlag*, G.

Preparation.—Take of Solution of Chlorinated Soda 2 fluidounces; Linseed Meal 4 ounces; Boiling Water 8 fluidounces. Mix the linseed meal gradually with the water, and add the solution of chlorinated soda, with constant stirring.—*Br.*

Action and Uses.—The chlorine poultice is useful in the same cases in which the yeast poultice is appropriate; that is to say, for correcting the fetor of foul and sloughing *ulcers* and for stimulating them.

CATARIA.—Catnep.

Herba nepetæ s. catariæ.—Catmint, E.; *Cataire, Chataire, Herbe aux chats, Menthe de chats*, Fr.; *Katzenminze, Katzenkraut*, G.

The leaves and tops of Nepeta Cataria, *Linné*, s. Cataria vulgaris, *Moench*. Bentley and Trimen, *Med. Plants*, 209.

Nat. Ord.—Labiatæ.

A perennial herbaceous plant 0.6 to 1.2 M. (2 to 4 feet) high, indigenous to many parts of Asia and Europe and naturalized in the United States, where it grows near dwellings, in waste places, and along roadsides.

Description.—The stem is quadrangular, gray-hairy, and branched; leaves opposite, petiolate, 25 to 75 Mm. (1 to 3 inches) long, triangular ovate, cordate or rounded at base, pointed at apex, the margin strongly crenate-serrate, grayish-green, soft hairy above and velvety beneath. The flowers are in terminal panicles, the lower stalked, the upper sessile, with a gray, hairy, obliquely five-toothed calyx and a whitish, purple-spotted corolla, which is hairy on the outside, has the three-lobed lower lip crenately toothed, and four stamens inserted in its tube. The stem and larger branches are rejected, the leaves and flowering tops only being collected in June and July. It has a peculiar mint-like, rather disagreeable odor, and a bitterish, aromatic, and pungent taste. A variety, N. citriodora, *Becker*, has an agreeable lemon-like or melissa-like odor. On drying, the fresh drug loses from 75 to 80 per cent. in weight.

Constituents.—The chemical constituents resemble those of other Labiatæ. The plant contains a small quantity of oxygenated volatile oil, some tannin, a bitter principle which has not been isolated, and other medicinally unimportant constituents. H. R. Gillespie (1889) found volatile and fixed oils, a crystalline wax, mucilage, dextrin, sugar, and small quantities of a bitter principle which is neither alkaloid nor glucoside, but possesses an acid reaction.

Action and Uses.—Catnep is stimulant and slightly tonic, and, like the mints and some other plants containing a volatile oil, it is prescribed in various disorders attended with debility of the nervous system and of the functions immediately depending upon it. It is most commonly used for the relief of *flatulent colic* in infants and to promote *menstruation* when it is retarded or painful. Its local application excites a sense of warmth and causes partial anæsthesia, for which reason it is used to relieve *toothache* and other local pains. Cats are fond of it, hence the name *catnep* (cat-nepeta). It is given in an infusion made with Gm. 15–30 (℥ss–j) in Gm. 500 (a pint) of water, and in the dose of from a teaspoonful to a tablespoonful.

CATECHU, *U. S., P. G.*—Catechu.

Terra Japonica, Catechu nigrum.—Cutch, E.; *Cachou de Pégu*, Fr. Cod.; *Katechu, Pegu-Catechu*, G.; *Catecu*, It., Sp.

An extract prepared principally from the wood of Acacia (Mimosa, *Linné filius*) Catechu, *Willdenow*. Bentley and Trimen, *Med. Plants*, 95.

Nat. Ord.—Leguminosæ, Mimoseæ.

Origin.—A tree about 9 to 12 M. (30 to 40 feet) high, with a pair of hooked brown prickles at the base of the numerous abruptly bipinnate leaves, which are 15 to 30 Cm. (5 to 12 inches) long, and with pale-yellow flowers arranged in dense cylindrical spikes about 75 Mm. (3 inches) long; the legume is brown, veined, flattened, and pointed.

The glabrous and pubescent varieties have formerly been regarded as distinct species, Mimosa Sundra and M. catechuoides, *Roxburgh*. The tree is indigenous to the East Indies and Ceylon, and is completely naturalized in Jamaica, where it is common in dry localities.

Preparation.—The wood, which is heavy and very durable, is covered by a dark-brown fibrous bark, and consists of the whitish alburnum and of the dark-colored heartwood, varying in color from red-brown to blackish-brown. This latter portion is cut into chips, which are boiled with water in earthen pots arranged over a rude fireplace, the decoction when sufficiently strong being decanted or strained into other vessels, in which the evaporation is continued until the extract is of sufficient consistence to be poured into clay moulds, into cups formed of leaves, or upon mats covered with the ashes of cow-dung.

In Southern India the wood of Acacia (Mimosa, *Roxburgh*) Suma, *Kurz*, whose bark is externally white, is employed in the same manner, the bark of both species being removed and used for tanning. The last-named species is also common in the forests of tropical Eastern Africa, and has been introduced into South America.

The importation of catechu and gambir into the United States increased from 2,645,000 pounds during the fiscal year 1866–67 to over 47,750,000 pounds in the year 1879-80; in 1882 but little over 15,000,000 pounds were imported.

Description.—Catechu is chiefly exported from Pegu and Calcutta, packed in mats,

chests, or boxes. It forms several layers of dark-brown masses, in which remnants of the matting and of leaves are observed, and which are frequently soft near the centre. When dry it is hard and brittle, breaking into irregular, somewhat porous and glossy fragments, which are scarcely translucent on the edges, almost wholly soluble in alcohol, partly soluble in water, and have but little odor and a strongly astringent and sweetish taste. The solutions have a slight acid reaction. Examined by the microscope under water or glycerin, catechu is somewhat crystalline. The catechu in balls and in quadrangular cakes, made in moulds as above described, is rarely met with in our commerce. A fourth variety, which is never exported, is made in Kumaon in Northern India by stopping the evaporation before the liquid becomes too thick; it bears a closer resemblance to gambir than to the ordinary catechu. Good catechu yields between 1.5 and 4.5 per cent. of ash; Flückiger obtained from Pegu catechu 0.6 per cent.

Catechu digested with ten times its weight of alcohol should leave an insoluble portion, which should not, after being dried at 100° C. (212° F.), amount to more than 15 per cent. The tincture, diluted with 100 parts, on the addition of solution of ferric chloride acquires a green color. If 2 parts of catechu be boiled with ten times the quantity of water, a brownish-red liquid results which turns blue litmus-paper red.—*U. S.*

The *Areca catechu*, obtained from the so-called betel-nuts, the seeds of Areca Catechu, *Linné*, does not form an article of commerce; it is said to be inferior to true catechu, and is known in India, in part at least, as *cata-cambu*. (See Areca).

Constituents.—The relation to one another of the principal constituents of catechu has been satisfactorily explained by the researches of Neubauer (1859), Hlasiwetz (1867), Etti (1877), and others. When catechu is treated with cold water mainly *catechu-tannic acid* is found in the brown solution, which yields precipitates of a grayish color with gelatin and of an olive-brown with ferric salts. The aqueous solution contains also some *catechin* and *quercetin*, the latter having been obtained by Löwe (1873) by treating the solution with ether. Most of the *catechin* or *catechuic acid* is, however, left undissolved by the treatment with cold water, and may be obtained pure by repeated crystallization and decolorizing with animal charcoal, or removing the adhering tannin by adding lead acetate until a dark-colored precipitate is no longer obtained. Catechin forms white silky needles which are sparingly soluble in cold water, but more readily in cold alcohol and ether; it requires for solution less than 4 parts of boiling water, about 3 parts of boiling alcohol, and 6 parts of boiling ether. It has a sweetish taste, imparts a green color to ferric salts, gives a violet color on being agitated with water and powdered iron, the color changing to green on exposure to air, and yields precipitates with most metallic salts, but not with tartar emetic nor with gelatin. Its formula, according to Rochleder (1869), is $C_{13}H_{12}O_5$. Subjected to dry distillation, it yields pyrocatechin, and when fused with potassa is converted into phloroglucin (see Phlorozinum) and protocatechuic acid. Gautier (1878) gives to catechin the formula $C_{21}H_{18}O_8$, and found among the products of decomposition by potassa, besides the two mentioned, also the hydrocarbon, CH_4, and carbonic and formic acids. By the action of dilute sulphuric acid at 140° C. an amorphous orange-colored body, protocatechuic acid, and a polyatomic phenol, probably $C_{14}H_{16}O_7$, were obtained. Etti adopts Hlasiwetz's formula, $C_{19}H_{18}O_8$, for catechin; this is partly decomposed at 110° C. (230° F.), and when heated to 160° C. (320° F.) yields an anhydrid, $C_{38}H_{34}O_{15}$, which is catechu-tannic acid, and has also been called *catechu-red*; it is a dark-red amorphous powder, soluble in water, alcohol, and ether. Below 180° C. (356° F.), or by continued boiling with dilute sulphuric acid, the anhydride, $C_{38}H_{32}O_{14}$, which is likewise a tannin, is obtained. By continuing the action of sulphuric acid the *catechuretin*, $C_{38}H_{28}O_{12}$, of previous investigators, and the anhydride, $C_{38}H_{30}O_{13}$, are obtained, which are insoluble in simple solvents and weak alkalies. H. K. Bowman (1869) determined the quantity of tannin in three samples of catechu, and found it to vary between 32.8 and 49.4 per cent. More than 30 samples examined by Lehmann (1880) yielded tannin varying between 22.6 and 50.8 per cent, and catechin varying between 13.8 and 33.8 per cent.

Protocatechuic acid, $C_7H_6O_4$, is formed from certain tannins, numerous resins, gum-resins, and other substances by adding them to melted potassa. It crystallizes in colorless shining needles or scales containing a molecule of water, dissolves readily in ether, alcohol, and hot water, melts at 199° C. (390.2° F.), and at a higher heat is decomposed into carbon dioxide and pyrocatechin. Its solution is colored dark-green by ferric chloride, the color changing to blue, and subsequently to red, on the gradual addition of a very dilute solution of sodium carbonate.

Pyrocatechin or *catechol*, $C_6H_6O_2$, is contained among the products of destructive distil-

lation of several tannins and vegetable extracts. It crystallizes in short rectangular prisms, melts at 104° C. (219.2° F.), and boils at 245° C. (473° F.). It sublimes in thin laminæ, and dissolves easily in water, alcohol, and ether. Its aqueous solution is colored dark-green by ferric chloride, the color changing to violet on the addition of ammonia, sodium bicarbonate, or tartaric acid. The methylic ether of pyrocatechin is guaiacol.

Impurities.—Fragments of leaves, mats, or cloth are usually found in the commercial article. An *artificial catechu*, proposed by Rave (1873), may be obtained by slightly roasting powdered mahogany or allied woods, and then boiling with water; it is said to be serviceable in dyeing.

Astringent Products of Other Species.—The bark of many species of acacia contains so much tannin as to render it valuable for tanning purposes. The *babul-bark* of India is obtained from Ac. arabica, *Willdenow*, the fruit of which contains about 22 per cent. of tannin, and is also known under the name of *neb-neb* or *bablah*: the aqueous extract of the latter, known as *akakia*, is used in India like catechu. The Australian *wattle-bark* is produced by A. decurrens, *Willdenow*, and other species.

Cortex adstringens brasiliensis, which was used in Europe during the first half of the present century, is obtained from Stryphnodendron polyphyllum, *Martius*, a tree known in Brazil as *barbatimão* or *barbimão*. The bark is covered with a thick fissured blackish red-brown cork, has a light-brown bast-layer readily separating in bands, possesses a strongly astringent and somewhat mucilaginous taste, and contains about 30 per cent of tannin, which yields with ferric salts a blackish gray-green precipitate. Pithecollobium Avaremotemo, *Martius*, s. Acacia virginalis, *Pohl*, and Acacia Jurema, *Martius*, yield similar barks.

CATECHU PALLIDUM.—Pale Catechu.

Catechu, Br., P. G.; *Terra japonica*, *Gambir*, *Gambier*, E.; *Gambir cubique*, Fr.; *Gambir*, *Gambir-Catechu*, G.

An extract of the leaves and young shoots of Uncaria Gambier, *Roxburgh*, s. Nauclea Gambir, *Hunter*. *Trans. Linn. Soc.*, vol. ix. plate 22; Bentley and Trimen, *Med. Plants*, 139.

Nat Ord.—Rubiaceæ, Naucleæ.

Origin.—This is a shrubby climber having opposite leaves, and bearing globular heads of pinkish flowers upon axillary laterally compressed peduncles, which taper toward the apex, are articulated above, and after the fall of the whole inflorescence curve backward and form stout and hard hooks, by which the plant supports itself in climbing. It is indigenous to Ceylon, Sumatra, and the countries about the Straits of Malacca, and is extensively cultivated near Singapore. Uncaria (Nauclea, *Hunter*) acida, *Roxburgh*, indigenous to Pulo Penang and neighboring islands, is nearly allied to the preceding species, and perhaps merely a variety of it; it appears also to be used in the preparation of gambir.

Preparation.—The fresh leaves and young shoots are boiled in water for an hour, after which the decoction is decanted and the residue expressed with the hands. The liquid is now evaporated to the consistence of a thin syrup, poured into buckets, and stirred by working a stick of soft wood up and down in a sloping direction, when it gradually sets into a soft mass; this is placed in shallow square boxes, and when sufficiently firm is cut into cubes and dried in the shade.

Gambir is principally exported from Singapore, packed in boxes. Catechu, *P. G.*, applies to gambir as well as to cutch.

Description.—It is met with in cubes or in large irregular masses, the latter having an external resemblance to, but are mostly of a lighter-brown color than, catechu, and presenting upon the irregular fracture a dull brown-gray appearance, with some streaks of a darker brown. The cubes are 25 Mm. (about an inch) square on each side, externally light or deep brown, internally brownish gray. Both varieties are friable, inodorous, of a bitterish, astringent finally sweet taste, and show under the microscope numerous small acicular crystals. Gambir is only partially soluble in cold water, but yields with hot water a turbid solution, and with hot alcohol a clear dark-brown solution, leaving only the impurities undissolved, and these should not exceed 15 per cent. in weight (*P. G.*). On incineration gambir yields $2\frac{1}{2}$ to $4\frac{1}{2}$ per cent. (not over 6 per cent., *P. G.*) of ash, consisting mostly of earthy salts.

Constituents.—Gambir contains the same constituents as catechu, but less *tannin* than the latter; the crystalline structure observed under the microscope is due to *catechin*. Hlasiwetz (1867) detected *quercetin* in gambir. De Vrij (1865) avers the presence of *quinovic acid* in many species of Nauclea, and it is not impossible that it may also be found in gambir. Gautier (1878) regards the catechin of gambir as differing in composi-

tion from that of catechu. Twelve samples of gambir examined by Lehmann (1880) yielded between 25.5 and 37.8 per cent. of tannin and between 19.96 and 28.69 per cent. of catechin.

Action and Uses.—Catechu is astringent by virtue of the tannic acid it contains, and was originally used to constringe relaxed tissues, arrest fluxes, and for similar purposes. It is harsher but more energetic than kino in its action. It continues to be one of the most commonly employed of astringent medicines for checking *diarrhœa* produced by cold or by irritating ingesta, after their removal by purgation. It is best administered for this purpose in the officinal chalk mixture. It is alleged to check the bronchial secretion in chronic *phthisis* and *bronchitis*, and to moderate uterine *hæmorrhage* and *leucorrhœa*. It is of greater utility as a local astringent, applied to the nostrils in *epistaxis*, to the mouth in case of spongy and bleeding *gums*, to the *vagina* in relaxation and leucorrhœa of this canal, and to the *throat* and *larynx* in cases of flaccidity of these parts. Lozenges containing it are used to correct *hoarseness* and roughness of the voice due to this cause. They sometimes are made with catechu, cascarilla, amber, orris, peppermint, etc., to conceal the odor of the breath caused by *fetid follicular secretions*, by *tobacco*, etc. The astringency of catechu renders it a useful ingredient of dentrifices. In gargles it relieves *sore throat* unattended with active inflammation; in lotions it forms a valuable application to ulcerated *nipples* and other *ulcers* after the acute state has passed; such lotions may contain catechu alone, or, in addition to it, borax, alum, sulphate of copper, etc. Gambir catechu has the same medicinal properties, but its astringency is rather less. The *dose* of catechu is from Gm. 0.05–2.0 (gr. i–xxx). A compound infusion of catechu is made with 1 troyounce of this drug, 60 grains of powdered cinnamon, and a pint of boiling water. It is especially useful in the diarrhœa of children, to whom it may be given in doses of a tablespoonful or more.

CAULOPHYLLUM, *U. S.*—Blue Cohosh.

Pappoose-root, Squaw-root, Blueberry-root.

The rhizome and rootlets of Caulophyllum (Leontice, *Linné*) thalictroides, *Michaux. Nat. Ord.*—Berberidaceæ.

Origin.—A smooth and glaucous perennial with a simple stem, bearing near its apex a large sessile triternately compound leaf, with obovate three-or five-toothed or lobed leaflets; the greenish-yellow flowers, about twelve in number, form a terminal raceme, and produce capsules which are soon ruptured by the two globular seeds, these remaining enclosed in a blue fleshy integument. The plant is found in rich woodlands from Canada south to Carolina and Kentucky. It flowers in April and May.

Description.—The rhizome is nearly horizontal, somewhat matted, 10 Cm. (4 inches) long, about 6 to 10 Mm. ($\frac{1}{4}$ to $\frac{2}{5}$ inch) thick, more or less bent, knotty from the numerous concave approximate stem-scars on the upper side, and from the short branches, externally brown-gray, internally whitish, the tough ligneous rays narrow and many. The numerous radical fibres are mostly on the lower side, 75 or 100 Mm. (3 or 4 inches) long and about 1 Mm. ($\frac{1}{25}$ inch) thick, rather tough, pale yellowish-brown externally, and white internally. Blue cohosh is nearly inodorous and has a sweetish-bitter afterward somewhat acrid taste. As met with in commerce, it is sometimes mixed with a large proportion of the rhizome of hydrastis, which is easily recognized by its different shape and its bright-yellow color internally.

Constituents.—F. F. Mayer (1863) found blue cohosh to contain *saponin* and a body with alkaloidal reactions. Ebert (1864) corroborated this statement, proved also the presence of two resins, starch, gum, and other common principles, and obtained $2\frac{1}{2}$ per cent. of ash, but could not obtain the alkaloid reactions. Lloyd (1887) isolated the alkaloid, *caulophylline*, and in 1893 studied it at some length. He extracted the powdered root with dilute alcohol (3 alcohol, 2 water), evaporated to drive off the alcohol, diluted with water, filtered, evaporated to a syrupy consistency and extracted with chloroform in the presence of ferric hydroxide and sodium bicarbonate. It was then taken up after evaporating the solvent with dilute sulphuric acid, made alkaline with ammonia, treated with chloroform, this evaporated to a small bulk and hydrochloric acid carefully added. The hydrochlorate thus obtained forms a crystalline magma, while the alkaloid itself on evaporation of its solutions forms a glass-like film. With Mayer's solution, a white precipitate; iodo-potassic iodide, heavy brown precipitate; sodium phosphomolybdate, heavy precipitate. On concentrating the alcoholic tincture and pouring it into water a precipitate of the resins is obtained amounting to about 12 per cent. of the root; it has the peculiar taste of blue cohosh and constitutes the so-called *caulophyllin*.

Action and Uses.—Nothing has recently been added to our knowledge of its reputed virtues. It is said to be demulcent, antispasmodic, emmenagogue, and diuretic. It is not proved to possess medicinal powers. A decoction made with Gm. 30 (℥j) of the root to a pint of water may be given in the dose of 1 or 2 ounces.

CEANOTHUS.—Red Root.

New Jersey tea, E.; *Céanothe*, Fr.; *Seckelblumen-Wurzel*, G.

The root of Ceanothus americanus, *Linné.*

Nat. Ord.—Rhamneæ.

Origin.—This is a shrubby plant indigenous to the greater part of North America, growing in pine barrens and dry woodlands. It is about 90 Cm. (3 feet) high, and has alternate ovate or oblong-ovate, serrate leaves, which are sometimes heart-shaped at the base, downy underneath, and three-veined. The small white flowers are in axillary panicles and produce three-lobed capsules containing three seeds.

Description.—The root is about 30 Cm. (a foot) long, nearly cylindrical, 25 Mm. (an inch) or more thick, with a knotty head and a few branches, and covered with a firmly adhering rust-colored bark, which is about 2 Mm. ($\frac{1}{12}$ inch) thick, with some longitudinal ridges, hard, breaks with a short granular fracture, and when cut with a knife has a brown-red and waxy appearance. The wood is very tough, of a light red-brown color and of a waxy lustre upon the recently-cut surface. The branches have a rather lighter-colored bark and a whitish wood. The root is without odor and has a bitterish-astringent taste, which is strongest in the bark.

Constituents.—Red root has not been analyzed, but is known to contain tannin. Bowman (1869) estimated the tannin of the leaves to amount to 9.21 per cent.

Other Species.—Ceanothus ovalis, *Bigelow*, which has narrow oval leaves, is indigenous from Vermont to the Rocky Mountains.

Cean. cœruleus, *Lagasca*, s. C. azureus, *Desfontaines*, a native of Mexico, has been employed there as a febrifuge.

Action and Uses.—The leaves of this plant were used during the American War of Independence as a substitute for Chinese tea, and in the late Civil War it was employed in the same manner, and pronounced "a good substitute for indifferent black tea." The root is astringent, and was applied locally by the Cherokee Indians in *gonorrhœa* and *cancer*, and given internally in *syphilis*. A decoction of the leaves and seeds has been used in *ulceration* of the mouth and throat, and internally in *dysentery*. In the West Indies and Mexico it is said that a species of Ceanothus (C. reclinatus, *De Candolle*) is used for the purposes mentioned (*Bull. de Therap.*, xcvii. 119).

CELASTRUS.—Staffтree-Bark.

False bittersweet, *Fevertwig*, *Staff-vine*, E.; *Celastre*, Fr.; *Celaster*, G.

The bark of Celastrus scandens, *Linné.*

Nat. Ord.—Celastraceæ.

Origin.—The staff tree is a native of Canada, and of the United States southward to North Carolina, growing in woods and thickets and twining about trees, ascending to a considerable height. The leaves are alternate, ovate-oblong, acuminate, and serrate; the flowers are in small axillary racemes, greenish-white, and produce orange-colored three-valved capsules containing from three to six seeds, which are covered with a scarlet-red arillus.

Description.—The root-bark, which is usually preferred, is in irregular thin quills or double quills, is nearly smooth, externally brown or dark orange-brown; the outer layer, which is rather tough, separates concentrically and shows another layer of a bright orange-red color, which covers the white, fragile, likewise concentrically-arranged liber. The internal surface is whitish and finely striate. The bark of the stem resembles the root-bark, but is externally of an ash-gray or brown-gray color. It is without odor and possesses a bitterish-sweet taste. The tough white wood is occasionally found adhering to the bark as met with in commerce.

Constituents.—The bark has not been analyzed, but Prof. Wayne (1872) obtained from it a principle in white minute crystals resembling chloral hydrate in appearance. The process for obtaining this *celastrin* has not been published.

Action and Uses.—"The bark has considerable reputation in domestic practice as an emetic, discutient, and anti-syphilitic; it also appears to possess some narcotic powers" (Griffith). It is popularly supposed capable of "removing hepatic obstructions," whatever that may mean.

CEPHALANTHUS.—Buttonbush.

Buttonwood, Crane willow, Swamp dogwood, E.

The bark of Cephalanthus occidentalis, *Linné.*

Nat. Ord.—Rubiaceæ, Cinchoneæ.

Origin.—The buttonbush grows in wet places in Canada and the United States, attains a height of 3 to 4.5 M. (10 to 15 feet), has ovate, acuminate, and entire leaves, which are opposite or in whorls of three, and the white flowers are aggregated in dense globular terminal and axillary heads.

Description.—Buttonbush-bark, as found in commerce, is in narrow curved pieces 25 Mm. (an inch) or more in length. The outer surface is somewhat glossy, gray-brown, finely striate longitudinally, or when older covered with a scaly and fissured ash-colored or brown-gray soft cork. The inner bark is white and smooth, after drying light rust-brown, rather tough, and breaks with a fibrous fracture. The bark is inodorous and has a slightly astringent and somewhat bitter taste.

Allied Plants.—Sarcocephalus esculentus, *Afzel.*—This plant is the *doundake* of the West Coast of Africa, in the neighborhood of Senegambia and Sierra Leone. In large quantities the fruit acts as an emetic. The grayish bark is used by the negroes as a febrifuge; experiments show, however, that it is a tonic astringent, and is of use in anorexia, atonic dyspepsia, and in anæmia following malarial fever.

Constituents.—Examined by E. M. Hattan (1874), the bark was found to contain tannin, a principle analogous to saponin, an uncrystallizable bitter principle freely soluble in alcohol and water, two resins, fat, gum, glucose, and starch. A fluorescent body was obtained from the precipitates occasioned by lead acetate and subacetate; it crystallizes in needles, is soluble in water, alcohol, and ether, yields a yellow precipitate with lead subacetate, and has in alkaline solutions a yellow color which in reflected light appears blue.

Action and Uses.—There is no evidence to prove that this plant possesses medicinal virtues sufficient to entitle it to consideration. It is reputed to have been useful in *paralysis*, *coughs*, and constitutional *syphilis*. In decoction and applied as a lotion it is one of the innumerable remedies for poisoning by *Rhus toxicodendron.*

CERA, *U. S., Br., P. G., F. It.*—Wax.

Wachs, G.; *Cire*, Fr.; *Cere*, It., Sp.

The prepared honeycomb of the hive-bee or honey-bee, Apis mellifica, *Linné.*

Class Insecta. Order Hymenoptera.

Official Varieties.—1. Cera flava, *U. S., Br., P. G.;* Cera, *F. It.;* Yellow wax (Cera citrina).—Beeswax, *E.;* Cere jaune, *Fr.;* Gelbes Wachs, *G.;* Cera virgine, Cera gialla, *It.;* Cera amarilla, *Sp.*

2. Cera alba, *U. S., Br., P. G.;* White wax, *E.;* Cire blanche, *Fr.;* Weisses Wachs, *G.;* Cera bianca, *It.;* Cera blanca, *Sp.* Yellow wax bleached by exposure to moisture, air, and light.

Origin.—The insect has been domesticated from an early period, and several varieties are known; but the Apis fasciata of Egypt, A. unicolor of Madagascar, and A. pallida of South America may perhaps be all distinct species. The bees live in societies called *swarms*, which are composed of one female or *queen bee*, several hundred males or *drones*, and ten thousand or more *working bees*, which are females with undeveloped ovaries. The wax is secreted in thin scales between the rings of the belly, and is used in the construction of the hexagonal cells which form the comb and are filled with honey. To obtain the wax the honey is drained off, the comb expressed, melted in water, and after the impurities have subsided the wax is allowed to cool or run into suitable moulds. By filtering the crude wax through paper at a sufficiently elevated temperature a very handsome product is obtained. Beeswax is largely produced in the United States, particularly in some of the Western and Southern States, and its importation from the West Indies has decreased to 6000 or 7000 pounds annually.

Wax-Bleaching.—Melted beeswax is solidified in thin ribbon-like sheets by passing it over wet revolving cylinders, or it is finely granulated and then exposed to the light and air, being moistened from time to time and occasionally turned. It is then remelted, and the process repeated until the desired degree of whiteness has been attained. Wax may also be deprived of its color by chlorine, but such a product is much inferior to the sun-bleached wax.

Properties.—Beeswax is a solid body, having a more or less deep-yellow, or sometimes a brownish-yellow, color, a slight lustre, a somewhat unctuous touch, a finely granular fracture, a peculiar aromatic honey-like odor, and a slight balsamic taste. Its specific gravity varies between about .955 and .967, and its fusing-point between 63° and 64° C. (145.4°–147.2° F.). The density of wax is, according to Hager, most conveniently determined by melting a small portion, dropping it upon a slightly dampened glass or porcelain tile, and immersing the solidified drops in alcohol of known density, in which they must float without rising to the surface or sinking to the bottom. Wax is brittle in the cold, becomes plastic by the heat of the hand, and when melted forms a clear reddish-yellow liquid, which congeals with a smooth and level surface and appears irregularly crystalline under the microscope. Wax is insoluble in water and slightly soluble in cold alcohol, but dissolves in 300 parts of boiling alcohol, leaving only a small-brownish-yellow residue, and depositing on cooling a whitish crystalline mass, while the filtrate is yellowish and not rendered turbid by water. Wax is wholly soluble in chloroform, ether, benzin, oil of turpentine, and other volatile oils, and in fixed oils, and partially soluble in cold benzene or carbon disulphide, and completely in these liquids at 25°–30° C. (77°–86° F.). According to Hager, ether dissolves only about one-half of the wax at 15° C. (59° F.), and benzene or benzin about 27 per cent. On dry distillation wax yields an aqueous liquid, a butyraceous oil, a scaly crystalline body, and empyreumatic products, but no acrolein.

White wax is usually met with in yellowish-white thin circular cakes, which are about 10 Cm. (4 inches) in diameter, slightly translucent, of a somewhat splintery fracture in the cold, have a specific gravity of about .965 to .975 at 15° C. (59° F.) and fuse near 65° C. (149° F.). Its slight odor suggests that of rancidity; its taste is insipid. In other respects it has the characteristics and answers to the tests of yellow wax.

Constituents.—Yellow wax contains some aromatic and coloring matters, which vary somewhat in wax from different localities, and are destroyed by the bleaching process; they are partly dissolved by cold alcohol, together with a very small quantity of *cerolein*, which resembles a fat in appearance. Boiling 90 per cent. alcohol dissolves 10 to 20 per cent. of *cerin* or *cerotic acid*, $C_{27}H_{54}O_2$, which exists likewise in Chinese wax, is crystalline, and fuses in its pure state at about 81° C. (177.8° F.). Schalfeief (1876) succeeded, by fractional precipitation with lead acetate, in separating it into several acids, one having the composition $C_{34}H_{68}O_2$. Repeated boiling of wax with alcohol leaves yellow *myricin* behind, which is *myricyl-palmitate*, $C_{30}H_{61}.C_{16}H_{31}O_2$; when pure it forms feathery crystals, has the fusing-point at 72° C. (161.6° F.), is very sparingly soluble in alcohol, more freely in ether and oil of turpentine, and is with difficulty saponified by boiling with concentrated solution of potassa. The principle to which bleached wax owes its rancid odor has not been ascertained.

Vegetable wax is obtained in different countries from various species of Myrica, Rhus, Corypha, etc. Some of them are glyceryl compounds of fatty acids, and therefore true fats, but the exact composition of most of them has not been ascertained.

Adulterations and Substitutions.—The coarse adulterations with flour, white lead, and similar substances are perhaps rarely practised at the present time, since they are so readily detected by their insolubility in ether, chloroform, and oil of turpentine, and by subsiding or mixing with hot water on fusing the wax with it. The materials most frequently employed are resin, commercial stearin (the residue left on expressing lard oil), suet, and similar fats, and paraffin and the closely-allied *ceresin* or *ozokerite* of Gallicia. The latter, which has also been termed *mineral-* or *earth-wax*, is found in nearly black masses, but is obtained in the process of purification of various shades of color varying between dark-yellow and white. This and *paraffin* may be readily detected and their quantity estimated by their stability when heated with concentrated sulphuric acid, by which the beeswax is completely destroyed, while they are not affected, and may be recovered nearly pure by fusing the residuary mass repeatedly with fresh portions of water. If the adulterated wax be previously exhausted with light petroleum benzin, which dissolves but little of the beeswax, the solution will contain the paraffin, together with any fat present, and the residue left on evaporation may be treated with sulphuric acid; this will destroy the fat and leave the paraffin. The determination of the specific gravity and fusing-point has been recommended for detecting adulterations, paraffin and tallow being lighter, while resins, stearin, Japan wax, etc. are heavier, than wax; but mixtures of the adulterants may be prepared which agree pretty well in these respects with the natural product. It must also be remembered that resins, like beeswax itself, are destroyed by the influence of hot sulphuric acid. But most resins and fatty acids are

soluble without difficulty in cold strong alcohol, which takes up but minute quantities of beeswax; and this behavior affords a means of detecting such adulterations. Fats, however, are not dissolved by alcohol. With few exceptions they are readily soluble in cold petroleum benzin, and their quantity may be estimated. To apply these tests the wax should be cut into very thin pieces and digested for some time near the boiling-point. After cooling the liquid is decanted, and will then contain fatty acids and resin should alcohol have been used, or fats and paraffin if petroleum benzin should have been employed as the solvent. Advantage may also be taken of the behavior of Japan wax and other fats to form a milky emulsion on being boiled with an aqueous solution of borax, from which on cooling pure wax separates completely. When melted wax is allowed to congeal without being disturbed, it presents a level surface, but the surface of paraffin is concave; and A. W. Miller (1874) has observed this distinctly even in mixtures of pure wax and paraffin; the translucent appearance of the latter is even noticed on the edges of the mixture, while pure yellow wax is almost opaque. Another perhaps still more deceptive fraud has been practised in coating adulterated with a thin layer of pure wax of the same color; and completely artificial wax has been made (1876) by fusing together rosin and paraffin or rosin, soap, and stearic acid; the solubility in cold strong alcohol, and in the former case the indestructibility of the undissolved portion by hot sulphuric acid, serve to detect these frauds. The admixture of fats may also be detected by the acrid odor of the vapors given off on throwing the suspected wax upon red-hot charcoal. (See paper on white wax and its adulterations by Prof. Bedford in *Proc. Amer. Phar. Assoc.*, 1877, p. 444.)

Tests.—If 1 Gm. of wax be boiled for half an hour with 35 Cc. of a 15 per cent. solution of sodium hydroxide, the volume being preserved by the occasional addition of water, the wax should separate on cooling, without rendering the liquid opaque, and no precipitate should be produced in the filtered liquid by hydrochloric acid (absence of fats or fatty acids, Japan wax, resin); nor should the same reagent produce a precipitate in water which has been boiled with a portion of the wax (absence of soap). If 5 Gm. of wax be heated in a flask for fifteen minutes with 25 Cc. of sulphuric acid to 160° C. (320° F.), and the mixture diluted with water, no solid, wax-like body should separate (absence of paraffin). If wax be ignited on platinum, it should not emit the odor of acrolein (absence of tallow and other fats).—*U. S.* If 1 Gm. of wax be boiled for a quarter of an hour with 10 Cc. of water and 3 Gm. of sodium carbonate, and cooled, the wax must congeal on the surface of the liquid, and the latter must not appear turbid (Japan wax, resin, stearic acid).—*P. G.* Boiling alcohol dissolves more or less of wax, leaving a yellow residue, 1 part of which should be entirely soluble in 10 parts of chloroform (absence of starch, mineral substances, etc.). On cooling the alcoholic solution, the wax should be precipitated in the form of a white crystalline magma, and after cooling the solution to 15° C. (59° F.) the almost colorless filtered liquid should become only opalescent with water, and should have at most only a slight acid reaction on blue litmus-paper (absence of curcuma or other yellow coloring-matters, stearic acid, and resins).—*P. G.*

Action and Uses.—Wax is simply a protective. Its use in ancient times as a remedy for *diarrhœa* and *dysentery* was doubtless due to this property. Quite recently it has been similarly employed. *Propolis*, a resinous matter with which bees cover the bottom of their hives, has been used for the same purpose. Until the introduction of caoutchouc, wax was generally employed for preparing impermeable tissues, and in the treatment of *rheumatism*, *gout*, *neuralgia*, and other local diseases to protect the affected parts from cold and favor cutaneous transpiration.

CERATA.—Cerates.

Cérats, *Céréolés*, *Elæocéréolés*, Fr.; *Cerate*, *Wachssalben*, G.

The term cerate is applied to a class of unctuous preparations which in consistence are about intermediate between ointments and plasters, sufficiently soft to be spread at the ordinary temperature, and at the same time firm enough to adhere to the skin without melting. They are composed of wax, united with a fatty or oleoresinous substance, and to obtain them of proper consistence 2 parts of wax require about 3 parts of fixed oil, 4 parts of lard, or 1 part of soft turpentine. In preparing cerates the wax or resin should be melted first by the aid of a water-bath or otherwise carefully-regulated heat. When thoroughly melted, the warm oil or lard should be added in quantities small enough not

to congeal the melted portion, and after all the ingredients have been liquefied and the vessel removed from the fire the mass should be well stirred or beaten with a spatula, to prevent the partial separation of the least fusible substances and ensure the perfect homogeneousness of the preparation. It is well to continue this manipulation until the temperature has been reduced to that of the room, but artificial refrigeration should not be applied until after the mass has thickened, and then only if vigorous stirring (or, better still, trituration) is kept up. With this in view, the soft cerate may be transferred to a mortar previously warmed by hot water, or the whole process may be completed in a well-enamelled iron vessel with a rounded bottom if a pestle fitting the curve of the latter be used. Straining is best avoided, and all the materials should therefore be free from dust and other foreign bodies. Powders, cantharides excepted, are gradually added while the cerate is merely soft enough to permit the whole to be uniformly mixed, and liquids should be previously warmed to 40° or 45° C. (about 110° F.). In dispensing cerates with extracts the latter should be previously rubbed with water in a warm mortar to a uniform thin paste, which should then be mixed with the cerate, added in small portions until the extract has been thoroughly incorporated; the remaining cerate may then be added in larger quantities.

Cerates should be kept in a cool place, where the temperature is not likely to rise much above 15° C. (59° F.), but even then those made with white wax, owing to its incipient rancidity, are liable to become rancid, while such as contain yellow wax keep unaltered for a much longer period. Some cerates, which are sufficiently firm, may be conveniently kept and dispensed in the form of square cakes, which are easily made by pouring the fused and nearly cool cerate into square moulds made of oiled or paraffin-paper and placed upon a flat slab. After the cerate has solidified it is without difficulty removed from the paper and cut into smaller pieces of any desired size or weight.

The name *steatina*, *steatins*, has been suggested by Mielck (1881) for a class of preparations which are of about the same consistence as cerates, but the base of which is suet, combined with either expressed oil of nutmeg, with wax, or with lead plaster deprived of glycerin and water.

CERATUM, *U. S.*—Cerate.

Ceratum simplex, U. S. 1850; *Ceratum adipis*, U. S. 1860; *Unguentum cereum*, P. G. —*Simple* (*lard*) *cerate*, E.; *Cérat simple*, Fr.; *Einfaches Cerat*, *Wachssalbe*, G.

Preparation.—White Wax 300 Gm.; Lard 700 Gm.; to make 1000 Gm. Melt them together, and stir the mixture constantly until cool.—*U. S.*

If 3 ozs. of white wax and 7 ozs. of lard be used, the official proportions will be preserved. The simple cerate of the French Codex is composed of 1 part of white wax to 3 parts of expressed oil of almonds, and the wax ointment, P. G., of 3 parts of yellow wax to 7 parts of olive oil.

CERATUM CAMPHORÆ, *U. S.*—Camphor Cerate.

Unguentum (*Pomatum*, F. Cod.) *camphoratum.*—*Pommade camphrée*, Fr.; *Kampfersalbe*, G.; *Cerata alcanforada*, Sp.

Preparation.—Camphor Liniment, 100 Gm.; White Wax, 300 Gm.; Lard, 600 Gm.; to make 1000 Gm. Melt the white wax and lard with the aid of gentle heat; then add the camphor liniment and stir the mixture occasionally until it has become cold.—*U. S.*

If 3 ounces of white wax, 6 ounces of lard, and 1 ounce of camphor liniment be used in place of the prescribed metric weights, the proportions will not be changed.

Melt at a moderate heat white wax 1 part and lard 9 parts; add powdered camphor 3 parts, and stir until the camphor is dissolved and until the ointment becomes cool.—*F. Cod.*

The consistence of the camphor cerate, U. S. P., is softer than that of most other cerates. The camphor pommade of the French Codex contains 12 per cent. of camphor, but the cerate of the U. S. P. only 2 per cent.; it was made so weak solely for the purpose of preparing the ceratum plumbi subacetatis extemporaneously.

Ceratum Camphoræ Compositum, N. F.—Compound Camphor Cerate, Camphor Ice.—Take of camphor in coarse powder 1½ troyounces, white wax 2 troyounces, castor oil 4 troyounces, spermaceti 7 troyounces, carbolic acid, liquefied by warming, 10 minims, oil of bitter almond 6 minims, benzoic acid 60 grains. Melt the wax and sperma-

ceti on a water-bath, add the castor oil, and afterward the camphor, and continue heating and stirring until the camphor is dissolved. Withdraw the heat, cover the vessel, and when the mixture has somewhat cooled add the remaining ingredients and thoroughly incorporate them by stirring. Lastly, pour the cerate into suitable moulds.

Action and Uses.—The only active ingredient of this apparently superfluous preparation is camphor. If intended as an antipruriginous application, it is no better than camphorated oil. If proposed as an anodyne, it is vastly inferior to the ancient opodeldoc, which, it appears to us, should not have been laid aside.

CERATUM CANTHARIDIS, *U. S.*—Cantharides Cerate.

Emplastrum cantharidis, Br.; *Emplastrum vesicans*, F. Cod; *Emplastrum cantharidum ordinarium*, P. G.; *Emplastrum epispasticum s. vesicatorium.—Blistering cerate or plaster*, E.; *Emplâtre de cantharides, Emplâtre vésicatoire*, Fr.; *Spanischfliegen-Pflaster, Blasenpflaster*, G.; *Pomatum di cantaridi*, It.

Preparation.—Cantharides in No. 60 powder 320 Gm.; Yellow Wax 180 Gm.; Resin 180 Gm.; Lard 220 Gm. Oil of Turpentine 150 Cc.; to make 1000 Gm. Moisten the cantharides with the oil of turpentine, and set the mixture aside, well covered, for forty-eight hours. Then add it to the yellow wax, resin, and lard, previously melted and strained through muslin, and keep the mixture in a liquid condition by means of a water-bath, stirring occasionally until its weight has been reduced to 1000 Gm. Then remove it from the bath and stir it occasionally until it is cool.—*U. S.*

If avoirdupois weight is more convenient, the following quantities should be used: Cantharides in No. 60 powder 4 ounces, yellow wax 2¼ ounces, resin 2¼ ounces, lard 2¾ ounces, oil of turpentine 2 fluidounces; to make 12½ av. ounces.

Take of Cantharides in powder 12 ounces; Yellow Wax, Prepared Suet, each 7½ ounces; Prepared Lard 6 ounces; Resin 3 ounces. Liquefy the wax, suet, and the lard together by a water-bath, and add the resin, previously melted; then introduce the cantharides, mix the whole thoroughly, and continue to stir the mixture while it is allowed to cool.—*Br.*

The object of previous treatment of the cantharides with oil of turpentine is to facilitate the subsequent solution of cantharidin in the fats, as oil of turpentine is known to exert a ready solvent effect upon the active blistering agent. The process of the U. S. Pharmacopœia always ensures an effectual blistering cerate, provided the cantharides are of good quality. It is important that the heat be not raised above 100° C. (212° F.), since cantharidin would volatilize with the watery vapors extricated from the powder, and, while weakening the cerate, vesication of the operator's face and hands would be apt to occur. Dragendorff (1872) recommended a process for increasing the efficacy of the cerate by treating the powdered cantharides first with solution of potassa or soda, heating the mixture in a water-bath for half an hour, supersaturating with hydrochloric acid, drying rapidly in a water-bath, and powdering the residue. Rother (1872) obtained by this process an ineffectual preparation, unless the powder was finally kept moist for several days with chloroform or oil of turpentine, whereby, however, the activity of cantharides powder was likewise increased. H. G. Greenish (1880) again recommended the process.

The blistering cerate of the U. S. P. contains 32 per cent., that of the Br. P. and F. Cod. 33⅓ per cent., and that of the P. G. 25 per cent. of powdered cantharides.

Allied Preparations.—The following preparations are occasionally used:

Ceratum extracti cantharidis, *U. S.* 1880; Cerate of extract of cantharides, *E.*; Cérat d'extrait de cantharides, *Fr.*; Cantharidenextract-Cerat, *G.*—Cantharides, in No. 60 powder, 30 parts (6 oz. av.); Resin 15 parts (3 oz. av.); Yellow Wax 35 parts (7 oz. av.); Lard 35 parts (7 oz. av.); Alcohol a sufficient quantity. Moisten the cantharides with 18 parts (3⅗ oz. av. or 4½ fluidounces) of alcohol, and pack firmly in a cylindrical percolator; then gradually pour on alcohol until 180 parts (36 oz. av., or nearly 2½ pints) of percolate are obtained, or until the cantharides are exhausted. Distil off the alcohol by means of a water-bath, transfer the residue to a tarred capsule, and evaporate it on a water-bath until it weighs 15 parts (3 oz. av.). Add to this the resin, wax, and lard, previously melted together, and keep the whole at a temperature of 100° C. (212° F.) for fifteen minutes. Lastly, strain the mixture through muslin and stir it constantly until cool.

This was proposed by W. R. Warner (1860). The cantharidin is completely extracted by the alcohol, and again dissolved from the resulting soft extract by the lard, the solution in the latter being facilitated by the prolonged digestion. A quantity of blackish extractive matter, insoluble in fats, separates, and is removed by straining. The finished cerate is of a yellow or greenish-yellow color.

Camphorated cantharides plaster, E.; *Vésicatoire camphrée*, Fr.—It is made by diffusing upon the surface of the spread cerate a concentrated solution of camphor in ether or chloroform. As either solvent evaporates readily, a thin film of finely-divided camphor is left behind.

Vesicating cloth or taffetas, E.; *Sparadrap* (*Toile, Taffetas*) *vésicant*, Fr.—Melt together 100 parts each of purified elemi and resin, 375 of yellow wax, 225 of basilicon ointment, and 40 of olive oil; add 420 parts of finely-powdered cantharides and spread the mass over waxed cloth. Dubuisson proposed a substitute for this, made by forming a thick solution of 1 part of gelatin in sufficient water, adding 4 parts of hydro-alcoholic extract of cantharides, and applying three layers of the mixture upon waxed cloth, allowing each one to dry before the next is applied.

Various proprietary articles of a similar nature are in the market; but the above, in addition to blistering-paper (see CHARTA EPISPASTICA), will probably meet all necessities.

Action and Uses.—Cantharides cerate forms the most usual blistering plaster. Its mode of action and remedial application are sufficiently explained under CANTHARIS. The other preparations described are used, the first under the impression that it tends to prevent strangury; and the second because it is convenient for applying to limited and uneven surfaces.

CERATUM CETACEI, *U. S.*—SPERMACETI CERATE.

Emplastrum spermatis ceti, Ceratum labiale album.—Cérat de blanc de baleine, Onguent blanc, Fr.; *Walrat-Cerat*, G.; *Cerato de Bell*, Sp.

Preparation.—Spermaceti 100 Gm.; White Wax 350 Gm.; Olive Oil 550 Gm.; to make 1000 Gm. Melt together the spermaceti and wax; then add the olive oil, previously heated, and stir the mixture constantly until cool.—*U. S.*

If 1 ounce of spermaceti, 3½ ounces of white wax, and 5½ ounces of olive oil be used, the official proportions will not be disturbed.

It should be white and free from rancidity. The preparation of the P. G. 1872 was similar, but firmer, so as to form a convenient application to chapped hands and lips. For the latter purpose it is usually colored red by carmine or by previously steeping some alkanet-root in the oil and scenting it with some volatile oil.

The following preparations are used for similar purposes:

CERATUM ROSATUM, *F. Cod.*—Rose cerate, Lip salve, *E.;* Cérat à la rose, Pommade pour les lèvres, *Fr.;* Lippenpomade, *G.*—Melt together at a moderate heat white wax 50 Gm. and expressed oil of almond 100 Gm.; when partly cooled add carmine 0.5 Gm. previously rubbed up with a little of the oil; stir well, and finally add essential oil of rose 0.5 Gm.—*F. Cod.*

MEDICATED CACAO-BUTTER.—Melt together 4 ounces of yellow wax and 28 ounces of cacao butter; add 1 drachm each of balsam of Peru and benzoic acid. Mix and pour into moulds (Ferris Bringhurst, 1867).

Action and Uses.—Spermaceti cerate forms a very bland dressing for *blisters*, superficial *abrasions*, and *ulcers* after their primary stage. It is less apt than simple ointment to grow rancid. Camphor ice and medicated cacao-butter are very useful both in preventing and in curing *chilblains*.

CERATUM PLUMBI SUBACETATIS, *U. S.*—CERATE OF LEAD SUBACETATE.

Unguentum glycerini plumbi subacetatis, Br.; *Unguentum plumbi*, P. G.; *Ceratum cum subacetate plumbico*, F. Cod.—*Goulard's cerate, Ointment of glycerin of lead subacetate*, E.; *Cérat de saturné, C. saturné, C. de Goulard*, Fr.; *Bleisalbe, Bleicerat*, G.

Preparation.—Solution of Lead Subacetate 200 Gm.; Camphor Cerate 800 Gm.; to make 1000 Gm. Mix them thoroughly. This cerate should be freshly prepared when wanted for use.—*U. S.*

Goulard's cerate may be conveniently prepared by mixing 120 grains (100 minims) of solution of lead subacetate with one troyounce of camphor cerate.

The preparations of the Br. and Germ. Pharmacopœias are less liable to spoil, owing to the entire absence of fat; the former is made by adding 3 parts of glycerin of lead subacetate to a previously melted mixture of 4 parts of hard paraffin and 12 parts of of soft paraffin; the latter consists of a mixture of 2 parts of solution of lead subacetate, sp. gr. 1.240, and 19 parts of paraffin ointment.

The official formula will yield an unobjectionable preparation, provided the camphor cerate is free from rancidity, but it should never, to avoid deterioration, be made up in large quantities.

Action and Uses.—This cerate is astringent and protective, and is employed to promote the healing of suppurating surfaces, such as *excoriations*, *blisters*, *ulcers*, etc. It is objectionable from its tendency to become rancid, and therefore irritating; and it must be cautiously applied upon extensive raw surfaces, lest it cause lead-poisoning.

CERATUM RESINÆ, *U. S.*—Resin Cerate.

Unguentum resinæ, Br.; *Unguentum basilicum*, P. G.; *Unguentum tetrapharmacum.*—*Ointment of resin*, *Basilicon ointment*, E.; *Cérat de résine anglais*, *Onguent basilicum*, Fr.; *Harzsalbe*, *Königssalbe*, *Zugsalbe*, G.

Preparation.—Resin 350 Gm.; Yellow Wax 150 Gm.; Lard 500 Gm.; to make 1000 Gm. Melt them together at a moderate heat, strain the mixture through muslin, and allow it to cool without stirring.—*U. S.*

If 7 ounces of resin, 3 ounces of yellow wax, and 10 ounces of lard be melted together, the official proportions will be preserved.

Take of Resin in coarse powder 8 ounces; Yellow Wax 4 ounces; Simple Ointment 16 ounces; Almond oil 2 fluidounces. Melt with a gentle heat, strain the mixture while hot through flannel, and stir constantly while it cools.—*Br.*

The impurities always present in the resin necessitate the straining of this and the following cerate. By melting and straining the resin alone the purified resin may be kept on hand and subsequent straining avoided. The formulæ of the French and German Pharmacopœias differ considerably from the foregoing, the former ordering black pitch, the latter turpentine, among the ingredients.

Allied Preparation.—Ceratum resinæ compositum, *U. S.* 1870.—Compound resin cerate, Deshler's salve, *E.*—Take of resin, suet, yellow wax, each 12 troyounces; turpentine 6 troyounces, flaxseed oil 7 troyounces. Melt them together, strain the mixture through muslin, and stir it constantly until cool.

This cerate, which was recognized by the U. S. P. until 1880, gradually becomes tough in consequence of the oxidation of the flaxseed oil—an alteration prevented by substituting for the flaxseed oil either a non-drying oil or paraffin oil, as suggested by S. A. D. Sheppard (1878).

Action and Uses.—Resin cerate is one of the most common and useful of the dressings employed for slowly-healing and indolent *sores*, particularly when they have followed a local shock, such as a *burn* or *scald* produces.

Compound resin cerate is rendered more stimulant than resin cerate by the turpentine it contains, and may be applied where that preparation appears to act too feebly.

CERATUM SABINÆ.—Savine Cerate.

Unguentum sabinæ, Br.—*Ointment of savin*, E.; *Cérat de sabine*, Fr.; *Sadebaumsalbe*, G.

Preparation.—Fluid Extract of Savin 25 parts (5 oz.); Resin Cerate 90 parts (18 oz.). Melt the resin cerate by means of a water-bath, add the fluid extract of savin, and continue the heat until the alcohol has evaporated; then remove the heat and stir constantly until cool.—*U. S.* 1880.

Take of Fresh Savin Tops, bruised, 8 ounces; Yellow Wax 3 ounces; Benzoated Lard 16 ounces. Melt the lard and the wax together on a water-bath, add the savin, and digest for twenty minutes. Then remove the mixture and express through calico.—*Br.*

Of the two preparations, we prefer the first, which was first suggested by Prof. Grahame (1858), and which contains all the soluble principles of savin. It is difficult to imagine that the brief digestion of the fresh savin ordered by the second formula should extract enough of the principles to render the cerate equally efficient. Both are, however, in point of elegance, improvements over the old method of incorporating the powder.

Action and Uses.—It is used exclusively as a stimulant of suppurating surfaces, whose discharges it tends to increase. Hence it is applied to prolong the discharge from *issues*, *setons*, and *blisters*, and has the advantage over preparations of cantharides that it does not tend to occasion strangury. Its application produces a white pellicle of coagulable lymph, which should be from time to time removed, lest the part heal prematurely.

CEREVISIÆ FERMENTUM, *Br.*—Beer Yeast.

Yeast, *Brewer's yeast*, E.; *Levûre de bière*, Fr.; *Bierhefe*, G.; *Levadura de cerveza*, Sp.

The ferment obtained in brewing beer.

Origin and Description.—It has been previously stated (see ALCOHOL) that alcoholic fermentation depends upon the development of a minute fungoid vegetable, Saccharomyces cerevisiæ, *Schwann et Meyen*, which has also been named Torula (Cryptococcus, *Kützing*, s. Hormiscium, *Bail*) cerevisiæ, *Turpin*. Leuwenhoek (1680) noticed already, under the microscope, the spherical granules in yeast, but their nature as vegetable organisms was not recognized until after 1820. Persoon, Desmazières, Kützing, and others determined their unicellular condition; Latour observed their budding; and Schwann studied their development. Besides the one named above, Reess (1870) has distinguished a number of other forms which are met with in fermenting liquids only under certain conditions. The possible vegetation of these organisms in the absence of free oxygen seems to have been proven, but the exact conditions have not been determined.

FIG. 57.

Yeast-cells.

There are two varieties of brewer's yeast—the *upper* or *top yeast*, and the *lower* or *bottom yeast* (*Oberhefe* and *Unterhefe* of the Germans). The former is the kind most generally met with in the United States, and is a viscid, semi-fluid, frothy mass of a peculiar odor and bitter taste, and containing oval or globular microscopic cells from which smaller ones are developed by budding; it appears upon the surface of the fermenting liquid, kept at a temperature ranging between about 15° and 20° C. (59° and 68° F.). But wort fermented with top yeast at a temperature near or below 10° C. (50° F.) will produce both top and bottom yeast, the latter being solely reproduced by the fermentation from below (Untergährung, *G.*) at a temperature of about 9° C. (48° F.) and less. It consists of various-sized cells, differing from those of the top yeast in not having any small cells attached, and appears to be reproduced from isolated spores instead of by budding. The cell-membrane consists of a kind of cellulose, and encloses protein compounds.

At a temperature less than 5° C. (41° F.) the yeast-plant ceases to vegetate, but it may be exposed to a cold of —60° C. (—76° F.) without being killed. At an elevated temperature of 75° C. (167° F.), and above it loses its vitality unless water be absent, when it will not be destroyed by a temperature of 100° C. (212° F.) or more. On removing most of the water by pressure the *dry yeast* of commerce is obtained, which may be kept in this condition without material alteration. *Vienna yeast* is the same article, and is stated by Dr. Vigla (1871) to be made by fermenting a wort obtained from a mixture of maize and rye with barley malt, skimming off the froth, draining, and subjecting it to pressure. So-called *artificial* or *patent yeast* is either made of flour dough with the addition of a little yeast, or of an infusion of hops to which malt is subsequently added. Soxhlet and Pasteur (1876) proved that the only effect of hops, when thus used, is to impart some bitterness to the mass and somewhat delay the spoiling of the product.

When yeast is added to a solution of pure sugar, active fermentation takes place, the yeast being gradually rendered inert, but in the presence of albuminous matters in the saccharine liquid the yeast-plant is continually reproduced and augmented.

Some investigators have assumed the presence in yeast of a peculiar fermenting principle, *invertin*, which is prepared by Barth (1878) by expressing the water from yeast, drying it completely, heating for six hours to between 100° and 105° C. (212° and 221° F.), macerating with water at 40° C. (122° F.), and pouring the filtrate into six times its bulk of alcohol. The precipitate consists of the ferment and albumen, of which the latter is rendered insoluble by prolonged treatment with strong alcohol. Invertin is then dissolved by water, the solution precipitated by alcohol, and the precipitate dried, when it constitutes a brown horn-like mass, which is reduced to powder with difficulty.

Medical Uses.—As a topical remedy yeast has been spoken of under CATAPLASMA FERMENTI. It is generally described as nutritive and antiseptic when used internally. The former it can be only in a slight degree, from the fermented malt liquor which may be mixed with it. It is antiseptic through the carbonic acid which it evolves. There is no doubt that it has appeared to be serviceable in the *typhoid states* of febrile diseases, and that it really is so when applied as a dressing to *gangrenous* and *phagadenic sores*, whose fetor it corrects while it stimulates the nutritive processes in the affected tissues. That its action is stimulant is shown by the pain it sometimes causes and by its popular use in the treatment of recent *bruises*. Through its carbonic acid it must also be anodyne. The power of yeast to convert starch directly into alcohol has been invoked in the treatment of *diabetes*, and in a few cases has caused the total disappearance of sugar

from the urine. Some patients show signs of alcoholic intoxication while undergoing this treatment. The yeast may be given in doses of Gm. 32 (2 tablespoonfuls) immediately before meals. It has also been used in *scurvy*, *purpura*, *dysentery*, infantile *diarrhœa*, and *diphtheria* (*Centralbl. f. Therap.*, vii. 90).

CERII OXALAS, *U. S.*, *Br.*—Cerium Oxalate.

Cerium oxalicum, *Oxalas cericus*.—*Oxalate de cerium*, Fr.; *Oxalsaures Ceroxydul*, *Ceroxalat*, G.

Formula $Ce_2(C_2O_4)_3.9H_2O$. Molecular weight 704.78.

Origin.—The metal cerium was discovered in 1803 in a Swedish mineral simultaneously by Klaproth and by Berzelius and Hisinger. The last-named chemists called the mineral *cerite*, after the planet Ceres, then recently discovered, and the metal *cerium*. Mosander (1839 and 1840) observed in the supposed pure cerium oxide the oxides of two other hitherto unknown metals, which received the names of *lanthanum* and *didymium*. The three metals exist together as silicates in the cerite and allanite, the latter mineral being found in Scandinavia and in the States of New York and Pennsylvania. Mendelejeff (1870) first showed the atomicity of cerium in ceric compounds to be quadrivalent $= C^{IV}$, and in cerous compounds trivalent $= Ce^{III}$; its atomic weight was afterward determined to be 139.9.

Preparation.—To obtain cerium oxalate F. F. Mayer (1860) recommended the following process: The powdered mineral is heated with concentrated sulphuric acid to decompose the silicates, the dry mass ignited, then dissolved in dilute nitric acid, and treated with hydrogen sulphide to remove copper, etc. A little hydrochloric acid is added to prevent the precipitation of calcium salt, and the cerite metals are precipitated as oxalates by oxalic acid. The precipitate is mixed with magnesium carbonate, the mixture calcined to decompose the oxalates, the residue dissolved in a small portion of concentrated nitric acid, and the solution thrown into a large quantity of water containing about ½ per cent. of sulphuric acid. Lanthanum and didymium remain in solution, together with the magnesium and a little cerium, most of which is precipitated as yellow *ceric* sulphate; the latter is dissolved in sulphuric acid and reduced to cerous sulphate by sodium thiosulphate, when the oxalate may be precipitated by oxalic acid. Ouvrard has succeeded in freeing cerium entirely from lanthanum and didymium by fusing the nitrates with ten times their weight of saltpetre.

Properties and Tests.—Cerium oxalate is a white granular, inodorous, and tasteless powder, permanent in the air, insoluble in the simple solvents, but soluble in diluted sulphuric and hydrochloric acids without effervescence (absence of carbonates); and this solution is not precipitated or colored by hydrogen sulphide (absence of heavy metals). "When heated to redness it is decomposed, leaving a residue of reddish-yellow ceric oxide (a brown color would indicate the presence of didymium). On boiling the salt with potassium hydroxide test-solution, white cerous hydroxide is left as insoluble residue, while in the filtrate, supersaturated with acetic acid, calcium chloride test-solution will produce a white precipitate insoluble in acetic, but soluble in hydrochloric, acid. If the yellow residue left after heating be dissolved in concentrated sulphuric acid, and a small crystal of strychnine added, a deep-blue color appears, which rapidly changes to purple and then to red. From the solution in diluted hydrochloric or sulphuric acid potassium hydroxide test-solution precipitates white cerous hydroxide, which does not redissolve in an excess of the reagent, and gradually turns yellow in contact with air. Ammonium carbonate test-solution precipitates white cerous carbonate, which is somewhat soluble in an excess of the reagent. If 0.1 Gm. of cerium oxalate be dissolved in 1 Cc. of sulphuric acid, and 2 Cc. of potassium sulphate test-solution be added, small, colorless crystals of cerium potassium sulphate will be deposited after some time. On boiling the salt with potassium hydroxide test-solution and filtering, no precipitate should be produced in the filtrate either by ammonium chloride test-solution (absence of aluminum) or by ammonium sulphide test-solution (absence of zinc)."—*U. S.* When incinerated 10 grains lose 5.2 grains in weight.—*Br.*

Other Salts of Cerium.—Cerii carbonas, $Ce_2(CO_3)_3.9H_2O$ (mol. weight 620.99), is prepared by precipitating cerous sulphate (see above) with ammonium carbonate. The white flocculent precipitate changes to scales of a silvery lustre, which are insoluble in water and contain 52.4 per cent. of cerous oxide and 26.2 per cent. of water of crystallization.

Cerii bromidum. On dissolving cerous carbonate in hydrobromic acid and evaporating the solution, Bullock (1871) obtained a chocolate-colored, sweet, styptic mass which is freely soluble in alcohol, but leaves an insoluble residue of cerous compound on treatment with water. Cerium

chloride and iodide are likewise readily decomposed, the former becoming yellow, the latter brown, on exposure to the air.

Cerii nitras, $Ce(NO_3)_3.6H_2O$ (mol. weight 433.51). It is conveniently made by the mutual decomposition of cerous sulphate and barium nitrate, and filtering the cerous nitrate from the insoluble barium sulphate. The salt is very deliquescent, crystallizes in colorless prisms or scales, contains 37.9 per cent. of cerous oxide, and is freely soluble in water and alcohol.

Action and Uses.—Oxalate of cerium was presumed to be a sedative of disordered nervous action, because it seemed to be an efficient remedy for the *vomiting of pregnancy*. *Valerianate* of cerium has been successfully employed by Blondeau for the same disorder (*Bull. de Soc. de Thérap.*, 1884, p. 59). It has less frequently been used for vomiting due to irritable conditions of the stomach itself. This statement has been amply confirmed by general experience since it was first made. In proportion as vomiting is of reflex origin it is under the control of this medicine. This explanation is suggested also by its alleged efficacy in *sea-sickness*. Gardner, and also Waldron (*Med. Record*, xxxiii. 608, 704) found that in doses of Gm. 0.6–1.20 (10 to 20 grs) it controlled the vomiting. It is far less efficient, or fails altogether, when the symptom is the result of material gastric disease, such as simple or cancerous ulcer, or the wasting of the mucous membrane which sometimes causes habitual vomiting in advanced phthisis. Many cases designated as "dyspepsia" present material lesions of the stomach, and in these oxalate of cerium is as useless as bismuth is useful; the one generally fails, the other usually succeeds, in relieving the irritability of the organ. Some have even attributed to it curative virtues in epilepsy and chorea, but experience has not confirmed these statements. In 1880 (*Med. Record*, xvii. 492, 664) attention was drawn to this preparation as an efficient palliative of the *cough* of phthisis. It was represented, however, to be by no means uniform in its effects, and as soon losing its primary control over the symptom. It was thought to have over other cough medicines the advantage of not deranging the digestion. It was administered in 10-grain, and even in 20-grain, doses, without injury, and some specimens of it were found to be quite inert. It has also been used in chronic *bronchitis* or *asthma*, in neither of which can it be recommended. It may be prescribed in doses of from Gm. 0.05–0.20 (gr. j–iv) three times a day, but if these doses prove inoperative they may be increased even to twice or thrice as much. It may be given in pill or in powder, the latter being preferable. Simpson, who first used the preparations of cerium in medicine, regarded the oxalate as "almost a specific in *chorea*," and the nitrate as a nervine tonic "useful in chronic intestinal eruption, irritable dyspepsia with gastrodynia and pyrosis, and chronic vomiting generally, as well as in that of pregnancy. The dose is the same as that of the oxalate."

CETACEUM, *U. S., Br., P. G.*—Spermaceti.

Spermaceti.—*Spermaceti*, Fr., G.; *Blanc de baleine, Cétine, Ambre blanc*, Fr.; *Walrat*, G.; *Cetina, Bianco di balena*, It.; *Esperma de ballena*, Sp.

Nearly pure cetin, obtained from the head of the sperm whale, Physeter macrocephalus, *Linné*.

Class Mammalia. Order Cetacea. Family Physeteridæ.

Origin.—The sperm whale, or great-headed cachalot, is principally met with in the Pacific and Indian Oceans and the seas of Australia. It is 15 to 21 M. (50 to 70 feet) long, with a head fully one-third of its entire length and correspondingly thick. Anterior to the cranium the upper jaw has a large cavity containing an oily liquid, which is removed with buckets soon after the animal has been killed, and then congeals into a yellow mass. This is drained in suitable bags, and then strongly expressed to remove the oil; the pressed cake is purified by melting it in water, skimming off the impurities, boiling with weak potassa solution, and washing with water; it is finally allowed to congeal.

Description.—Spermaceti is in white, translucent, scaly-crystalline masses somewhat unctuous to the touch, of a slight fatty odor, a mild bland taste, a laminated pearly fracture, and of a neutral reaction. Its specific gravity is 0.943 (0.945, *U. S.*) at 15° C. (59° F.), melts near 50° C. (122° F.) (between 50° and 54° C., *P. G.*) to a clear and nearly colorless liquid, and congeals at about 45° C. (113° F.). It contains variable but small quantities of oil, which causes spermaceti to become yellowish on exposure to air and to acquire a rancid odor and acid reaction. It is insoluble in water and nearly so in cold alcohol, is slightly soluble in cold benzin and benzene, but dissolves in chloroform, ether, carbon disulphide, warm methyl and ethyl alcohol, and in fixed and volatile oils. On dry distillation an oily liquid, a solid fatty compound, and various gases and

volatile acids are obtained. Spermaceti is readily inflammable, and burns with a bright somewhat sooty flame.

Spermaceti oil is yellow, has an unpleasant odor, a density of .910, remains liquid at — 18° C. (— 0.4° F.), and is difficult to saponify.

Constituents.—When repeatedly recrystallized from boiling alcohol the fat is removed and Chevreuil's *cetin* is obtained, which crystallizes in soft white pearly scales, melts between 50.5° and 53.5° C. (123° and 128.3° F.), and is slowly decomposed by aqueous solution of potassa, but readily saponified on fusion with potassium hydroxide or on boiling with its alcoholic solution. It consists mainly of cetyl palmitate, $C_{16}H_{33}.C_{16}H_{31}.O_2$, which melts between 54.5° and 55° C. (130° and 131° F.), and yields on saponification palmitic acid and cetyl alcohol, or *ethal*, $C_{16}H_{34}O$. Heintz (1854) obtained also small quantities of myristic, lauric, and stearic acids, and of the alcohols methal, $C_{14}H_{30}O$, and stethal, $C_{18}H_{38}O$. When boiled with nitric acid spermaceti is slowly oxidized, œnanthylic, succinic, and other acids being found among the products.

Impurities and Adulterations.—Rancid spermaceti may be restored by boiling it with a weak solution of potassa, and afterward with water. The admixture of fats deprives it of its pearly lustre. "1 part of spermaceti should be completely dissolved by 50 parts of boiling alcohol spec. grav. .832 (absence of fats); after cooling the solution and filtering from the crystalline mass the filtrate should not have an acid reaction, and should yield at most a slight precipitate on the addition of water (absence of fatty acids)."—*P. G.* "On boiling 1 Gm. spermaceti with 1 Gm. exsiccated sodium carbonate and 50 Cc. alcohol, the cold filtrate, on being acidulated with acetic acid, should merely become turbid, but should not afford a precipitate (absence of stearic acid)."—*U. S., P. G.*

Pharmaceutical Preparations.—When needed in the form of powder, spermaceti is triturated in a mortar, a little alcohol being added from time to time; or, better still, it is fused, and then well triturated until cold.

Cetaceum saccharatum s. præparatum.—Prepared or saccharated spermaceti, *E.;* Blanc de baleine saccharé, *Fr.;* Walratzucker, *G.*—Spermaceti 1 part and white sugar 3 parts are rubbed together to a very fine powder.

Action and Uses.—Spermaceti, like other fatty substances, is a lenitive and protective. In the form of a fine powder and mixed with sugar (1 part to 3), it is a popular and useful remedy for commencing *sore throat* and catarrhal inflammation of the *air-passages*. *Alvine* and *urinary irritations* are also reputed to be benefited by its use. For these affections it is best administered in emulsion with the yolk of egg or with almond oil.

CETRARIA, *U. S., Br.*—Cetraria.

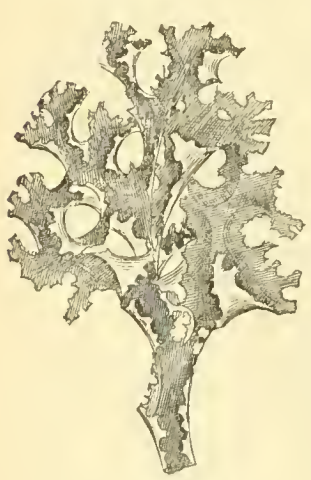
Lichen Islandicus, P. A., P. G.—*Iceland moss*, E.; *Lichen (Mousse) d'Islande*, Fr. Cod.; *Isländisches Moos, Isländische Flechte, Lungenmoos*, G.; *Liquen islandico*, Sp.

Cetraria islandica, *Acharius*, s. Lichen islandicus, *Linné*. Bentley and Trimen, *Med. Plants*, 302.

Nat. Ord.—Lichenes, Cetrariei.

Origin.—The plant is indigenous to the northern hemisphere; in its southern limits it is found in mountainous regions, and farther north in the plains. In North America it is met with southward to the mountains of North Carolina, northward throughout British America, and westward to the Rocky Mountains as far south as Colorado; in Europe it grows as far south as Spain and Italy, and in Asia throughout Siberia and in the Himalaya Mountains; it is plentiful in Iceland, from which island its name is derived.

Fig. 58.



Cetraria islandica.

Description.—It is from 5 to 10 Cm. (2–4 inches) high, foliaceous, irregularly branched, with smooth somewhat channelled, nearly linear, obtuse, toothed, and ciliate lobes; the upper surface is greenish-gray or olive-brown and toward the base red; lower surface whitish, with depressed spots; the apothecia or so-called fruits, when present, are situate near the margin, round or oval, chestnut-brown, and flattish with an elevated margin. When dry it is brittle and inodorous, but immersed in water it becomes soft, leathery, and cartilaginous, and has a slight odor; its taste is mucilaginous and bitter. Boiled with 20 parts of water, it yields a liquid which on cooling forms a bitter jelly; and on diluting

this with an equal weight of water and adding alcohol a flocculent precipitate is obtained, which while moist is colored blue by iodine.

Impurities, such as pine-leaves and mosses and other lichens, are usually found in the commercial article, and the drug frequently requires garbling. Adulterations are not likely to be intentional, but the lichen, as collected from different localities, is apt to vary somewhat in size and color and in the shape and width of the divisions.

Constituents.—Iceland moss was last analyzed by Knop and Schnedermann (1845). The principal constituent is *lichenin* or *lichen starch*, $C_{12}H_{20}O_{10}$, which is present to the amount of 70 per cent. It separates from the decoction as a jelly; on washing this frequently with pure water, T. Berg (1873) removed a carbohydrate called *isolichenin* (Errera, 1882), which is colored blue by iodine, is precipitated by alcohol, insoluble in ammoniated copper, soluble in zinc chloride, and is not altered by boiling potassa solution. Lichenin is not colored by iodine, is soluble in zinc chloride and in ammoniated copper, combines with potassa, and swells in cold water without dissolving. The bitter taste is due to about 2 per cent. of *cetraric acid* or *cetrarin*, $C_{18}H_{16}O_8$, which is contained, in an uncombined state, mainly in the outer layer of the tissue. It forms colorless fine needles, nearly insoluble in water, but soluble in boiling alcohol and alkalies, and yields with ammonia a yellow very bitter solution, which on exposure turns brown. The other constituents of Iceland moss are *lichen-stearic acid*, $C_{14}H_{24}O_3$ (about 1 per cent., soluble in alcohol, ether, volatile oils, and fats, fusible at 120° C.), *thallochlor* (a variety of chlorophyll, not soluble in hydrochloric acid), *fumaric* (formerly called *lichenic*) and *oxalic acids*, sugar, etc., and 16.7 per cent. of cellulose. The production of alcohol from Iceland moss, as proposed by Sten. Stenberg (1870), depends upon the formation of glucose from lichenin by boiling with a dilute acid. Iceland moss yields about 2 per cent. of ash.

Pharmaceutical Preparations.—LICHEN ISLANDICUS AB AMARITIE LIBERATUS is Iceland moss freed from bitterness, for use in decoction or jelly, by maceration in solution of potassium carbonate, and afterward well washing in cold water.

GELATINA LICHENIS ISLANDICI, Iceland-moss jelly. "Boil 3 parts of Iceland moss for half an hour with 100 parts of water, express, strain, and, after adding 3 parts of white sugar, evaporate to 10 parts." The French Codex adds about 3 per cent. of orange-flower water.

GELATINA LICHENIS ISLANDICI SACCHARATA SICCA.—Saccharure (Gelée sèche) de lichen, *Fr.*—10 parts of Iceland moss are deprived of bitterness by heating to boiling with a small quantity of water, expressing, and washing with cold water (or as stated above); the residue is exhausted by boiling with water for 1 hour; the decoctions are strained and decanted, mixed with 10 parts of sugar, evaporated, dried, and powdered.—*F. Cod.* It has a gray-brown color.

Action and Uses.—Iceland moss is nutritious, demulcent, and tonic. The first two properties it owes to the starch in its composition, the last to its bitter principle, cetrarin. It increases the appetite, promotes digestion, and improves nutrition. It does not excite the circulation nor constipate, but in excessive doses may occasion nausea and diarrhœa. Its bitterness is said to be perceptible in the milk of nursing women who use it.

This medicine has been chiefly employed as a remedy for chronic *pulmonary affections* attended with profuse expectoration and cough and with more or less of the other symptoms belonging to consumption. It acts in these by its nutritious qualities in part, but more usefully by reducing the bronchial secretion, and thereby lessening both the waste of tissue and the fatigue of coughing. The amount of good which the medicine can effect will depend upon how far the *bronchitis*, which it chiefly influences, is simple. If this is accompanied by compression of the lung originating in pleurisy, or consolidation of the lung produced by pneumonia or by tubercle, etc., the influence of the remedy must necessarily be subordinate, or even null. Chronic *diarrhœa* and *dysentery* are sometimes greatly benefited by it. Kobert found cetrarin to increase the richness of the blood, and thereby quicken all the nutritive processes. In this manner it relieves *constipation* caused by debility. Iceland moss is usually administered in decoction, but an infusion is sometimes prepared by steeping Gm. 90 (℥iij) of bruised cetraria in Gm. 750 (f℥xxiv) of boiling water for three hours, evaporating the liquid with gentle heat to the consumption of one-half, and adding Gm. 4 (gr. lx) of extract of liquorice. Of this a fluidounce may be taken every three or four hours in chronic bronchitis with urgent cough. A decoction made with milk is less bitter, and may be employed as food. Either of the pharmaceutical preparations mentioned above will be found convenient. Cetrarin has been given in doses Gm. 0.1 (gr. iss).

CHAMÆLIRIUM.—Starwort.

Blazing star, Devil's bit, False unicorn-root, E.

The rhizome of Chamælirium (Veratrum, *Linné*) luteum, *Gray*, s. Cham. carolinianum, *Walter*, s. Helonias lutea, *Aiton*, s. Hel. dioica, *Pursh*.

Nat. Ord.—Melanthaceæ.

Origin.—The plant is indigenous to Canada and the United States, where it grows in low grounds west to the Mississippi. The stem is about 45 Cm. (18 inches) high; the leaves are alternate, spatulate below, lanceolate above, smooth; and the small whitish flowers are in a dense terminal raceme, which is rather slender on the barren plant, about 15 Cm. (6 inches) in length. It flowers in May and June.

Description.—The oblique rhizome is about 25 Mm. (1 inch) long and 6 Mm. (¼ inch) in diameter, somewhat curved, of a dark gray-brown color, closely annulated from the leaf-scars, on the upper side with a few circular stem-scars, on the lower side with wiry rootlets or their scars in lines parallel with the leaf-scars. The rhizome breaks with a nearly smooth and horny fracture, and shows on a transverse section the fibro-vascular bundles crowded together near the centre, with a few scattered near the surface, passing into the rootlets. The drug is destitute of odor and has a strongly bitter taste. We have repeatedly found it as an admixture with the commercial rhizome of Aletris, from which it is easily distinguished.

Constituents.—Dr. F. V. Greene (1878) extracted from it the bitter principle, which he proposed to call *chamælirin*, and of which over 9 per cent. was obtained. It is prepared by evaporating the cold aqueous infusion with magnesia, washing the dry mass with ether to remove fatty acid, and extracting with absolute alcohol, concentrating, diluting with water, treating with animal charcoal, and evaporating. It is a yellowish-white neutral powder, freely soluble in water and alcohol, the solutions frothing like those of saponin, but insoluble in other simple solvents. With sulphuric acid an orange color is produced, changing to crimson, brown, green, and purple, after which it fades. Chamælirin is also soluble in and colored reddish by strong hydrochloric acid, and yellowish-brown by Fröhde's reagent. It has a very bitter taste, and is split by dilute acids into glucose and a resinous body, *chamæliretin*, which is soluble in alcohol and ether, insoluble in water, and is colored brown by sulphuric acid. The so-called *helonin* of the eclectics is the hydro-alcoholic extract of the rhizome.

Action and Uses.—Starwort is reputed to be tonic, diuretic, and anthelmintic. An infusion of the rhizome has been found useful in atonic *dyspepsia* and for checking nausea and vomiting. It is also claimed by certain pseudo-physicians to be a "uterine tonic," "removing abnormal conditions and imparting tone to the reproductive organs." "It has been somewhat extensively used in the treatment of leucorrhœa, amenorrhœa, and dysmenorrhœa, and likewise with a view of correcting the tendency to repeated miscarriage." All of these ailments are usually associated with dyspepsia, constipation, and anæmia, and have from time immemorial been cured with bitter tonics, and for a long while with iron and cinchona. It is incredible that a medicine which depresses the heart and the nervous system should remove ailments that depend essentially upon the debility of exhaustion. An infusion of chamælirium may be prepared with an ounce of the rhizome, Gm. 32 to Gm. 500 (a pint) of water, and given in doses of a wine glassful.

CHARTÆ.—Medicated Papers.

Papiers sparadrapiques, Fr.; *Medicamentirte Papiere*, G.

This class of preparations was introduced into the 1880 edition of the United States and 1867 edition British Pharmacopœias; they resemble plasters spread upon non-absorbent paper, the process necessarily varying with the nature of the material. Similar preparations have been long in use on the continent of Europe; one which enjoys considerable popularity is—

Charta antirheumatica, s. antarthritica, s. resinosa, Sparadrapum antharthriticum.—Antirheumatic paper, *E.*; Papier antirhumatique, P. antiarthritique, *Fr.*; Gichtpapier, *G.*—Melt together 10 parts of resin, 6 parts each of black pitch and turpentine, and 4 parts of yellow wax; strain and spread upon paper.—*P. G.* 1872. The same preparation of the Belgian Pharmacopœia is a cerate containing 1 per cent. of ethereal extract of mezereon. The *Papier au garou* of the French Codex is spread with a cerate containing 3 per cent. (No. 1) or 4 per cent. (No. 2) of ethereal extract of mezereon.

The process of coating such papers is sufficiently described by the pharmacopœial

directions. It is, however, sometimes convenient to spread certain cerates or plasters directly upon paper, which may be accomplished by fastening the latter upon a smooth table by means of thin iron ledges attached lengthwise to the margin, then pouring the melted and partly-cooled material upon the paper and spreading it rapidly, using a warm smooth iron which is long enough to rest upon both ledges; a very uniform and quite thin coating may thereby be obtained. If the material melts to a uniform mass a flat brush may be employed, and care should be taken to apply it in one direction only. Should it be desirable to render the paper more impervious, it may be coated first with well-boiled linseed oil, and then exposed to the air until perfectly dry, after which the material is applied in the manner described. In most cases, however, the intention is to impregnate the paper to some extent with the plaster-like material, which is most readily effected by placing two sheets of the paper upon smooth sheet iron, which is kept warm by means of a low fire or of a sand-bath; some of the melted mass is poured upon the upper sheet, and spread with some pressure by means of a pad about 3 inches in diameter and formed of cotton or tow, which is first covered with tin-foil and then with two or three layers of flannel. When the upper sheet has been thoroughly and uniformly impregnated, it is replaced by another, and this is repeated until the desired quantity of paper has been obtained. The lower sheet of paper is used merely to protect the others from becoming soiled.

The last-described method is followed in making *wax paper*, *Charta cerata*, thin, well-sized paper being impregnated with white wax. It is very convenient for dispensing odorous substances, powders containing volatile oil, etc., for covering soft plasters, and for various other purposes. *Paraffin paper*, prepared in the same way, is employed in a similar manner.

Of an entirely different nature is the potassium nitrate paper which was admitted into the U. S. Pharmaeopœia of 1880, and which consists of unsized paper containing minute crystals of potassium nitrate uniformly distributed through the pulp.

CHARTA EPISPASTICA, *Br.*—Blistering Paper.

Charta cantharidis, U. S. 1880; *Charta vesicatoria.—Cantharides paper*, E.; *Papier vésicant*, *P. épispastique*, *Papier à vésicatoire aux cantharides*, Fr.; *Spanischfliegen-Papier*, G.

Preparation.—Take of White Wax 4 ounces; Spermaceti 1½ ounces; Olive Oil 2 fluidounces; Resin ¾ ounce; Canada Balsam ¼ ounce; Cantharides, in powder, 1 ounce; Distilled Water 6 fluidounces. Digest all the ingredients, excepting the Canada balsam, in a water-bath for two hours, stirring them constantly; then strain and separate the plaster from the watery liquid. Mix the Canada balsam with the plaster melted in a shallow vessel, and pass strips of paper over the surface of the hot liquid, so that one surface of the paper shall receive a thin coating of plaster. It may be convenient to employ paper ruled so as to indicate divisions, each of which is 1 square inch.—*Br.*

White Wax 8 parts; Spermaceti 3 parts; Olive Oil 4 parts; Canada Turpentine 1 part; Cantharides, in No. 40 powder, 1 part; Water 10 parts. Mix all the substances in a tinned vessel and boil gently for two hours, constantly stirring. Strain through a woollen strainer without expressing, and by means of a water-bath keep the mixture in a liquid state in a shallow, flat-bottomed vessel with an extended surface. Coat strips of sized paper with the melted plaster, on one side only, by passing them successively over the surface of the liquid; when dry, cut the strips into rectangular pieces.—*U. S.* 1880.

The second formula is that of the French Codex.

Action and Uses.—Cantharides paper forms a neat and efficient blistering agent, and is very convenient when the vesicant action is to be accurately limited, as in blistering over nerves and veins, near the eye, etc. It is, however, less efficient than cantharides cerate when a full and prolonged vesicant operation is desired. Before applying it the skin should be cleansed with warm soap-and-water.

CHARTA POTASSII NITRATIS, *U. S.*—Paper of Potassium Nitrate.

Charta nitrata, P. G.—*Saltpetre paper*, E.; *Papier nitré*, Fr.; *Salpeterpapier*, G.; *Carta nitrata*, It.

Preparation.—Potassium Nitrate 200 Gm.; Distilled Water 800 Cc. Dissolve the potassium nitrate in the distilled water. Immerse strips of white, unsized paper in the solution and dry them. Preserve the paper in securely-closed vessels.—*U. S.*

If 4 av. ozs. and 75 grains of potassium nitrate be dissolved in 1 pint of distilled water, the solution will be of the strength directed by the Pharmacopœia, which is very nearly saturated.

This is the formula of the P. G. 1872; in the recent edition of this work the salt is to be dissolved in 5 parts of water.

Ordinary saltpetre will answer if the paper is to be used for moxas, but for the preparation of *medicated cigarettes* potassium nitrate free from chloride should be used, and the paper should also be free from chlorine compounds. Such cigarettes are either made in the same manner as ordinary cigars, except that stramonium, belladonna, hyoscyamus, or other leaves are substituted for tobacco, or the nitrated paper is impregnated with other solutions, or simply rolled into a thin tube having the edges fastened with a trace of gelatin; the substance whose smoke is to be inhaled is then introduced and the paper tube ignited at one end, when combustion without flame takes place. The following is a formula for *cigarettes antiasthmatiques* which is much employed in France: A decoction is made of 5 Gm. each of the leaves of belladona, stramonium, digitalis, and sage with 1000 Gm. of water, and strained. 75 Gm. of potassium nitrate and 40 Gm. tincture of benzoin are added, and into this solution is then introduced, sheet by sheet, one quire of red-tinted absorbent paper, the whole remaining in contact for 24 hours; after which time the paper is dried and cut into rectangular pieces of 10 by 7 Cm., which are formed into tubes by rolling them around a thin cylinder about 1 or 1½ Mm. in diameter and fastening the edge with gelatin.

For forming *moxas* of nitrated paper it is rolled into pretty firm cylinders having a diameter of about ¾ inch, which are afterward cut into pieces of suitable lengths.

Action and Uses.—Under POTASSII NITRAS the uses of this medicated paper are described. It is intended to be burned and its fumes inhaled. Since the investigations of Reichert on potassium nitrite (*Amer. Jour. of Med. Sci.*, July, 1880, p. 158) there is some reason to think that, besides relieving nervous *asthma* by its irritant action on the bronchial mucous membrane, potassium nitrate may be converted during combustion into potassium nitrite, which, like nitrite of amyl, has an anæsthetic action.

CHARTA SINAPIS, *U. S., Br., F. Cod.*—MUSTARD PAPER.

Charta sinapisata, P. G.; *Papier sinapise, Moutarde en feuilles*, Fr.; *Senfpapier*, G.; *Carta senapata*, It.

Preparation.—Black Mustard, in No. 60 powder 100 Gm. (about 3½ ozs.); Caoutchouc, 10 Gm. (about 155 grains); Benzin, Carbon Disulphide, each a sufficient quantity. Pack the black mustard in a conical percolator, and gradually pour benzin upon it until the percolate ceases to produce a permanent greasy stain upon blotting paper. Remove the powder from the percolator and dry it by exposure to the air. Having meanwhile dissolved the caoutchouc in a mixture of 100 Cc. (about 3½ fluidounces) each of benzin and carbon disulphide, mix the purified mustard with a sufficient quantity of the solution to produce a semi-liquid magma, and apply this, by means of a suitable brush, to one side of a piece of rather stiff, well-sized paper, so as to cover it completely, and then allow the surface to dry. A surface of sixty square centimeters should contain about 4 Gm. of black mustard deprived of oil. Before it is applied to the skin mustard paper should be dipped in warm water for about fifteen seconds.

Take of Mustard (black and white), in powder, 1 ounce; Solution of Gutta-percha 2 fluidounces or a sufficiency. Mix the mustard with gutta-percha solution so as to form a semi-fluid mixture, and having poured this into a shallow flat-bottomed vessel, such as a dinner-plate, pass strips of cartridge-paper over its surface, so that one side of the paper shall receive a thin coating of the mixture. Then lay the paper on a table with the coated side upward, and let it remain exposed to the air until the coating has hardened. Before being applied to the skin let the mustard paper be immersed for a few seconds in tepid water.—*Br.*

The mustard, previous to powdering, should be deprived of most of its fixed oil by pressure, or the powdered mustard may, with the same end in view, be treated with benzin, as above directed, or with carbon disulphide. Rigollot (1867), who introduced this preparation, already called attention to the removal of the oil to prevent rancidity, and gave preference to a solution of caoutchouc as the adhesive agent. Hager (1867) regarded a solution of resin as equally useful, and recommended the paper to be first covered with the solution, and the powder to be sifted upon the adhesive layer and pressed, preferably by passing between cylinders suitably adjusted so as to make the

stratum uniform and the surface smooth. Following the pharmacopœial directions, by spreading the soft mixture upon paper a layer more uniform in thickness is obtained than by merely passing it over the surface of the former. If the paper has been properly prepared the mustard will adhere well without peeling off on bending.

Action and Uses.—Mustard paper forms a very convenient means of obtaining the effects of a sinapism. Before being applied it should be immersed for a few seconds in warm (not hot) water.

CHELIDONIUM, *U. S.*—Chelidonium.

Herba chelidonii.—Celandine, Tetterwort, E.; *Chélidoine, Herbe à l'hirondelle*, Fr.; *Schöllkraut*, G.; *Celidonia mayor*, Sp.

The herb of Chelidonium majus, *Linné.*

Nat. Ord.—Papaveraceæ.

Origin.—A perennial herb indigenous to Europe and introduced on this continent. It grows in waste places, and flowers from May to September.

Description.—The root is several-headed, fusiform, about 15 Mm. ($\frac{3}{5}$ inch) in diameter, branching, somewhat scaly, and of a red-brown color externally, deeply wrinkled, and internally whitish. The stem is 30, 60, or 90 Cm. (1, 2, or 3 feet) high, light-green, hairy, obtusely angled, with thickened joints, brittle and branching; the leaves are 15 or 20 Cm. (6 or 8 inches) long, and petiolate, the upper ones short-petiolate or sessile, alternate, oblong or oval in outline, lyrately pinnatifid or pinnate, the terminal segment obovate and mostly three-lobed, the others ovate, cut-toothed, or lobed, obtuse, somewhat hairy, light-green above and glaucous underneath. The flowers are in small four- to eight-rayed auxillary umbels on long peduncles, have a calyx of two caducous sepals, four obovate yellow petals, about twenty stamens, and produce long linear one-celled and two-valved capsules containing many crested seeds. All parts of the plant contain a bright saffron-colored milk-juice. In the fresh state the odor is rather unpleasant, disappearing almost completely on drying; the taste is bitter and acrid. The herb should be gathered when it begins to flower.

Constituents.—Probst (1838), and shortly afterward Polex, isolated from celandine two alkaloids, *chelidonine* and *chelerythrine* or *pyrrhopine;* the latter Probst (1840) declared to be identical with sanguinarine, which was proven by Shiel (1855). Chelidonine, $C_{19}H_{17}N_3O_3$, is separated from chelerythrine by ether, in which it is insoluble; it crystallizes in colorless shining plates, has a bitter, afterward acrid taste, and yields with acids colorless salts having an acid reaction and a strongly bitter taste. Probst isolated also *chelidoxanthin*, which crystallizes in small yellow needles, has a bitter taste, is insoluble in ether, sparingly soluble in alcohol, and freely soluble in hot water; it is not altered by acids or alkalies. E. Schmidt (1890) isolated from the raw alkaloids of commerce, besides the two mentioned above, also *α-* and *β-chelidonine* and *protopine.* The last alkaloid is said to be identical with protopine of sanguinaria and opium. The alkaloids are combined with malic and *chelidonic acid*, $C_7H_4O_6$ (Lerch, 1846). The latter is slightly soluble in cold water and alcohol, crystallizes from hot water in colorless silky needles having a strongly acid taste and becoming opaque on exposure, is bibasic, decomposes carbonates, dissolves metallic iron and zinc, and yields white-lead salts insoluble in water and acetic acid. When boiled with an alkali, acetone and oxalic acid are produced. By an excess of cold alkali it is converted into a yellow acid yielding yellow lead salts and red ferric salts (Lieben and Haitinger, 1873); this new acid is doubtless identical with Zwenger's (1860) *chelidoninic acid*, which was regarded as succinic acid by Walz (1860). The other constituents are those of common occurrence—gum, extractive, albumen, chlorophyll, etc.

Pharmaceutical Preparations.—Extractum chelidonii. The expressed juice is freed from albumen by heating to 80° C. (176° F.), evaporated to a small bulk, mixed with an equal weight of alcohol, strained from the gummy precipitate, and the filtrate evaporated to the proper consistence.—*P. G.* 1872. It has a dark-brown color.

Allied Plants.—Glaucium luteum, *Scopoli*, s. Chelidonium Glaucium, *Linné.*—Horn poppy, *E.;* Pavot cornu, *Fr.;* Hornmohn, *G.*—A biennial plant, a native of Europe and to some extent naturalized in the United States. It grows mainly near the sea-coast, has pale-green, glaucous, clasping pinnatifid or sinuate toothed leaves, yellow flowers, and linear capsules which are beset with numerous short projections. It is less acrid than celandine: the juice, particularly of the root, is saffron-yellow, and contains, besides sanguinarine, the white alkaloids *glaucine* and *glaucopicrine:* the former is in the herb, the latter in the root. Glaucium corniculatum, *Curtius*, has similar properties; the petals are scarlet-red, with a black spot near the base.

Action and Uses.—The yellow juice which exudes from this plant when wounded was formerly employed, according to the doctrine of signatures, as a remedy for jaundice; and it justified the superstition in so far that by violent purging it relieved cases of the disease depending upon obstruction of the gall-ducts with inspissated bile. In experiments upon animals, and in certain cases of poisoning in man, its effects were those of a violent local irritant, with a special narcotic action upon the nervous system. The fresh plant, as well as the juice, irritates the skin, and the latter is in popular use as a remedy for *warts*. In many rural districts of Europe the fresh juice is employed as a purgative in *jaundice*, abdominal *dropsy*, and inveterate *intermittent fever*, as well as in *scrofula* and chronic *diseases of the skin*. Like other drastic cathartics, it is sometimes used as a vermifuge. When the fresh juice can be obtained it is given in doses of Gm. 2–3 (gtt. xxx–xl), or more, in sweetened water or in whey. An extract is used in doses of about Gm. 0.60 (gr. x), and an infusion is made with half an ounce of the plant, Gm. 16 to Gm. 500 (a pint) of water.

Glaucium luteum is stated by Cazin to be a narcotic poison, and he refers to a case in which, having been eaten by mistake, it occasioned delirium and made all objects appear yellow. It is said to be used by the peasants in Provence for the cure of ulcers, bruises, stings, etc., both in man and animals, and to act as an anodyne when applied to hæmorrhoids and spasmodic stricture of the anus. The juice, mixed with white of egg, is employed for the latter purposes.

CHELONE.—Balmony.

Snakehead, *Turtlehead*, *Shellflower*, E.; *Chelone*, Fr., G.

The herb of Chelone glabra, *Linné*.

Nat. Ord.—Scrophulariaceæ.

Origin.—The plant is perennial, a native of Canada and the United States south-westward to Texas, grows in wet places, and flowers from July to September. The white corolla is inflated, two-lipped, with the upper lip arched and the mouth a little open; hence the botanical and some of the popular names.

Description.—The stem is 2 to 3 feet (60 to 90 Cm.) high, nearly simple and smooth; the leaves are opposite, nearly sessile, oblong-lanceolate, pointed, serrate, smooth, and shining above. The flowers are in a short, dense terminal spike, and have the lower lip bearded in the throat and the four stamens with woolly filaments and woolly heart-shaped anthers. The plant is inodorous and has a decidedly bitter taste.

Constituents.—The bitter principle appears to be soluble in alcohol and water, but has not been isolated.

Action and Uses.—The extreme bitterness of the leaves of this plant probably led to its medicinal use by the American aborigines. It is not, however, tonic, but laxative or purgative according to the dose of it employed. Like other active cathartics, it is reputed to "act upon the liver." It is sometimes used as a purgative in *jaundice* and as an *anthelmintic*. The *dose* of the powder is Gm. 4 (℥j). A decoction made with Gm. 60 to Gm. 500 (℥ij in Oj) may be given in the dose of Gm. 64 (2 fluidounces).

CHENOPODIUM, *U. S.*—Chenopodium.

Fructus chenopodii anthelmintici.—American worm-seed, E.; *Anserine vermifuge*, (*plante fleurie*), F. Cod.; *Amerikanischer Wurmsamen*, G.; *Epazote*, Sp.

The fruit of Chenopodium ambrosioides, *Linné*, var. anthelminticum, *Gray;* Ambrina anthelmintica, *Spach;* Orthosporum (Chenopodium, *Linné*) anthelminticum, *R. Brown*. Bentley and Trimen, *Med. Plants*, 216.

Nat. Ord.—Chenopodiaceæ.

Origin.—The genus Chenopodium is characterized by alternate leaves and bractless flowers with a five-cleft calyx, five stamens, two or three styles, and bearing a one-seeded utricle as fruit. The plants are frequently covered with a white mealiness. The officinal species is never mealy, but viscid glandular. The stem is angular and branched; the leaves are short petiolate, oblong or ovate, narrowed at both ends, remotely toothed; the small greenish flowers are in dense and leafy spikes; the fruit is enclosed in the calyx. The variety differs from the typical form by having usually a perennial root, the leaves more deeply toothed, the lower being often deeply incised, and the dense racemes usually leafless. Both forms are indigenous to the West Indies, Central and South America, and have become completely naturalized in this country, the typical form having also estab-

lished itself in some portions of Europe and Southern Africa. The variety is cultivated in Maryland with a view of obtaining the oil, and is quite frequent in waste places in the Southern and in some of the Middle States.

Description.—The fruit is about $\frac{1}{12}$ inch (2 Mm.) in diameter, depressed or irregular globular, glandular when viewed with a magnifier, of a dull-green color, assuming a brownish tint on exposure; the thin, friable, but not brittle integuments enclose a vertical seed which is lenticular in shape, obtuse at the edge, brownish-black and glossy, and has the embryo strongly curved around the albumen. The fruit has a peculiar aromatic somewhat terebinthinate odor and a bitterish and pungent taste. The fruit of Chen ambrosioides cannot be distinguished from the official, except by its weaker and rather pleasanter odor.

Constituents.—American wormseed has not been analyzed; its medicinal importance is due to volatile oil (see OLEUM CHENOPODII), which is the only preparation for which the fruit is used.

Allied Species.—Several European pharmacopœias recognize the herb of Chen. ambrosioides, *Linné*, which is known as Herba botryos mexicanæ; Mexican tea, *E.*; Ambroisie du Mexique, Thé des Jésuites, *F. Cod.*; Mexikanisches Traubenkraut, *G.*; Té de España, *Sp.*

CHEN. BOTRYS, *Linné.*—Jerusalem oak, Feather geranium, *E.*; Chénopode à grappes, *Fr.*; Traubenkraut, *G.*—It is indigenous to Asia and Europe, and naturalized to some extent in North America. It is glandular pubescent, has oblong sinuate-pinnatifid leaves and leafless cymose racemes of greenish flowers, and is strongly aromatic.

CHEN. BONUS-HENRICUS, *Linné.*—Good King Henry, *E.*; Bon Henry, *Fr.*; Guter Heinrich, *G.*; Zeñiglo, *Sp.*—A European plant somewhat naturalized here. It is slightly mealy, and has triangular halberd-shaped leaves which have a mucilaginous saline taste.

CHEN. ALBUM, *Linné.*—Pigweed, Lamb's quarters, *E.*; Ansérine sauvage, *Fr.*; Weisser Gänsefuss, *G.*—A variable mealy annual, common in cultivated ground. The leaves vary between rhombic-ovate and lanceolate, and are angulate-toothed, the upper ones often entire. The taste is mucilaginous and saline.

CHEN. VULVARIA, *Linné.*—Fetid Goosefoot, *E.*; Stinkender Gänsefuss, *G.*; Ansérine puante, Vulvaire, *F. Cod.*—It is indigenous to Western Central Europe; the leaves are covered with a whitish mealiness, and the plant smells strongly of fish-brine, due to *trimethylamin*.

Action and Uses.—All parts of the plant producing worm-seed possess anthelmintic properties, and were long used by the Southern negroes and others as a vermifuge for *lumbricoid worms*, the expressed juice and the seeds being most commonly employed. These have been supplanted by the oil (oleum chenopodii). The fresh expressed juice may be given in doses of Gm. 16 (a tablespoonful) two or three times a day. A decoction made by boiling an ounce of the leaves, Gm. 30 in Gm. 500 (a pint) of milk or water has also been used. The bruised or pulverized seeds may be given in an electuary in doses of Gm. 1.30 (20 or more grains) three times a day. Carbonate of iron may be advantageously added to this preparation. After the anthelmintic has been used for days a purgative dose of castor oil should be administered.

Chenopodium ambrosioides and C. vulvaria are used in Europe for various nervous derangements, both internally and topically. C. Bonus-Henricus is a popular remedy in Europe for many local pains. The contused plant, mixed with butter, is applied. C. botrys is reputed to be a stimulant expectorant and antispasmodic, and C. olidum to have similar properties.

CHIMAPHILA, *U. S.*—CHIMAPHILA.

Pipsissewa, Prince's pine, Wintergreen, E.; *Herbe de pyrole ombellée*, Fr.; *Doldenblüthiges Harnkraut, Wintergrün*, G.

The leaves of Chimaphila umbellata, *Nuttall*, s. Chim. corymbosa, *Pursh*, s. Pyrola umbellata, *Linné*. Bigelow, *Med. Bot.*, ii. 21; Woodville, *Med. Bot.*, v.; Bentley and Trimen, *Med. Plants*, 165.

Nat. Ord.—Ericaceæ, Pyroleæ.

Origin.—The genus is characterized by flowers having five petals, ten stamens with the filaments enlarged in the middle and the anthers conspicuously two-horned; the short style, with the disk-like and five-lobed stigma, is nearly immersed in the top of the ovary; the capsule is five-celled and many-seeded. The officinal species is a low shrub, 10 to 20 Cm. (4 to 8 inches) high, bearing the leaves near the summit of the stem, and a terminal peduncle with five or six wax-colored flowers in a corymbose umbel. It is indigenous to North America, Northern Asia, and Northern and Central Europe; is found in dry woods, and flowers in June and July.

Description.—The leaves are 25 to 50 Mm. (1 to 2 inches) long, on very short petioles, oblanceolate and sharply serrate above, with the base wedge-shaped and entire, leathery, upper side dark-green and glossy, paler beneath. They are nearly inodorous, and have a sweetish afterward astringent and bitterish taste.

The closely-allied Chim. maculata, *Pursh*, spotted wintergreen or pipsissewa, with lanceolate or ovate-lanceolate and toothed leaves, which are variegated with white on the upper surface, is indigenous to North America, and is used like the preceding. The leaves have the same constituents as the Pyrolas, but contain citric instead of malic acid (E. N. Smith).

Constituents.—Besides the widely-diffused principles sugar, gum, etc., S. Fairbank (1860) found tannin, and obtained 5.24 per cent. (of the dry leaves?) of ash. The tannin amounts to 4.15 per cent. (Bowman, 1869). On distilling the stems with water, golden-yellow crystals of *chimaphilin* are obtained in the neck of the retort; these are inodorous and tasteless, slightly soluble in water and freely soluble in alcohol, ether, chloroform, and the fixed and volatile oils. It may also be obtained from the tincture (of the leaves alone?) made with diluted alcohol by agitating it with water. Zwenger and Himmelmann (1864) isolated from the leaves *arbutin*, which, together with tannin, was found by J. Oxley (1872) and E. N. Smith (1881) in several other ericaceous plants. (See EPIGÆA, GAULTHERIA, and UVA URSI.) It does not contain andromedotoxin.

Allied Plants.—1. PYROLA ROTUNDIFOLIA, *Linné;* 2. P. CHLORANTHA, *Swartz;* and 3. P. ELLIPTICA, *Nuttall.*—Shinleaf, Wintergreen, *E.:* Pyrole, *Fr.:* Waldmangold, *G.*—These species are indigenous to North America, the first one also to Europe and Asia. They have thin rhizomes, a cluster of radical petiolate leaves, and simple racemes of nodding wax-like flowers. The leaves are leathery, orbicular, and glossy (in 1), short-petiolate, suborbicular, and dull-green (in 2), or thin, not glossy, elliptic or oval-obovate (in 3); in odor and taste they resemble the preceding. E. N. Smith (1881) showed them to contain arbutin, ericolin, urson, tannin, malic acid, gum, sugar, albumen, and a trace of volatile oil.

Action and Uses.—The fresh bruised leaves of pipsissewa applied to the skin cause redness, and even vesication. Internally, it is diuretic, tonic, and astringent, and, like uva ursi, darkens the urine by means of the tannin it contains. Indeed, in all its operations it closely resembles uva ursi. It was used by the natives and by the early settlers of this country for *rheumatism* and *nephritic* disorders. The former disease in the joints was treated with fomentations or poultices of the leaves, while a hot decoction of them was administered internally, to the production of sweating. In cases of scanty or suppressed secretion of *urine* it was often resorted to, as well as in *gravel* and *hæmaturia* from various causes. The cure of many cases of *dropsy* was attributed to its use, and the evacuation of the fluid through the kidneys in other cases depending upon incurable organic lesions. Physicians of sound judgment have testified to its usefulness in *scrofula* of the glands and skin, both as an internal remedy and as an application to scrofulous ulcers. In the treatment of dropsy and of scrofula the generally superior efficacy of other medicines should not cause this one to be overlooked. Chimaphila has also been prescribed in the treatment of *intermittent fever*, chronic *diarrhœa*, *leucorrhœa*, and *gleet*, and Pyrola rotundifolia has been similarly employed. The best form of the medicine is the decoction or the fluid extract.

CHINOIDINUM.—CHINOIDINE.

Chinioidinum, *Chinoidina*, *Quinoidina.*—*Quinoidine*, E., Fr.; *Amorphous quinine*, E.; *Quinine amorphe*, Fr.; *Chinoidin*, G.

Preparation.—In the preparation of quinine sulphate, cinchonine, and the other alkaloids from cinchona-bark there remains finally a mother-liquor from which crystallizable salts cannot be readily prepared; this mother-liquor, on being precipitated with soda, yields chinoidine, which is further purified by redissolving it in diluted hydrochloric acid, precipitating by ammonia, washing, and drying. Blews (1874) proposed to effect the purification by adding sodium thiosulphate to the neutralized solution in dilute sulphuric acid, then filtering, warming, and finally precipitating by soda.

Properties.—Chinoidine is met with in commerce in cylindrical rolls or in masses having a more or less deep-brown (brownish-black or almost black) color and a resin-like appearance. At a low temperature it is brittle and breaks with a glossy conchoidal fracture; exposed to the summer heat, it gradually assumes the shape of the vessel in which it is kept. When heated it becomes plastic, then melts, and at a still higher heat burns with a bright flame. It has only a slight taste, faintly bitter on mastication, and

is almost insoluble in water; should alkaloidal salts be present, they would give a precipitate if the aqueous solution be treated with ammonia-water. It is freely soluble in alcohol, the solution showing an alkaline reaction, dissolves in chloroform and in diluted acids, and also more or less in ether and benzene. The solutions have a very bitter taste and are dextrogyre. The alcoholic solution is precipitated by water; the solution in diluted acids on being treated with chlorine-water in excess and ammonia assumes an emerald-green color, and with chlorine-water, potassium ferrocyanide, and ammonia, added successively, a red color closely resembling quinine in these tests.

Composition.—The alkaloidal nature of chinoidine was first observed by Sertürner. Subsequently, Henry and Delondre, Duflos, Winckler, and others showed that this amorphous mass still contained quinidine (then confounded with quinine) and cinchonine. Freed from the crystallizable alkaloids, Liebig regarded chinoidine as quinine rendered amorphous by the influence of heat and of chemicals. Hesse (1877) has shown that aside from the crystallizable bases which may be present chinoidine has been formed by the condensation or polymerization of their molecules.

Diconchinine, $C_{40}H_{46}N_4O_3$, is the principal constituent of chinoidine, of barks containing much quinine, and quinidine; it is amorphous and does not yield quinicine, but resembles the two cinchona alkaloids in the fluorescence of the sulphuric acid solution and in its behavior to chlorine and ammonia (green coloration). The chinoidine of barks yielding much cinchonine or cinchonidine contains amorphous *dicinchonine*, $C_{38}H_{44}N_4O_2$, which is not easily freed from diconchinine. *Dihomocinchonine*, $C_{38}H_{44}N_4O_2$, like diconchinine, has also a right rotation.

Pharmaceutical Preparations.—CHINOIDINI BORAS, CHINOIDINE BORATE. De Vrij (1881) gives the following directions: Heat 20 parts of chinoidine, 10 parts of boric acid, and 200 parts of water to incipient boiling and filter through moist cotton; heat the clear liquid to boiling, again filter from the resinous matter, and repeat this operation until no more matter is separated on boiling; evaporate to 20 parts, set aside over night at a temperature not exceeding 15° C. (59° F.), filter from the boric acid, and evaporate. It forms brown-yellow transparent scales or a yellowish powder, becomes damp on exposure, has an alkaline reaction and a bitter taste, and yields with 3 parts of cold water a perfectly clear dark-yellow solution. Dissolved in 10 parts of water, the solution becomes cloudy on boiling, but clear again on cooling.

CHINOIDINI CITRAS, CHINOIDINE CITRATE, made by dissolving chinoidine in an aqueous solution of citric acid and evaporating, forms transparent red-brown scales soluble in water.

CHINOIDINI HYDROCHLORAS, CHINOIDINE HYDROCHLORIDE, is prepared by saturating warm diluted hydrochloric acid with chinoidine, filtering, and evaporating; it is a yellow or brown yellow hygroscopic powder.

CHINOIDINI TANNAS, CHINOIDINE TANNATE.—Reiher and Klamann give the following directions for this compound: 100 Gm. tincture of chinoidine (see below) are diluted with 500 Gm. of water and a solution of 50 Gm. tannin in 1000 Gm. of water, and subsequently a solution of ammonium acetate. After ten hours the precipitate is washed and dried at a temperature not exceeding 30° C. (86° F.). It forms a yellowish-brown powder, which yields with water and hydrochloric acid a dark-yellow solution. The dose for small children is from 0.5 to 1.0 Gm. (gr. viij to xv).

TINCTURA CHINIODINI, TINCTURE OF CHINOIDINE.—Dissolve 10 parts of chinoidine in a mixture of 85 parts of alcohol sp. gr. .894 and 5 parts of hydrochloric acid. It is dark-brown, transparent in thin layers, very bitter, and without distinctive odor; on mixing it with an equal bulk of water and of ammonia the chinoidine is precipitated and the liquid becomes yellowish.—*P. G.* 1882.

Action and Uses.—This preparation was first employed in Philadelphia (1824) in the treatment of *intermittent fever*, and regarded as not less efficacious in the cure of that disease than quinine, provided it were given in larger doses. In 1878, Vinkhuysen (*Practitioner*, xx. 81) drew the following conclusions regarding it from his own observations: 1. "The only malarious disease in which chinoidine cannot be employed in place of quinine is pernicious fever, for it requires more time to act than quinine. 2. In all forms of pure malarial intermittent fever it is no less powerful than quinine, but acts more slowly. It must therefore be given in larger doses and at longer intervals before the paroxysm than quinine. 3. It may be taken during the fit without exciting any unpleasant feeling. 4. It never causes noises in the ears. 5. Persons liable to suffer from the toxic effects of quinine can take chinoidine without discomfort, and yet obtain a similar therapeutical result. 6. In chronic cases its influence is greater than that of

quinine. 7. Its tonic action is similar to, and perhaps greater than, that of quinine. 8. Its action in cases of masked or larval malarial disease, and especially in rheumatic affections due to malarial influences, is incomparably greater than that of quinine." In 1882, Hagens of Dantzic, in an exhaustive examination of the various surrogates for quinine (*Zeitschrift f. klin. Med.*, v. 242), and from a clinical point of view, reached almost identical conclusions respecting the citrate of chinoidine, admitting, however, that it is apt to provoke vomiting unless associated with proper correctives. According to Nothnagel and Rossbach, its dose must be two or three times greater than that of the quinine salts; and Bernatzik states the dose at one-half greater than that of quinine. Burdel, whose field of practice was in a very malarial region, states the dose for an adult at from Gm. 0.45–1 (7 to 15 grains), and for very young children Gm. 0.13–20, (2 or 3 grains), recommending it to be given in strong coffee highly sweetened. He points out that its special merits are exhibited in mild and also in chronic cases of the disease, especially where the malarial cachexia is marked (*Bull. de Thérap.*, c. 142). Similar testimony abounds. There can be no doubt that this preparation might be very usefully substituted in many cases in which the bitterness of quinine or its cost renders it objectionable.

CHINOLINA.—Quinoline.

Quinoline, Fr.; *Chinolin*, G.

Formula C_9H_7N. Molecular weight 128.74.

History and Source.—Gerhardt (1842) obtained an impure base by distilling quinine with potassa, to which he gave the name chinoleine; Runge had previously (1834) separated a basic body from coal-tar, called by him leucoline, the identity of which with quinoline has since been established. Williams (1855) first obtained quinoline in a pure state. Numerous methods were published for producing quinoline synthetically, but to Skraup belongs the credit of having suggested a process by which it is now cheaply manufactured on a large scale. A mixture of nitrobenzene, aniline, glycerin, and concentrated sulphuric acid is heated (gently at first to avoid violent reaction), then diluted with water, and distilled to remove nitrobenzene; the residue is made alkaline with sodium hydroxide, and the new base distilled in a current of steam. The crude product is purified by fractionation, and quinoline is precipitated as an acid sulphate from its alcoholic solution by addition of sulphuric acid. The reactions in Skraup's process are, briefly stated, as follows: Glycerin is converted into acrolein by the sulphuric acid, and this combines with aniline under the oxidizing influence of nitrobenzene, forming quinoline. About 60 per cent. of the theoretical yield is obtained by this method.

Quinoline is a tertiary amine, and may be looked upon as naphtalene, $C_{10}H_8$, in which an atom of N has displaced one of the groups CH.

Properties.—Pure quinoline is a colorless or faintly yellow, mobile, highly refractive liquid, with a peculiar aromatic odor and bitter pungent taste; its spec. grav. at 15° C. (59° F.) is 1.084, and its boiling-point is 237° C. (458.6° F.). It volatilizes at ordinary temperatures, and when exposed to a freezing mixture of solid carbon dioxide and ether congeals to a crystalline mass. It is readily soluble in alcohol, ether, benzin, and chloroform, and to some extent in hot water. Quinoline is hygroscopic, and if exposed to a damp atmosphere forms a hydrate, $C_9H_7N + 1\frac{1}{2}H_2O$, which becomes turbid at 40° C. (104° F.). By the action of light and air it is rapidly turned brown, but may be decolorized by shaking with solid potassa and slow rectification. Quinoline is converted into quinoline sulphonic acid by fuming sulphuric acid, and this, when fused with potassa, yields oxyquinoline, C_9H_6NOH. (See Kairin.)

The salts of quinoline when pure are odorless, mostly crystallizable, and precipitated by most alkaloidal reagents; those of the mineral acids are very hygroscopic.

Tests.—A higher or lower boiling-point would indicate the presence of homologous compounds and water. Aniline, if present, causes a violet coloration with chlorinated lime, and nitrobenzene will separate as oily drops if quinoline is mixed with an excess of sulphuric acid and cooled.

Quinoline is largely used in the manufacture of *cyanin*, a golden-green product obtained by acting on quinoline with amyl iodide and afterward with soda; it dyes wool blue.

Allied Compounds.—Analgen, Ortho-oxyethylana-monobenzoyl-amidoquinoline.—This new antipyretic is the result of an endeavor to produce a compound having high physiological power; its synthetic composition was thought out before actual production of the substance. The chemical formula for analgen is $C_9H_5NOC_2H_5NHCOC_6H_5$; the process for its manufacture is

complicated. It occurs as a white crystalline powder, slightly soluble in cold, but more readily in hot water, and soluble in alcohol and dilute acids. Its melting-point is 155° C. (311° F.). It has been used in doses of 1.0 Gm. (15 grains) with gratifying results to relieve rheumatic pains.

Orexine hydrochloride, Phenyldihydroquinazoline hydrochloride.—This complex derivative of quinoline was introduced in 1890 as a stomachic of remarkable activity. It is prepared by starting from formanilid, making sodium formanilid, then orthonitrobenzyl-formanilid, and finally orexinehydrochloride. It forms a white powder, melting at 80° C. (176° F.), or colorless acicular crystals. It is soluble in 13 parts of water, also in alcohol, but insoluble in ether. Its taste is bitter and pungent, and it exerts a powerful irritant effect on the mucous membrane of the nose. Orexine is usually administered in doses of 4 to 8 grains; it should never be given in pill form, but always in wafers, followed by a large draught of some liquid to prevent local irritant action. The reports regarding its efficacy are conflicting. Its chemical formula is $C_6H_4.NCH.CH_2NC_6H_5HCl$.

Diaphtherin, Oxyquinaseptol.—As its name indicates, this new antiseptic is a compound of oxyquinoline and aseptol. It is obtained by first preparing oxyquinoline phenolsulphonate, and introducing into this a second molecule of oxyquinoline. Its chemical formula is $C_6H_4.OHNC_9H_6OH.SO_2OHNC_9H_6OH$. Diaphtherin is a brightly-yellow powder, readily soluble in water; on the addition of weak alkalies and blood active oxyquinoline is separated. A 1 per cent. solution is said to be sufficiently strong for wounds. It is said to be non-toxic and non-caustic.

Action and Uses.—Although quinoline tartrate and salicylate have been frequently recommended for medicinal use, they have been employed only to a limited extent, and by some are considered useless, and even irritating to the stomach; both salts occur in the form of permanent white crystals (the tartrate requiring 8 parts and the salicylate about 75 parts of water for solution), and are given in the same dose, 0.5–1.0 Gm. (7½–15 grains).

Laborde and others assert that *cinchonine* is rather a convulsive agent than an antiperiodic. It is used to cure *periodical fevers*, but whether its dose should be greater or less than that of quinine is undetermined. The therapeutical value of *chinolin*, of whose use the most important effects were predicted, has not fulfilled the anticipations of its usefulness. Like many other agents, it is an antipyretic, and must, therefore, be credited with sometimes interrupting the course of simple *intermittent fevers*. Brieger employed it without the slightest benefit in typhus, pneumonia, rheumatism, and remittent fever; in some cases it was vomited, and thereby reduced the temperature very slightly. In Philadelphia, Harrington found it valueless as an antiperiodic (*Phila. Med. Times*, xii. 392). It had also bad effects, such as disturbed digestion, vomiting, and nausea. The observations of Hiller, which extended to phthisis and typhoid fever, gave like results. He therefore abandoned its use (*Amer. Jour. of Med. Sci.*, July, 1882 p. 246). Seifert claims that a 5 per cent. solution of chinolin is an efficient solvent of *diphtherial* membranes; and Marcell makes a similar statement (*Centralbl. f. Therap.*, i. 540). Donath and also Unruh proclaimed its efficiency, but it has ceased to be relied upon (*Therap. Gaz.*, ix. 29; *Med. News*, xlvi. 293). Brieger pointed out anew that the similarity of composition of chinolin and quinine led physicians into the common error of concluding that the therapeutical action of the two were identical, but that when the former was subjected to the only legitimate test, clinical experience, it proved to be worthless as a medicine (*Zeitschrift f. klin. Med.*, iv. 206).

Orexin (*hydrochlorate*) was alleged to have a remarkable property of stimulating the appetite for food (whence its name, which means hunger); but the original statements concerning it have not been confirmed.

CHIRATA, *U. S., Br.*—Chirata.

Chiretta, U. S. 1870.—*Chiretta*, E., G.; *Chirette*, Fr.; *Ostindischer Enzian*, G.

The entire plant Swertia (Ophelia, *Griesbach*) Chirata, *Hamilton*, s. Agathotes (Gentiana, *Roxburgh*) Chirayta, *Don.* Wallich, *Plant. Asiat.*, iii. 252; Bentley and Trimen, *Med. Plants*, 183.

Nat. Ord.—Gentianeæ.

Origin.—The plant is an annual, and indigenous to the mountainous portions of Northern India, where it grows at an elevation of from 5000 to 9000 feet, and is collected when the fruit begins to form. It has long been in use in India, and became known in England as a medicine about 1839.

Description.—It is met with in flattened bundles about 90 Cm. (3 feet) long, tied with a thin slip of bamboo, and has a pale purplish-brown color. The simple and tapering root is about 75 Mm. (3 inches) long. The stem is 0.9 to 1.5 M. (3 to 5 feet) long,

cylindrical below, slightly quadrangular above, much branched, smooth, and slightly thickened at the nodes, and containing a narrow wood-circle and a large yellowish pith The leaves are opposite, closely sessile, ovate or ovate-lanceolate, entire at the margin, and five-nerved; in the outer layer of the bundles they are usually broken off, leaving the stems almost bare. The flowers are numerous and small, in loose axillary racemose cymes, on the upper branches often single, stalked, with a deeply four-lobed calyx and corolla, the latter upon each acute lobe with a pair of fringed scales; stamens four. The fruit is an ovate capsule, tapering above into the two styles and projecting but little from the persistent calyx and corolla. The seeds are very numerous, minute, and angular. The drug is inodorous and has a purely and persistently bitter taste.

Constituents.—The older analyses failed to isolate the active principles of chirata, and demonstrated only the presence of the common constituents of plants and the almost total absence of tannin. Henry Höhn (1869) succeeded in isolating two distinct bitter principles—*ophelic acid*, $C_{13}H_{20}O_{10}$, and *chiratin*, $C_{26}H_{48}O_{15}$, the former of which was obtained as a brown, very hygroscopic, amorphous mass which is readily soluble in water, alcohol, and ether, has a slightly acidulous afterward intensely bitter taste, precipitates cuprous oxide from Trommer's solution, and produces with the lead acetates yellow precipitates; a crystalline salt could not be obtained. Chiratin forms a pale-yellow powder, which, though hygroscopic, is not freely soluble in cold water, but dissolves readily in alcohol and ether, and has a neutral reaction to test-paper and an intensely bitter taste. Its aqueous solution produces a flocculent white precipitate with tannin, and is not affected by Trommer's solution. When boiled with diluted hydrochloric acid it is split into ophelic acid and *chiratogenin*, $C_{13}H_{24}O_3$, which is yellowish-brown, amorphous, bitter, nearly insoluble in water, soluble in alcohol, not precipitated by tannin, and not affected by Trommer's solution. It is not improbable that chiratogenin may exist in the drug. The presence of a yellow crystalline wax-like substance and of some tannin was also observed. Dried at 100° C., the stems yielded 3.7 and the leaves 7.5 per cent. of ash, which is mainly composed of potassa, lime, and magnesia, combined with carbonic and phosphoric acids.

Substitutes.—Several species of Ophelia and allied genera are known in India as chirata, and are distinguished from the official drug as *puharee* (hill), *dukhunee* (southern), *ooda* (purple), and *meetha* (sweet) chirata; they appear to be indiscriminately collected and sent to Bombay, where, according to Dymock, the drug is garbled. Prof. Bentley (1874) met with such a substitution (probably Ophelia angustifolia or O. pulchella, *Don*), which had the stem obscurely quadrangular below and evidently four-sided and winged above, the leaves narrow and tapering to both ends, the leaf-scars not prominently marked, the flowers larger, the woody circle of the stem thicker, and the infusion less bitter than the true chirata.

Action and Uses.—In Hindostan this medicine is held to be *stomachic*, tonic, antiperiodic, cholagogue, and deobstruent, as well as efficient in chronic *bronchitis*. In truth, it possesses virtues very similar to those of gentian and other simple bitters. But in India the natives are said "to attribute almost miraculous properties to the plant" (Hunter, *Lancet*, Dec. 1890, p. 1975). The dose of chirata is about Gm. 1.30 (gr. xx). An infusion may be made with Gm. 16 (℥ss) of chirata to Gm. 500 (Oj) of boiling water, or this preparation may be reduced by boiling for twenty minutes. *Dose*, Gm. 30–60 (f℥i–ij), three times a day.

CHLORAL, *U. S.*—Chloral.

Chloral hydras, Br., F. Cod.; *Chloralum hydratum*, P. G.; *Aldehydum trichloratum.*—*Chloral Hydrate, Hydrous Chloral, Trichloraldehyde-hydrate*, E.; *Hydrate de chloral*, Fr.; *Chloralhydrat*, G.; *Cloralio idrato*, It.; *Cloral hidratado*, Sp.

Formula $C_2HCl_3O.H_2O$. Molecular weight 164.97.

A crystalline solid, composed of trichloraldehyde or chloral with one molecule of water. It should be kept in glass-stoppered bottles, in a cool and dark place.—*U. S.*

It is unfortunate that the new Pharmacopœia has continued the title of 1880 for this preparation; since the hydrated condition distinguishes the official crystalline compound from the liquid anhydrous chloral, it seems to us this fact should have been recognized in the official title, as has been done in European pharmacopœias.

Formation and Preparation.—Chloral was discovered by Liebig (1832), and its production and composition were soon after determined by him and by Dumas. As a

result of these investigations it was stated that when dry chlorine is passed into absolute alcohol, aldehyde and hydrochloric acid are first formed: $C_2H_5OH + Cl_2 = C_2H_4O + 2HCl$; by the continued action of dry chlorine gas 3 atoms of hydrogen are abstracted from the aldehyde, with the formation of hydrochloric acid, and are replaced by 3 atoms of chlorine, producing chloral; the reaction was explained by the following equation: $C_2H_4O + 3Cl_2 = 3HCl + C_2HCl_3O$. The fact that when chlorine is brought in contact with aldehyde, trichlorbutylaldehyde, a condensation product, is formed instead of chloral, renders the substitution theory above stated untenable. According to Lieben, the nascent aldehyde produced by action of chlorine on alcohol acts upon the alcohol present, forming acetal or ethidene diethyl ether; thus, $C_2H_4O + 2C_2H_5OH = CH_3.CH(OC_2H_5)_2 + H_2O$. The acetal is converted into trichloracetal, and this by the hydrochloric acid into ethyl chloride and chloral alcoholate; thus, $CCl_3.CH(OC_2H_5)_2 + HCl = CCl_3.CHO\text{-}HOC_2H_5 + C_2H_5Cl$. The chloral alcoholate upon addition of sulphuric acid yields chloral and ethyl sulphuric acid, as shown by the following equation: $CCl_3.CHOHOC_2H_5 + H_2SO_4 = C_2HCl_3O + C_2H_5HSO_4 + H_2O$. Other products of decomposition are formed in smaller quantities, and necessitate the subsequent purification of the chloral. The yield is very materially reduced if water be present, in which case a portion of the aldehyde at first produced is converted into acetic acid ($C_2H_4O + H_2O + Cl_2 = C_2H_4O_2 + 2HCl$), and this acid, reacting with some alcohol, forms acetic ether, which is not transformed into chloral by the action of chlorine. In preparing chloral, therefore, the materials reacting upon one another must be as nearly free from water as they can be obtained. Chlorine gas is generated in the usual manner, and passed first into a Woulf's bottle, where some of the moisture is condensed; then over calcium chloride or through sulphuric acid, by which it is completely dried; and finally into the absolute alcohol, which is kept cool as long as the chlorine gas is rapidly absorbed, but after a few days requires to be warmed, the heat being slowly increased, until at the end of the process it has reached 60° to 70° C. (140° to 158° F.). The whole process requires about two weeks (for 600 Gm. of alcohol three days, Dumas); but if larger quantities of alcohol be operated upon a longer time is required. In the experience of Dr. Squibb (1870), 92 pounds of alcohol required the continuous generation of chlorine gas for twenty-eight days, using about 1¼ tons of a mixture of manganese dioxide and common salt, and yielded about 160 pounds of crude chloral. Large quantities of hydrochloric acid gas containing some chloral escape during the latter part of the process, and if passed through a reversed condenser the vapors of the latter will be condensed and returned to the vessel. Kraemer observed (1874) that the ethereal liquid which accumulates beneath the hydrochloric acid is a mixture of the *chlorides of ethylene* and *ethylidene*.

Crude chloral for its purification should be treated first with about its own weight of strong sulphuric acid, by which the chloral hydrate and alcoholate are decomposed and colorless chloral separates as an oily layer, which is at once rectified over some burned lime. To avoid combustion the lime must be completely covered by the liquid. Dr. Squibb prefers to distil the chloral directly from the sulphuric acid, to combine the distillate partly with water, rectifying it over a mixture of lime and calcium carbonate, and hydrating this second distillate completely by adding the necessary quantity of water, ascertained by calculation from the weight of the first distillate (82 parts require 10 parts of water); while still hot the mass is poured upon plates covered with a bell-glass and allowed to crystallize.

Properties.—Chloral (anhydrous) is a colorless, thin, oily liquid of a peculiar pungent, irritating odor and caustic taste. It has the density 1.502 at 18° C. (64.4° F.), boils at 99.1° C. (210.4° F.), and is gradually, or sometimes rapidly, converted into *insoluble chloral* or *metachloral*, which is a white mass or powder of the same elementary composition as chloral, but of a much weaker odor, and at about 180° C. (356° F.) distils without melting, and becomes again liquid and soluble in water. The change into the insoluble condition is prevented by the addition of a little chloroform (Markoe, 1870).

Chloral hydrate is met with in white crystalline masses or in separate colorless, oblique-rhombic crystals of a saccharoid aspect, and attracts moisture in a damp atmosphere, but in a nearly dry atmosphere evaporates slowly without liquefying. It has a peculiar aromatic and somewhat irritating odor, the pungency of which is increased with the temperature, and a bitterish caustic taste. Its vapors are but slightly affected by the vapors of ammonia, except at a somewhat elevated temperature, when white clouds are produced. It fuses at about 58° C. (136° F.) to a clear, colorless liquid having the spec. grav. 1.575, and congealing again to a crystalline mass at about 50° C. (122° F.) (between 35° and 50° C. = 95° and 122° F., *U. S.*). At about 78° C. (172° F.) it begins to yield vapors

of water and of anhydrous chloral, and it boils near 95° C. (203° F.), and evaporates without leaving any residue. It is soluble in 4 parts of chloroform and in less than its own weight of water, alcohol, or ether. Chloral which has been insufficiently hydrated contains the insoluble modification, and is therefore not completely soluble in water. It dissolves in petroleum benzin, benzene, and carbon disulphide, and may be readily obtained in crystals from the hot solutions. It is soluble in glycerin, liquefies in contact with camphor and carbolic acid (see below), and forms solutions with fats and volatile oils (Jehn, 1874). The solution of chloral hydrate in strong alcohol has and retains a neutral reaction, but when dissolved in water it slightly reddens blue litmus-paper; it is, however, not precipitated by silver nitrate (absence of hydrochloric acid); exposed to a damp atmosphere or when kept in aqueous solution, it acquires a permanent acid reaction. Treated with warm soda or other alkali hydroxide, chloral is decomposed into chloroform and alkali formate; $C_2HCl_3O + KOH$ yields $CHCl_3 + KCHO_2$.

On adding to the aqueous solution of chloral contained in a test-tube water of ammonia and a few drops of test-solution of silver nitrate, a silver mirror will be obtained upon the glass. An aqueous solution, treated with test-solution of ammonium sulphide, gives a reddish-brown precipitate. Chloral hydrate which has acquired an acid reaction may be purified by recrystallization from hot benzin or carbon disulphide; should the decomposition have proceeded further, it is best to treat with strong sulphuric acid, etc., as in the purification of crude chloral.

Tests.—The presence of chloral alcoholate is indicated by the combustion which takes place on heating a sample upon platinum-foil over a flame. Smaller quantities are detected by the turbidity resulting from the production of iodoform if a strong aqueous solution is warmed with a slight excess of potassa solution, iodine being then added as long as it is decolorized. On cooling, microscopic crystals of iodoform will separate. The presence of various organic impurities is detected by warming the chloral hydrate with sulphuric acid, which will then acquire a brown color. If decomposition has set in, the aqueous solution of chloral hydrate on being acidulated with sulphuric acid will readily decolorize a weak solution of potassium permanganate and cause a white precipitate with silver nitrate. The decomposition of chloral hydrate by alkalies affords a means of estimating its value: when perfectly pure, 100 grains of it, dissolved in an ounce of water and mixed with 30 grains of slaked lime and distilled, yield not less than 70 grains of chloroform. Moist chloral hydrate yields less in proportion to the excess of moisture; chloral alcoholate produces only 60 per cent. of chloroform. V. Meyer and Heffter (1873) estimate the purity of chloral from the amount of formic acid produced by warming the solution of chloral hydrate with an excess of normal solution of soda and determining the excess of soda volumetrically by an acid. Pure sodium hydroxide will decompose 4.1375 times its weight of pure chloral hydrate. "Chloral should be dry, and should not readily attract moisture in ordinarily dry air; when dissolved in diluted alcohol, acidulated with nitric acid, it should remain unaffected by test-solution of silver nitrate (absence of hydrochloric acid and chlorides). If 1 Gm. be dissolved in 2 Cc. of warm distilled water, and about 8 Cc. (or a slight excess) of solution of potassa added, the mixture filtered clear through wet filter-paper, and the filtrate treated with test-solution of iodine until it is yellowish, no yellow crystalline precipitate (iodoform) should appear even after standing half an hour (absence of chloral alcoholate)."—*U. S.*

Pharmaceutical Preparations.—Chloral hydrate and camphor. In 1873 attention was drawn to the fact that if powdered camphor be triturated with an equal weight of chloral hydrate, a colorless liquid of syrupy consistence is obtained, which has since been used under the name of *camphorated chloral*. E. C. Saunders (1876) regards it as a simple solution, camphor being the solvent; but from its optical behavior Cazeneuve and Imbert (1880) consider it a true chemical compound. It is soluble in alcohol, ether, chloroform, glycerin, fixed oils, and in aqueous solutions of chloral; but it is decomposed by water, chloral hydrate being dissolved and camphor precipitated.

Chloral camphoratum, N. F.—Camphorated Chloral, Chloral and Camphor.—Take of chloral, 50 parts; camphor, 50 parts. Mix them by agitation in a bottle, or by trituration in a warm mortar until they are liquefied and combined.

Chloral hydrate as a solvent.—R. F. Fairthorne (1874) observed that solutions of chloral hydrate in water or glycerin will dissolve morphine, veratrine, and other alkaloids, and suggested a class of preparations which he named *chloral-glycerites*, the basis of which is a solution of 1 drachm of chloral hydrate in half a fluidounce of glycerin.

Derivatives and Allied Compounds.—Hypnal.—This name has been given to a compound of chloral and antipyrine known as monochlorantipyrine. It is prepared by mixing in a separatory funnel a solution of 47.0 Gm. of chloral hydrate in 50 Cc. of distilled water, and a solution of 53.0 Gm. of antipyrine in 50 Cc. of distilled water; after an hour the oily-looking liquid is drawn off into a capsule, and in twenty-four hours will be found to have congealed to a mass of transparent rhombic crystals, which should be drained and dried in a desiccator (Demandre). The crystals are odorless and tasteless, melt at 58°–60° C. (136.4°–140° F.), and dissolve in 5–6 parts of water. Hypnal is said to combine analgesic and hypnotic properties, 1.0–2.0 Gm. (15–30 grains), relieving pain and producing quiet sleep in troublesome coughs (Bardet).

Somnal, Ethylated chloral-urethane.—Under this name a new hypnotic was introduced in 1889, which is made by union of chloral, alcohol, and urethane; it has the formula $C_7H_{12}Cl_3O_3N$, differing in formula from *ural* by containing C_2H_4 additional. It melts at 42° C. (107.6° F.), does not react with silver nitrate, and is not acted upon by acids. It is administered in doses of 2.0 Gm. (30 grains) in aqueous solution flavored with syrup. Half an hour after its administration a sound sleep, lasting from six to eight hours, is produced without any unpleasant after-effects.

Ural, Chloral-urethane, Uralium.—Melted chloral hydrate is capable of dissolving urethane; if to such a solution concentrated hydrochloric acid is added, it solidifies within twenty-four hours to a mass insoluble in water. This is then treated with concentrated sulphuric acid and washed with water, by which an oily liquid results, which subsequently crystallizes. The product, $C_5H_8Cl_3O_3N$, is insoluble in cold and decomposed by boiling water; it is abundantly taken up by alcohol and ether, and reprecipitated by water; its melting-point is 103° C. (217.4° F.). The average dose as a hypnotic is 1.0 Gm. (15 grains), but its sparing solubility has operated against its use.

Chloralcyanhydrin, Chloral Hydrocyanin, Chloral Hydrocyanate.—This compound was first obtained in 1872 by treating chloral with anhydrous hydrocyanic acid at an elevated temperature. Pinner (1884) suggested to prepare it by dissolving chloral hydrate in a 10 or 12 per cent. solution of hydrocyanic acid obtained from potassium ferrocyanide, equal in weight to that of the chloral hydrate; the solution after twenty-four hours is digested for several hours, and finally evaporated on a water-bath. It crystallizes from water in white rhombic plates, melts at 61° C. (141.8° F.), boils with some decomposition between 215° and 220° C., has an odor recalling that of hydrocyanic acid and chloral, and is readily soluble in water, alcohol, and ether. Its chemical formula is $CCl_3.CHOHCN$. An aqueous solution of chloralcyanhydrin will remain unchanged for some time, and is not precipitated by silver nitrate, except after heating; alkalies decompose the salt, yielding chloroform, hydrocyanic and formic acids. It has been recommended as a substitute for hydrocyanic acid, of which it yields 15.5 per cent.; 1.29 Gm. chloralcyanhydrin dissolved in 9 Gm. distilled water furnishes a solution equal in strength to the official 2 per cent. hydrocyanic acid.

Chloral-ammonium, or Trichloramidoethylic Alcohol, has been suggested as a hypnotic in doses of 15–30 grains. It may be obtained by passing a rapid current of dry ammonia through a solution of anhydrous chloral in chloroform as long as it is absorbed, pouring off the chloroform from the crystalline deposit, pressing this between bibulous paper, and drying in vacuo. It occurs as small needle-shaped crystals, which melt at 62°–64° C. (143.6°–147.2° F.) and are soluble; the aqueous solution is prone to change.

Chloralose—This name has been proposed by Hanriot and Richet for a new hypnotic obtained by heating equal quantities of anhydrous chloral and dry glucose together, to 100° C. (212° F.) for one hour; upon cooling the mass is treated with a little water, and then boiling ether. After distilling the ether-soluble portions five or six times with water to remove chloral, the new compound is obtained by crystallization; it is soluble in hot water and alcohol. Parachloralose is produced at the same time. Very little is known thus far regarding this new body.

Chloral-phenol is made by triturating equal weights of chloral hydrate and carbolic acid; it forms a colorless viscid liquid, sp. gr. at 20° C. (68° F.) 1.289; it possesses prominently the odor of chloral hydrate, has a sweet caustic taste, and produces blisters when placed upon the skin. It is miscible with alcohol, acetic acid, chloroform, carbon disulphide, and ether. Chloral-phenol in small quantities coagulates albumen; an excess redissolves it. Cotton impregnated with it, has been recommended for relief in toothache. J. B. Garrison (1881) prefers for this purpose the firm and short cotton from the cottonwood tree, Populus canadensis, *Michaux;* when saturated with the liquid it is known as *chloro-carbolated cotton.*

Action and Uses.—Applied in its pure state to the sound skin, chloral occasions a slight redness, but it acts as a powerful irritant upon the derma and upon wounds, even occasioning eschars, and it excites pain in healthy mucous membranes. A warm saturated solution of chloral in water is said to have acted as a caustic upon the skin of the temple, and a paste composed of chloral and finely-powdered tragacanth to have vesicated the skin of the forearm. It has been used to produce vesication when applied on adhesive plaster after being melted. The operation is said to be painless. Its taste, even in a watery solution, is somewhat acrid and bitter, causing a sense of burning in the throat, and sometimes in the stomach also, and producing more or less salivation,

In enema it occasions heat and irritation in the rectum, and its subcutaneous injection is not only painful, but is apt to be followed by sloughing.

Chloral allays pain and produces sleep, but less perfectly, than opiates. It seldom produces the untoward effects of opium, such as nausea, dryness of the fauces, constipation, anorexia, dysury, headache, giddiness, or malaise; nor, except in very large doses, does it occasion anæsthesia. Indeed, the effects of occasional and appropriate doses closely resemble natural sleep, except that the face is flushed and the pupils are more or less contracted; the patient may sometimes even be temporarily awakened to take food or to obey a call of nature without interfering permanently with its soporific action. As in natural sleep, respiration and circulation are retarded and the temperature is slightly lowered. The pupils are contracted and insensible to light. Exceptions to these statements may be found in certain cases in which the sleep is restless or unrefreshing, or in which a state of delirious excitement exists, and in which the conjunctiva becomes injected and the eyelids swollen, or in which there is subsequently experienced a degree of dulness or headache or sick stomach, or a partial loss of power in the limbs. Numerous cases are reported of violent delirium produced by this preparation (Kane, *Phila. Med. Times*, xi. 225). According to Bouchut, children can take chloral with much less danger than adults.

Like chloroform, chloral sometimes produces poisonous, and even fatal, effects without its being possible to explain them by its excessive dose or by any special condition of the patient. Death has resulted from the use of even 10 grains of the drug. The phenomena of acute chloral-poisoning usually denote failure of the heart's action. They include faintness, feeble pulse, fluttering heart, paralyzed and cold extremities, a sense of sinking, pallor, and partial lividity of the face; in a word, the phenomena of syncope.

A state of chronic disorder, which may be called chloralism, and is sometimes very persistent, comprises many of the following phenomena: mental hebetude and irritability, hallucinations, insanity, emotional excitability and obstinate insomnia, loss of memory, with physical incapacity for exertion, and extreme prostration on attempting it; uncertainty of movement and a tendency to fall forward, or absolute inability to stand or walk or perform various co-ordinated movements, as writing, articulation, etc.

Chloral appears to be indicated when *sleeplessness* is dependent upon a vascularity due to exhaustion rather than to primary excitement of the brain; thus it has been found useful where loss of sleep follows severe and prolonged mental application or excitement of feeling, or accompanies the general debility following acute diseases attended with delirium or severe pain, or is associated with acute *mania*, especially of the puerperal form. The somewhat analogous condition which exists in *delirium tremens* is very amenable to this medicine, especially in the forming stage of the affection known as "the horrors," and which so frequently follows surgical injuries in drunkards; it is useful also when great nervous excitement and restlessness are associated with extravagant phantasms. Nevertheless, its depressing effects are to be guarded against in this affection as well as in the different forms of *insanity*. "The tide of opinion seems to have set directly against its use, save in certain cases and under certain conditions" of the latter disease. The weight of authority is opposed to it, partly upon the ground that it tends to suddenly depress the heart and the nervous system, and partly because it aggravates the delirium in many cases. (Compare Kane, *Med. Record*, xix. 60.) The grounds of this condemnation are distinctly and emphatically set forth by Weiss (*Centralblatt f. Therapie*, i. 119), who from a large experience shows that the medicine does more harm by its depressing than good by its hypnotic influence in all protracted maniacal seizures, and by its continued use induces a cachectic condition that prolongs and even perpetuates the disease. He charges it with the production of numerous lesions from decubitus (ulcers, etc.) in the paralytic and chronic insane, and, in a word, as a double-edged sword that, while it overcomes maniacal manifestations, tends to undermine the powers of life. In a case of *poisoning* by $\frac{1}{30}$ gr. of *hydrochlorate of hyoscine*, chloral in 10-grain doses repeated every quarter of an hour, seems to have arrested the convulsions and secured recovery (*Practitioner*, xxxvii. 370).

Although far inferior for the relief of *pain*, chloral is a very useful substitute for opium and its preparations in many cases in which the pain is of moderate intensity or when an idiosyncrasy exists which renders these medicines ineligible. Pain in nervous trunks and extremities, particularly in neuralgia, whether of central or peripheral origin, in toothache, lead-colic, cancer, and tumors compressing nerves, is more or less palliated by chloral. But its anodyne influence is very transient, and when it passes off the pain

appears to be intensified. This remark applies also to the use of chloral in nervous *headache*. It has been employed with advantage in cases of *angina pectoris* unconnected with obstructive disease or degeneration of the heart; but it should be used with extreme caution, if at all, whenever, from these or other causes, the action of the heart is irregular, feeble, or tumultuous. Chloral is very efficient during *labor* in producing those effects for which chloroform and ether are commonly employed; that is to say, for allaying fruitless and excessive pains and permitting rhythmical contractions of the uterus to occur; for promoting dilatation of the os uteri; for procuring repose for the mother during prolonged labor; and for quieting alarm and allaying nervous irritability. It should be given in doses of not less than Gm. 2 (30 grains), repeated every half-hour until the desired effect is produced. The *vomiting of pregnancy*, originating in uterine irritation, may be allayed or arrested by enemas of from Gm. 1.30–4 (20 to 60 grains) of chloral.

Among spasmodic affections, *tetanus*, especially of the subacute form, has proved very amenable to this remedy, administered hypodermically and also by the mouth and rectum. Statistics appear to show that the mortality under its use is rather less than under that of curare, Calabar bean, and other medicines. It is said that in the more acute and active forms of the disease its efficacy is less demonstrable, but in three acute cases out of four occurring in the Pennsylvania Hospital cure followed the use of chloral. The tetanic spasm produced by *strychnine-poisoning* is equally under its control; it seems to reduce the force and frequency of the paroxysms, but a lethal dose of strychnine cannot be combated by an adequate dose of chloral, for the latter would be equally dangerous to life. A summary may here be given of Th. Husemann's conclusions after a thorough rational and experimental investigation of this subject in animals: There is no reciprocal antagonism between chloral and strychnine. But an animal under the influence of chloral will escape the effects of five or six times the minimum lethal dose of strychnine, or even of much larger doses of the latter, so long as the proper toxical effects of the chloral are not developed. In this way, even when it does not prevent death, it may greatly delay it. In animals, and also in man, its power of saving life in strychnine-poisoning depends very much upon its ability to prevent or to moderate the spasms which, if unchecked, hasten so greatly the fatal issue by exhausting the nervous centres and lowering the temperature. (Compare Faucon, *Archives générales*, Jan. 1883, pp. 74, 153, who advises that chloral should be administered hypodermically as well as by the mouth, and even by the veins.) In some instances of *tonic spasm* its effects have been beneficial. It has been used to mitigate the fits of *epilepsy* by giving it before their regular hour of recurrence when they are periodical. It may lessen the movements in *paralysis agitans*. *Puerperal convulsions* are perhaps more amenable to the influence of chloral than any other form of spasmodic disease, although it is far from being a certain remedy. To ensure its favorable action it should be given in doses of not less than Gm. 1–1.30 (gr. xv–xx), repeated every fifteen minutes until its appropriate effects appear. Its use in *infantile convulsions* is common, but its utility is not clearly proved. In a case of *hydrophobia* the medicine was found to control the active symptoms completely, but the patient died by syncope (Gunning). A case of supposed hydrophobia, reported by Broadbent as recovering under the use of chloral, was considered by some members of the Clinical Society of London as being of a different nature (*Times and Gaz.*, March, 1883, p. 308). The treatment of *chorea* with chloral has not been encouraging, and the same may be said of *insanity*, and, indeed, of all diseases in which the medicine must continue to be used for a long time. In *chorea*, however, it displays a decided control over the spasmodic element of the disease, and must be regarded as a valuable adjuvant in the cure of cases depending upon definite blood-disorder, nervous shock, or reflex irritation. In some uncomplicated cases it suffices for the cure, especially if given in full doses. It appears to have been very serviceable in *laryngismus stridulus* when taken by children six months old in doses of 2 grains three times a day. It has been recommended in the form of an atomized solution of 10 grains to the ounce as a remedy for the "*winter cough*" of old persons. In *whooping cough* it is of service by mitigating the violence of the paroxysms and preventing the loss of strength occasioned by their occurrence at night. It sometimes also appears to shorten the duration of the attack. In other varieties of *cough* it is a useful palliative, but is not to be compared with opium. The paroxysms of nervous *asthma* are sometimes very favorably modified by this medicine, but it is unsuited for the continuous treatment of so chronic a disease. It is one of the best remedies for obstinate *hiccup*. There is an alleged physiological antagonism between chloral and *Calabar bean*, but it is exhibited only when the doses of the two

agents are fully proportioned and the chloral is administered within a very few minutes after the bean. Organic diseases of the *heart*, and especially of the aortic orifice and muscular degeneration, are contraindications to the use of chloral, because it tends to lessen the vigor of that organ. It should rarely be used in substantial diseases of the stomach, the pharynx, or the larynx on account of its irritant properties, nor in any case of pulmonary obstruction.

A mixture of chloral and morphine has been used by Trelat to produce partial anæsthesia for surgical purposes, and either exclusively for minor operations or as preparatory to the use of chloroform in graver ones. It is contended that in this manner the dangers of the latter agent are diminished, both by the action of the morphine and by the smaller quantity of the anæsthetic required (Choquet, 1880). Equal parts of camphor and chloral form an excellent topical anodyne in *neuralgia*. Chloral hydrate, sprinkled on adhesive plaster and melted with a gentle heat, acts as a vesicant within ten minutes when applied to the skin. It has been said that healing takes place underneath the plaster, but, on the other hand, ulceration, and even gangrene, may ensue if the action is too long maintained. This mode of vesication is convenient and efficient when applied over the tender parts of a neuralgic nerve. A 50 per cent. solution of chloral has been applied in pharyngeal *diphtheria* by means of a brush at intervals of half an hour, with the effect of loosening the false membrane. After the separation of the latter a weaker solution, applied at longer intervals, appeared to hasten the cure. This efficacy of chloral has been alleged by Mercier, who, however, gave the medicine in a syrup containing 20 per cent. of the drug (*Amer. Journ. Med. Sci.*, April, 1888, p. 396). The combined deodorizing, antiseptic, and stimulating qualities of chloral have caused various applications of it, especially as a *surgical dressing*. A solution of 1 part in 100 of water has been found sufficiently strong. This is applied on lint to unhealthy surfaces, such as gangrenous, indolent, erysipelatous, diphtheritic, cancerous, mercurial, and carious *ulcers*, or as an injection for parts not so easily reached, as in cases of *dysentery*. It has been recommended internally (Curci) in acute dysentery and in *typhoid fever*, but should unequivocally be condemned, as well as in the treatment of the acute *gastro-enteritis* of children. It corrects the fetor and lessens the discharge in *ozæna*, for which purpose a solution of 1 part in 200 to 300 may be applied by a syringe or the nasal douche. A solution of 1 or 2 parts in 100 corrects *fetor of the feet*. A solution of 7 grs. to an ounce of brandy and water is said to be an efficient lotion in the *night-sweats* of phthisis. Stronger solutions, containing from Gm. 1.30–2 (gr. xx–xxx) of chloral to Gm. 32 (f℥j) of water, have been used to prevent the decomposition of animal tissues immersed in them, which they are stated to do without injuring the color or the texture. They have also been successfully employed to inject dead bodies used for dissection. A solution of 1 part in 20 of water forms an excellent lotion in *pityriasis* of the scalp, and sometimes cures the disease if it is recent. Such a solution has been applied to *chapped nipples*. A 10 per cent. solution of chloral injected into an *erectile tumor* has effected its cure, and a like result has followed in *varicocele*. A 1 or 2 per cent. solution has been found an efficient injection in *gonorrhœa*.

Poisoning by chloral should be treated by the same general method which is applicable to other forms of narcotism, including cold to the head and neck, the use of coffee or caffeine, galvanism applied to the diaphragm, mechanical stimulants, such as friction and flagellation, etc. Atropine and digitalis have been employed to stimulate and tonify the heart, and nitrite of amyl for an analogous purpose. Carbonate of ammonium has been injected into the veins. Strychnine has also been used as a physiological antidote to chloral. It would seem to be appropriate, so far as it tends to rouse the activity of the spinal cord, but it does not tend to diminish the action of chloral upon the brain. But clinical evidence leaves no doubt of the efficacy of *strychnine* in chloral-poisoning. Its first effect is to reduce the abnormal frequency of the pulse and increase its volume, while it causes the respiratory act to be fuller (Moore, *Med. News*, xli. 566; DaCosta, *Phila. Med. Times*, xiii. 421). A hypodermic injection of 2 minims of "solution of strychnine," *Br. Ph.* (gr. $\frac{1}{60}$), may be given at intervals of about half an hour. It is of the utmost importance to combat the singular coldness which the poison tends to produce by means of artificial heat, such as hot cloths, bottles, sand, etc., applied over the heart, to the spine and extremities, and by small and repeated doses of alcohol, which may be administered by the mouth or rectum or hypodermically. The treatment of the *chloral habit* must consist in the withdrawal of the noxious agent and the use of hygienic and medicinal tonics. It is alleged that Indian hemp appeases the desire for the drug and improves the appetite (*Lancet*, Mar. 1889, p. 625).

Chloral is too irritating for ordinary hypodermic use, but in strychnine-poisoning it may be so administered in the dose of from Gm. 0.60–1.20 (gr. x–xx). This operation is apt to be followed by abscess. Its injection into the veins may be mentioned only to be condemned. By the mouth the average dose for an adult is between Gm. 0.60–2.00 (gr. x–xxx), which may be repeated at intervals of one or two hours. In convulsive disorders much larger doses may be required. For children about Gm. 0.05 (gr. j) may be prescribed for each year of the child's age. The solution should be flavored with an agreeable syrup; peppermint-water masks its taste effectually. Enemas of chloral may be prepared by dissolving from Gm. 1–4 (gr. xv–lx) of the compound in a little water, rubbing up the solution with the yelk of egg, and mixing it with a sufficient quantity of milk. Suppositories may be made as follows: Cocoa-butter, spermaceti, of each 2½ Gm.; powdered chloral, ½ Gm.: or, cocoa-butter 2 Gm.; spermaceti, powdered chloral, of each 3 Gm., for one suppository (Mayet). The ready solubility of chloral hydrate in fatty excipients has led to the preparation of the following for external use: Chloral 6 parts, almond oil 30 parts; or chloral 7 parts, lard 27 parts, white wax 3 parts; or, for a plaster, chloral 1 part, white wax 2 parts, cocoa-butter 2½ parts.

Dr. Markoe has shown that chloral hydrate should not be associated with bromide of potassium or of sodium, unless in diluted mixtures. In a concentrated alcoholic mixture the chloral will rise to the surface as an alcoholate. The addition of more water or alcohol will render the solution perfect. Dr. Sherwin (*Boston Med. and Surg. Jour.*, Nov. 1886, p. 487) states that chloral will reduce the copper when added to Fehling's test for diabetic sugar, and hence may lead to grave errors.

Hypnal.—Dujardin-Beaumetz, who introduced this preparation in 1885, regarded it as soporific rather than anodyne. Its action was compared to that of chloral and also of paraldehyde. In the dose of 6–8 drops it usually caused tranquil sleep, but many persons did not feel its influence. Some immediately after swallowing it complained of heat in the throat and stomach, pricking in the nostrils, a slight cough, and even nausea or retching. Offensive eructations (of acetone) were apt to follow. Headache and slowing of the pulse were noted among its remoter effects. The sleep produced by it is said to be calm, and the awaking not attended with unpleasant feelings. These conclusions, were more or less confirmed by Vigier, Limousin, Lailler, Van Schuder (1887), and Pensato, who also assigned to the medicine antiseptic powers, and denied that it depressed the heart. They were opposed by those of Hirt, who found it absolutely null in its action when employed by him in hospital practice (*Centralbl. f. d. g. Ther.*, iv. 260). Already in 1886 its effects were said to be illusory, and itself doomed to oblivion (*Therap. Gaz.*, x. 699), and Mairet and Combemale found it a feeble hypnotic with a tendency to induce coma and paralysis of the heart and lungs (*Am. Jour. Med. Sci.*, July, 1887, p. 528), while in 1889, Jastrowitz declared it unsafe and unreliable, and that it had fallen into disuse (*Therap. Gaz.* xxii., 647). But a more recent experimenter declares it to combine the virtues of chloral and antipyrine, and to be appropriate for sleeplessness caused by pain (Frankel, *Bull. de Thérap.*, cxix. 249).

Hypnal cannot be relied upon to secure sleep for those who cough or suffer pain, but only when wakefulness is due to nervous excitement.

It is best administered in capsules each containing about 4 drops dissolved in almondoil.

Somnal, which belongs to the same group of compounds, has been condemned as a very uncertain hypnotic, and as exerting a dangerous action on the heart.

Ural exhibits hypnotic qualities in doses of Gm. 1–3 (gr. xv–xlv), but has no special advantages.

CHLORAL BUTYLICUM.—Butylchloral Hydrate.

Butyl-chloral hydras, Br.; *Croton-chloral Hydrate*, wrongly so called.—*Hydrate de chloral butylique*, Fr.; *Butylchloralhydrat*, G.

Formula $C_4H_5Cl_3O.H_2O$. Molecular weight 192.91.

Preparation.—It is prepared by passing chlorine gas into acetic aldehyde, C_2H_4O, which should be placed in a refrigerating mixture to lessen the violence of the reaction. The apparatus is connected with a reversed condenser, which carries the condensable products back into the flask, while the uncondensable gases are allowed to escape. Gradually the temperature is permitted to rise until the hot liquid ceases to absorb the chlorine gas. The mass is now subjected to repeated fractional distillation until a product is obtained boiling uniformly between 163° and 165° C. (325.4° and 329° F.), which is

butylchloral, and by dissolving in water and crystallizing the hydrate is obtained. That portion of the crude product distilling at a lower temperature requires treatment with sulphuric acid to decompose the hydrate contained in it, and subsequent fractional distillation.

Properties.—Butylchloral is a colorless oil heavier than water, of a peculiar odor somewhat like that of ordinary chloral. The hydrate crystallizes from water in thin white scales of a silky lustre, a peculiar somewhat fruit-like odor, a warm bitterish taste, and a neutral reaction. It melts at 78° C. (172.4° F.) to a colorless clear liquid, and at a higher heat vaporizes without leaving any residue. It is freely soluble in alcohol and ether, from which it crystallizes unaltered, is soluble in cold water with difficulty, freely soluble in glycerin and hot water, and volatilizes with the vapors of boiling water. By soda and other alkalies it undergoes decomposition in a manner analogous to the official chloral under the same conditions, but does not yield chloroform, yielding *bichlorallylene*, $C_3H_2Cl_2$, sodium formate and chloride. The alcoholic solution of butylchloral acidulated with nitric acid does not yield a precipitate with silver nitrate. Its solutions gradually undergo decomposition, and should therefore not be kept on hand except for a short time.

Composition—When Krämer and Pinner first obtained this body (1870) they considered it to be *crotonchloral*, $C_4H_3Cl_3O$, but have since (1875) ascertained that it is *trichlorbutylaldehyde*, which is butylaldehyde, C_4H_8O, with 3H replaced by 3Cl. The hydrate contains a little over 9 per cent. of water.

Action and Uses.—In the dose of from 10 to 30 grains butyl chloral occasions, in the course of from five to ten minutes, a sense of heaviness, confusion of ideas, and dulness of the senses; cutaneous sensibility is blunted, in the face first, and afterward in the limbs, motility being at the same time more or less impaired. In from ten to thirty minutes sleep sets in; it is deep and tranquil, and while it lasts neither respiration, circulation, temperature, nor muscular tone is greatly affected. On the return of consciousness some dulness or lightness of the head may be experienced, but it soon passes off. The most striking peculiarity of these symptoms is the conservation of muscular tone. It was pointed out by Liebreich in his original communication respecting "croton-chloral hydrate." He described two maniacs to whom it was administered as "remaining quietly sitting on their chairs in a deep sleep for two whole hours together." In medicinal doses it does not appear to derange the stomach, but its acrid taste, which persists in the throat, may excite nausea, and even vomiting. Very large doses may cause both vomiting and diarrhœa, and the former effect has been induced by the hypodermic administration of the medicine.

Butyl-chloral hydrate is anodyne or anæsthetic rather than narcotic. The indications for its employment were originally stated to be—1, its substitution for chloral hydrate in cases of heart disease; 2, in neuralgia of the trigeminus; 3, when very large doses of hydrate of chloral are necessary to produce sleep. In the last case it was recommended to associate the two hypnotics. Experience has proved that it is of little use even in *neuralgia* unless the pain affect the fifth pair. In that form of the disease, however, it is a most useful anodyne. If doses of Gm. 0.30–1.30 (gr. v–xx) are given at intervals of fifteen or thirty minutes, the pain is apt to be palliated even before sleep is induced. In this manner it has proved very useful in cases of *painful spasm* (tic douloureux) of the face. In ordinary facial neuralgia occuring in young persons, and especially in anæmic women and girls, it is peculiarly efficient. It is also serviceable in *nervous headache*, and is a palliative of *dysmenorrhœa*. In some cases of *insomnia*—such, for instance, as are frequent in chronic phthisis—a dose at bedtime of from Gm. 0.30–1.0 (gr. v–xv) is useful, but its primary effect is not maintained, and larger doses become necessary. Butyl chloral is contraindicated by hyperæmia of the brain, by an irritable condition of the gastro-intestinal mucous membrane, and by diseases which impair the vigor of the heart.

It may be given as a soporific in doses of from Gm. 0.20–0.60 (gr. iij–x) but the smaller dose is preferable, and may be repeated at intervals of an hour or less until the due effect is obtained. Females are much more readily than men affected by small doses. Much larger doses have been recommended, as from 8 to 15 grains, and even from Gm. 0.40–1.00, 2.00–4.00 (gr. xxx–lx); but they can rarely be necessary or safe. The extreme bitterness of the medicine requires it to be administered in a solution capable of masking its taste, such as glycerin and syrup flavored with essence of peppermint, or, still better, in syrup of liquorice-root. It may also be given in a mixture of the following description: butyl-chloral hydrate 5 to 10 parts; glycerin 20 parts; distilled

water 130 parts; the mixture to be shaken before it is used. The dose of this preparation is half an ounce, followed in five minutes by a second, and in ten minutes by a third. It is well to begin with a small dose, so as to avoid hypnotism, when the anæsthetic effect alone is desired; but to produce sleep, from Gm. 1–3 (gr. xv–xlv), according to the patient's constitution, may be given at bedtime. As a topical application for the relief of neuralgia a mixture of equal parts of butyl chloral and tincture of camphor may be applied. Its hypodermic use is not recommended, on account of the abscesses it occasions. If poisonous effects result from an overdose, it is advised to combat them with artificial respiration and electricity along the spine at the superficial portion of the pneumogastric nerves, while stimulants are applied to the extremities.

CHLORALUM FORMAMIDATUM, *P. G.*—Chloral Formamide.

Chloral formamidum.—Chloralamide, E., Fr.; *Chloral formamid, Chloralamid*, G.

Preparation.—Chloralamide is obtained as the result of interaction between anhydrous chloral and formamide, and must be looked upon as an addition product of the two bodies; thus, chloral CCl_3CHO + formamide $CHONH_2$ = chloral formamide $CCl_3CH.OH.CONH_2$.

Properties.—The German Pharmacopœia describes chloral formamide as occurring in white lustrous crystals, without odor and having a faintly bitter taste. It melts at 115° C. (239° F.), and is slowly soluble in 20 parts of cold water and in 1½ parts of alcohol. By water heated to over 60° C. (140° F.) it is decomposed into chloral hydrate and ammonium formate, the same effect being produced by alkalies, but not by dilute acids.

Tests.—"A 10 per cent. alcoholic solution should not redden blue litmus-paper, nor be at once affected by addition of silver-nitrate solution. When heated, chloral formamide should volatilize without evolving inflammable vapors."—*P. G.*

Chloralimide, a chloral derivative obtained by the action of heat on chloral ammonium, must not be confounded with the above. Its chemical formula is CCl_3CHNH, and it occurs in long crystalline needles, without color, taste, and odor, melting at 166° C. (330.8° F.), and insoluble in water, but soluble in alcohol, ether, chloroform, and fixed oils. Chloralimide is very stable, being unaffected by light, air, and moisture. Its use has been almost entirely discontinued.

Action and Uses.—As a medicine, Kny (*Therap. Monatsh.*, iii. 345), and many others more recently, who employed chloralamid in various forms of *insanity* (including mania and delirium tremens), found that it always failed to overcome active excitement, but that in the absence of this symptom it acted favorably as a soporific. A like conclusion was reached by Strahan (*Lancet*, Feb. 1890, p. 339) and by Kinneir (*Med. Record*, xxxviii. 41). In various moderately painful affections it was equally efficient—*e. g.* in *asthma*, muscular *rheumatism*, and *spinal diseases*—while in *chorea* and diseases of the *heart* (Alt) its action was also favorable. In the *insomnia* of the aged it was very useful unless severe pain existed. It induces sleep in from fifteen to forty minutes, which continues for six or more hours, and is rarely followed by any unpleasant effects. It does not derange the digestion nor irritate the mucous membrane, and its taste is but slightly and transiently bitter. These conclusions have been confirmed by many observers, including Hagen and Häfter (*Lancet*, Aug. 1889, p. 397), Reichmann (*Therap. Gaz.*, xiii. 612), Peiper (*Centralbl. f. Therap.*, vii. 602), Paterson (*Lancet*, Oct. 1889, p. 849), and Schaffer (*Centralbl. f. Therapie*, viii. 89). Occasionally giddiness, slight delirium, nausea, and dry mouth have followed its use, and in rare instances it has seemed to render the pulse small and frequent, according to Robinson (*Therap. Monatsh.*, iv. 45), Umpfenbach (*ibid.*, p. 66), and Mairet (*Annuaire de Thérap.*, 1890, p. 227). Cholralamid, in doses of Gm. 1.5–4 (gr. xx–lx), may be admimistered in beer, sweetened wine, or whiskey and water. It may also be given by enema. It is said not to create tolerance as readily as other members of its class. On the whole, however, it seems to possess no superiority over chloral hydrate, and to be less reliable in its action than that medicine.

CHLOROFORMUM, *U. S., Br.*—Chloroform.

Chloroformum purificatum, U. S. 1880; *Chloroformium*, P. G.; *Formylum trichloratum.—Chloroforme*, Fr.; *Chloroform*, G.; *Cloroformio*, It.; *Cloroformo*, Sp.

Formula $CHCl_3$. Molecular weight 119.08.

A liquid containing at least 99 per cent., by weight, of absolute chloroform, and not more than 1 per cent. of alcohol. It should be kept in dark amber-colored glass-stoppered bottles in a cool and dark place.—*U. S.*

Origin and Preparation.—Chloral is formed from alcohol and chlorine, and, on decomposing chloral by an alkali, chloroform and a formate of the alkali are produced; the conditions for these two reactions are present on bringing together alcohol and chlorinated lime, the chlorine of which converts the former into chloral, which is at once decomposed by the calcium hydroxide, yielding chloroform and calcium formate, $Ca2CHO_2$ (see CHLORAL). Calcium formate is, however, not found in the residue of the distillation, but is decomposed by another portion of the chlorinated lime into calcium carbonate and chloride and water. Omitting all intermediate reactions, and using for chlorinated lime the formula of Odling or of Stahlschmidt (see page 361), the final result is expressed by the equations:

$$2C_2H_5OH+10CaOCl_2=2CHCl_3+7CaCl_2+2CaCO_3+Ca(OH)_2+4H_2O,$$
$$\text{or } 2C_2H_5OH+11CaHClO_2=CHCl_3+4CaCl_2+3CaCO_3+4Ca(OH)_2+7H_2O.$$

The theoretical quantity of chloroform obtainable according to the first of these equations would be 33.6 per cent., according to the second 30.6 per cent., of the weight of available chlorine contained in the chlorinated lime; by working on the large scale the yield of chloroform ranges between 22 and 24 per cent.

To prepare chloroform, 6 parts of the assayed chlorinated lime are mixed with about 24 parts of water, and the mixture strained into a still; 1 part of stronger alcohol is added, and the whole heated to 40° C. (122° F.). With the further application of very little heat the reaction now proceeds rapidly, the temperature rises, and the chloroform, mixed with some alcohol, distils over. The distillate is washed with water; the subsiding layer constitutes *crude chloroform*. The washings are preserved and employed in a subsequent operation. (For papers on the manufacture of chloroform consult *Amer. Jour. Phar.*, 1862, pp. 25, 42; and 1868, p. 289.)

The British Pharmacopœia gives a process for preparing chloroform in which less water (18 parts for the above quantities) is used, and slaked lime is put into the still with the chlorinated lime—an addition which has been recommended by Siemerling, Larocque, and others, but seems superfluous; otherwise, the process scarcely differs from the one given, except that the water is mixed with the alcohol and the solid ingredients are mixed with the liquid in the still.

Thus prepared, crude chloroform varies in specific gravity between 1.45 and 1.49, and imparts to strong sulphuric acid, after having been agitated with it, a brownish or brown color, the degree of coloration depending upon the amount of impurities present.

Considerable quantities of chloroform are obtained on a commercial scale by the action of sodium hydroxide on chloral hydrate, and, as the following equation shows, 165 parts of the latter are capable of yielding 119 parts of chloroform, sodium formate being produced at the same time: $C_2HCl_3O.H_2O + NaOH = CHCl_3 + NaCHO_2 + H_2O$.

Since 1885 chloroform has been made on a large scale by what is known as the acetone process. Liebig (1832) pointed out that chloroform could be made from acetone by treatment with bleaching powder, as well as from alcohol. Large quantities of pure acetone are now made by destructive distillation of calcium acetate, and although the statement appears in Watt's *Dictionary of Chemistry* that acetone will yield but 33 per cent. of chloroform, it has in practice been found to yield as much as 200 per cent., making it the richest chloroform-yielding substance known. When acetone is distilled with chlorinated lime, chloroform is produced, together with calcium acetate, hydroxide, and chloride, as may be seen from the following equation: $2(C_3H_6O) + 6(CaOCl_2) = 2(CHCl_3) + Ca(C_2H_3O_2)_2 + 2Ca(OH)_2 + 3CaCl_2$. The chloroform obtained by this method (for a full account see *Amer. Jour. Phar.*, 1889) is quite free from the chlorinated by-products frequently found in chloroform made from alcohol.

Chloroform may likewise be prepared by distilling wood-spirit (methylic alcohol) with chlorinated lime. Chautart proposed to prepare chloroform from oil of turpentine, but Soubeiran proved that chlorinated lime diffused in water acts violently upon the oil, and that but a little chloroform having a turpentine odor is obtained. Damoiseau (1881) thinks that pure chloroform may be advantageously prepared by passing a mixture of methyl chloride, CH_3Cl, and chlorine in proper proportion through a long tube containing animal charcoal and heated to between 250° and 350° C. (482° and 662° F.).

Purification.—Crude chloroform is purified by treatment with strong sulphuric acid during twenty-four hours, subsequent washing with a solution of alkali carbonate, and final rectification over lime; at a moderate temperature the acid removes certain by-products which usually accompany the crude chloroform, especially if made by the alcohol process.

Chloroform which fails to respond to the pharmacopœial tests the U. S. P. directs to be purified by the following process: Chloroform, 400 Gm.; sulphuric acid, 80 Gm.; dried sodium carbonate, 20 Gm.; deodorized alcohol, 4 Cc.

Add the sulphuric acid to the chloroform, contained in a glass-stoppered bottle, and shake them together occasionally during twenty-four hours, avoiding exposure to bright daylight. Separate the lighter chloroform layer, add to it the dried sodium carbonate, previously rendered anhydrous by heating it in a porcelain capsule on a sand-bath, until it ceases to give off aqueous vapor, and shake them together frequently and thoroughly during half an hour. Then transfer the chloroform to a dry retort, add to it the alcohol, and distil, by means of a water-bath, at a temperature not exceeding 67.2° C. (153 F.), into a well-cooled tared receiver, until the distillate weighs 380 Gm.—*U. S.*

Special methods have recently been proposed for the preparation of chemically pure chloroform, notably that of Pictet by means of refrigeration to—82° C. (—147.6° F.), at which point the pure chloroform is obtained in solid form, to be subsequently distilled at a low temperature under reduced pressure. R. Anschutz (1892) proposed the formation of a salicylide-chloroform, to be obtained in crystallized form by allowing salicylide, C_6H_4COO, and also ortho-homosalicylide, $CH_3C_6H_4COO$, to remain in contact with chloroform for twenty-four hours; the compounds, which contain 33.24 and 30.8 per cent. chloroform respectively, can be kept in closed vessels for a long period, and yield the chloroform by distillation very readily, the union being a feeble one and comparable with water of crystallization. None of the impurities have been found to form crystallizable compounds with salicylide or ortho-homosalicylide, and the latter substances may be used over and over in this process.

Properties.—The U. S. P. *chloroform* is a heavy, colorless, mobile, and diffusible liquid, not inflammable, of an agreeable ethereal odor, a hot saccharine taste, and of a neutral reaction. It is soluble in about 200 parts of water, to which it imparts its taste, and in all proportions in alcohol and ether; also in benzene, benzin, and fixed or volatile oils. Sp. gr. 1.490 at 15° C. (59° F.) or 1.473 at 25° C. (77° F.). It boils in a dry flask at 60° to 61° C. (140° to 141.8° F.), corresponding to the presence of ¾ to 1 per cent. of alcohol. It is a solvent for paraffin, gutta-percha, caoutchouc, many resins, most alkaloids, iodine, bromine, etc.

Pure (absolute) chloroform has at 15° C. (59° F.) the density 1.499 (Hirsch), is very prone to change when in contact with air and diffused light; it keeps, however, entirely unaltered in direct sunlight if the air has been completely expelled from the vessel. Chloroform below the density 1.475 is not affected by light. This behavior explains the necessity of keeping chloroform of 1.49 protected from the light, which is not required if the density is lowered to about 1.48 by the addition of 1½ per cent. of alcohol. The products of decomposition have the suffocating odor of *phosgene gas*, $COCl_2$, redden and often bleach moistened blue litmus, and liberate iodine from potassium iodide; even an incipient decomposition is detected by evaporating spontaneously a drachm of chloroform with a drop of neutral solution of litmus, which will thereby acquire a red color. Regarding the stability of pure chloroform and the effect of light upon the same, the latest investigations of Drs. Schacht and Biltz (*Phar. Jour. and Trans.*, June, 1893) have clearly established the fact that the purer the chloroform and the less alcohol present, the more readily does it undergo decomposition when exposed to light in the presence of air. The decomposition-products formed are free chlorine and carbonyl chloride ($COCl_2$, phosgene gas), but in the presence of alcohol the chlorine set free will react with the same and yield hydrochloric acid; the presence of free chlorine may therefore escape detection as long as alcohol is present as such. Chloroform can only be freed absolutely from alcohol by repeated shaking with twice its volume of fresh water, and this operation must be repeated at least ten times; when thus rendered absolutely pure it has the specific gravity 1.502 at 15° C. (59° F.), and its boiling-point is 62.5° C. (144.5° F.). Absolutely pure chloroform will readily decompose when exposed to daylight, the time varying from one to ten hours, dependent upon the intensity of the sunlight: the presence of atmospheric air (oxygen), however, is requisite to induce decomposition, as it has been proven by Brown (*Phar. Jour. and Trans.*, March, 1893) that when oxygen is rigidly excluded direct sunlight cannot effect decomposition; absolute

chloroform has been exposed to sunlight in a Torricellian vacuum for five months, equal to one hundred and fifty-three hours of sunshine, without change. That the presence of alcohol retards, and even prevents, the decomposition of chloroform has been repeatedly shown, and, according to the above-named investigators, ¼ of 1 per cent. is sufficient to prevent recognizable decomposition for a month or longer, ½ per cent. for nearly twelve months, and 1 per cent. for several years. Recent experiments made by Dr. Squibb (spring of 1893) have shown that chloroform containing 0.625 per cent. of 92 per cent. alcohol (but otherwise pure) may be exposed in half-filled bottles, cork- or glass-stoppered, to daylight (including frequent direct sunshine) for forty-eight days without suffering decomposition. The preservative influence of alcohol is due to the fact that it chemically combines with the deleterious decomposition-products, rendering them harmless.

Partially-decomposed chloroform may be restored to its original purity by agitating it with solution of sodium carbonate and rectifying it afterward over a little lime. Previous treatment with strong sulphuric acid will be necessary only when it becomes colored on being agitated with the chloroform.

When chloroform is shaken in a perfectly clean glass-stoppered vial with an equal bulk of sulphuric acid, no color should be imparted to either liquid after remaining in contact for twenty-four hours. Should a coloration appear, the chloroform must be regarded as unfit for inhalation, and should be purefied by the official process. When it is agitated with an aqueous solution of silver nitrate a white precipitate of silver chloride is not produced.

Tests.—"If 20 Cc. of chloroform be poured upon a round paper filter laid flat upon a warmed porcelain or glass plate, and the plate be rocked from side to side until the liquid is all evaporated except what is held by the paper, no foreign odor should become perceptible as the last portions disappear from the paper, and the paper should be left odorless. If 10 Cc. of chloroform be well shaken with 20 Cc. of water, and the liquid be allowed to separate completely, the water should be neutral to litmus-paper, and should not affect silver nitrate test-solution (absence of chlorides), potassium iodide test-solution (absence of free chlorine), or barium hydroxide test-solution (absence of decomposition-products from chloroform). If 40 Cc. of chloroform be shaken with 4 Cc. of colorless, concentrated sulphuric acid (absolutely free from chlorine compounds) in a 50 Cc. glass-stoppered cylinder during twenty minutes, and the liquids be then allowed to separate completely, so that both are transparent, the chloroform should remain colorless, and the acid should appear colorless or very nearly colorless when seen in a stratum of not less than about 1 Cm. in thickness (absence of impurities decomposable by sulphuric acid). If 2 Cc. of the sulphuric acid, separated from the chloroform, be diluted with 5 Cc. of water, the liquid should be colorless and clear, and, while hot from the mixing, should be odorless or give but a faint vinous or ethereal odor (absence of odorous decomposition-products). When further diluted with 10 Cc. of water, it should remain clear, and should not be affected by silver nitrate test-solution (absence of chlorinated compounds.) If 10 Cc. of the chloroform separated from the acid be well shaken with 20 Cc. of water, and the liquid be allowed to separate completely, the watery portion should not be affected by silver nitrate test-solution (absence of chlorinated compounds)."—*U. S.*

Detection of Chloroform.—Chloroform has sometimes been used for the adulteration of volatile oils; in these and in other liquids it may be detected by distilling them with a little alcohol at a temperature of about 65° C. (149° F.). Hager (1868) recommended the treatment of this distillate with zinc and sulphuric acid, when the chloroform will be decomposed and hydrochloric acid recognized in the liquid by silver nitrate. Lustgarten (1882) suggested as a reliable test the transient blue-green color which is produced on warming chloroform with naphthol and soda solution. A. W. Hofmann (1870) recommended the addition of the alcoholic liquid to a mixture of aniline and alcoholic solution of soda and warming, when the characteristic odor of isocyanides will be developed; 1 part of chloroform in 5000 to 6000 parts of alcohol may thus be detected, and it may be readily distinguished from *chlorethylidene*, which closely resembles chloroform in physical properties. All compounds, however, which on treatment with an alkali produce chloroform, iodoform, or bromoform give the same reaction.

Pharmaceutical Uses.—Chloroform is used as a solvent in the preparation of atropine and other alkaloids.

Chloramyl, recommended by Dr. Sanford (1879), is a mixture of chloroform 1 pound and amyl nitrite 2 drachms. There being a chloride and several chlorine substitution-products of amyl, the name does not appear to be a proper one.

Action and Uses.—Chloroform is an irritant, producing redness of the skin when topically applied, and even vesication if its evaporation is prevented. When from 10 to 20 minims of pure chloroform are injected subcutaneously, very considerable pain is experienced, which, however, presently subsides, and is succeeded by a feeling of numbness and by anæsthesia of the adjacent parts; a puffy swelling forms at the seat of the injection, and an induration which remains for several days. The numbness may continue for a week or more, and in the case of the leg may affect all the region to which the nerve is distributed near which the injection was made (Bartholow). Other observers have noted the persistent induration following the puncture, and have also described gangrene as an effect of it, but they have not spoken of the numbness just referred to. The local phenomena of swelling and inflammation appear to have been due to an imperfect manipulation of the syringe; indeed, one reporter (Féréol) declares that the operation causes no more pain than if water instead of chloroform were injected. The soporific action of chloroform used in this manner comes on slowly, but is curiously prolonged. At least 4 Gm. (fʒj), and sometimes more, of chloroform are necessary to cause sleep even at the end of several hours; it is not accompanied by anæsthesia, the least disturbance sufficing to arouse the patient, but it may last for six or seven hours. The temperature is reduced by 1° or 2° C., and the pulse by perhaps ten beats. The tardy and feeble sleep can only be explained by the very gradual absorption of the chloroform into the blood. Chloroform when taken into the stomach in a moderate dose produces effects very much like those of alcohol, such as a general sense of stimulation, fulness of the head, of giddiness and confusion of thought, followed by sleep. Gm. 4 (a fluidrachm) may be given as an average dose, provided it be administered as an emulsion. Otherwise it may irritate, and even seriously inflame, the stomach. Many cases of poisoning by chloroform taken into the stomach are recorded (*Amer. Jour. of Med. Sci.*, July, 1881, p. 277; Eliot, *Med. Record*, xxviii. 29; Niemann, *Centralbl. f. Therap.*, v. 405; Dunlap, *Edin. Med. Jour.*, xxiii. 523). In a case of recovery a weakly man had swallowed 3 ounces of chloroform (*Practitioner*, xxx. 47). Doses of half an ounce or more produce general convulsions, insensibility, partially dilated pupils, trismus, foaming at the mouth, slow and stertorous respiration, and lividity of the face. The pulse is feeble and sometimes irregular. The stools may be bloody and blood may be vomited. Death may result from pulmonary asphyxia alone, or from this together with gastritis. After death the brain is found greatly congested, and the mucous membrane of the air-passages and of the alimentary canal are in a similar condition. The bronchia are filled with mucus tinged with blood or mixed with pus. The blood in the vessels is fluid. A similar condition of the bronchia has been met with in persons who died with suffocative symptoms one or two days after inhaling chloroform, especially in the old and obese (Richet). A case of alleged homicide by chloroform swallowed occurred in England in 1886 (*Amer. Jour. Med. Sci.*, July, 1886, p. 303).

The vapor of chloroform when inhaled slowly is apt to produce excitement, usually of an agreeable sort, with extravagant gayety and gesticulation. In fuller anæsthetic doses it occasions a sense of warmth and stimulation, radiating from the chest to the extremities, followed by whirring noises in the ears and a sense of numbness throughout the body, soon followed by a complete loss of consciousness. Sometimes consciousness is more or less preserved, while the sense of touch and that of pain are abolished. But, as a rule, sensibility is first suspended, then perception, and finally motility. Sensibility to pain is lost before the sense of temperature or tactile sensibility is greatly impaired. During the full anæsthetic sleep the respiration is at first soporose and quickened, but soon becomes tranquil and slow; the pupil presents all degrees of dilatation; the pulse is at first fuller and more frequent, but subsequently nearly normal; the voluntary muscles are relaxed, but sometimes rigid or even cataleptic; and in females hysterical phenomena occasionally appear.

The question has been raised whether a person could be chloroformed during sleep, the numerous alleged instances of its having been done with criminal intent being naturally open to doubt, and even to suspicion. It is certain that on various occasions the experiment has been tried with the result of awaking the sleepers (Girdner, *Med. Record*, xxiv. 454), but it is equally certain that when conducted with due precautions it has been successful, especially with children. In a girl eight years old an abscess was opened under such circumstances by Curtis in 1873 (*Med. Record*, xxiii. 595). Schauffler (*Kansas City Med. Jour.*, June, 1875, p. 106) removed a pebble from the nostrils of a child that he had chloroformed while sleeping. The experiments of Cereeuil in France, although for the most part negative, were in several instances affirmative (*Ohio Med. Recorder*, Jan. 1877, p. 338), and the editor

of the journal just referred to says: "Of three attempts at chloroforming during natural sleep of which we were personally cognizant, two were successful." Dr. Quimby also not only accomplished it upon a person forewarned of the intention, but also upon two lads, on one of whom he performed evulsion of the toe-nail, and in the other case opened an abscess in the mouth and extracted several teeth. In both of the latter cases the anæsthetic was administered during the first sleep at night, and neither patient awoke until the usual hour the next morning (*Trans. Amer. Med. Assoc.*, 1880, xxxi. 519). Halderman reports two successful cases as well as several failures (*Med. Record*, xxiii. 594), and Neilson a complete chloroform narcosis obtained during sleep in a boy of ten years, during which the operation of circumcision was performed (*ibid.*, p. 595). (For additional illustrations see *Boston Med. and Surg. Jour.*, June, 1883, p. 595; *Med. Record*, xxiv. 23, 613; *ibid.*, xxxvi. 262; xxxvii. 41, 352: *Journ. Amer. Med. Assoc.*, i. 244.

The advantages of chloroform over other anæsthetics consist in its agreeable odor, the small quantity of it required, its non-inflammability, and the rapidity and completeness of its effects. Its one disadvantage is that it often destroys life. The number of deaths caused directly and exclusively by the inhalation of chloroform, independently of any error in the mode of its administration or in the quality of the agent or any unfitness of the patient, may now be counted by hundreds. A large proportion of them took place during operations which under other circumstances are considered trifling. It seems probable that many of these operations, such as that for strabismus, the extraction of teeth, the opening of abscesses, etc., were performed while the patient was in a sitting posture, and therefore most exposed to the danger of syncope, which it has been shown is the chief cause of death in chloroform inhalation. No other solution is so plausible of the otherwise singular fact that the danger of chloroform is in an inverse proportion to the severity of the operation performed. Again, the most complete safety of chloroform inhalation during natural labor lends itself to a similar explanation. The gravid uterus restricts the circulation of the blood in the lower limbs and increases it in the upper portion of the body, and this condition is mechanically exaggerated by the throes of labor, as well as by the mental excitement of the parturient female. On the other hand, in the state of exhaustion and terror which accompanies most of the serious accidents of labor and of operative obstetrics the conditions of safety are reversed, and chloroform becomes peculiarly dangerous. It is maintained by some of those who admit the dangers of chloroform that they do not exist when this agent is employed in operations upon children. It is alleged that their immunity is owing to the absence of that dread of the possible consequences of the inhalation which older persons experience, and to the much greater rapidity with which they fall into the anæsthetic condition. These reasons may be valid in favor of using a safe anæsthetic in operations upon infants and children, but they do not appear to be sufficient to warrant the selection of chloroform for this purpose. It is not improbable that the generally favorable action of chloroform anæsthesia in children is due in part to ignorance of their danger, and in part to the rapid elimination of the medicine by the kidneys. But confidence in this belief may be carried too far. As a leading medical journal has remarked, "It is likely to aid in increasing the number of victims who are yearly sacrificed to chloroform" (*Lancet*, Apr. 14, 1888). In some cases the effect, though short of being fatal, was alarmingly near it, as in the case of a strong girl between three and four years old, who inhaled a very moderate amount of chloroform to facilitate the extraction from her arm of a very large pin (*Med. News*, liii. 195). There has been adduced in favor of chloroform the interesting statement that in operations performed on the field after battle and in military hospitals chloroform has been generally used without any fatal action of the anæsthetic. In this case must be considered the generally robust condition of the patients and their state of mental excitement, both of them exceptionally salutary influences. In the *Surgical History of the Civil War in the United States* it is stated that 37 cases of death by chloroform were reported (*Part III.* p. 890), but it cannot be assumed that this number represents the totality that occurred. It may be stated that the preference given to chloroform or other anæsthetics by European surgeons has been sensibly modified since the death of its introducer, Sir James Y. Simpson, and that professional opinion tends to the point occupied by Schiff, who "considered that chloroform should be banished from practice as an anæsthetic agent, except in cases in which extraordinary resistance to the action of ether shows itself, in which instances it might be allowed to mix a little chloroform with it in order to produce the commencement of anæsthesia, which should afterward be continued with pure ether." Long ago (1858) Snow declared, "I believe that ether is altogether incapable of causing the sudden death by paralysis of the heart which

has caused the accidents which have happened during the administration of chloroform;" and Perrin, one of the most earnest advocates of the latter anæsthetic, admits that its dangers are "the result of an accident arising most frequently during an incomplete or untimely administration of it." In 1872, Dr. Thomas Jones, who was for eleven years administrator of anæsthetics in St. George's Hospital, London, wrote: "I have administered chloroform in more than six thousand cases." . . . . "I confess experience has taught me that chloroform, even when most carefully administered, is more dangerous than is generally supposed. If I was unfortunately compelled to take an anæsthetic, nothing would induce me to take chloroform." In 1880, Mr. Osborne, chloroformist to St. Thomas's Hospital, stated in his report on anæsthetics, "Ether is given in all possible cases because of its undoubted greater safety." And in 1881 it was declared that "there have been *reported* an average of about a death [from chloroform] for every month since the time of its introduction" (Reichert). At a meeting of the Medical Society of London in 1884, Mr. Braine, reviewing the subject of surgical anæsthesia, concluded that—1. For short operations nitrous oxide is the best agent. 2. For long operations (with certain exceptions) ether answers perfectly. 3. Nitrite of amyl is the best cardiac stimulant. (*Times and Gaz.*, Nov. 1884, p. 758). Chloroform was not even mentioned by the speaker. The *Practitioner*, in 1889 stated that experienced London anæsthetists were then almost wholly employing nitrous-oxide gas and ether, and using chloroform for only exceptional cases (vol. xlii. p. 44). Already, in 1887, Dr. Hewitt, administrator of anæsthetics at Charing Cross Hospital, stated as a result of his experience that ether is practically free from danger to life, whereas he had on several occasions been obliged to rescue patients from a condition induced "simply and solely by the administration of chloroform" (*Practitioner*, xxxix. 94). In the same year a leading medical journal (*Med. News.* l. 468) remarked that "the increasing employment of ether and the corresponding disuse of chloroform during several years past are the result of a conviction that the former is far safer." Among the many in the United States who were driven to substitute ether for chloroform by the alarming effects of the latter may be named Dr. H. Knapp (*Med. Record*, xxxi. 473) and Dr. R. F. Weir (*Med. News*, l. 442). Citations like these might be multiplied to show that in England and Ireland and on the continent of Europe the use of chloroform as an anæsthetic in surgery is much less general than it was formerly. The deaths directly due to its use—occurring, with one exception, in London alone, and published in the *Medical Times and Gazette* during the four years from 1875 to 1878—amounted to 15, and in every case but one the mode of death was by syncope. Between 1885 and 1887 nine persons died in Australia while under the influence of chloroform (*Jour. Amer. Med. Assoc.*, xi. 576). Mr. Wilson, anæsthetist to the Manchester Infirmary, found reported "20, if not more, cases of death under chloroform" (*Lancet*, Sept. 1889, p. 564); and Mr. Hewitt found that in a total of 139 chloroform deaths, 54 took place in connection with minor surgical operations (*ibid.*, Mar. 1890, p. 515). Charpentier collected 40 cases of death attributed to obstetrical anæsthesia by chloroform (*Amer. Jour. Med. Sci.*, Aug. 1889, p. 208. Compare Allwright, *Lancet*, 1889, i. 93; 1241, ii. 589). Such deplorable results ought certainly to be considered seriously by surgeons before they add to the ordinary and inevitable risks of an operation one which no sagacity can foreknow and no skill prevent.

In the fourth edition of this work (p. 441) it was stated that "the Committee on Anæsthetics of the British Association (1879) found that chloroform may cause death in dogs by primarily paralyzing either the heart or the respiratory organs, and that its action on the former is sometimes unexpected, and apparently capricious, as it is found to be in surgical operations performed with chloroform." In 1889 a report from the Hyderabad Medical School combated this doctrine, on the ground of experiments upon animals, and maintained the innocuousness of chloroform anæsthesia; but it was severely criticised (*Lancet*, 1889, i. pp. 394, 438, 949, 952). The causes of death by chloroform have been variously explained by different investigators. In 1870, Richardson stated them to be several, including "syncopal apnœa, epileptiform syncope, paralysis of the heart, or chloroform combined with surgical shock" (*Amer. Jour. Med. Sci.*, xcix. 507). Ungar, and later Strassmann, attributed it to fatty degeneration of the heart and liver (*Lancet*, July, 1889, p. 127); and this view was adopted by Ostertag, who placed cardiac paralysis first among the causes. A similar view was entertained by Dastre, who classified the deaths from chloroform under "primary syncope, respiratory or cardiac, secondary syncope, and toxæmic anæmia" (*Jour. Amer. Med. Assoc.*, xiii. 559). More recently (*Lancet*, Aug., 1890, p. 302) Prof. McWilliam assigned paralysis of the heart in diastole

as the primary cause of death, and arrest of the lungs as a secondary cause. In 1890, however, the second Hyderabad Commission reached a diametrically opposite conclusion from their experiments on animals, and assigned the place of first importance to the lungs; a member of the commission declaring that "chloroform has never, under any circumstances whatever, a direct action on the heart" (*Lancet*, Dec. 1890, p. 587). These statements encountered a prompt opposition and protest from experimenters, surgeons, and chloroformists (compare *Lancet*, 1889, 1890, *passim*), one of whom did not scruple to call them "preposterous" (Jan. 1890, p. 317). Dr. Richardson renewed his former protest against applying to man the results of the action of chloroform upon animals (*Asclepiad*, No. 1, 1890), and the error was vigorously combated and exposed by Drs. Wood and Hare (*Med. News*, lvi. 190), Laborde (*Archives gén.*, July, 1890, p. 108) and Franck (*ibid.*, p. 235), who endeavored to prove that the arrests of the lungs and of the heart are independent of each other, and that either may take place primarily. This conclusion is nearly the same that Dr. Wood arrived at in his paper presented to the International Congress at Berlin, Aug. 6, 1890, in which he showed that chloroform "is capable of causing death by primaril arresting the respiration or primarily stopping the heart;" that ether usually acts much more powerfully upon the respiration than upon the circulation, but that occasionally . . . . ether is capable of acting as a cardiac paralyzant; . . . . and that "chloroform kills, as near as can be made out, proportionately four or five times as frequently as ether" (*Med. News*, lvii. 121). These conclusions have received the confirmation of many surgeons, and, amongst others, of Dr. Reeve (*ibid.*, lvii. 381) and Dr. Dunlop, professor of surgery in Glasgow, who having demonstrated that chloroform death may occur either by asphyxia or by syncope, and that experiments upon animals are of little practical importance as guides to the surgical administration of chloroform, concludes that "under all circumstances it cannot be administered without some risk to the patient's life" (*Lancet*, Sept., 1890, p. 659). These conclusions might be reinforced by the published opinions of many surgeons at home and abroad. (Compare *Therap. Monatsh.*, iv. 244, 247, 249.) The witnesses of the dangers of the anæsthetic use of chloroform might be multiplied, but it must suffice to cite only two or three of the latest: Dr. Kirk, in his commentary on the report of the second Hyderabad Commission, expresses his conviction that asphyxia "has nothing to do with the fatalities due to chloroform narcosis in the human subject" (Glasgow, 1890). Dr. McWilliams (*British Med. Jour.*, Oct. 25, 1890) concludes a review of the matter by asserting that "chloroform is fatal by paralyzing the heart;" and Dr. B. W. Richardson declares that "no other narcotic approaches it for danger" (*Amer. Jour. Med. Sci.*, ciii. 696).

When chloroform is repeatedly used, or employed, as it frequently is, to produce intoxication, it occasions cerebral disorders resembling those caused by alcohol and by morphine. According to Svetlin, this occurs in two forms, of which the most usual may continue indefinitely, as hypochondriasis, melancholy, irritability, moral depravity, the delirium of persecution, or intellectual decay. (Compare *Med. Record*, xxvii. 297, 452; *Therap. Gaz.*, ix. 792.) More rarely the symptoms are acute, lasting for about a week, and characterized by violent delirium, maniacal fury, and hallucinations of sight or hearing. Similar effects have been produced by chloral (*Archives gén.*, Juill. 1883, p. 96). The chloroform habit is as inveterate as the opium habit, and far more pernicious.

What has been said above indicates the limits of the uses of chloroform in *surgery* which, in our judgment, experience has established. If the patient is robust and not exhausted, if the anæsthetic is administered to him in a recumbent position, and if its action is restrained within the limits of complete narcotism, its dangers are diminished, but they are not removed, and they cannot always be foreseen.

During pregnancy chloroform has been given with advantage, both by the stomach and by inhalation, to arrest obstinate *vomiting*, but its tendency to relax the mouth of the uterus should restrict its use to cases in which other remedies have failed, and also to the production of the first stage of narcotism only. During *labor* chloroform is indicated by the presence or the imminence of convulsions, by excessive sensitiveness of the maternal soft parts, by irregular and efficient pains, and by the necessity of manual and instrumental interference. In all operations for the success of which the contraction of the uterus is essential the full anæsthetic action of chloroform is unsafe. Chloroform is contraindicated during labor by great relaxation of the uterus, with a tendency to flooding, and when there is persistent vomiting or acute or chronic disease of the lungs or heart, and especially degenerative changes in the latter. It is worthy of notice that in France chloroform-anæsthesia was far from being accepted by obstetricians, the two professors

of obstetrics in the Medical Faculty of Paris, among others, having warmly opposed it (1878). As regards its use for palliating the ordinary pains of labor, its action ought not to go beyond the production of the first, or analgesic, stage, not only because it is sufficient, but also because in the stage of complete anæsthesia the contractile power of the uterus is very apt to be suspended.

Various spasmodic diseases have been favorably influenced by chloroform inhalation. Of these, spasmodic *asthma* is very speedily relieved, but the habit of using the medicine soon lessens its influence. The same remark applies to *cough*, whatever may be its immediate cause. *Tetanus*, traumatic as well as idiopathic, has been cured by it in many instances, and in the tetanoid spasms produced by the *strychnine*-poisoning its influence is salutary and has often saved life (*Philada. Med. Times*, xiv. 504). It has been used beneficially in *chorea* by subjecting the patient to its moderate operation for an hour or two every day, but in this disease its virtues do not counterbalance its dangers.

In *puerperal convulsions* the advantages of chloroform are very decided. Its inhalation should be commenced as soon as the indications of an impending paroxysm appear, such as restlessness, rigidity of the muscles, a staring expression, etc. *Infantile convulsions*, excited by a reflex irritation proceeding from the teeth, the digestive apparatus, etc., may be promptly allayed by chloroform inhalation, and its use for this purpose does not appear to have been injurious. All pains due to spasms are readily relieved by it, as in *colic*, including *biliary*, *nephritic*, and *painter's* colic, *dysmenorrhœa*, *spasms of the bladder*, *rectum*, etc.

It affords prompt relief in paroxysms of *angina pectoris*, but when this affection is associated with heart disease chloroform vapor must be very circumspectly employed.

As a local anodyne the applications of chloroform are as numerous as the seats and varieties of pain. It is very efficient in ointments or liniments made with lard, vaseline, or camphorated oil, or used hypodermically. It may also be applied as an atomized vapor or on wads of cotton at the bottom of a cupping-glass or wineglass, etc. As a topical anodyne and revulsive, chloroform with aconite is particularly useful in *neuralgia* when applied over the neuralgic points upon compresses protected by an impermeable covering. In 1873, Dr. Bartholow published three cases of *tic douloureux*, two of which were alleviated by the deep injection of chloroform, and not temporarily, but for weeks or months. In 1874, Dr. Mattison reported a case with a like issue; in 1877, Dr. Doe related a case of intercostal neuralgia accompanying *herpes zoster* which was relieved by the same method; and Dr. Stedman treated eight cases of different forms of neuralgia and produced a suspension or a marked mitigation of the paroxysms. These cases, all of which occurred in the United States, appear to have suggested a trial of the method in Europe, where it seems to have been first used in Switzerland by Cérenville, and afterward by Besnier in Paris. The latter judged it to be no less efficient than hypodermic morphine as an anodyne. It has been suggested that the chloroform dissolves the affected nerve (Batzer) or causes its necrosis. Dujardin-Beaumetz (1879) concluded that chloroform is not comparable to morphine as a local anodyne in *cancer;* that, moreover, nervous patients and those addicted to alcohol experience no general impression from it; and, finally, that in unskilled hands it is apt to cause serious local mischief. Cotton saturated with a solution of camphor in chloroform is one of the best applications for the pain of an *aching hollow tooth*, and rheumatic *toothache* is palliated by bathing the gum with chloroform. Among the many affections for which chloroform is topically useful are *headache*, *rheumatism*, *dysmenorrhœa*, *painful parturition*, *swelled testicle*, the use of the *moxa* and the *cautery*, *painful hæmorrhoids*, etc. In the case of a woman affected with an accumulation of the larvæ of the house-fly in her nostrils, insufflations of calomel and of salt water proving ineffectual, the vapor of chloroform caused the *maggots* to be discharged (*Med. Record*, xvi. 326). Chloroform has been introduced upon a sponge into the uterus to arrest *hæmorrhage* after delivery, but the well-known power of lemon-juice, etc., and even of mechanical irritation, to produce a like effect deprives chloroform of any claim to special power in the case. It should, however, be stated that chloroform-water (1 per cent.) is alleged by Spaak to arrest surgical hæmorrhage without coagulating the blood. Like ether, chloroform has been used successfully in the treatment of *tænia*. From half a drachm to a drachm of it should be administered, followed within an hour by half an ounce or an ounce of castor oil. The internal administration of liquid chloroform has been resorted to to assuage inflammation of the *tonsils*, *pharynx*, etc., various abdominal pains, and especially of *gastric ulcer*, *gastralgia*, *dyspepsia*, *colic*, the pain caused by *biliary* and *urinary calculi*, etc. (See *Spiritus Chloroformi.*) It has also been recommended in drachm doses as a potent remedy in conges-

tive *periodical fevers*, in *convulsions*, *infantile* or *puerperal*, by Dr. D. Scott (*Therap. Gaz.*, x. 20).

Chloroform should never be administered to persons afflicted with feeble or obstructed hearts, or brain or lung disease, or obstructive disease of the kidneys. It is comparatively safe in parturition and in childhood, but hazardous for delicate females, especially when of a nervous temperament, and for old persons of both sexes. No food should be taken by the patient for four hours previous to the inhalation of chloroform, and then in small quantity and of a digestible nature. Immediately before the chloroform is inhaled a draught of wine or of brandy or whiskey and water should be given. It is recommended by Prof. Zweifel that when chloroform inhalation is practised at night, the air should be allowed to circulate freely around the patient, for a peculiarly noxious atmosphere he thought was created by the mixture of chloroform emanations and those of burning gas, etc. (*Lancet*, May, 1889, p. 903). A more definite opinion is that the coughing and choking are produced by a pungent and acrid gas, which is said to be carbon oxychloride (Paterson, *Practitioner*, xlii. 420). The first portion of vapor should be largely diluted with air, or, in other words, the full effect of the anæsthetic should be reached gradually in this manner, and not by intermitting its administration. A too rapid inhalation of it tends to produce symptoms of asphyxia. It should always be given by some one who in the habit of using it and who will attend to it alone (Osborn). Chloroform vapor should be administered by means of a napkin folded into a funnel-shape, and held over the nostrils and the mouth during inspiration, yet so as to admit a sufficient supply of atmospheric air, or by means of an appropriate inhaler; and in every case the patient should be in a recumbent position. To protect the skin of the face from irritation it should first be anointed. The quantity of chloroform used must vary with numerous conditions, but in surgery chiefly with the duration and painfulness of the operation. An intermittent administration prolongs unduly the ante-anæsthetic stage. The best guide is the condition of the pulse and the respiration; if the latter is normal and unembarrassed, not intermittent, shallow, gasping, or sighing, the administration may be continued, provided the pulse warrants it by its strength and regularity. No more chloroform should be administered than is necessary to produce and preserve the requisite degree of anæsthesia. W. R. Williams (*British Med. Jour.*, 1883) lays down as the most important rules: 1. In chloroformization too much air cannot be admitted; in etherization as much as possible should be excluded. 2. The full effects of chloroform cannot be obtained in less than fifteen minutes; those of ether are secured in five minutes. 3. The epigastrium should be bared, so that the respiratory movements may be accurately watched. 4. The indications furnished by the pulse appear too late to be practically useful. An earlier warning is sometimes given by the pupil. If it contracts under the full influence of the anæsthetic (as it should do), no more should be given until it begins to relax again. Its sudden and complete dilatation is a sign of imminent danger.

Chloroform may be preferred before ether when the latter fails to produce unconsciousness and muscular relaxation; also in operations about the nostrils, mouth, or brain, and in persons suffering from pulmonary, renal, or cerebral disease. On the other hand, ether is preferable to chloroform where from any cause, material or nervous, there exists great debility, and where the heart is affected with muscular debility or with valvular disease. In 1864, Claude Bernard found that morphine intensified and prolonged the action of chloroform, so that a given effect could be produced by a much smaller dose of chloroform than when morphine had not been previously administered. He stated that, in 1863, Nussbaum, in performing surgical operations, was able to prolong the chloroform anæsthesia by means of morphine previously administered subcutaneously, and that Guibert, in 1869, had employed the same expedient successfully. He illustrated these propositions by numerous experiments and cases (*Les Anæsthésiques, etc.*, 1875). Labbé also administered hypodermically ⅛ grain morphine fifteen or twenty minutes before the inhalation of chloroform was commenced, and concluded that this method dispensed with the use of a large amount of chloroform and avoided its dangers (*Annuaire de Thérap.*, xxxiii. 56). In 1879, Bossis contended that complete analgesia was thus produced without altogether suspending consciousness or the sense of touch, sight, and hearing (*Bull. de Thérap.*, xcviii. 476). In 1868, Harley spoke of the use of atropine "in failure of the heart's action from chloroform" (*Old Vegetable Neurotics*, p. 244). Finally, Dr. Crombie reported the results of his extensive use of the method in India, where, however, he did not administer the morphine until the inhalation of chloroform had commenced. He fully concurred with previous reporters in regarding it as safer

and more convenient than the use of chloroform alone. (For details see *Practitioner*, xxv. 401.) In 1880, Fraser advised the hypodermic injection of $\frac{1}{120}$ to $\frac{1}{60}$ grain of sulphate of atropine and $\frac{1}{12}$ to $\frac{1}{8}$ grain of acetate or hydrochlorate of morphine fifteen or twenty minutes before the administration of chloroform is commenced (*ibid.*, xxvi. 201. The same method was employed in 1876, by Dr. J. C. Reeve, in this country, and more recently was recommended by Aubert (*Centralbl. f. Therapie.*, iii. 470). The hypodermic use of chloroform is certainly efficient, but there are two dangers associated with it: the first is of throwing the liquid into a vein; the second is the production of local inflammation and abscess, and even gangrene. These dangers may be lessened, the former by puncturing the skin with the tube unattached, and waiting to see that no blood escapes from it; the other by avoiding to wound the lower surface of the skin. The dose thus administered has varied from Gm. 1–4 (15 to 60 grains). The danger of causing gangrene by hypodermic injections within the mouth, and especially into the gums, is very great.

There is no medicinal antidote to chloroform. It destroys life more or less gradually by asphyxia or more or less rapidly by syncope. For the former condition artificial respiration is the appropriate remedy, and should not be abandoned until death is certain. For the latter the essential treatment consists in instantly placing the patient in such a position as will cause the blood to flow into the brain, but not with the head absolutely dependent, and the hypodermic use of atropine. It has been proposed by Dr. G. E. Sanford (1878) to counteract the dangers of chloroform by administering it mixed with nitrite of amyl, in the proportion of 1 pound of the former to 2 drachms of the latter. After having employed it in a number of surgical operations and obstetrical cases, he arrived at the conclusion that "it seems to be fully as safe as sulphuric ether, and far more pleasant in its administration, possessing all the advantages of pure chloroform, but without its dangers." Burrall refers to nine cases, in all of which impending death seems to have been averted by nitrite of amyl inhaled or injected hypodermically (*Med. Record*, xxi. 235). If time and the circumstances permit, the sedative tendency of the chloroform may be counteracted by alternating its use with that of ether. In some cases the symptoms have been removed by titillating the nostrils with a feather or by the emanations of ammonia (Schirmer); and a case is reported of reaction from alarming syncope induced by swallowing a fluidounce of chloroform "after four half-drachm injections of liquor ammoniæ (*B. P.*)" had been introduced into the veins of the arm. The patient, however, died (*Times and Gaz.*, May, 1871, p. 616). Billroth and many other surgeons endeavor to prevent the dangers of chloroform by diluting it with ether and alcohol. A mixture of 3 parts of chloroform, 1 of sulphuric ether, and 1 of alcohol is often employed. But a death under the use of this mixture occurred to Billroth himself in a case of attempted reduction of a dislocation of the hip-joint (*Boston Med. and Surg. Jour.*, Dec. 1880, p. 649), and others have since then been met with. A mixture of oxygen and chloroform vapor has been recommended by Neudorfer and employed by Kreutzmann (*Therap. Gaz.*, xi. 847).

Chlorodyne is the name given to a popular nostrum which is much used for the relief of flatulent colic, and generally as an anodyne. According to E. Smith (1870), its composition is as follows: R. Chloroformi ʒiv; morphiæ mur. gr. xx; æther. rect. ʒij; ol. menthæ pip. ♏ viij; acid. hydrocyan. dil. ʒiv; tinct. capsici ʒvj; mucil. acaciæ ℥j; theriacæ [syr. fusci] ad ℥iv.—M. Such a combination is often useful, but is too dangerous to be entrusted to ignorant persons. A girl of twenty-three years drank about eight ounces of "chlorodyne," and died comatose in about eight hours. Her lungs and liver were congested, and the left heart contained a soft white clot (*Times and Gaz.*, May, 1881, p. 575). Another case occurred in 1889 (*Lancet*, March, 1889, p. 647).

Acetone Chloroform is said not to be poisonous when taken internally, but to lower febrile temperatures and to be mildly narcotic (*Ther. Gaz.*, xi. 471).

CHONDRUS, *U. S.*—Irish Moss.

Carrageen, P. A., P. G.; *Fucus crispus.—Carragaheen, Mousse perlée*, Fr. Cod.; *Irländisches Moos, Perlmoos, Knorpeltang*, G.; *Fuco carageo*, F. It.; *Caragaheen*, Sp.

The entire plant, Chondrus (Sphærococcus, *Agardh*, Fucus, *Linné*) crispus, *Lyngbye*, and Chondrus (Sphærococcus, *Agardh*, Mastocarpus, *Kützing*) mamillosus, *Greville*, s. Gigartina mamillosa, *J. G. Agardh.* Bentley and Trimen, *Med. Plants*, 305.

Nat. Ord.—Algæ, Florideæ, Gigartineæ.

Origin.—These plants grow on rocks of the American and European shores of the Atlantic Ocean, and are collected in the spring on the coasts of New England and Ireland; on the coast of Massachusetts about 15,000 barrels are stated to be annually procured.

Description.—Both plants are attached to the rocks by means of a small disk. The frond, about 15 to 20 or 30 Cm. (6–8–12 inches) long, is cylindrical below, repeatedly forked above, flattened, and gradually dilated, acquiring a width varying at the forks between 3 and 25 Mm. ($\frac{1}{8}$ and 1 inch), and across the branches between 2 and 6 Mm. ($\frac{1}{12}$ and $\frac{1}{4}$ inch); the final lobes are linear or more or less broadly wedge-shaped, emargi-

Fig. 60.

Narrow form, with fruit.

Fig. 59.

Chondrus crispus, broad form.

Fig. 61.

Chondrus mamillosus, with fruit.

nate or two-lobed, and ragged or crisp at the rounded margin from newly-forming segments. The capsules (cystocarps) of Ch. crispus are imbedded near the end of the segments and project slightly above the surface; those of Ch. mamillosus are scattered along the channelled branches of the frond, are oval or elliptic, and raised upon a short stalk. In the fresh state both plants are cartilaginous, of a brownish or purple, or frequently yellow or green, color. After drying in the sun they turn whitish or yellowish, and become somewhat translucent and of a horny appearance. The drug has a slight seaweed-like odor and a mucilaginous somewhat saline taste and becomes soft and slippery in water. Boiled with 30 parts of water, it yields a thick mucilaginous liquid which is not colored blue by iodine; and with 10 parts (or 1 part of the well-dried drug with 15 parts) of water the solution gelatinizes on cooling.

Constituents.—The principal constituent is mucilage, of which Herberger (1834) obtained near 90 per cent., 9.5 of which were soluble in cold water. The mucilage is insoluble in ammoniated copper, is precipitated by lead acetate, and yields mucic acid on being treated with nitric acid. Flückiger found the mucilage to contain 0.88 per cent., and the whole plant 1.012 per cent., of nitrogen. The same author obtained over 15 per cent., Herberger only 8.8 per cent., of ash, which consists of chlorides, sulphates, and phosphates of sodium, potassium, calcium, and magnesium. Grosse detected also traces of iodine and bromine. Church (1877) determined in the air-dry drug 6.4 per cent. of sulphur, a portion of which is present as sulphates; also 9.38 albuminoids, 55.54 mucilage, 2.15 cellulose, 14.15 ash, and 18.78 water. Starch is absent; but after treating thin sections of the drug for a day with alcoholic solution of potassa, and then washing with water, the cell-contents, but not the cell-walls, acquire a dark-blue color on being left in contact with solution of iodine (Flückiger).

Admixtures.—Other algæ are not unfrequently collected with the officinal species, and are in most cases readily distinguished from the latter: those of similar appearance are Gigartina acicularis, *Lamouroux*, with slender cylindrical branches, and Gig. pistillata, *Lamouroux*, with prominently stipitate capsules.

Allied Drugs.—Dulse is the name given to Halymenia (Fucus, *Linné*, Rhodomenia, *Greville*, Sphærococcus, *Kützing*) palmatus and edulis, *Agardh*, two florideous algæ growing on the coasts of the Atlantic and Mediterranean. Both are of a deep blood-red, or after drying dark-purple, color, and have flattened fronds, that of the first species being palmately divided into oblong,

wedge-shaped lobes. Stenhouse (1844) found it to contain mannit, and Magin-Bonet proved the presence of bromine and iodine.

Helminthochorton, Corsican moss; Mousse de Corse, *Fr. Codex.*—This consists partly of Sphærococcus (Fucus, *Linné*, Ceramium, *Willdenow*, Gigartina, *Lamouroux*, Alsidium, *Kützing*) Helminthochorton, *Agardh*, which grows in the Mediterranean, but as found in commerce is always a mixture, sometimes of twenty or thirty different species of algæ. The drug is cartilaginous, filiform, repeatedly forked, varies in color between brown, yellowish, and whitish, and has the odor of sea-weeds and a strongly saline and mucilaginous taste. It contains mucilage and various salts, among them bromides and iodides, but its anthelmintic principle, if any, is unknown.

Fucus amylaceus, Ceylon moss, also called *Jaffna* and *edible moss*, comes from the Indian Ocean, and consists of Sphærococcus (Plocaria, *Montag*, Gracilaria, *Greville*) lichenoides, *Agardh*. It is about 10 Cm. (4 inches) or more long, about 1.5 Mm. ($\frac{1}{16}$ inch) thick, cylindrical, irregularly forked, filiform above, and has in the fresh state a reddish color, but on drying becomes nearly white and rather brittle. It has a slight seaweed odor and a mucilaginous taste. H. G. Greenish (1882) found in it moisture 15, ash 10.2, albuminoids 7.5, and matter soluble in alcohol 0.1 per cent., and determined the absence of mannit and the presence of various carbohydrates differing in their behavior to water and alkalies and in the sugar they yield with acids—namely, metarabin 1.32, and others soluble in soda 3.12; gelose and others soluble in hot water 36.7; paramylon 6.5, wood-gum 3.2, and cellulose 10.2 per cent.

Agar-agar consists of Eucheuma spinosum, E. gelatinæ, *Agardh*, and other florideous algæ of the Indian Ocean; is of a brownish-white color, and has short projections on the branches. The so-called *Japanese* or *Chinese gelatin* or *isinglass* is prepared from these algæ, and forms irregular thin and soft pieces, or rectangular, nearly colorless, light and spongy cakes about 4 Cm. ($1\frac{1}{2}$ inches) wide. It consists mainly of gelose, or, according to Scheibler (1875), of pararabin.

Edible birds' nests are the nests of Collalia (Hirundo) esculenta and several other swallows of the Indian Archipelago, and consist of different species of Gelidium and allied seaweeds after they have been altered in the crop or gizzard of the bird. They contain a large amount of gelatinous matter.

Pharmaceutical Preparations.—Gelatina de fuco-crispo, *Fr. Cod.*—Irish-moss jelly, *E.*—Boil 60 Gm. of Irish moss for half an hour in 250 Gm. of water; express, strain, add 25 Gm. of sugar, evaporate to 250 Gm., and add 10 Gm. of orange-flower water.

Carrageen gelatin dried in sheets has been used as a substitute for other fomentations and poultices. A piece of convenient size is placed between two pieces of cotton cloth or flannel, then dipped in hot water, pure or medicated, until it is saturated, and then applied to the skin and covered with waterproof cloth.

Action and Uses.—Irish moss is demulcent and slightly nutritious. Its nutritious elements exist in an exceedingly minute proportion. It once had an extensive reputation in the treatment of chronic *bronchial* and *intestinal fluxes* and irritations of the *urinary passages*. The degree of its efficacy in these affections was probably due to its protective qualities, and possibly also to the influence of its iodic constituent upon nutrition, which has generally been admitted, but not demonstrated. The following preparation is agreeable and useful: Irish moss, macerated and washed, gr. xxx; pure water, ℥xvj; boil down to one-half and strain with expression, and add white sugar, ℥iv; gum-arabic, ℥j; powdered orris-root, gr. xxx; heat to dryness with a gentle temperature, stirring constantly so as to obtain a pulverulent mass, to which 3 ounces of arrowroot should be added with trituration. To prepare a jelly with this powder, rub a teaspoonful of it with a little cold water and then pour a cupful of boiling water on it (Neligan).

Helminthochorton, as its name indicates, is used as a *vermifuge*, and is given in coarse powder, mixed with honey or milk, in the dose of from Gm. 1 to 10 (gr. xv–cl.). It is also used, in decoction, for induration of the *lymphatic glands*.

CHRYSAROBINUM, *U. S., Br., P. G.*—Chrysarobin.

Chrysarobine, Fr.; *Chrysarobin*, G.; *Crisarobina*, It.; *Chrysarobina*, Sp.

A neutral principle in its impure, commercial form, extracted from Goa powder, a substance found deposited in the wood of Andira Araroba, *Aguiar*.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—The *Pó de Bahia*, *araroba* or *arariba* tree, is closely allied to the West Indian cabbage tree (see page 208), and is common in the damp forests of Bahia, Brazil, where it is locally known as *angelim amargoso*. It attains a height of about 30.5 M. (100 feet), has long petioled paripinnate leaves and paniculate racemes of purple flowers with a one-ovuled ovary. It was first described by Aguiar (1879), but Monteiro (1878) had recognized it already as being distinct from Andira anthelmintica, *Bentham*, and from And.

vermifuga, *Martius*, known in Brazil as *angelim doce*. According to Peckolt (see ANDIRA). the former, and according to F. M. de Mello Oliveira (1878) both species named, are known in Brazil as angelim amargoso. Oliveira gives *uraremá* as the common name of And. spectabilis, and Martius mentions in his *Materia Medica of Brazil* that the name araroba is given to two species of Centrolobium (C. robustum and C. tomentosum).

ARAROBA is contained in the large porous vessels and in clefts or cavities which traverse the wood in the direction of the diameter and are prolonged through the entire trunk; it is obtained by cutting down the tree, splitting the trunk, and scraping the powder from the clefts, and is seen in commerce as a rough powder or in small irregular pieces, originally of a light-yellow color, but usually darkened by exposure to light and moisture to a dull-ochrey, pale-brown, or even umber-brown or deep-purple, color. It has a bitter taste. When carefully heated it yields a moss-like sublimate, which is colored red by alkalies. Formerly it was largely exported from Brazil to Portugal, whence it appears to have been shipped to the Portuguese colonies in Africa and Asia, and from the settlement Goa on the Malabar coast it became known in East Indian pharmacy, and subsequently in European and American, as Goa-powder; its identity with araroba was first pointed out by Dr. Da Silva Lima (1875); the wood to which the powder is attached was found by E. M. Holmes to be very similar to that of Cæsalpinia echinata, *Lamarck;* but J. L. Macmillan (1879) observed that this wood yields its coloring matter to water, while araroba does not. Examined by Prof. Attfield (1875), araroba was found to be free from starch, to leave only .43 per cent. of ash, and to yield to boiling water about 7 per cent. of gum, a glucoside precipitable by lead subacetate, and a bitter principle precipitated by lead subacetate; from the residue hot benzene dissolves over 80 per cent. of chrysarobin, and alcohol afterward takes up 2 per cent. of resin, leaving 5½ per cent. of red wood-fibre.

Properties.—Chrysarobin is "a pale orange-yellow, crystalline powder, odorless and tasteless, and turning brownish-yellow on exposure to air; very slightly soluble in cold water or alcohol; soluble, without leaving more than a small residue, in 150 parts of boiling alcohol; also soluble in 33 parts of boiling benzene and in solutions of the alkalies. When heated to 151° C. (304° F.) it fuses, forming a dark, opaque mass; and, when ignited, it is partly sublimed, and finally consumed without leaving a residue."—*U. S.* The dust of chrysarobin is irritating to the eyes and nostrils.

As obtained from araroba by hot benzene chrysarobin was by Attfield supposed to be chiefly chrysophanic acid, until Liebermann and Seidler (1878) showed it to be mainly a hitherto unknown compound, $C_{30}H_{26}O_7$, for which they retained the name chrysarobin proposed by Attfield. It is a pale-yellow powder, consisting of small wart-like crystals and acquiring on exposure a darker tint. By repeated crystallization from glacial acetic acid it is obtained pure in the form of small yellow scales, which are fusible and partly sublimable, nearly insoluble in water and ammonia, sparingly soluble in alcohol, more freely soluble in amylic alcohol, ether, collodion, chloroform, and various hydrocarbons. It is inodorous and, on account of its insolubility in water, tasteless. Chrysarobin dissolves in concentrated sulphuric acid with a yellow color, is nearly insoluble in very diluted potassa solution, and yields with melted potassa a brown mass. Chrysophanic acid, on the other hand, dissolves in concentrated sulphuric acid and in very dilute potassa solution with a red color, and on being melted together with potassa yields a blue mass. The solution of chrysarobin in strong potassa solution has a yellow color and a strong green fluorescence, and on being agitated with atmospheric air rapidly acquires a red color, through the formation of chrysophanic acid; $C_{30}H_{26}O_7$ (chrysarobin) + $2O_2$ yields $2C_{15}H_{10}O_4$ (chrysophanic acid) + $3H_2O$.

Tests.—If boiled with 2000 parts of water, chrysarobin should not be completely dissolved; the filtrate should be pale reddish-brown, tasteless, neutral to test-paper, and should not be colored by ferric chloride.—*U. S., P. G.* In concentrated sulphuric acid it is soluble with a deep-red color; on pouring this solution into water the substance is again deposited unchanged. On adding 0.1 Gm. of chrysarobin to 10 Cc. of potassium hydroxide test-solution, in a test-tube and shaking the latter, the solution, which is at first yellow or yellowish-red, will gradually acquire a deep-red color.—*U. S.* Chrysarobin should be almost wholly soluble in 150 parts of hot alcohol. If .001 Gm. ($\frac{1}{64}$ grain) of chrysarobin be sprinkled upon a drop of fuming nitric acid, the red solution extended to a thin layer, and a little ammonia added by means of a glass rod, a violet color should be produced.—*P. G.* If sprinkled on concentrated sulphuric acid, chrysarobin should give a reddish-yellow solution.

Pharmaceutical Uses.—Chrysarobin, having been at one time mistaken for

chrysophanic acid, is still occasionally prescribed by the latter name. It is an ingredient of Unguentum chrysarobini, *U. S.*

Acetum araroba, *vinegar of araroba*, is prepared by Da Silva Lima by digesting for a week 25 parts of araroba in 100 parts of diluted acetic acid. When used it may be mixed with glycerin.

Allied Compounds.—Anthrarobin, Desoxyalizarin, $C_{14}H_{10}O_3$.—This substance, obtained from alizarin, a coal-tar product, by action of nascent hydrogen, is prepared as follows: Commercial alizarin is dissolved in warm ammonia-water, zinc dust is added, and heat applied until the blue color is changed to yellow; the solution is filtered into water strongly acidulated with hydrochloric acid, and the precipitate formed is washed by decantation until free from acid, and then dried on porous tiles at 100° C. (alizarin $C_{14}H_8O_4$ + hydrogen H_4 = anthrarobin $C_{14}H_{10}O_3$ + water H_2O). The commercial article occurs as a yellowish-white powder, practically insoluble in water and dilute acids, but readily soluble in cold aqueous solutions of the hydroxides of alkalies and alkaline earths; it is soluble in glycerin, readily in 5 parts of alcohol, but difficultly soluble in chloroform and benzene. Its alkaline solutions greedily absorb oxygen from the air, and the color changes to green, and finally to blue, alizarin being again formed. 0.1 Gm. of anthrarobin should yield a clear yellow solution with 1 Cc. of soda solution, which assumes a violet color if air be forced through it. It should not leave more than 1 or 2 per cent. of residue upon ignition. Although weaker than chrysarobin in its action, it has been used as a substitute for the same on account of the absence of irritating properties and its greater solubility.

Hydroxylamine hydrochloride, NH_2OHHCl.—The base hydroxylamine is only known in the free state in solution; the hydrochloride is obtained from the sulphate by treatment with barium chloride. By a rather complicated process hydroxylamine sulphate is obtained by the interaction of sodium nitrite and acid sodium sulphite at a temperature of 0° C. (32° F.). The hydrochloride occurs as colorless hygroscopic crystals, soluble in an equal weight of water, also in glycerin and in 15 parts of alcohol. The solutions redden blue litmus-paper. It possesses strong reducing properties, precipitating metallic gold, silver, and mercury from solutions of their salts; it also reduces Fehling's solution in the cold. The salt must be kept in well-closed bottles. On account of its non-staining properties hydroxylamine hydrochloride has been suggested as a substitute for other reducing bodies, chrysarobin, pyrogallol, and anthrarobin, in the treatment of skin diseases; but by some authorities it is pronounced dangerous if absorbed, being a powerful blood-poison and generally destructive to vegetable and animal life (Helbing).

Action and Uses.—It is stated that the irritating effects of chrysarobin on the skin and mucous membranes are such that the workmen employed in cutting up and pounding it are obliged to protect the face, nostrils, and throat against its dust. Gaskoin relates that in treating ringworm of the scalp he first wetted the part thoroughly with lemon-juice or carbolic-acid water, and for a few minutes rubbed in the powder, after which the face was apt to become swollen and covered with an ugly brown stain, accompanied by considerable inflammation. This effect was observed oftenest in children. The usual experience with chrysarobin is that when applied to the face or scalp it is very apt to occasion redness of the eyes and erythema, with swelling of the skin, followed by desquamation of the cuticle. The inflammation is sometimes intense and painful, producing a crop of boils and lasting for several weeks. Applied to the broken skin, as in psoriasis, it has been known to excite vomiting.

Internally, chrysarobin is by some alleged to be purgative in the dose of Gm. 0.50 (gr. vij). It is stated, however, to be very slow in its operation, which begins only at the end of twenty-four hours, but may continue for several days without griping. It is more apt to act at first as an emetic when given to children of twelve years in doses of Gm. 0.35 (6 grains) and to adults in doses of Gm. 1.60 (25 grains), according to Thompson, who adds that chrysarobin is likely to purge and chrysophanic acid to vomit (*British Med. Jour.*, May, 1877, p. 607). The urine of persons using chrysarobin turns red on the addition of alkalies. A case is reported in which after Gm. 0.20 (3 grains) of chrysophanic acid a woman was seized with burning pain in the stomach, vomiting, pain in the bowels, diarrhœa, hæmaturia, and pain over the bladder, with tenesmus (*Glasgow Med. Jour.*, Oct. 1881). It is probable that the substance taken was not chrysophanic acid merely.

The use of Goa-powder in *ringworm of the scalp* is thus described by Dr. Fayrer: A few grains of the powder are mixed with common vinegar or lemon-juice to about the consistence of cream, and with it the eruption is painted over, as well as the skin a little distance beyond its margin. It causes no pain at first, but in the course of a few hours there is a sensation of a dull, heavy nature, the eruption becoming white, while the surrounding skin is stained of a dark color. The sense of uneasiness soon passes away, the integument resumes its natural color, and all traces of the disease disappear at the

same time. Unna's method differs from this in the application of the following ointment: Chrysarobin, 5.0; salicylic acid, 2.0; ichthyol, 5.0; simple ointment, 100.0 (*Therap. Monatsh.*, iv. 302). In chronic cases the process of cure is necessarily more gradual. Da Silva Lima has verified these statements, and also tested the virtues of the application in an obstinate case of *mentagra*, in which he twice a day applied to the roots of the affected hairs, by means of a camel's-hair pencil, an ointment composed of 20 grains of araroba-powder, 10 drops of acetic acid, and an ounce of benzoin ointment.

Chrysarobin has been oftener used in the treatment of *psoriasis* than of any other disease of the skin. When Goa-powder was employed, 1 part of it was mixed with 3 of lard, and applied with friction twice a day for six successive days. An ointment made with from Gm. 0.60–4 (gr. x–lx) of chrysarobin to Gm. 32 (an ounce) of lard may be applied to the patches only with a mop night and morning, after removing the scales with warm water. It should not be used on the face and head, on account of the discoloration of the skin it produces, but which may be removed by alkaline solutions.

To prevent irritation of the sound skin, a paste made by adding only a small quantity of water to the acid may be applied to the patches alone, and when dry it may be covered by a film of collodion, which will preserve it for several days (Fox). Continued experience in the use of chrysarobin has not increased confidence in its virtues. Besides the objectionable discoloration and inflammation of the skin produced by it, the eruption, after being cured, is apt to break out anew and more extensively (Jarisch, *Centralbl. f. Therap.*, i. 14). These conclusions are confirmed by Morrow (*Amer. Jour. of Med. Sci.*, Apr. 1883, p. 565). Napier claims that cases of psoriasis which had resisted arsenic and external applications were cured by chrysophanic acid administered in pills containing half a grain each of the preparation. At first, one was given after each meal, and the dose gradually increased until signs of gastro-intestinal disturbance occurred. In one case 9 grains a day were taken without trouble. In nearly all the cases the improvement of the skin disease was marked and rapid (*Practitioner*, xxiv. 132). Externally, the medicine has proved its efficacy in the treatment of contagious or parasitic *ringworm*, and is more or less useful in that of *herpes tonsurans*, *herpes circinatus*, *chronic lichen*, and the *ephelides* of pregnancy. Dr. Metcalfe (*Boston Med. and Surg. Jour.*, Jan. 1887, p. 88) reports remarkable success in the treatment of *acne* by an ointment containing 3 grains of chrysophanic acid to an ounce of vaseline. It seems to possess no special virtue in pityriasis, eczema, or tinea versicolor. It has been applied to hæmorrhoids.

Originally, Goa-powder was made into a paste with a little vinegar or lemon-juice and smeared over the eruption daily for several days. Afterward an ointment was used containing from Gm. 0.60–4 (gr. x–lx) of the powder or of chrysophanic acid (chrysarobin) melted together with an ounce of lard. The officinal chrysarobin ointment is preferable. Better still is probably the gelatin mixture proposed by Pick, containing from 5 to 15 per cent. of chrysarobin, or a solution of 20–40 grs. of chrysarobin in an ounce of gutta-percha solution (*Br. Ph.*). Its action can be confined to the affected spot (Jarisch, *loc. cit.*). Alexander has apparently improved upon these methods in the treatment of *tinea tonsurans*; after shearing and epilation he applied to the areas a saturated solution of chrysarobin in liquid gutta-percha, renewing it as often as it became loose or fissured (*Jour. Cutan. Dis.*, 1885, No. 2).

According to Liborius, a tincture made from the fibres of a Siamese plant, Rhinacanthus communis, which contains chrysarobin, may be used to cure *ringworm*.

Anthrabobin was introduced as a substitute for chrysarobin and pyrogallic acid. It resembles the former in its deoxidizing power, and acts essentially in the same manner as chrysarobin, but less intensely and more gradually; but it stains the skin more deeply. It was also found by Behrend an efficient remedy for *psoriasis*, etc. His results were corroborated by Bronson (*Therap. Gaz.*, xiii. 31). But Rosenthal, Köbner, and others found that it was not curative, and that it was open to the serious objection of staining the skin and the linen.

Hydroxylamin.—Experiment has shown that this compound produces a brown color of the blood, and, like nitrite of amyl, a fall of the blood-pressure. In medicine the hydrochlorate is used as a substitute for pyrogallic acid, chrysarobin, etc., dissolved in a mixture of equal parts of glycerin and spirit of wine, in the proportion of 1 to 1000. It has been used in the treatment of *lupus*, *ringworm*, *parasitic sycosis*, *psoriasis*, etc. by means of a brush, care being taken not to apply it at one time over a large surface. Some observers, however, question its efficiency, and dwell upon the poisonous effects it is liable to cause.

CICUTA.—Water-Hemlock.

Cowbane, E.; *Ciguë vireuse*, Fr.; *Wasserchierling*, G.; *Cicuta virulenta*, Sp.

The herb of Cicuta virosa, *Linné*, s. Cicutaria aquatica, *Lamarck*. Bentley and Trimen, *Med. Plants*, 119.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—Water-hemlock is a native of the northern section of the northern hemisphere, and is found in America from Canada northward. It grows in swamps and wet places, has a short, thick, rather ovate, hollow rhizome beset with circles of thin rootlets, and flowers from July to September.

Description.—The stem is about 40 inches (1 M.) high, hollow, often purplish. The leaves are on sheathing petioles, bright-green, and smooth, triangular-oblong in outline, twice or thrice pinnate, the leaflets opposite, narrow lanceolate, narrowed at both ends, sharply serrate, and the teeth with whitish points. The umbels are large, compound, the flowers small, white, and the fruit subglobose, laterally flattened, with thick corky ribs, and six oil-tubes in each mericarp, the two on the face being very thin. The herb has a slight aromatic odor and a somewhat aromatic and acrid taste.

Constituents.—Polex, Wittstein, and Buignet have observed the presence of a volatile alkaloid, *cicutine*, which, however, according to Van Ankum (1868), does not exist in the root. The fruit yields about 1¼ per cent. of a volatile oil which was proved by Trapp (1858) to be identical with oil of cumin. *Cicutoxin* is a tenacious, non-drying, amorphous, resinous principle in bright-yellow drops, which is contained in the resinous cortical zone of the rhizome. It was isolated by Van Ankum (1868), and further examined by Boehm and Trojanowski (1876); it is insoluble in petroleum benzin, but dissolves readily in alcohol, ether, and chloroform; also in hot water and in alkalies. The dried root yields about 3.5 per cent. of it.

Allied Plants.—Cicuta maculata, *Linné—Spotted water hemlock, Spotted parsley*—is a common perennial of North America, and is distinguished by its elongated, fleshy, tuberous roots, the purplish spotted stem, and the broader leaflets. Its properties are similar to those of the preceding species. J. E. Young (1855) obtained from the fruit a volatile alkaloid which he regarded as being identical with *conine*.

Sium latifolium, *Linné—Water-parsnip*—is a European perennial, probably indigenous to California; the nearly-allied S. lineare, *Michaux*, which is a native of North America, has been often mistaken for it. Another poisonous species, S. angustifolium, *Linné*, is indigenous to Europe and North America. The subterraneous portion of the California plant was examined by A. R. Porter (1876), who found in it an aromatic volatile oil, and attributed its poisonous properties to a resinous body. These results were in the main confirmed by N. Rogers (1876), who in addition obtained a non-poisonous volatile alkaloid resembling Wittstein's *pastinacine;* but according to Porter, this is probably ammonia.

Œnanthe crocata, *Linné* (Bentley and Trimen, *Med. Plants*, 124)—*Water-dropwort* or *dead-tongue*, also known as *water-hemlock*—is a European perennial, with fleshy fusiform roots containing a yellow juice, roundish-obovate, wedge-shaped, lobed, or toothed leaflets, and oval-oblong fruits, which are crowned with the long erect style, have thickened lateral ribs and six oil-tubes in each mericarp. *Œnanthin*, an acrid and emetic principle, was observed by Gerding (1849) in Œnanthe fistulosa, *Linné*, and is probably an impure alkaloid.

Ammi Visnaga, *Lamarck*.—Herbe-aux-cure-dents, *Fr.*, is indigenous to Southern France, the Orient, and Northern Africa. The leaves are bi- or tripinnatifid, with linear segments. Corolla is composed of five unequal, obovate, and emarginate petals. The fruit is compressed from the side. The plant possesses an aromatic odor. I. Mustapha (1875) isolated the crystalline glucoside, *kelline*, which is colorless, bitter, and soluble in alcohol and chloroform.

Action and Uses.—Administered to dogs, the root is found to cause salivation, vomiting, diarrhœa, and tetanoid convulsions, followed by resolution. A boy eight years old, who had eaten of the root, became insensible, with dilated pupils, pallid face, salivation, cold limbs, frequent and stertorous breathing, irregularity and intermission of the heart, and anæsthesia of the skin. Later on he grew restless, was convulsed, tetanically rigid, and cyanotic. At the end of twelve hours these symptoms subsided (*Berlin. klin. Woch.*, 34, 1885). In various fatal cases it is reported that the gastro-intestinal mucous membrane was inflamed, and even ulcerated and gangrened; but it is possible that these appearances, if they existed, were due to the mechanical irritation of the ingested root.

This plant, in consequence partly of its poisonous qualities, and partly because its efficacy is not established, is hardly ever used internally. It is said to be employed by the Kamschatdales as a topical anodyne in *rheumatism*, and others have applied it for a similar purpose in *gout* and *neuralgia*.

Cicuta maculata.—A case is reported of poisoning with the root of this plant, mis-

taken for angelica. The symptoms were delirium; cold skin; pulse 46, thready, and scarcely perceptible; vomiting of blood and mucus; a haggard and pale countenance: and complete prostration. Recovery took place after the internal and external use of stimulants and the hypodermic injection of morphine (*Med. News*, xl. 524). Linnæus ascribed narcotic qualities to *Sium latifolium*, and it has been used to treat diseases of the skin. *Œnanthe crocata* has been the cause of a great many cases of poisoning in Europe, where its root is apt to be eaten by mistake for that of parsnip, celery, radish, carrot, etc. Hogs, cows, and horses have frequently been killed by it. It excites a burning pain in the throat and stomach, nausea and vomiting, and sometimes purging, vertigo, delirium, coma, and violent convulsions, with trismus and bloody foam on the lips, while consciousness and sensibility are lost. Respiration is labored, the face cyanosed, the pupils dilated, the pulse small. Death occurs in asphyxia, with convulsions. The bruised root has been applied to hæmorrhoidal swellings. In poisoning by any of these plants the stomach should be emptied at once by a vegetable emetic, and anæsthetics and narcotics used to control the spasm. (Compare Leme, 1857, and Falck, 1880.)

El Kellah is the Moorish name applied to *Ammi visnaga*, or toothpick plant. It is alleged to contain a glucoside, kelline, which in animals occasions vomiting, usually slowing of the respiration, and irregular action of the heart. A decoction of the seeds (8 per cent.) is recommended as a lotion for ulcerated states of the mouth and for painful rheumatic joints. Internally it is said to cure rheumatism, and to relieve uric-acid ailments by its diuretic action and its obtunding action on the urinary passages (*Bull. de Thérap.*, cxii. 315).

CIMICIFUGA, *U. S.*—Cimicifuga.

Cimicifugæ rhizoma, s. *Actææ radix*, Br.—*Black snakeroot, Black cohosh*, E.; *Racine d'actée à grappes*, Fr.; *Schwarze Schlangenwurzel*, G.

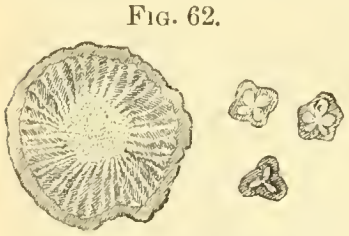
The rhizome and rootlets of Cimicifuga racemosa, *Nuttall*, s. Cim. Serpentaria, *Pursh*, s. Actæa racemosa, *Linné*, s. Macrotys actæoides, *Rafinesque*. Bentley and Trimen, *Med. Plants*, 8.

Nat. Ord.—Ranunculaceæ, Actææ.

Origin.—A perennial herbaceous plant growing in rich woodlands of the United States and Canada. The slender stem is 1.8 to 2.4 M. (6 to 8 feet) high, is leafless below and above, and bears near the middle several large, petiolate, thrice-ternate leaves, with ovate-oblong, acute, and deeply-toothed leaflets. The white flowers are in terminal racemes 20 to 30 Cm. (8 to 12 inches) long, have small clawed two-horned petals, numerous stamens on slender filaments, and usually one pistil, producing a dry capsular fruit containing many flat seeds. It flowers in June and July and ripens its fruit in September, after which time the rhizome should be collected.

Description.—The rhizome is about 5 Cm. (2 inches) long, and 25 Mm. (1 inch) thick, horizontal, somewhat flattened, with distinct nodes and numerous stout branches, the remains of overground stems, which are upright or curved upward, and increase the length of the underground portion to 15 Cm. (6 inches) or more. These branches are somewhat annulate by the prominent nodes, and are, according to their age, either hollow or have a cup-shaped, flat, or even convex, termination like the rhizome, they are hard and tough, and break with a slightly fibrous nearly smooth fracture. The rootlets originate mainly from the nodes, are 15 to 25 Cm. (6 to 10 inches) long, the older ones 6 Mm. ($\frac{1}{4}$ inch) in diameter near their place of attachment, mostly about 2 Mm. ($\frac{1}{12}$ inch) thick; when dry of a wiry appearance, obtusely quadrangular, and longitudinally wrinkled; brittle, and break with a short fracture. The color of the fresh rhizome and root is dark-brown, becoming purplish-black or brown-black after drying, the stem-remnants of a grayish tint. It has a slight but heavy odor and a bitterish and acrid taste. As met with in commerce, the rootlets, and often also the rhizomes, are much broken.

Fig. 62.



Cimicifuga racemosa: transverse section through a branch of the rhizome and through rootlets.

The transverse section of the branches shows a large central usually dark-colored pith, which is surrounded by numerous almost linear wood-bundles, the whole being covered by a rather thin, firm bark. The rhizome itself has irregular-shaped wood-bundles and a thicker bark. The rootlets have a thick dark-colored bark and a white woody meditullium, projecting with from five to two rays into the former; the largest number of rays is near the base, and gradually diminishes toward the tip of the rootlets.

Constituents.—Tilghman (1834), J. S. Jones (1843), and G. H. Davis (1861) analyzed black snakeroot, finding starch, some tannin, gallic acid (?), resin, a little volatile oil, and other widely-diffused principles. F. H. Trimble (1879) found tannin to be absent; a principle which is colored green-black by ferric chloride is not a glucoside, and the white precipitate of the aqueous infusion, after having been washed with water, is not colored by ferric salts; the portion of the resin which is precipitated by lead acetate yields a crystallizable acid. T. E. Conard (1871) obtained a crystalline principle which is insoluble in benzin, oil of turpentine, and carbon disulphide, slightly soluble in ether and water, and freely in chloroform and diluted and strong alcohol; its alcoholic solution has an intensely acrid and sharp taste. It was obtained from the fresh root by exhausting it with alcohol, precipitating the tincture with lead subacetate, removing excess of lead by hydrogen sulphide, evaporating the alcohol, washing the residue with benzin and water, and crystallizing the undissolved portion from alcohol after decolorizing with aluminum hydroxide. It appears to be a neutral principle. It was isolated by L. F. Beach (1876) from the so-called *cimicifugin* or *macrotyn*, which is prepared by precipitating a concentrated tincture of cimicifuga with water.

Action and Uses.—Cimicifuga appears to depress the nervous and vascular systems, in that it occasions, in large doses, vertigo, dimness of vision, nervous tremors, depression of the pulse, and more or less nausea, with increased pulmonary and cutaneous secretion. It was originally employed in the treatment of chronic pulmonary diseases, and particularly of *chronic bronchitis* with profuse purulent expectoration. In *chorea* independent of definite local disease there is no doubt of its efficacy when administered so as to produce its specific effects. Probably it is most useful in rheumatic chorea, since it has proved to be an efficient remedy for acute *articular rheumatism* when freely administered. It is also excellent in muscular rheumatism, and especially in *lumbago* and rheumatic *neuralgia*. That it exerts a powerful impression upon the uterine system is rendered probable by the relief it affords in *dysmenorrhœa* and to the symptoms of pelvic congestion which often are present during the decline of the *menstrual function* (*Lancet*, March, 1889, p. 476; *Practitioner*, xlvii. 265), and by its curing many cases of atonic *amenorrhœa* when its administration is duly prolonged. It is also alleged to be useful in the treatment of *seminal emissions*. Exceptional virtues have been claimed for it as an antidote to nearly all the ills that attend the later stages of *pregnancy*, and to the pains and weariness of *labor;* but these claims have not been allowed (*Thérap. Gaz.*, ix. 336).

The average *dose* of cimicifuga is represented by Gm. 1.30 (gr. xx) of its powder. This form is seldom used, a decoction or the fluid extract being preferred. The latter is officinal; the former may be prepared by boiling for a short time Gm. 32 (an ounce) of the bruised root in Gm. 500 (a pint) of water; one or two fluidounces may be given at a dose. The tincture is the least eligible of its preparations, but may be given in the dose of 30 to 60 minims.

CINCHONA, *U. S., Br., P. G.*—Cinchona.

Peruvian bark, E.; *Quinquina*, Fr.; *Chinarinde*, G.; *China*, It.; *Quina*, Sp.

The bark of several species of Cinchona.

Nat. Ord.—Rubiaceæ, Cinchoneæ.

Official Kinds.—1. Cinchona, *U. S.*; Cinchonæ cortex, *Br.*; Cortex Chinæ, *P. G.* The bark of Cinchona Calisaya, *Weddell*, Cinchona officinalis, *Linné*, and of hybrids of these and of other species of Cinchona (of cultivated Cinchonas principally Cinchona succirubra, *Pavon*, *P.G.*), containing not less than 5 per cent. of its peculiar alkaloids, at least one-half of which should be quinine,—*U. S.*, *P. G.*, from which the characteristic alkaloids of the bark may be obtained, *Br.*

A. Cinchona Calisaya, *Weddell.*—Cinchona flava, *U. S.*, 1880; Cinchonæ flavæ cortex; Cortex chinæ calisayæ; Cortex chinæ regiæ; China regia.—Yellow cinchona, Calisaya-bark, *E.;* Quinquina calisaya, Quinquina jaune royal, *Fr.;* Calisayarinde, Königschina, *G.;* China gialla, *It.;* Quina Calisaya, *Sp.*

Weddell, *Hist. Nat. des Quinq.*, Plates 3, 3 bis, and 28; Bentley and Trimen, *Med. Plants*, 141.

B. Cinchona officinalis, *Linné.*—Cinchona pallida; Cinchonæ pallidæ cortex; Cortex chinæ fuscus; China fusca, s. grisea s. pallida s. cinerea.—Pale Peruvian bark, Loxa bark, Crown bark, *E.;* Quinquina gris de Loxa, *Fr.;* Braune (Graue) Chinarinde, Loxarinde, Kronchina, *G.;* Quina gris de Loja, Quina charhuarguera, *Sp.*

Humboldt and Bonpland, *Plant. Æquinoct.* i. 33; Bentley and Trimen, *Med. Plants*, 140.

2. CINCHONA RUBRA, *U. S.*, *Br.*—The bark of Cinchona succirubra, *Pavon*, containing not less than 5 per cent. of its peculiar alkaloids, *U. S.*; containing between 5 and 6 per cent. of total alkaloids, of which not less than half shall consist of quinine and cinchonidine (the bark of the stem and branches of cultivated plants being directed).—*Br.*

Cortex chinæ ruber, China rubra.—Red cinchona, Red Peruvian bark, Red bark, *E.*; Quinquina rouge, *Fr.*; Rothe Chinarinde, *G.*; China rossa, *It.*; Quina roja, *Sp.*

Pavon, *Nueva Quinologia*; Howard's *Illustrations*, plate 9; Bentley and Trimen, *Med. Plants*, 142.

Origin.—The genus Cinchona, as at present constituted, consists of about thirty-one or thirty-six species, all of which are indigenous to South America, from 10° north latitude to 19°, or probably 22°, south latitude. It follows the eastern slope of the central chain of the Andes from the southern limits, beginning in Bolivia, through Peru; and from about 2° south latitude in Ecuador, it occupies also the eastern slope of the western chain of the Cordilleras until by two narrow belts it enters the highlands of New Granada, whence it spreads north-east and northward into Venezuela, to the neighborhood of Caracas and in proximity to the Caribbean Sea. The climate in which the most valuable species are found is, according to Karsten (1858), characterized by a rainy season lasting for 9 months, heavy rains falling principally during the night and alternating with sunshine and fog through the day; during the remaining 3 months the temperature frequently sinks in the night to below the freezing-point, but reaches in the daytime 25° C. (77° F.), producing dense fogs. The mean annual temperature of these regions is 12° to 13° C. (about 55° F.). The less valuable species are found in regions in which the moisture is less evenly distributed throughout the year, and in which the mean temperature is higher, rising, according to Martius (1863), to about 20° C. (68° F.).

The cinchonas are not met with in the valleys; the lowest altitude observed by Karsten was at the northern limits of the cinchona region, where the valueless Cinch. barbacoensis, which is not a true cinchona, is at an elevation of 100 M. (330 feet). Caldas gives the highest limits at 3270 M. (10,700 feet), Karsten at 3500 M. (11,500 feet). The really valuable species, however, according to Weddell, grow at an altitude of 1600 to 2400 M. (5300 to 7900 feet); an exception is C. succirubra, which descends to about 700 M. (2300 feet). They are confined within about 11° to the north and south from Loxa, beyond which limits the barks are of little or no value. The most southern species is Cinch. australis, *Weddell*, the most northern ones Cinch. tucujensis, *Karsten*, and C. cordifolia, *Mutis*. All grow in the primeval forests either singly or with but few specimens together.

The cinchonas are evergreen trees or shrubs, most of the valuable species attaining a height of from 12 to 24 M. (40 to 80 feet). Their laurel-like opposite leaves have deciduous stipules, are entire at the margin, and vary in shape between lanceolate and roundish obovate, occasionally with a heart-shaped base. The petiole and the leaves are often purplish or red while young or before falling, and most of the valuable species (Cinch. succirubra is an exception) are pitted (scrobiculate) on the lower side in the angles formed by the prominent midrib with the lateral veins. The fragrant flowers form terminal panicles, and have a tubular often soft-hairy corolla, with the margin divided into five spreading lobes, and of a white-rosy or purplish color. The small five-toothed calyx crowns the ovate or oblong two-celled capsular fruit, which splits from the base upward to the persistent short calyx margin, and contains many flat and winged seeds. With several allied genera they constitute the tribe Eucinchoneæ, which is characterized by the valvate præfloration, and with the two genera Cascarilla and Remijia they form a group in which the dehiscence of the fruit is septicidal and the placentas are found upon the middle of the dissepiments, the principal distinction of the two genera being the dehiscence of their capsules from the apex downward. Most of the species are variable in their foliage and in other characters, and easily produce hybrids; hence the species form more or less distinct varieties, and are connected with one another by intermediate forms. The most important medicinal species are—

CINCH. CALISAYA, *Weddell*, discovered by Weddell (1847), a stately tree, is found in Bolivia and Peru, between 17° and 13° S. lat., at an altitude of 1500 to 1800 M. (5000 to 6000 feet), and has an ovate smooth capsule about 10 Mm. ($\frac{2}{5}$ inch) long. At a higher elevation it forms the shrubby variety Josephiana, and in Bolivia is seen the variety boliviana, which has the lower surface of the leaves purplish. Several other varieties are distinguished, including C. Ledgeriana, which by some botanists is regarded

as a hybrid or even as a species, and the bark of which has attracted much attention for its richness in alkaloids.

C. OFFICINALIS, *Hooker filius*, the first species discovered by La Condamine (hence the name Condaminea), is a tree of about 15 M. (50 feet), and is found in Ecuador and Peru, principally near Loxa; its oblong capsules are ribbed and 12 to 20 Mm. (½ to ⅘ inch) long.

C. SUCCIRUBRA, *Pavon*, 15 to 25 M. (50 to 82 feet) high, has oblong smooth capsules 25 to 31 Mm. (1 or 1¼ inches) long, and is chiefly confined to the western declivity of Chimborazo, but is found south to Northern Peru.

The barks of the above species constitute the officinal cinchona-barks. Several other species yield barks which are consumed in the manufacture of the cinchona alkaloids.

From his observations made in the cinchona-plantations of Java and the Himalayas, O. Kuntze (1878) endeavored to reduce the numerous recognized species of cinchona to four typical forms, regarding all others as hybrids; and he finds this view supported by the fact that hybrids capable of perpetuation by seed are known to exist in the plantations; his four species are named: I. C. Weddelliana = C. Calisaya, *Weddell*, in part (and perhaps C. glandulifera, *Ruiz et Pavon*); II. C. Pavoniana = C. micrantha, *Weddell* (and perhaps C. nitida, *Ruiz et Pavon*); III. C. Howardiana = C. succirubra, *Pavon* (and perhaps C. purpurea, *Ruiz et Pavon*); and IV. C. Paludiana (as characterized by Howard).

Regarding Kuntze's views of the other species, we indicate here the supposed derivation of the best-known ones only: C. pubescens, *Vahl*, is a hybrid of III. and IV.; C. officinalis, *Hooker*, of II. and I.; C. pitayensis, *Weddell*, of II. and I.; C. cordifolia, *Mutis*, of III. and IV.; C. lancifolia, *Mutis*, of III. and I.; and C. scrobiculata, *Humboldt et Bonpland*, of II., I., and II.

Karsten unites Cascarilla, Buena, and Remijia with the genus Cinchona as a sub-genus, Ladenbergia, and groups nearly all true cinchonas in the sub-genus Quinquina, the two sub-genera being united by his sub-genus Heterasca, in which the capsules are dehiscent both from the base and apex, and which, among others, contains Cin. micrantha.

Cultivation and Commerce.—The cinchona barks found in commerce at the present time are derived from cultivated trees, the bark of wild trees rarely entering commerce, principally because it was found that by cultivation of the trees, and collection of the bark in certain ways the percentage of alkaloids, especially quinine, could be increased. Formerly the barks were collected entirely from wild-growing plants, and on account of the great distance from populous districts at which they grew it was necessary to undertake expeditions of several months duration. A number of collectors, named *cascarilleros*, united in gangs under the direction of a magistral or mayor-domo, undertook the journey across the mountains during the dry season. A shed or hut was constructed in which to dry the bark. The bark of the trunk and of the large roots just beneath the surface was loosened by beating with a mallet and then removed. The tree was then felled and the stripping completed. The bark of the branches was dried in the sun and rolled either in single or double quills, while the bark of the trunk, after being partly dried, was placed in layers crossing each other at right angles, and heavy weights placed on top. After drying completely the bark was superficially examined, and enclosed in rough canvas in bundles weighing about 150 pounds. In this shape it was shipped to the coast, where the bundles were enclosed in fresh hides, thus making, after drying, a firm and compact package, the so-called *seroon*. The bark was also shipped in bales and wooden boxes. The only South American country of any interest commercially in this line at the present time is Bolivia, as it is the only country of that continent where cinchona cultivation is carried on.

La Condamine (1738) noticed the reckless destruction of the cinchona in South America, and others have since corroborated his statements. As early as 1792, Ruiz suggested the cultivation of cinchonas, and since 1837, Fritze, Blume, Miquel, and others have advocated their transplantation to Java, while Royle (1839) pointed out several districts in India as suitable. In 1848, Weddell obtained considerable quantities of seeds, mostly C. Calisaya, which germinated at the Jardin des Plantes in Paris, the seedlings being sent to Algeria and to Java.

Weddell's *Histoire naturelle des Quinquinas* (1849) directed the attention of the Dutch government to this subject. Carl Hasskarl, previously director of the botanical garden at Buitenzorg, Java, was selected by Pahud, the colonial minister of Holland, to procure plants and seeds from Peru, and left Holland Dec. 4, 1852. His first collection of 50 plants remained through an oversight in Panama, but the seeds reached Holland, and yielded a number of seedlings, which were sent to Java. A collection of 400 plants of C. Calisaya was transported amid many difficulties to the sea-coast, and shipped Aug. 21,

1854, from Callao to Batavia, where, notwithstanding every care, only 46 plants arrived Dec. 13 in a good or partly sick condition. They were planted a short distance from Batavia at an elevation of 4700 feet. In 1855, Junghuhn arrived there from Holland with 139 seedlings, nearly half of which perished, and when Hasskarl resigned in 1856 there were only 251 living cinchonas in the plantations. Junghuhn (died 1864) established plantations in more favorable localities, but ripe seeds were not obtained until 1858. Propagating from seeds and cuttings, there were toward the close of 1863 nearly 1,160,000 cinchonas in the plantations, not quite one-half of which number had been planted in the open air. Only 1.1 per cent. of the plants belonged to the more valuable species. In 1865 the value of the cinchona plantations of Java was decidedly increased by a chance purchase of a lot of cinchona-seeds which had been sent to Georges Ledger by his brother, then travelling in Bolivia. When the seeds arrived in London, Hooker was sick and Markham was absent, so, in order to save at least half of the seeds, Ledger offered the same to the Dutch government. The seeds were shipped to Java, and by the following year Gorkum could report that 20,000 plants had grown from them. These are the mother-plants of *Cinchona Ledgeriana*, which plant is now being cultivated more and more in that country. Since De Vrij had undertaken frequent assays of the barks of the different species grown under different conditions, the cultivation of the less valuable ones was abandoned by K. W. Van Gorkum, who succeeded Junghuhn, and by the close of 1876 nearly 2,000,000 cinchonas, not counting C. Pahudiana, were planted in the open air in the government plantations, and of this number 1,142,715 were C. Calisaya (including C. Hasskarliana). At present the plantations are in charge of Van Romunde.

In the mean time, Boyle, Falconer, and others having again urged the introduction of the cinchonas into India, the British government decided in 1859 to organize an expedition under the direction of Clements Robert Markham, embracing all the districts of the most valuable species. Aided by John Weir, Markham explored the border-land of Peru and Bolivia, April and May, 1860, and collected 529 plants, 497 of which belonged to different varieties of C. Calisaya, the remainder to C. ovata and C. micrantha. Of these, 456 were shipped from Islay June 24. Owing to the jealousies of the population and the obstacles raised by the Bolivian government, he was unable to return to the districts for the purpose of collecting seeds, which do not ripen before August. (See Markham's interesting work, *Peruvian Bark*, London, 1880.)

Richard Spruce undertook the collection of plants and seeds from the red-bark districts (C. succirubra) in Ecuador, in the forests of Chimborazo, where he arrived in June, and was joined near the end of July by Robert Cross, who collected a large number of cuttings and young plants, and with these and the seeds gathered by Spruce embarked at Guayaquil Jan. 2, 1861. Plants and seeds in the neighborhood of Huanuco were collected by G. J. Pritchett, who embarked from Lima in Sept., 1860, mainly with specimens of C. micrantha and nitida. The government having neglected to provide for their direct transportation to India, the shipments were made by way of Panama to England, and thence through the Red Sea to Bombay. The plants, and particularly those collected by Markham, suffered considerably from various delays and from the hot weather encountered during a part of the journey; but those in charge of Cross mostly arrived in good condition, as also did the seeds collected by the explorers mentioned, and those obtained on a second journey undertaken by Cross in 1861 to the neighborhood of Loxa.

The first cinchona-plantation in India was established in the south-west, in the Neilgherry Mountains, near Ootacamund, at an elevation of 7000 feet. Under the care of William Graham McIvor (died 1876) this was soon extended, so that in this district alone there were in 1866 over 1,500,000 cinchonas, besides those which had been distributed to or raised by private parties. While here C. officinalis appears to be the most valuable, C. succirubra and Calisaya succeed better in the Himalaya Mountains in Sikkim, where the cultivation was commenced in 1862. Plantations were also formed in Ceylon (1861), in Punjab (1864), and other portions of India. The packages of the Indian bark are always made up from the same species cultivated under the same circumstances, so that the *unmossed*, *mossed*, and *renewed* barks are never mixed. This distinction is due to McIvor, who proved that under an artificial covering of moss the bark of certain species becomes thicker and richer in alkaloids, and also that trees which have been partly peeled will under a covering of moss rapidly *renew* the bark. The Ceylonese bark, principally in the form of the shaved bark, is packed in bales, into which the shavings have been pressed by hydraulic presses.

Attempts at the cultivation of cinchonas have been made in many countries and islands, and have been partly abandoned. Of some importance is the experiment made in Jamaica,

where the plants were introduced late in 1861; the cultivation on a large scale, however, was not commenced until 1868, and under the care of Robert Thomson had in 1876 extended over 300 acres, the plantations being situated in the Blue Mountains at an elevation of from 4000 to 6000 feet, with a variation of temperature between about 50° and 70° F. The official species, C. Calisaya, succirubra, and officinalis, are mainly cultivated here, and since 1880 cinchona-bark has been sent into the market from Jamaica. The same species appear also to be cultivated to some extent near Cordova, Mexico, where seeds were distributed in 1866; at least, Hugo Fink exhibited (1876) handsome specimens of these barks and sections of the trees. In the last twelve or fifteen years cinchona plantations have been started in Bolivia, especially in the department of La Paz. In Western Africa plantations have been started in 1882, and 2,500,000 trees were under cultivation a few years ago.

In the beginning of 1892 the estimate of the number of trees under cultivation in different parts of the world was as follows: Ceylon, 19,000,000; India: Sikkim, 4,000,000; Darjeeling, 1,500,000; Neilgherry, 6,000,000; Travancore, Mynad, Mysore, 7,000,000; Straits Settlements, North Borneo, Australia, 1,000,000; Java, 30,000,000; Africa, 2,500,000; Jamaica, 500,000; Mexico, 40,000; Central America, 2,000,000; Bolivia, 2,000,000,—altogether a grand total of 75,540,000 trees.

It is not unlikely that the cultivation of several valuable species of Remijia mentioned further on may be extended to many countries where the cinchonas cannot be profitably raised.

For the collection of cinchona-barks several methods are in use. One, known as *mossing*, originally recommended by Karsten (*Deutsche Flora*, p. 1201), and introduced by MacIvor, consists in removing rather narrow longitudinal strips of the bark, and then covering the trunk with moss, when the bared portion will again become covered with bark, frequently richer in alkaloids than the unmossed bark. Another method is that of *coppicing:* the trees are cut down above the root and deprived of the bark, while the remaining stumps again produce shoots, from which bark may be collected after the lapse of about eight years; a portion of the roots may then also be used for the collection of bark (*uprooting*). The method of coppicing is practised also on the cinchona plantations of Bolivia. A third method is that of *shaving*, introduced by Moens in 1880, and consisting in the removal and collection of the outer layers, leaving a sufficiently thick layer of the inner bark to preserve the vitality of the tree. Shaved cinchonas have been attacked in Ceylon by a stag-beetle, a species of Lucanus, and mossed trees in Bengal have suffered from the destruction of the young bark by ants and other insects.

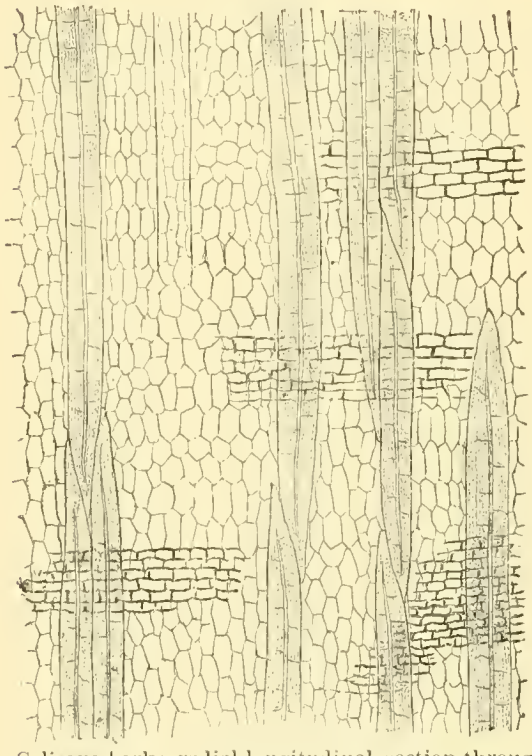
Commercial Terms.—The word *quina* (pronounced *ghcena*) in the language of the Peruvian Indians signifies bark, and *quina-quina* a medicinal bark, the term being originally applied to other barks. It is equivalent to the Spanish *cascarilla*, the diminutive of *cascara*, by which name the cinchona, with many other barks, is known in South America and Spain. From the former word come the French *quinquina* and the German *china*, by which terms the cinchona-barks are known in those countries. As the barks of different species are collected, they are in the first place distinguished as *quilled* or *flat* according to the manner in which they were dried; and, secondly, by some striking peculiarity, principally the color. The color of the external layer necessarily varies with the age of the bark and with the presence or absence of lichens and other cryptogamous plants. The fresh inner surface is always light-colored, but becomes darker on drying; it is always distinct in color from the natural surface, and in the bark of branches is invariably lighter than in the trunk-bark. Since the cultivated cinchonas in India and other countries have commenced to yield valuable bark, this is now almost exclusively found in the market, and is, as a rule, distinguished by the botanical name of the species and the manner of production. (See above under CULTIVATION and COMMERCE.)

General Physical Description.—The shape of the commercial bark depends upon its treatment during the drying process, as described above. The cultivated bark is generally seen in rather uniform quills. The corky layer of the branch-bark, unless this is quite young, is usually more or less cracked. The surface of the bark of old wood is influenced in appearance by the presence or absence of the corky layer, which in some species is easily detached. The inner surface, if not torn, always presents a striate appearance, which is coarser or finer according to the relative thickness of the bast-fibres and their arrangement; the immature barks of very young branches have a slimy appearance upon the inner surface. The size, arrangement, and relative number of the bast-fibres impart to the transverse fracture its peculiar character, and the almost complete absence of these in younger barks causes them to break with a smooth fracture.

The density of cinchona-barks varies considerably, but, according to Arnaud (1881), is in most cases less than that of water; Calisaya bark, however, is slightly heavier than water.

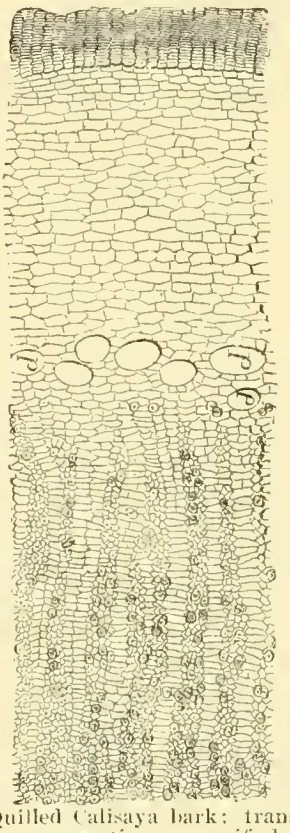
General Structural Characters.—The most important characteristics of cinchona-barks are due to their bast- or liber-fibres, which are never branched, are rather short, with their ends obtusely pointed, of a rather quadrangular appearance upon the transverse section under the microscope, showing the secondary deposits of the cell-walls, by which the central cavity has been almost closed. They present some distinctions in their arrangement as seen upon the transverse section. In some species they are grouped together to the number of four to six, rarely more; in others they form single or double radial rows, four to ten in number; in others, notably in Calisaya, nearly every bast-cell is entirely distinct from the others, and is separately imbedded in the bast-parenchyma,

FIG. 63.



Calisaya bark: radial longitudinal section through liber, showing cinchona bast-fibres; magnified 60 diameters

FIG. 64.



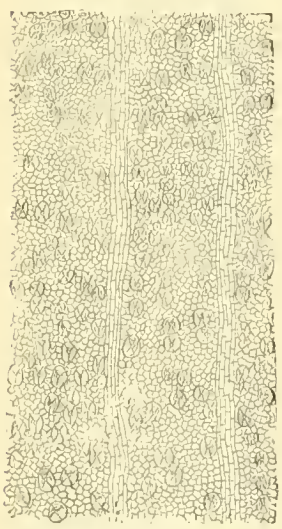
Quilled Calisaya bark: transverse section; magnified 30 diameters.

FIG. 65.

Bark of Cinchona laneifolia, with numerous thick-walled cells in the outer bark and outer bast-layer; magnified 30 diameters.

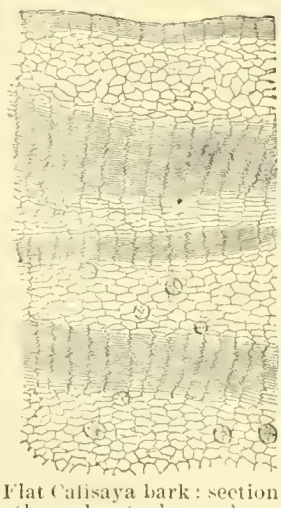
forming with the others not very regular interrupted lines. The medullary rays are distinct, but usually narrow; together with the preceding they form the *liber* (endophlœum or inner bark). The liber is covered by the *primary layer* (middle bark, mesophlœum, cellular envelope, and green layer of authors) or *outer bark*, which consists of parenchyma; in some of the species (C. Calisaya, succirubra, scrobiculata, officinalis) one or two irregular rows of *laticiferous ducts* (or vessels—lacunæ of Pereira) are found just outside of the bast-rays; these ducts are thin-walled, rather short, not anastomozing, upon transverse section subcircular, and occasionally more or less filled with delicate cells, and they are observable even in old barks, unless the primary bark has been destroyed by secondary cork. Some species have in the primary bark laterally-elongated cells with thickened walls, either scattered or in groups; some of these *stone-cells* contain a brown mass of resinous aspect; others are filled with granular crystals containing cal-

FIG. 66.



Flat Calisaya bark: section through inner layer; magnified 30 diameters.

FIG. 67.



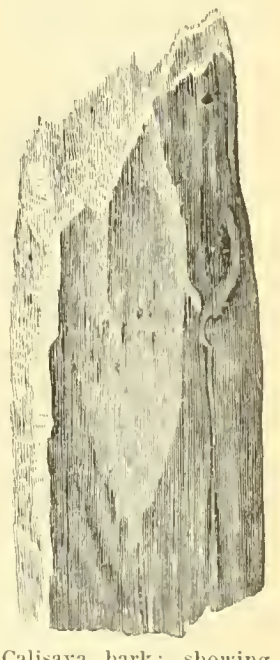
Flat Calisaya bark: section through outer layer, showing secondary cork; magnified 30 diameters.

cium oxalate; hence they have been sometimes distinguished as *resin-cells* and *crystal-cells*. The epidermis is never present in the commercial bark; its place has been taken by a thinner or thicker *corky layer*, the primary cork (or epiphlœum). In some species, like Calisaya, bands of thin-walled suberous tissue, or *secondary cork*, penetrate into the primary, and even into the bast-layer, of the bark, throwing off the outer tissues and remaining as the outer covering of the bark—Mohl's rhytidoma, the periderm of Weddell and others. The distinction between these tissues is neglected by some authors, but the formation of secondary cork evidently tends to obliterate characteristics observed in young barks.

General Chemical Characteristics.—All cinchona-barks contain astringent and alkaloidal principles, but they are present in very variable proportions. Grahe (1858) showed that if about 10 grains of the bark are heated in a test-tube characteristic red vapors are evolved, which condense in an oily carmine-red liquid. Cinchona-barks which have been deprived of their alkaloids by treatment with dilute acids do not show this reaction, but ligneous tissue which has been impregnated with a solution of cinchona alkaloids yields the sublimate; and the reliability of the reaction is increased, according to Hesse, by incorporating an alcoholic tincture of cinchona with powder of the same bark. This reaction, in connection with the presence of cinchona bast-fibres, noticed above, may be regarded as conclusive proof of the genuineness of cinchona-barks, in the absence of the peculiar bast-fibres, merely as evidence of the presence of cinchona alkaloids; for Flückiger (1871) observed a white bark which contained cinchona bast-fibres and an alkaloid (*paytine*), but yielded a brown tarry instead of a red oily sublimate; and the latter is obtained from *cuprea-bark* (see below), which contains cinchona alkaloids, but is destitute of cinchona bast-fibres.

Description of the Official Barks.—1. Under the head of Cinchona the U. S. P. now admits barks of any species of Cinchona, mentioning two, C. Calisaya and C. officinalis, the only requirement being that they contain at least 5 per cent. of alkaloids. As found in commerce at the present time, calisaya bark consists largely, if not wholly, of the quilled bark. The quills vary in length, being usually 30 Cm. (12 inches) or more long. The quills are either single or double, and from 1 to 5 Cm. ($\frac{1}{2}$ to 2 inches) in diameter, the bark varying in thickness from 2 to 3 and 5 Mm. ($\frac{1}{12}$ to $\frac{1}{8}$ and $\frac{1}{5}$ inch). The outer surface of the bark, where it is not covered by variously colored lichens, consists of a gray or brownish-gray, with C. officinalis occasionally blackish-brown cork. This on Calisaya bark is usually wrinkled and longitudinally and transversely fissured. The fissures are about 25 Mm. (1 inch) apart, forming irregular meshes with raised edges, and often enclosing shorter transverse and oblique cracks. The corky layer when removed leaves the impressions of the meshes on the cinnamon-colored primary bark as slightly elevated lines corresponding to the deeper fissures. The older and thicker bark of C. officinalis is marked by at first rather distant, later more approximate, transverse sometimes annular fissures, and with longitudinal wrinkles or slight wart-like, corky ridges. The inner surface of the bark is cinnamon-brown, somewhat darker than the primary bark, and finely striate from the bast-fibres. Occasionally quills of Calisaya bark are observed with the outer surface formed of secondary cork, which is brown, rather smooth, and has fine transverse fissures.

Fig. 68.



Calisaya bark: showing digital furrow and short fibrous fracture.

Calisaya bark was formerly met with in commerce, now, however, never as the so-called flat bark. It came in pieces often 38 Cm. (15 inches) long, 7 to 12 Cm. (3 to 5 inches) broad, and from 4 to 10 Mm. ($\frac{1}{6}$ to $\frac{2}{5}$ inch) thick. The external layer of secondary cork was rarely present, except as small, irregular dark-brown patches lining the shallow longitudinal depressions, the so-called *conchas* of the cascarilleros or *digital furrows* of Pareira and others. Otherwise the entire bark consisted only of bast-layer, and was of a bright cinnamon-brown color, and had the inner surface closely and uniformly marked with fine, often wavy, striæ.

The fracture of the barks, short in the outer layer and fibrous in the inner, is easily explained by examining the structure. The structural characteristics (see Figs. 63, 64, 67) of Calisaya bark are found in the one or two rows of large laticiferous ducts which are found in the parenchyma outside of the bast-layer. Stone-cells are almost entirely absent, and the

bast-fibres are, with occasional exceptions, located singly in the bast-parenchyma, and show radially, still more so tangentially, an imperfect arrangement in rows. Secondary cork is soon formed, penetrating obliquely into the bast, thereby throwing off the primary bark and laticiferous ducts, and on removal leaving the conchas. The disposition of the bast-fibres, their fineness and brittleness, permit them to be easily detached, and to penetrate the skin on handling, especially the flat bark; in like manner may the fibrous fracture of the latter bark be explained.

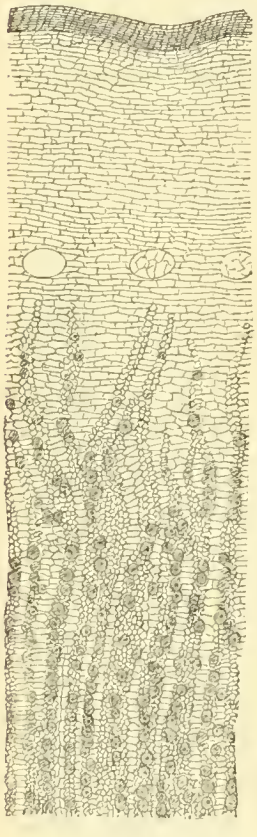
Fig. 69.

Bark of Cinch. scrobiculata.

The flat Calisaya bark was occasionally found mixed with flat pieces of the bark obtained from the variety Boliviana (see *Origin*). It is thinner, with the conchas more shallow and numerous, and shows on longitudinal and transverse fracture large whitish spots It agrees with the bark of the typical form in anatomical structure, but occasionally the secondary cork penetrates the primary bark-layer only, leaving the laticiferous ducts present; and it has a portion of the bast-fibres arranged in but slightly interrupted radial lines; its transverse fracture is therefore more fibrous. Similar in physical appearance to Calisaya bark, but breaking with a long fibrous fracture, are the barks of Cinch. scrobiculata and C. lancifolia; they have for this reason been known as *fibrous Calisaya bark.* The tissue of both barks is of a reddish-yellow tint, and contains in the outer portion numerous large stone-cells. The scrobiculata bark has the inner bast-fibres in nearly uninterrupted radial lines, and contains on the margin of the bast-layer a circle of laticiferous ducts. The lancifolia bark has the bast-fibres in interrupted single or double radial lines, often forming groups, and accompanied by axially elongated but transversely narrow stone-cells, called *staff-cells;* laticiferous ducts are absent; the cork, if present, is soft and scaly, gray or whitish.

2. Cinchona rubra is now found in commerce mostly in the form of quills or incurved pieces varying in length, and from 12 to 25 Mm. ($\frac{1}{2}$ to 1 inch) in diameter, with the bark 2 to 4 or 5 Mm. ($\frac{1}{12}$ to $\frac{1}{6}$ or $\frac{1}{5}$ inch) in thickness. The outer surface, even of very young bark, is more or less rough from corky warts and longitudinal warty ridges, the latter being formed by the confluence of the former, thus producing long meshes, and from a few mostly short transverse fissures. These markings become more prominent in the older barks. The subserous layer of young barks is grayish-brown, and that of the older as dark as rust-brown in color. The inner surface and inner layers of the bark are cinnamon-brown in young and more or less deep reddish-brown in older barks, the surface being distinctly striate. The bark breaks with a short fibrous fracture, especially in the inner layer. The bark possesses a slight odor, a bitter and astringent taste, and forms a reddish-brown powder.

Fig. 70.



Cinch. succirubra: transverse section of bark; magnified 30 diameters.

Fig. 71.

Bark of Cinchona pubescens.

The bark of old wood is termed flat, but is often in curved pieces 5 to 10 Mm. (2 to 4 inches) in width and 12 Mm. ($\frac{1}{2}$ inch) or less in thickness. It shows the characteristics described, except that the bark throughout is of a deeper red color, the inner surface more closely striate, and the subserous layer thicker, very warty and firm, sometimes longitudinally fissured, more or less scaly, rather soft and spongy. This flat bark is now rarely seen in commerce.

The structural characteristics are a row of laticiferous ducts, and in the inner bast-layer narrow medullary rays and bast-fibres forming interrupted radial lines.

The structure of the cultivated barks differs according to which methods of cultivation and collection are practised. With coppicing the structure of the bark is not dis-

turbed, and only slightly so by shaving, if this is not carried deep enough. However, if the bark is shaved close to the cambium, a bark is obtained which in the outer layer consists principally of parenchyme tissue, while the inner layer is made up of secondary bast. In the outer portion we find laticiferous ducts which are not anastomosing, and can be distinguished from the parenchyme cells by being larger. In mossed bark we find the arrangement of the tissues differing according to whether we have the mossed bark or the renewed bark. The mossed bark—that is, the portion remaining on the trunk—has a layer of parenchyme close to the cambium, from which the callus closing the open space takes its origin. In case the cambium is uninjured and is sufficiently protected against drying out, it also takes part in the formation of the callus. In the renewed bark we have a similar arrangement of tissues as found in the bark described above.

The structural characteristics of the most important cinchona-barks, may be briefly stated as follows:

1. Bast-fibres single, occasionally in groups of two, or rarely more:

C. CALISAYA.—No stone- (or resin-) cells, but laticiferous ducts in young bark. Secondary cork in old bark; bast-fibres of medium thickness; medullary rays narrow.

2. Bast-fibres occasionally single, more frequently in groups of three or more:

C. MICRANTHA.—Few or no stone-cells; no laticiferous ducts; medullary rays narrow; bast-fibres of medium thickness, in groups of two and three, and in older barks of five to eight.

3. Bast-fibres in interrupted single, or occasionally double, radial lines:

C. SUCCIRUBRA.—No stone-cells; laticiferous ducts in one row, in old bark often filled with cells; bast- and medullary rays narrow; bast-fibres medium, in lines of two to five, and occasionally eight.

C. OFFICINALIS.—No stone-cells; laticiferous ducts thin, soon obliterated; medullary rays narrow; bast-fibres medium, in somewhat irregular lines of two to four.

C. LANCIFOLIA.—Stone-cells numerous; laticiferous ducts none; medullary rays large celled; bast-rays rather narrow, the fibres medium and thicker, in single and double lines of two to four, intermixed with incomplete fibres (staff-cells).

4. Bast-fibres in nearly uninterrupted radial lines:

C. SCROBICULATA.—Stone-cells numerous; laticiferous ducts in one or two rows; medullary rays large celled; bast-fibres very numerous, in but little interrupted single, or occasionally double, lines.

The structural peculiarities of cinchona-barks are, to some extent, influenced by the local conditions of growth, more particularly as regards exposure to or protection from the sunlight. This influence becomes more marked in the artificially-protected (*mossed*) bark of the Eastern plantations, and still more in the second and third crops of (*renewed*) barks, in which the modifications of the parenchymatous tissue are very considerable, while the arrangement and characteristics of the bast-fibres are likewise subject to striking changes.

Allied Barks.—So-called *spurious cinchona-barks* are now rarely if ever met with in commerce. They were mostly obtained from trees belonging to the genera Cascarilla, Ladenbergia, Nauclea, and Exostemma; some of these are quite similar to cinchona-barks in appearance, while others have not the slightest resemblance to them. In those barks most nearly allied to the cinchona a cinchona bast-fibre is occasionally met with, but nearly all the bast-fibres have large central cavities. Others (Nauclea) have the thin fibres nearly filled up, but regularly arranged in radial and tangential rows. Grahe's test—and, more reliable still, the microscope—will at once prove their distinctiveness.

Spurious cinchona-barks—which, however, are very valuable for the manufacture of quinine—are the *cuprea* or *copper-colored barks*, a name given to them by Flückiger (1870) on account of their dull copper-red color. Samples of this bark were noticed in London in 1820, and occasionally it was observed as an admixture to the soft bark of Cinchona lancifolia; at the present time it is imported in large quantities, both from the central and southern parts of Colombia, along the eastern chain of the Andes. The bark from the former region was ascertained by Triana (1882) to be derived from Remijia Purdieana, *Weddell*, and R. (Cinchona, *Karsten*) pedunculata, *Triana*. It is in quills or curved pieces with a brown-red inner surface, externally with fragments of gray or brownish cork, and copper-red in the interior; the transverse fracture is coarsely granular, the longitudinal fracture rather splintery; the transverse fracture shows thick-walled cork-cells; sometimes scattered laticiferous ducts, many transversely elongated stone-cells, both in the outer bark and bast-layer, and in the latter numerous wavy medullary rays and radial lines of closely-packed, thin, elongated, obtuse bast-fibres, with the central cavity usually large; these bast-rays are less numerous in the inner than in the outer portion of the liber. The bark is very compact, hard, and heavier than water; that from Southern Colombia is denser, more compact, and shows a more horny fracture. Cuprea-bark varies considerably in the amount of alkaloids, which in bark from high elevations sometimes reaches 3 per cent. or 2 per cent. of

quinine, the balance being quinidine and cinchonine; De Vrij (1882) obtained even 5.9 per cent. of alkaloids (Flückiger). Hesse first pointed out the entire absence of cinchonidine; and his observations have been confirmed by Howard and others. Cuprea-bark from Southern Colombia contains cinchonamine; Planchon (1882) found this bark to be free from laticiferous ducts and stone-cells, and the inner layer of the outer bark to be formed of laterally-elongated parenchyma.

Fraudulent red barks have been offered which had been made by exposing inferior cinchona-barks to ammonia, whereby cinchona-red is produced. Such barks were found by Thomas and Guignard (1882) to be deep-red in the parenchyma, to have pale-yellow bast-fibres, to yield red-colored infusions and decoctions, and these to give brown-red precipitates with Nessler's reagent, while the infusion of normal cinchonas gives a white precipitate with the same reagent; the chloroplatinate precipitate was found to contain 22 per cent. Pt, while that with the cinchona alkaloids contains only between 16.8 and 17.8 per cent. of this metal.

Pinckneya pubens, *Michaux*, s. Cinchona caroliniana, *Biret*, is a small tree growing in swampy localities from South Carolina to Florida. The bark is employed as a tonic and febrifuge under the name of *Georgia bark*. Dr. Farr claims having detected a considerable amount of cinchonine in the bark (Porcher, *Resources*, p. 442), which is probably incorrect, though the plant is likely to contain an alkaloid.

Crossopteryx febrifuga, *Bentham*, s. Cross. Kotschyana, *Fenzl*, is a tree of tropical Africa having febrifuge properties, and, like the preceding, belonging to the sub-order Cinchoneæ. Hesse (1879) isolated from the bark .018 per cent. of an amorphous white alkaloid, *crossopterine*, which is easily soluble in alcohol, ether, and ammonia, and yields bitter salts. The aqueous infusion of the bark shows blue fluorescence, which disappears on acidulation with sulphuric acid, and even after boiling reappears on the addition of an alkali.

Unofficial Cinchona-bark.—A large number of commercial varieties have appeared in the market, made up frequently of the barks of different species, and therefore difficult to characterize. This difficulty is greater with the small quills, but even the old barks of botanical varieties of the same species often present considerable differences in their physical and histological characters.

Constituents.—(1) Alkaloids. Cinchona-barks contain one or more of four alkaloids, which, according to their composition, form two groups—namely, *quinine* and *quinidine* = $C_{20}H_{24}N_2O_2$, and *cinchonine* and *cinchonidine* = $C_{19}H_{22}N_2O$. Gomes of Lisbon (1812) obtained a crystalline body without recognizing its chemical relations; its basic properties were discovered by Houton-Labillardière (1820), and Pelletier and Caventou found in its two alkaloids, which they named quinine and cinchonine. Henry and Delondre (1833) obtained from a red-colored bark a distinct alkaloid, which they named *quinidine*, and which constituted, most likely, the greater portion of Van Heijningen's *betaquinine*, obtained (1849) from chinoidine, and of the *cinchotine*, which Hlasiwetz (1850) found in the alcoholic mother-liquor of cinchonine. Quinidine is identical with the *conchinine* of Hesse (1869), but the latter considers Henry and Delondre's alkaloid to have been chiefly cinchonidine. F. L. Winckler (1847) separated from Maracaibo bark an alkaloid which he likewise called quinidine, but which Pasteur (1853) proved to be distinct from the former and named *cinchonidine*. Pasteur's nomenclature has been adopted not only in France, but also in England and America; until recently several German writers, however, followed Winckler, and to some extent Hesse's nomenclature is employed in Germany.

Pasteur observed that by fusing the alkaloids of either group in the presence of acids they are converted into the amorphous bases *quinicine* and *cinchonicine*, which have the composition of the alkaloids from which they are obtained.

The bark of C. succirubra, cultivated in Sikkim, was found by Hesse (1872 and 1877) to contain also two other alkaloids, *quinamine*, $C_{19}H_{24}N_2O_2$, and *paricine*, $C_{16}H_{18}N_2O$. The latter is pale-yellow, amorphous, when fresh soluble in ether, and converted into a dark-green resinous mass by strong nitric acid. The same acid yields a dark-green solution with *aricine*, $C_{23}H_{36}N_2O_4$, discovered in Arica bark by Pelletier and Coriol (1829). It is crystallizable, and its oxalate and acetate are sparingly soluble. Winckler (1842) regarded it as identical with an alkaloid, *cusconine*, obtained by Leverköhn (1829) from Cusco bark, and with the *cinchovatine* of Manzini (1842), from Jaën bark, and the production of a green color by nitric acid due to the presence of impurities. But cusconine, though of the same composition as aricine and in the same bark, differs from all cinchona alkaloids in the gelatinous form of many of its salts, including the sulphate, which is not soluble in sulphuric acid. The same bark contains also the yellow amorphous alkaloid *cusconidine*, discovered by Hesse in 1877, and amorphous *cuscamidine* and crystalline *cuscamine*, discovered by the same chemist in 1880; the last two alkaloids are insoluble in nitric acid, cuscamine also in oxalic acid; both are readily soluble in ether, chloroform, and hot alcohol, and melt at 218° C. (424.4° F.). The *pitoyine* of Peretti (1835) does not exist, according to Kerner (1872) and Hesse (1873); it had been obtained from

so-called Pitoya bark, or Cinchona bicolorata, the bark of a species of Ladenbergia, characterized by the gray and fawn-colored patches of its external surface.

Quinamine (chinamine), together with its isomer *conquinamine*, is found in the bark of Cinch. succirubra, rosulenta, and other species; both are crystalline, dextrogyre; their solutions are not fluorescent, do not produce thalleioquine, are precipitated by platinum chloride only when in concentrated solutions, and yield with gold chloride yellow precipitates changing to purple. Their hydriodates are slightly soluble in cold water and crystallizable. Quinamine melts at 172° C. (341.8° F.), conquinamine at 123° C. (253.4° F.). The former is dextrogyre, is soluble in 32 parts of ether, and on boiling with dilute sulphuric acid is converted into amorphous *quinamidine*, isomeric with the former and having a similar behavior to gold chloride; its hydrochlorate crystallizes in prisms and is sparingly soluble in water. On heating quinamine sulphate to 100° C. (212° F.) it is converted into the isomeric *quinamicine*, which is white, amorphous, fusible in boiling water, and precipitated from acid solutions by sodium bicarbonate. When quinamine sulphate, however, is heated to 120° C. (248° F.), *proto-quinamicine*, $C_{17}H_{20}N_2O$, is formed, which is insoluble in ether, and the sulphate of which is nearly insoluble in cold water. By treating quinamine or conquinamine with concentrated hydrochloric acid, H_2O is eliminated, and *apoquinamine*, $C_{19}H_{22}N_2O$, is formed, which is white, amorphous, very soluble in ether; its hydrochlorate is amorphous and freely soluble in water; the precipitate with gold chloride does not turn purple.

The last-named alkaloid is isomeric with *homocinchonidine*, *homocinchonine*, and *homocinchonicine*, the first of which forms the bulk of Winckler's *cinchovatine* (*aricine*), from Cinch. ovata, has a left rotation, and forms a sulphate crystallizing with $6H_2O$ in delicate needles of a gelatinous aspect which fuse near 30° C. (86° F.). It resembles magnesia when anhydrous, and in this condition forms with chloroform a jelly-like mass. On melting, the anhydrous monobasic sulphate of this alkaloid, homocinchonicine, is formed. Homocinchonine is present in the bark of Cinch. rosulenta, which contains also *dihomocinchonine*, $C_{38}H_{44}N_4O_2$; it has a right rotation and is amorphous, like its salts.

Commercial cinchonidine sometimes contains the preceding alkaloids, and in addition thereto *hydrocinchonidine* or *cinchamidine*, $C_{19}H_{24}N_2O$, which was isolated (1881) by Hesse and by Forst and Boehringer; it melts near 230° C. (446° F.), is levogyre, and sparingly soluble in chloroform, ether, and water.

The same chemists have shown (1881, 1882) in commercial quinidine the presence of *hydroquinidine* or *hydroconchinine*, $C_{20}H_{26}N_2O_2$, which melts near 167° C. (332.6° F.), is dextrogyre, dissolves freely in hot alcohol and chloroform, and with some difficulty in ether, and yields fluorescent solutions and thalleioquine, like quinine. This base has been found by Hesse also in cuprea-bark.

Hesse (1882) isolated also from cuprea-bark *hydrocinchonine*, $C_{19}H_{24}N_2O$, which differs in some of its properties from Skraup's cinchotine (see CINCHONINÆ SULPHAS), and *hydroquinine*, $C_{20}H_{26}N_2O_2$, which melts at 168° C. (334.4° F.), is easily soluble in ether, and yields fluorescent solutions and thalleioquine, like quinine. The above hydro-bases are not oxidized by potassium permanganate in the cold.

Homoquinine, $C_{19}H_{22}N_2O_2$, was observed in cuprea-bark by Tod (1880), and further studied by Howard, Paul, Whiffen, and others. It melts at 177° C. (350.6° F.), is freely soluble in alcohol and chloroform, sparingly in ether, and shows fluorescence and thalleioquine reaction, like quinine. It is Whiffen's *ultraquinine*. Arnaud's *cinchonamine*, $C_{19}H_{24}N_2O$, discovered (1881) in a Colombian cinchona-bark, is soluble in ether, melts at 195° C. (383° F.), and yields crystallizable salts which, with the exception of the sulphate, are sparingly soluble in cold water and in diluted acids.

Diconchinine, $C_{40}H_{46}N_4O_3$, and *dicinchonine*, $C_{38}H_{44}N_4O_2$ are the principal constituents of *chinoidine*. (See CHINOIDINUM.)

The white cinchona-bark of Payta contains, according to Hesse (1870), crystallizable *paytine*, $C_{21}H_{24}N_2O + H_2O$, and amorphous *paytamine*, which resemble quinamine in their behavior to gold chloride and solubility in ether, but differ in being levogyre and readily precipitated by platinum chloride. This bark, however, has been ascertained by Hesse (1883) to come from a species of Aspidosperma.

Hesse (1877) obtained from a young Bolivian Calisaya bark a liquid alkaloid having a penetrating odor suggesting that of quinoline, and from Java Calisaya bark crystallizable *javanine*, which is very easily soluble in ether and dissolves in dilute sulphuric acid with an intense yellow color. From the mother-liquors of the preparation of quinine, Hesse (1882) obtained a volatile base, *cincholine*, as a pale-yellow oil, freely soluble in ether, alcohol, and chloroform, and nearly tasteless in neutral solutions. Flückiger (1883) sug-

gests that it may have originated from the hydrocarbons used in the process. Howard's liquid alkaloid (1871) had the composition $C_{20}H_{24}N_2O_2$, and yielded thalleioquine and a crystallizable freely-soluble oxalate.

The relation of the cinchona alkaloids to each other in regard to their ultimate composition will be observed from the following:

$C_{23}H_{26}N_2O_4$: cusconine and aricine.

$C_{21}H_{24}N_2O$: paytine.

$C_{20}H_{26}N_2O_2$: hydroquinine, hydroquinidine (hydroconchinine).

$C_{20}H_{24}N_2O_2$: quinine, quinidine, quinicine, and $2(C_{20}H_{24}N_2O_2) - H_2O$: diconchinine.

$C_{19}H_{24}N_2O_2$: quinamine, conquinamine, quinamidine, and quinamicine.

$C_{19}H_{24}N_2O$: hydrocinchonine (cinchotine), hydrocinchonidine (cinchamidine), and cinchonamine.

$C_{19}H_{22}N_2O_2$: homoquinine, apoquinine.

$C_{19}H_{22}N_2O$: cinchonine, cinchonidine, cinchonicine, apoquinamine, homocinchonine, homocinchonidine and homocinchonicine, and $2(C_{19}H_{22}N_2O)$: dicinchonicine.

$C_{17}H_{20}N_2O$: protoquinamine.

$C_{16}H_{18}N_2O$: paricine.

Not analyzed: cusconidine, cuscamine, cuscamidine, javanine, cincholine.

The characteristic properties of the four principal cinchona alkaloids may be compared as follows:

	QUININE.	QUINIDINE.	CINCHONINE.	CINCHONIDINE.
Rotary power,	Levogyre.	Dextrogyre.	Dextrogyre.	Levogyre.
Soluble in water,	167 parts.	2000 parts.	3740 parts.	1680 parts.
Soluble in 80 per cent. alcohol,	6 "	26 "	133 "	20 "
Soluble in ether,	23 "	30 "	371 "	76.4 "
Sulphuric acid solutions,	Are fluorescent, 1 in 200,000.		Not fluorescent.	
Chlorine-water and ammonia,	Emerald-green thalleioquine.		White precipitates.	
Chlorine-water, ferrocyanide of potassium, and ammonia,	Dark-red solutions.		No coloration.	
Anhydrous sulphate, soluble in chloroform,	1000 parts.	19.5 parts.	60 parts.	1000 parts.
Hydriodate,	More soluble than next.	Soluble in 1270 parts water, or 110 parts alcohol.	Readily soluble in chloroform, alcohol, ether, and water.	Slightly in water, readily in alcohol.
Iodosulphate,	Green in reflected, colorless in transmitted light; soluble in 1000 parts boiling water.	Similar to preceding, but different tint.	Purplish-black; in transmitted light yellow or reddish.	Purplish garnet-red; in transmitted light like preceding.

The iodosulphates are obtained by dissolving the sulphates in weak alcohol, acidulating with sulphuric acid, precipitating with tincture of iodine, and crystallizing the precipitate from alcohol.

A mixture of the more or less purified alkaloids obtained from red and other cinchona-barks has been used in India and other countries under the designation of *quinetum*, *cinchona febrifuge*, etc. In this country several secret preparations have been introduced under various names, consisting either wholly or chiefly of cinchonine or chinoidine.

Other Constituents.—The alkaloids are combined with one or more of the following acids: kinic, kinovic, and cinchotannic acids.

Kinic or *quinic acid* (Chinasäure), $C_7H_{12}O_6$, is found in cinchona-barks and in many plants of the natural orders Rubiaceæ, Vaccineæ, etc. The calcium salt was first prepared by De Legaraye (1745); the acid was recognized by Hermbstaedt (1785) as being organic, and supposed to be tartaric acid. But F. C. Hoffmann (1790) proved it to be distinct, and named it kinic acid. The investigations of Deschamps (1795), Vauquelin (1806), and others corroborated these results, and Liebig (1830) and others determined its composition. According to Hesse, it is not present in cuprea-bark. In the preparation of quinine it is contained in the filtrate from the precipitated alkaloids. It appears to be present to the amount of 5 to 7, or even 9, per cent., and when pure forms transparent colorless oblique rhombic prisms which fuse at 162° C., are readily soluble in water, less in strong alcohol, and slightly in ether. On treating it or one of its salts with manganese peroxide and sulphuric acid, it yields, besides carbon oxide and formic acid, a golden-yellow crystalline sublimate of *kinone* or *quinone*, $C_6H_4O_2$. On being heated with hydriodic acid it is converted into benzoic acid, and when fused with potassium hydroxide it yields protocatechuic acid.

Kinovic or *quinovic acid*, $C_{24}H_{38}O_4$, is met with in the East Indian barks, and forms a tasteless shining crystalline powder which is insoluble in water and chloroform, slightly soluble in ether and cold alcohol, but soluble in alkalies and alkaline carbonates. It was discovered by Hlasiwetz (1859) as a product of the decomposition of kinovin.

Kinovin or *quinovin*, $C_{30}H_{48}O_8$, was discovered by Pelletier and Caventou (1821), and at first named *quinovic acid*, afterward *quinova bitter;* its glucoside nature was determined by Hlasiwetz (1859). It is an amorphous mass of a disagreeable bitter taste, sparingly soluble in cold water, soluble in ether, acetone, chloroform, fixed and volatile oils, and freely soluble in alcohol. Its compounds with the alkalies, lime, and magnesia are soluble in water. Its solution in alcohol, treated with hydrochloric acid gas, yields kinovic acid and uncrystallizable mannitan (kinovin sugar), $C_6H_{12}O_5$. It has been found in different cinchona-barks in quantities varying between 0.11 and 1.74 per cent., and is also contained in the barks of Esenbeckia febrifuga and Buena magnifolia (*China*, s. *Quina nova*, hence its name).

Cinchotannic (or *quinotannic*) *acid* appears to be present in the best cinchona-barks to the amount of 2 to 4 per cent. By treating the decoction with magnesia, precipitating the filtrate with lead acetate, decomposing with hydrogen sulphide, and repeating this process, it is obtained as a pale-yellow mass of an acidulous and astringent taste, readily soluble in water, alcohol, and ether, turning greenish with salts of iron, and yielding cinchona-red with alkalies or on being boiled with water. According to Rembold (1867), by boiling with dilute sulphuric acid it is split into sugar and

Cinchona-red, $C_{28}H_{22}O_{14}$, which is nearly insoluble in water and ether, but dissolves readily in alkaline solutions and alcohol. It yields protocatechuic acid when treated with fusing potassa. Though contained in all cinchona-barks, those having a red color contain it in largest proportion —thick red bark over 10 per cent.

The odor of cinchona-barks is due to a minute quantity of a butyraceous *volatile oil*, which was first obtained by Fabbroni. Trommsdorff obtained 2 grains from 20 pounds of pale bark. The remaining constituents are of no importance either medicinally or pharmaceutically; they comprise starch, gum, sugar, resin, fat, wax, ammonium salts, and calcium oxalate, all in small quantities. Kerner's *cinchocerotin*, $C_{27}H_{48}O_2$, according to Helms (1883), appears to be related to betulin. The ash amounts to between 1 and 3 per cent., and consists mostly of the carbonates of calcium and potassium.

Variation of Alkaloids.—The *distribution* of the various constituents, and more especially of the alkaloids, is a matter of as great importance to the physician and pharmacist as to the manufacturer of quinine. It has been amply demonstrated that barks obtained from the same species grown in different localities, according to Karsten, even in their native forests, may vary greatly, not only in the total amount of the alkaloids contained therein, but likewise in the relative proportion of the alkaloids. Cultivated barks have been found to contain from 9 to 12 per cent. of alkaloids, and Cinch. Ledgeriana is often very rich in quinine, containing sometimes 13 per cent.; yet these same species yield frequently much smaller amounts. While there can be no doubt that this variation is caused by external influences, the proper course to be pursued in cultivation for increasing the percentage of alkaloids, of quinine in particular, has as yet not been discovered. More or less shade has an effect on the percentage of alkaloids of the bark; it has been found that quinine and quinidine are present in larger quantity in the bark of trees growing in the interior of the woods—in other words, in the shade—than in those growing on the border. With quinine the difference may amount to ½ to 1½ per cent. The opposite is the case with cinchonidine, cinchonine, and the amorphous alkaloids—*i. e.* the largest yield being from trees growing in the sun. Hooper (1888) has studied the variation of alkaloidal strength in Cinchona succirubra and C. officinalis and their hybrids, which is of importance in view of the fact that although C. officinalis is rich in quinine, it is a rather slow grower, while C. succirubra is of rapid growth, but contains less quinine. The hybrids resemble their parent-plants in being of a rapid growth, like the former, being near to the latter in alkaloidal strength. Young barks are known to yield, as a rule, a smaller percentage of alkaloids than the bark of older wood, and attention has been directed to the frequently large yield from the root-bark. Investigations by D. Howard (1877) point to the general tendency of the root-barks obtained from different species of Cinchona to augment very materially the amount of dextrogyrate alkaloids (quinidine and cinchonine), while the levogyrate alkaloids (quinine and cinchonidine) are produced in much smaller proportion. The bark of the root-fibres usually contains a still smaller percentage of these alkaloids.

That a certain protection is beneficial for the production of the alkaloids has been shown by experiments made in the East Indies. Howard (1871) demonstrated the presence of 9.75 per cent. of quinine (or a total of 11.40 per cent. of alkaloids) in bark from Cinch. officinalis, var. lanceolata, and Broughton (1870), a total of 13.5 with 9 per cent.

of quinine. The variety pubescens, of the same species, yielded to Howard (1878) 12.90 per cent. of alkaloids, of which 6.94 was quinine and 4.48 cinchonidine. Indian red bark in quills often yields from 9 to 11 per cent. of alkaloids, one-sixth to one-third of which is quinine (De Vrij, 1873), and from the bark of C. officinalis, grown at Ootacamund, between 3.72 and 10.86 per cent. of alkaloids, one-fifth to two-thirds of which is quinine; the extraordinary yield of some of this bark has been referred to above.

The *wood* of the root and trunk contains kinovin, and occasionally about ½ per cent. of alkaloids, according to Moens (1880). A minute amount of alkaloid has also been found by Broughton (1870) in the *leaves*, the bitter taste of which is mainly due to about 2 per cent. of kinovin; while Happersberger (1883) reports having obtained 0.5 per cent. of alkaloids from the leaves of C. officinalis, 1.5 per cent. from those of C. succirubra, and 2 per cent. from those of C. Calisaya. The bitter taste of the *flowers*, according to Broughton, is due to kinovin, and the *fruit*, which is likewise bitter, contains mere traces of alkaloid.

Valuation of Cinchona-bark.—Cinchona should contain not less than 5 per cent. of alkaloids, at least one-half of which should be quinine.—*U. S.* This last requirement is not made of Cinchona rubra. A definite percentage of alkaloids for yellow and pale cinchona is not required by the British Pharmacopœia; red cinchona, on the other hand, should contain between 5 and 6 per cent. of total alkaloids, quinine and cinchonidine making up more than half of this amount. Cinchona should contain at least 5 per cent. of alkaloids.—*P. G.*

Process of U. S. P.—I. For total alkaloids: Cinchona, in No. 80 (or finer) powder, and completely dried at 100° C. (212° F.) 20 Gm.; Alcohol; Ammonia-water; Chloroform; Ether; Normal Sulphuric Acid; Normal Potassium Hydroxide solution each, a sufficient quantity. To 20 Gm. of cinchona, in very fine powder, and contained in a bottle provided with an accurately-ground glass stopper, add 200 Cc. of a previously prepared mixture of 19 volumes of alcohol, 5 volumes of chloroform, and 1 volume of ammonia-water; stopper the bottle, and shake it thoroughly and frequently during four hours. Then separate the liquid by pouring it into another bottle through a funnel containing a pellet of cotton, in such a manner that no material loss may result from evaporation. Transfer 100 Cc. of the clear filtrate (representing 10 Gm. of cinchona) to a beaker, and evaporate it to dryness. Dissolve the residue of crude alkaloids thus obtained in 10 Cc. of water and 4 Cc. of normal sulphuric acid with the aid of a gentle heat, filter the cooled solution into a separatory funnel, and wash the filter until the filtrate no longer has an acid reaction, using as small a quantity of water as possible. Now add 5 Cc. of normal potassium hydroxide solution, or such an amount as will render the liquid decidedly alkaline, and extract the alkaloids by shaking the mixure, first with 20 Cc., and then repeatedly with 10 Cc. of chloroform, until a drop of the last chloroform extraction, when evaporated on a watch-glass, no longer leaves a residue. Evaporate the united chloroform extracts in a tared beaker, dry the residue at 100° C. (212° F.), and weigh. The weight found, multiplied by 10, will give the percentage of *total alkaloids* in the specimen of cinchona tested.

II. For quinine: Transfer 50 Cc. of the clear filtrate remaining over from the preceding process (and representing 5 Gm. of cinchona) to a beaker, evaporate it to dryness, and proceed as directed in the assay for total alkaloids, using, however, only one-half the amounts of volumetric acid and alkali there directed. Add the united chloroformic extracts containing the alkaloids in solution, gradually and in small portions at a time, to about 5 Gm. of powdered glass contained in a porcelain capsule placed over a water-bath, so that, when the contents of the capsule are dry, all or nearly all of the dry alkaloids shall be in intimate mixture with the ground glass. Now moisten the residue with ether, and, having placed a funnel containing a filter of a diameter of 7 Cm. and well wetted with ether, over a small graduated tube (A), transfer to the filter the ether-moistened residue from the capsule. Rinse the latter several times, if necessary, with fresh ether, so as to transfer the whole of the residue to the filter; then percolate with ether added drop by drop, until exactly 10 Cc. of percolate has been obtained. Then collect another volume of 10 Cc., by similar slow percolation with ether, in a second gradulated tube (B). Transfer the contents of the two tubes completely (using ether for washing) to two small, tared capsules, properly marked (A and B) so as to avoid confusion, evaporate to a constant weight, and weigh them. (The residue in A will contain practically all the quinine, together with a portion of the alkaloids less soluble in ether; the residue in B will consist almost entirely of these alkaloids.) From the amount of residue obtained in capsule A deduct that contained in B, and multiply the remainder by 20. The product will represent, approximately, the percentage of *quinine* in the specimen of cinchona tested.

Process of the Br. P.—Cinchona in No. 60 powder 200 gr.; mix intimately with calcium hydroxide 60 gr., then with water ½ oz. and set aside for an hour or two. Transfer the moist dark-brown powder to a six-ounce flask, add 3 fl. oz. of benzolated amylic alcohol (benzene 3 vol., amyl alcohol 1 vol.); boil for half an hour: decant and drain off the liquid on to a filter, leaving the powder in the flask; repeat boiling and decanting; then boil a third time; turn the contents of the flask on to the filter, and percolate with benzolated amylic alcohol until the bark is exhausted. (During the boiling a convenient condenser is formed by placing a funnel in the mouth of the flask, and in the funnel a flask with cold water.) Mix in a stoppered glass separator the still warm filtrate with 20 minims of diluted hydrochloric acid and 2 fluidrachms of water; shake

well, let separate, draw off the acid liquid, and repeat this process with slightly acidulated water until the alkaloids have been removed. Neutralize while warm exactly with ammonia: evaporate to 3 fluidrachms, add solution of tartarated soda 15 gr. in water 30 gr.; stir, after an hour, filter, and dry the precipitated tartrates; eight-tenths of their weight, divided by 2, represents the percentage of *quinine* and *cinchonidine*. To the mother-liquor add ammonia in slight excess; collect, wash, and dry the precipitate; its weight, divided by 2, represents the percentage of the *other alkaloids*, and this, added to the preceding, gives the percentage of *total alkaloids*.

Process of the P. G.—Agitate powdered cinchona 20 Gm. with ammonia-water 10 Cc., alcohol 20 Cc., and ether 170 Cc., and macerate for a day; decant off the clear liquid 100 Gm., add to it 3 Cc. normal hydrochloric acid; distil and evaporate the ether, and, if necessary, acidulate the residue with normal hydrochloric acid; filter, and, without heating, add 3.5 Cc. normal potassa solution, or sufficient to redden phenolphthalein solution; collect the precipitate upon a filter, and wash it repeatedly with small portions of water until the filtrate ceases to produce a red color with solution of phenolphthalein; drain the precipitate, press it between bibulous paper, and dry it first in the air, next over sulphuric acid, and finally in the water-bath, when it should weigh at least 0.5 Gm. A small quantity boiled with 300 parts of water, and filtered while hot, should on cooling separate floccules of quinine, and on adding to 5 parts of the clear cold liquid 1 part of chlorine-water, and afterward a little ammonia-water, a bright-green color should be produced.

De Vrij's Process (1885).—20 gr. of finely-powdered bark are mixed with a previously prepared mixture of 3.4 Gm. of strong hydrochloric acid (30 per cent.) and 20 Cc. of water, so as to form a thick paste, and then macerated for some hours. In case the bark contains more than 10 per cent. of alkaloids, the quantity of acid must be increased, as the quantity of acid specified is for a bark of this strength. More water is then stirred in until the whole is sufficiently fluid to pour freely. As soon as the foam has disappeared the whole is placed into a cylindrical glass percolator which has been closed by a plug of charpie. As soon as the percolate runs clear it is collected, percolation being continued by pouring on water until an excess of sodium hydroxide fails to produce a precipitate in the percolate, which will happen when 180 or 200 Cc. have been collected. This is then precipitated by a large excess of solution of sodium hydroxide, collected on a double filter, and the precipitate washed until the water runs off nearly colorless. The whole filtrate is then measured, and 0.0585 Gm. for every 100 Cc. added to the weight of alkaloid found. The drained filter is carefully dried on blotting-paper until the precipitate ceases to adhere, when it may be easily detached without loss. It is transferred to a tared dish and dried over a water-bath until it ceases to lose weight. Add to this the compensation for the dissolved alkaloids, multiply the sum by 5, and the product is the percentage of alkaloids in the bark. Or after precipitating with caustic soda the liquid can be shaken with one litre of benzene, and allowed to stand not longer than five minutes, the benzene decanted on to a filter previously moistened with benzene, and the red-colored aqueous liquid put into a separatory funnel for complete separation. The aqueous liquid is drawn off and shaken with 200 Cc. benzene, which latter, after filtration, is mixed with the other benzene solution. The benzene solution is shaken with 30 Cc. very dilute nitric acid, this drawn off and replaced by 20 Cc. water, which after shaking is drawn off and mixed with the first. The liquids are then heated to drive off all odor of benzene; when cool are transferred to a separatory funnel and shaken with 200 Cc. ether and an excess of caustic soda. After separating the ethereal solution, another 100 Cc. of ether is shaken with the alkaline liquor and added to the first. The ether is then distilled and the alkaloids obtained in a state of purity.

The alkaloids can be estimated volumetrically by using in place of the nitric acid 70 Cc. decinormal sulphuric acid, and subsequently 30 Cc. water. The aqueous solutions are then heated and accurately neutralized with decinormal solution of caustic soda until the color of reddened litmus is affected by it. The quantity of soda solution used is deducted from 70, the quantity otherwise necessary; the difference, multiplied by .031, is the weight of alkaloid in 20 Gm. of bark. The product, multiplied by 5, gives the percentage.

Action and Uses.—The action and uses of cinchona will be more conveniently studied in connection with its several preparations and those of its constituents, to the articles upon which the reader is referred. A brief account of its introduction into medicine is given under *Quininæ Sulphas*.

CINCHONIDINÆ SULPHAS, *U. S.*, *Br.*—Cinchonidine Sulphate.

Cinchonidinum sulfuricum.—Sulphate of cinchonidine, E.; *Sulfate de cinchonidine*, Fr.; *Cinchonidin-Sulfat*, G.; *Solfato di cinconidina*, It., Sp.

Formula $(C_{19}H_{22}N_2O)_2H_2SO_4.3H_2O$. Molecular weight 738.5.

The neutral sulphate of an alkaloid prepared from certain species of Cinchona, chiefly red bark.

Origin.—Certain cinchona-barks, notably those obtained from Cinch. succirubra, *Pavon*, and Cinch. officinalis, *Hooker*, cultivated in India, and the South America barks from Cinch. lancifolia, *Mutis*, and Cinch. tucujensis, *Karsten*, contain cinchonidine. A very

similar alkaloid, called *homocinchonidine*, is rarely, and then only in minute quantities, found in these barks; but in certain lots of South American red barks the second alkaloid named is present in considerable proportion, wholly or partly replacing the former (Hesse, *Berichte*, 1881, p. 1890). These alkaloids were at first described by Winckler (1847) and others as *quinidine* or *chinidine*, a name which was retained for them long after Pasteur's investigations in 1853 (see CINCHONA, *Constituents*) by several chemists, and until recently by several manufacturers in Germany and Austria.

Preparation.—In the process of manufacturing quinine sulphate, and while recrystallizing this salt, mother-liquors are obtained containing mainly cinchonidine sulphate. On concentrating the solutions the salt crystallizes, and requires purification by recrystallization from water in order to obtain it free from quinine and quinidine sulphate. Formerly, it could be prepared from commercial chinoidine, which sometimes contained notable quantities of this alkaloid.

Properties.—Like the corresponding salts of the other cinchona alkaloids, cinchonidine sulphate is colorless, inodorous, very bitter, and has a neutral or faintly alkaline reaction. It crystallizes from alcohol in handsome prisms containing $2H_2O$, but from water it may be obtained in two forms—either in colorless square glossy prisms, or in less lustrous fine and silky needles, the formation of either crystals depending upon both the concentration and the quantity of the solution. The commercial salt resembles quinine sulphate in appearance. The anhydrous salt dissolves, according to Hesse, at 22° C. (71.6° F.) in 97.5 parts, and the crystallized salt in 67 parts (70 parts at 15° C., *U. S. P.*), of water; it is soluble in 66 parts of alcohol at 15° C. (59° F.), in 1.42 parts of boiling water, and in 8 parts of boiling alcohol (*U. S. P.*); it dissolves readily and freely in diluted acids, the solutions being free from fluorescence, is very sparingly soluble in ether and benzene, becomes gelatinous from the separation of its water of crystallization when immersed in chloroform, and dissolves in 1316 parts of that liquid at 15° C. (59° F.) and in 300 parts at 63.5° C. (146.3° F.), but more freely in chloroform containing alcohol. The solubility in ether and chloroform is increased by the presence of the sulphates of other cinchona alkaloids. On exposure to air the salt effloresces; at 100° C. (212° F.) it loses its water of crystallization, and in moist air absorbs again $2H_2O$; at 215° C. (419° F.) it fuses, and on ignition it is decomposed and volatilized, without leaving any residue. The aqueous solution yields with barium chloride a white precipitate insoluble in diluted hydrochloric acid; it is precipitated by potassio-mercuric iodide and other regents for alkaloids, by neutral tartrates, and by ammonia. The latter precipitate dissolves in about seventy-five times its weight of ether, and requires about twelve times more ammonia-water for solution than the precipitate from a corresponding solution of quinine sulphate (Kerner, 1862). On mixing a drop of an aqueous solution of the salt with a drop of solution of potassium sulphocyanate, microscopic crystals are formed, which are either feathery and

FIG. 72.

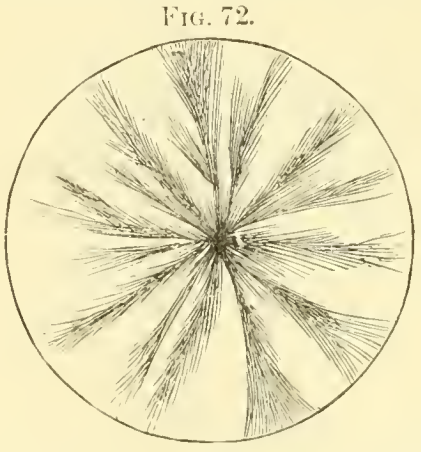
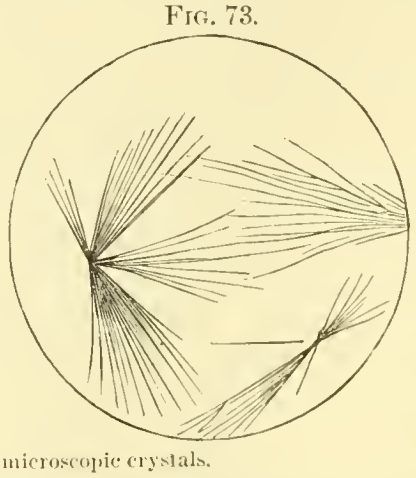


FIG. 73.



Cinchonidine sulphate with KSCy: microscopic crystals.

stellately arranged around a centre, or are spike-like and united in star-like or fan-shaped groups. According to Hesse (1878), cinchonidine sulphate is so completely precipitated by an excess of potassium sulphocyanate that the filtrate is not rendered turbid by ammonia.

Homocinchonidine sulphate has the composition and properties described above, but crystallizes either in dull-white prisms or in delicate white needles, requires at 22° C. (71.6° F.) 69 parts of water for solution, and its aqueous solution, saturated at 50° C.

(122° F.), congeals on cooling to a gelatinous mass consisting of delicate crystals and enclosing the mother-liquor, while under the same conditions the cinchonidine salt yields glossy needles, from which the mother-liquor may be readily drained. Both salts on being treated with potassium permanganate yield *cinchotenidine*, $C_{18}H_{20}N_2O_3$, which was discovered by Skraup (1879), crystallizes with $3H_2O$ in colorless prisms, melts at 256° C., and is not fluorescent in acid solutions (Hesse, 1881).

Tests.—The solution of the salt (1 in 1000) in dilute sulphuric acid should not show more than a slight blue fluorescence (absence of more than traces of sulphate of quinine or of quinidine). The salt should not be colored by the addition of sulphuric acid (absence of foreign organic matters); on adding to this solution a crystal of potassium dichromate the liquid should become yellowish-green, gradually changing to grass-green in color. If 1 Gm. be dried at 100° C. (212° F.) until it ceases to lose weight, the residue, cooled in a desiccator, should weigh not less than 0.92 Gm. (loss is equivalent to $3H_2O$, water of crystallization; absence of an undue amount of water.) If 0.5 Gm. of the salt be digested with 20 Cc. of cold distilled water, 0.5 Gm. of potassium sodium tartrate added, the mixture macerated, with frequent agitation, for 1 hour at 15° C. (59° F.), then filtered, and a drop of ammonia-water added to the filtrate, not more than a slight turbidity should appear (absence of more than small proportions of sulphates of cinchonine or quinidine).—*U. S.*

Composition.—Pasteur (1853) gave to cinchonidine the formula $C_{20}H_{24}N_2O$; Skraup (1879) corrected it to $C_{19}H_{22}N_2O$, which has been verified by Hesse and Claus (1881), although the latter states that commercial cinchonidine occasionally corresponds better with the first formula. Skraup and Claus regard homocinchonidine as slightly impure cinchonidine. Besides the differences given above, Hesse states that the alkaloid cinchonidine melts at 200° to 201° C. (392° to 393.8° F.), while homocinchonidine melts between 205° and 206° C. (401° and 402.8° F.). The sulphate crystallizes with $6H_2O$, according to Goddefroy (1878), from hot concentrated solutions with $3H_2O$. The U. S. P. has adopted the formula of Skraup, requiring 7.31 per cent., and for the salt with $6H_2O$ 13.6 per cent. of water of crystallization.

Action and Uses.—In a number of experiments made with this alkaloid Cerna found that "its effects are more or less similar to those produced by quinine," but larger doses of it are required to produce the same results (*Phila. Med. Times*, x. 495). This conclusion has been confirmed by Sée, Rochefontaine, and Doureleurs. In regard to its action on man, it would seem to occasion less disturbance of the nervous system than quinine, less ringing in the ears, and less disturbance of vision, and vertigo. Like quinine, it reduces the febrile pulse.

Repeated and extended observation of the use of cinchonidine in the treatment of *intermittent fever*, *remittent fever*, and malarial *neuralgia*, made both in this country (*e. g.* Sinkler, 1874) and in British India, proves conclusively its equal or nearly equal efficacy with quinine in these diseases, both as a prophylactic and as a remedy. Yet Marty, who had a large clinical experience of its use, declares that its action is extremely uncertain, and that it is apt to occasion toxical effects when used in doses necessary for its curative operation (*Bull. de Thérap.*, cvi. 458). In *typhoid fever* it has been found to induce the same subsidence of the pulse as quinine, and its equal advantages as a tonic have been fully shown. It has seemed to be well borne where quinine could not be tolerated, and to be especially favorable in its action upon children. *Hydrobromide* of cinchonidine has been used in the summer complaint of children, in various malarial diseases, inflammations, and organic affections. The chief result of these experiments is, that it may be administered hypodermically without causing local irritation, and that it is a more efficient antipyretic agent than quinine in an equal dose (*Med. Record*, xviii. 10, 153). *Salicylate* of *cinchonidine* has been found useful by Prosser James "as a tonic and antiperiodic" in doses of from 5 to 10 grains (*British Med. Jour.*, 1881, i. 428).

The modes of administration of sulphate of cinchonidine are the same, in general, as are employed for sulphate of quinine, but it does not appear to have been given hypodermically; the hydrobromide, however, has been so employed in the dose of Gm. 0.20 (gr. iv) twice a day. As an antiperiodic either preparation should, like quinine, be prescribed in doses of from Gm. 0.60–1.30 (gr. x–xx) five or six hours before the expected paroxysm. In mild cases Gm. 0.60 (gr. x) in divided doses may be given during the day.

CINCHONINA, *U. S.*—Cinchonine, Cinchonia.

Cinchoninum.—Cinchonine, Fr.; *Cinchonin*, G.; *Cinconina*, It., Sp.
Formula $C_{19}H_{22}N_2O$. Molecular weight 293.41.

An alkaloid prepared from the bark of different species of Cinchona.

Origin.—This alkaloid was discovered by Pelletier and Caventou in 1820, and has been found in most cinchona-barks, in largest proportion in some of the pale cinchonas.

Preparation.—It is best prepared by precipitating the aqueous solution of cinchonine sulphate with ammonia-water, washing the precipitate with water until free from ammonium sulphate, and crystallizing from alcohol.

Properties.—Cinchonine is in transparent "white, somewhat lustrous prisms or needles, permanent in the air, odorless, at first nearly tasteless, but developing a bitter aftertaste, and having an alkaline reaction; soluble in 3760 of water, and in 116 parts (84.3 parts, Prunier, 1879) of alcohol at 15° C. (59° F.), in 3500 parts of boiling water, in 26.5 parts of boiling alcohol, 526 parts of ether, 163 parts (101.6 parts, Prunier) of chloroform, and readily soluble in diluted acids, forming salts of a very bitter taste. At 240° C. (464° F.) the crystals fuse together, and at 258° C. (496.4° F.) they melt, forming a brown liquid. On ignition the alkaloid is dissipated without leaving a residue."—*U. S.* Cinchonine is insoluble in ammonia and potassa, but dissolves in 108 parts of amylic alcohol, in warm fixed oils, volatile oils, benzene, and benzin. Its solutions are dextrogyrate; its acid solutions are not fluorescent, and do not give the thalleioquine reaction, but with chlorine-water and ammonia yield a white precipitate. Its alcoholic solution gives a yellow precipitate with picric acid which is insoluble in acids. The aqueous solutions of its salts are not precipitated by bicarbonates in the presence of tartaric acid, but yield precipitates with ammonia and other alkalies, their carbonates, with tannin, potassio-mercuric iodide, gold chloride, platinum chloride, phosphomolybdic acid, picric acid, and other reagents for alkaloids; also, by potassium ferrocyanide (Dollfus, 1848). This last reaction, according to the Pharmacopœia, is to be applied in the following manner: If enough solution of potassium ferrocyanide be added to a neutral or not more than faintly acid solution of cinchonine, or of any of its salts, to redissolve the precipitate first formed, and afterward an acid, a golden-yellow precipitate will occur, which when slightly warmed will dissolve in the liquid, and on cooling separate in minute scales or needles.

By the action of potassa on cinchonine Gerhardt (1842) obtained quinoline, and Greville Williams (1855, 1864) showed that in addition to this base the distillate also contained lepidine, cryptidine, and other bases. By long-continued boiling of its chloride with alcohol and potassa, Koenigs (1881) produced from cinchonine a crystallizable volatile base, *cinchene*, $C_{19}H_{20}N_2$. Michael (1886) obtained an oily, non-volatile base, $C_{20}H_{26}N_2$, by exposing sodium hydroxide, cinchonine, and absolute alcohol to a temperature of 130° C. (266° F.) in a closed tube. On oxidizing cinchonine or its salts by the action of lead dioxide and sulphuric acid, E. Marchand (1844) obtained *cinchotenine*, which is more readily obtained, according to Caventou and Willm, by the action of potassium permanganate, formic acid being formed at the same time. Cinchotenine, $C_{18}H_{20}N_2O_3$, by the further action of oxidizing agents yields Weidel's (1874) *cinchonic* (quinoline-carbonic acid), $C_{10}H_7NO_2$, *cinchomeronic*, $C_7H_5NO_4$, and other acids.

Tests.—"A solution of the alkaloid (1 in 1000) in diluted sulphuric acid should not exhibit more than a faint blue fluorescence (absence of more than traces of quinine or quinidine). On precipitating the alkaloid from this solution by water of ammonia it is very sparingly dissolved by the latter (difference from and absence of quinine), and requires at least 300 parts of ether for solution (difference from quinine, quinidine, and cinchonidine). It should not be colored, or but very slightly colored, by the addition of sulphuric acid (absence of readily carbonizable, organic impurities)."—*U. S.*

Composition.—The formula given above is that of Laurent (1848), which has been corroborated since 1877 by Skraup and others and has been adopted by the Pharmacopœia. The alkaloid crystallizes anhydrous. As found in commerce, it contains a very similar alkaloid, which is not affected by cold potassium permanganate, is freely soluble in alcohol, yields a sulphate crystallizing in sharp needles, and is freed from cinchonine by fractional precipitation; Skraup proposed to call it *cinchotine*, and found it to be identical with Caventou's and Willm's *hydrocinchonine*, $C_{19}H_{24}N_2O$.

CINCHONINÆ SULPHAS, *U. S.*, *Br.*—Cinchonine Sulphate.

Cinchoniæ sulphas, U. S. 1870; *Cinchonium sulfuricum.—Sulfate de cinchonine*, Fr.; *Schwefelsaures Cinchonin*, *Cinchoninsulfat*, G.; *Solfato di cinconina*, It., Sp.

Formula $(C_{19}H_{22}N_2O)_2.H_2SO_4.2H_2O$. Molecular weight 720.54.

Preparation.—The first mother-liquors obtained in the preparation of quinine sulphate are precipitated with soda, and the precipitate is washed first with water to free it from sodium sulphate, afterward with small quantities of cold alcohol, in which the other cinchona alkaloids are more readily soluble than cinchonine. The residue is then mixed with about eight times its weight of water, the mixture heated, and sulphuric acid is dropped in until a clear neutral solution is obtained, which is treated with animal charcoal, filtered while hot, and set aside to crystallize; the crystals are drained and dried.

Properties.—Cinchonine sulphate crystallizes in hard, transparent and colorless, or semi-transparent and white clinorhombic prisms, which have a glassy lustre, are permanent in the air, inodorous, lose their (4.98 per cent.) water of crystallization at 100° C. (212° F.), fuse like wax at a somewhat higher temperature (at about 215° C. =419° F., forming a brown liquid, *U. S. P.*), then acquire a handsome red color, and finally burn, giving off a peculiar empyreumatic odor and leaving no residue. It is apt to form supersaturated solutions with water, of which it requires 13.50 parts to dissolve it at the boiling temperature; its solubility in cold water has been variously determined: 1 part of the salt was found to be soluble in 66 parts of water at 15° C. (*U. S.*), in 54 parts (Kerner), in 65.5 parts (Hesse), and in 75 parts (Schwabe) at 13° C. (55.4° F.); these solutions have a neutral, or frequently a slight alkaline, reaction. The salt is very readily soluble in dilute acids, requires 3.25 of boiling and 10 parts of cold alcohol for solution, dissolves in 78 parts of chloroform, readily in dilute acids, and is insoluble in ether, benzin, and benzene. Its solutions have a very bitter taste and are destitute of fluorescence. They yield a white precipitate with barium chloride (sulphate), are insoluble in dilute hydrochloric acid, and are precipitated by the reagents mentioned above, the precipitate by ammonia being so sparingly soluble in an excess that this reagent may be employed for the quantitative determination of the alkaloid. When a drop of the saturated aqueous solution of the salt is mixed with a drop of solution of potassium sulphocyanate, crystals will be formed which under the microscope will appear long, radiating, and considerably branched, resembling antlers or equisetum.

Fig. 74.

Cinchonine sulphate with KSCy microscopic crystals.

Composition.—The formula as given above is that of Laurent (1848), which has been adopted by most writers since Skraup's investigations (1877, 1879); it requires 82.8 per cent. of cinchonine. Skraup found that by repeated fractional precipitation the commercial salt will yield *cinchotine*, $C_{19}H_{24}N_2O$, an alkaloid very similar to cinchonine, and identical with Caventou's and Willm's (1869) *hydrocinchonine*. It is more freely soluble in alcohol than cinchonine, yields a sulphate crystallizing in sharp needles, and is not affected by a cold solution of potassium permanganate.

Tests.—"A solution of the salt (1 in 1000) in diluted sulphuric acid should not show more than a faint blue fluorescence (limit of sulphate of quinine or of quinidine). If 1 Gm. be dried at 100° C. (212° F.) until it ceases to lose weight, the residue, cooled in a desiccator, should weigh not less than 0.95 Gm. If 1 part of the salt, reduced to powder, is macerated, with frequent agitation, with 80 parts of chloroform at ordinary temperature, it should wholly, or almost wholly, dissolve (limit of sulphate of quinine or cinchonidine). The salt should not impart more than a faintly yellowish tinge to concentrated sulphuric acid (limit of readily carbonizable organic impurities)."—*U. S.*

Other Salts of Cinchonine.—Acid cinchonine sulphate—$C_{19}H_{22}N_2O.H_2SO_4.3H_2O$, mol. weight 445.15—obtained by dissolving the official sulphate in dilute sulphuric acid and crystallizing, forms octahedral crystals, which become opaque in dry air, and dissolve in about half their weight of water and in 90 parts of alcohol. They are insoluble in ether, and contain 59.2 per cent. of cinchonine.

Cinchonine hydrochloride—$C_{19}H_{22}N_2O.HCl.2H_2O$, mol. weight 365.7—made by treating an excess of cinchonine with dilute hydrochloric acid, crystallizes in needles closely resembling sulphate of quinine, dissolves in 24 parts of water at 10° C (50° F.), in 3.2 parts of boiling water,

in 22.2 parts of chloroform, in 1.3 parts of 80 per cent. alcohol, and in 273 parts of ether spec. grav. .730, at 15° C. The salt melts above 130° C. (266° F.). It has been occasionally used for adulterating, or fraudulently sold for, quinine sulphate, from which it is readily distinguished by the absence of fluorescence of its acidulated solution, by the white precipitate occasioned with silver nitrate, and by the sparing solubility in ether of the white precipitate with ammonia. It contains 80.24 per cent. of cinchonine.

Action and Uses.—Sulphate of cinchonine is more poisonous to frogs and dogs than sulphate of quinine The former in full doses does not so speedily produce buzzing in the ears and disordered vision, but, on the other hand, it is more apt to occasion a peculiar pain and sense of oppression in the frontal region of the head. It is also prone to excite præcordial pain, jerking of the tendons, muscular exhaustion, and faintness when freely used. Laborde, indeed, denies to this alkaloid and to cinchonidine an equality with quinine, alleging that they belong to the class of convulsing poisons (*Archives gén.*, Mar. 1880, p. 368).

Its therapeutical application is generally regarded as identical in nature with that of quinine, at least in the treatment of *periodical fevers*. But the certainty of its curative effects is by no means so well established. It has the advantage over quinine of being less bitter and much more soluble in water, as well as cheaper; but it has the disadvantage of being less reliable. The dose of sulphate of cinchonine is variously stated to be from one-third to twice as large as that of quinine.

CINNAMOMUM, *U. S., Br., P. G., F. It.*—Cinnamon.

Canelle, Fr.; *Zimmt*, G.; *Canella*, It., Sp.

The bark of several species of Cinnamomum.

Nat. Ord.—Laurineæ.

Official Kinds.—1. Cinnamomum Cassia, *U. S.*; Cortex Cinnamomi, *P. G.*; Cortex cinnamomi chinensis, Cortex cinnamomi cassia, Cinnamomum chinense, Cassia cinnamomea.—Cassia cinnamon, Chinese cinnamon, Cassia bark, Cassia lignea, *E.*; Canelle de Chine, *Fr.*; Zimmtkassie, Chinesischer (Gemeiner) Zimmt, *G.*; Canella, *It.*, *Sp.*

The bark of the shoots of one or more species of Cinnamomum, grown in China (Chinese cinnamon).

2. Cinnamomum saigonicum, *U. S.*; Cortex cinnamomi saigonici.—Saigon cinnamon, *E.*; Canelle de Saigon, *Fr.*; Saigonzimmt, *G.*

The bark of an undetermined species of Cinnamomum.

3. Cinnamomum zeylanicum, *U. S.*; Cinnamomi cortex, *Br.*; Cortex cinnamomi zeylanici, Cinnamomum acutum, *s.* verum.—Ceylon cinnamon, Cinnamon-bark, *E.*; Canelle de Ceylon, *Fr.*; Zeylonzimmt, *G.*; Canella del Ceylon, *It.*

The inner bark of the shoots of Cinnamomum zeylanicum, *Breyne*, *s.* Laurus Cinnamomum, *Linné*. Bentley and Trimen, *Med. Plants*, 224.

Origin.—The tree mentioned above is variable in size, but usually of small stature, and is met with in forest districts of Ceylon, reaching an elevation of 920 M. (3000 feet). It has opposite coriaceous three- to five-nerved leaves, which are bright-green and glossy above and glaucous beneath; the small flowers are in terminal panicles, producing a somewhat fleshy ovoid fruit, which at the base is surrounded by the enlarged perianth. Not less than seven or eight well-marked varieties are distinguished, some of which are regarded by some botanists as distinct species.

Cinnamon was known and highly esteemed as a spice in the most remote times of history, but the kind first used appears to have been that derived from China, while Ceylon cinnamon is first mentioned about the year 1275. Cinn. zeylanicum is now cultivated in many tropical countries, without, however, producing a bark equal in aroma to that obtained in Ceylon.

Collection.—Ceylon cinnamon, the cultivation of which is gradually declining through the extension of coffee-culture, is produced in the south-western part of that island in the vicinity of Colombo, where the plants are pruned so as to cause them to form stools, from which four or five shoots are raised for eighteen months or two years, until the bark begins to turn brown by the production of a corky layer. The shoots, which are now about 2.4 M. (8 feet) high and 5 Cm. (2 inches) or less thick, are cut off and deprived of their leaves and thin portions, which are sold as *cinnamon chips*. The bark is cut transversely, either obliquely or in a straight line, at distances of about a foot, after which two or more longitudinal incisions are made and the strips of bark

removed by inserting beneath it the peeling-knife called *mama*. The pieces are put one within the other, and the sticks thus formed tied together into bundles. After about twenty-four hours the external layers of the bark are carefully removed by placing each piece upon a suitable stick of wood and scraping with a knife. The small quills are then placed in the larger ones in such a manner as to form congeries of quills about 1 M. (40 inches) long. These sticks are kept one day in the shade, then dried in the sun, and finally made into bundles of about 30 pounds each. Cinnamon produced in Senegal, Brazil, and the West Indies is inferior in quality; that from Tellichery and Java comes nearest to Ceylon cinnamon.

The trees yielding Cassia cinnamon are a number of species of Cinnamomum cultivated in India and also South-eastern China. Among the former can be named Cinnamomum Tamala, *Mes*, and C. iners and nitidum, considered by some botanists to be only coarse forms of C. zeylanicum which had been transplanted from Ceylon to India. The bark yielded by these trees is the Indian cassia. The true Chinese cassia-bark is cultivated in Kwangsi and Kwangtung, the south-eastern provinces of China, and is obtained from C. Cassia, *Blume*, according to Charles Ford (*Jour. Linn. Society*, Dec. 1882). This tree is cultivated in the Chinese cinnamon plantations along with Machilus velutina, *Champ.*, Laurineæ, the bark of which is used for preparing a glutinous extract. The facts about Chinese cassia were ascertained through personal observation by Charles Ford, who gives the following description of the collection of cinnamon: "When the trees are about six years old the first cut of bark is obtained. The season for barking commences in March and continues until the end of May, after which the natives say the bark loses its aroma, and is therefore not removed from the trees. The branches, which are about an inch thick, being cut to within a few inches of the ground, are carried to houses or sheds in the vicinity of the plantations. All the small twigs and leaves being cleared off, a large-bladed knife, with the cutting edge something like the end of a budding-knife, is used to make two longitudinal slits and three or four incisions, at 40 Cm. (16 inches) apart, round the circumference through the bark; the bark is then loosened by passing underneath it a kind of slightly-curved horn knife with the two edges slightly sharpened. Pieces of bark 40 Cm. (16 inches) long and half the circumference are thus obtained. The bark, after its removal and while it is still moist with sap, is then laid with the concave side downward, and a small plane passed over it and the epidermis removed. After this operation the bark is left to dry for about twenty-four hours, and then tied up in bundles about 45 Cm. (18 inches) in diameter, and sent into the merchants' houses in the market-towns."

Cassia cinnamon must not be confounded with the true Chinese cinnamon, which is not cultivated in China, but grows wild in Annam. It never reaches our commerce, but is entirely exported to China on account of the high price there paid for it. The bark is collected from old trees, which are entirely denuded, and consequently die.

Java and Sumatra also yield a Cassia-bark, which has been ascribed to C. Cassia, *Blume*, and C. Burmanni, *Blume*. C. Cassia is cultivated in Java; indeed, the original specimen which Blume describes was obtained from Java, and had been introduced there from China, as he also mentions.

A kind of Chinese or *Saigon cinnamon* is now official under the name of Cinnamomum Saigonicum. The trees yielding the bark have not been determined. This variety appeared in our commerce early in the seventies, and since then has been found in increasing quantities.

The U. S. Pharmacopœia recognizes three varieties of cinnamon—Cassia, Ceylon, and Saigon; the British Pharmacopœia recognizes only the Ceylon; and the German Pharmacopœia the Cassia cinnamon.

The importation into the United States of the Ceylon cinnamon has decreased from 20,600 pounds in 1877 to about 5000 to 10,000 annually, while little over 1,000,000 pounds of Chinese cinnamon were imported in 1877, against nearly 2,500,000 pounds in 1880.

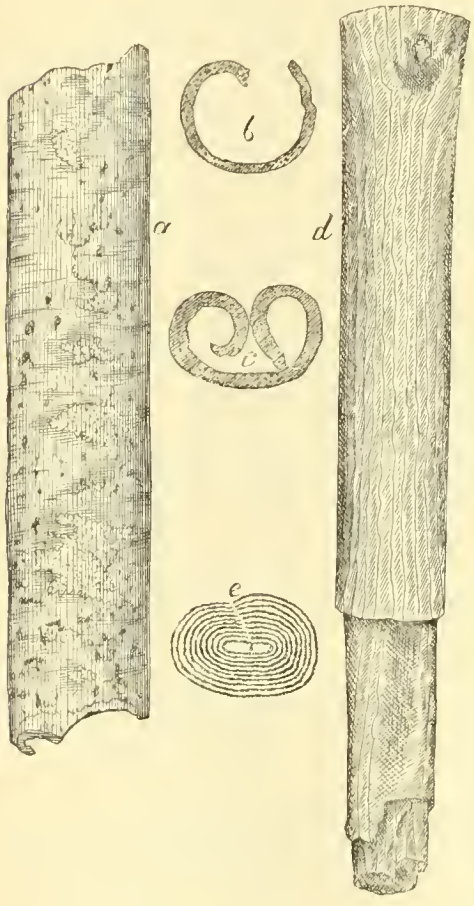
Description.—Cassia cinnamon, or cassia-bark, comes loose or packed in bundles with bands of bamboo. The pieces vary considerably in length, and are either curved, double quilled, or in quills of 6 to 25 Mm. (¼ to 1 inch) in diameter. The bark is 1 Mm. ($\frac{1}{25}$ inch) or more thick, and has a smooth or finely-wrinkled reddish-brown outer surface, marked with some dark leaf-scars, occasionally with lighter-colored lines, and very generally covered with larger or smaller irregular patches of cork. It breaks with a short, nearly smooth fracture, and when of good quality has a strong though less delicate cinnamon odor and taste.

Ceylon cinnamon is in sticks about 1 M. (40 inches) long and nearly 12 Mm. ($\frac{1}{2}$ inch) thick, formed of eight or ten layers of very thin bark, which are together spirally rolled up from both edges. The bark itself has the thickness of stout writing-paper, is brittle and splintery, and has the external surface of a dull light yellowish-brown, smooth, marked with faint longitudinal wavy lines of bast-bundles, and with a few scars or holes left by the leaf-stalks or branches. The inner surface is smooth, scarcely striate, and of a somewhat darker brown. The odor is fragrant, peculiar; the taste sweetish, aromatic, and pungent. Inferior kinds of cinnamon are usually somewhat thicker, darker in color, of less agreeable fragrance, and occasionally of a bitterish taste. Cayenne cinnamon has a reddish tinge and is quite mucilaginous. Java cinnamon is often very similar to Ceylon cinnamon in appearance, though hardly equal to it in flavor; sometimes it is of a darker color, resembling Chinese cinnamon, but thinner and of better flavor.

Saigon cinnamon comes in the form of unscraped quills about 15 Cm. (6 inches) long and 10 to 15 Mm. ($\frac{2}{5}$ to $\frac{3}{5}$ inch) in diameter. The bark is 2 to 3 Mm. ($\frac{1}{12}$ to $\frac{1}{8}$ inch) in thickness, having a gray or grayish-brown outer surface, which has whitish patches and more or less rough from numerous warts and some transverse ridges and fine longitudinal wrinkles. The inner surface is cinnamon-brown or dark-brown in color, is granular, and slightly striate. The bark breaks with a short granular fracture, which is cinnamon-colored in the outer layer, and shows near the cork an almost uninterrupted line of numerous whitish striæ. The bark possesses a sweet, warmly aromatic, and somewhat astringent taste, a fragrant odor, and yields a darker-colored powder than Cassia cinnamon.

Under the microscope Ceylon cinnamon is seen to consist of the bast-layer only, the outer surface being formed by a continuous circle of stone-cells intermixed with bundles of bast-fibres; the narrow medullary rays separate the broad bast-wedges, consisting of regularly-arranged small groups or single bast-fibres and of bast-parenchyma, containing starch-granules and mucilage and scattered oil-cells. Cassia cinnamon, aside from the cork, consists of primary bark and of the bast-layer, in which the bast-fibres, groups of stone-cells, and oil-cells are scattered, and which contains more mucilage and starch than the preceding kind. Saigon cinnamon resembles the Cassia cinnamon in that the commercial article consists of the cork, primary bark, and bast-layer. In the thinner barks there is a great similarity between it and Ceylon cinnamon, with this exception, that the primary bark, which contains a large number of oil-cells, is present. The older and thicker barks resemble in structure the Cassia cinnamon.

Fig. 75.



Cinnamon.
a, *b*, *c*, from China. *d*, *e*, from Ceylon.

The term *cassia lignea* is sometimes applied indiscriminately to Chinese cinnamon or it is used only for the inferior varieties. Some writers have restricted it to a thicker bark, of a slight cinnamon odor and a mucilaginous, faint cinnamon taste. The origin of these barks is not positively known.

Constituents.—The two kinds of cinnamon agree in the main in their chemical constituents, the most important of which is volatile oil. (See Oleum Cinnamomi.) They also contain a considerable amount of tannin, some sugar, mannit, starch, and mucilage. Flückiger and Hanbury noticed that the infusion made with cold water becomes turbid on the addition of iodine or potassium iodide, and the decoction of both cinnamons discharges the color of a considerable quantity of iodine before it permanently assumes the blue color of iodide of starch. The body producing this reaction with iodine appears to be insoluble in alcohol and ether, but its nature has not been ascertained. A strong tincture of cinnamon gradually becomes gelatinous and loses its astringent taste.

Pharmaceutical Uses.—Syrupus cinnamomi, P. G. Macerate for two days cinnamon 10 parts, cinnamon-water 50 parts, and dissolve in 40 parts of the filtered infusion 60 parts of sugar.—*P. G.*

Tinctura aromatica, P. G. Macerate Cassia cinnamon 5 parts, ginger 2 parts, cardamom, cloves, and galanga, each 1 part, in alcohol, sp. grav. .893, 50 parts.—*P. G.*

Allied Products.—Cassia-buds, *Flores cassiæ*, s. *Clavelli cinnamomi*, are the small, pedicellate, unripe fruits of one or more species of Cinnamomum; they bear some resemblance to cloves, but are smaller, and consist of the thick perianth, the six small lobes of which are folded over the depressed ovary. They have a cinnamon-like but less agreeable odor and taste, and contain a volatile oil and tannin. The average importation of cassia-buds into the United States is about 40,000 pounds annually.

The following barks, which resemble cinnamon in some respects, are similarly employed in their native countries, and are occasionally met with in commerce:

Culilawan-bark is obtained from Cinn. Culilawan, *Nees*, indigenous to the Molnccas. It is in flat or curved pieces, 2.5 to 6 Mm. ($\frac{1}{10}$ to $\frac{1}{4}$ inch) thick, grayish or brownish externally, dark cinnamon-brown internally, with the fracture corky and short fibrous. The odor resembles cinnamon with a mixture of cloves and sassafras; taste mucilaginous and aromatic.

Cassia caryophyllata, s. *Cortex caryophyllatus*, the clove-bark (Nelkenzimmt, *G.*), from Dicypellium caryophyllatum, *Nees*, of Brazil. It usually comes in quills 2 to 4 Cm. ($\frac{3}{4}$ to $1\frac{1}{2}$ inches) thick, and about 60 Cm. (2 feet) long, which are made up of from six to ten pieces of bark rolled up together. The bark is about 1.5 Mm. ($\frac{1}{16}$ inch) thick, smooth or slightly wrinkled, chestnut-brown, often with a bluish tinge, fracture short, showing a whitish line near the outer margin; odor clove-like; taste mucilaginous, resembling cinnamon.

Action and Uses.—The oil of cinnamon, like that of other aromatics, first stimulates, and then exhausts and depresses, the nervous system. Locally, it is a rubefacient and stimulant. The water and the oil of cinnamon are used to impart an agreeable flavor to medicines, and the former is associated with astringents in the treatment of *diarrhœa*. Cinnamon was anciently believed to stimulate the uterus, and recently has been used in conjunction with more powerful medicines, such as borax, ergot, cotton-root, etc., to promote *parturition* and to check *uterine hæmorrhage* after labor and during menstruation or depending upon disease of the womb. Powdered cinnamon may be prescribed in doses of from Gm. 0.60–2.00 (gr. x–xxx). An infusion may be made with Gm. 4.0 (℥j) of the bruised bark to half a pint of boiling water, and administered in doses of a tablespoonful or two every hour.

CLEMATIS.—Virgin's Bower.

Clematite, Fr.; *Waldrebe*, G.; *Barbas de chivo*, Sp.

The herb of different species of Clematis.

Nat. Ord.—Ranunculaceæ, Clematideæ.

Description.—The genus consists of perennial herbs or woody vines climbing by the aid of the bending petioles of their opposite pinnate leaves. The flowers have four to six colored sepals, minute or no petals, numerous stamens, and many akenes, which are prolonged into a feathery or rarely naked tail, consisting of the permanent style. The following species have been used:

Clem. erecta, *Linné*, indigenous to Europe. The leaflets are five to nine in number, oblong, narrowed below or usually cordate at the base, acute, entire, pale-green beneath, three- to five-nerved. The white flowers are in cymose clusters. It was formerly known as *Herba flammulæ Jovis*.

Clem. Vitalba, *Linné*, indigenous to Europe. The leaflets are about five in number, ovate, heart-shaped at the base, acute, coarsely serrate or entire, three- to five-nerved, pubescent when young. The white flowers are in cymose clusters and have the sepals clothed with felt-like hairs.

Clem. Flammula, *Linné*, indigenous to Southern Europe. The leaves are twice pinnate, the leaflets small, varying between lanceolate and oblong, entire, but two- or three-lobed.

Clem. virginiana, *Linné*, common in Canada and the United States. Leaflets three, ovate, rounded or heart-shaped at base, lobed and cut-dentate, with mucronate teeth. Flowers white, in cymose panicles.

Clem Viorna, *Linné*—*Leather flower*—indigenous to the Southern States. Leaflets three to seven, ovate, acute, smooth. Flowers single, nodding, with dark-purple leathery sepals.

Clem. cylindrica, *Sims*, resembles the preceding, but has single bell-shaped, bluish-purple flowers, with the sepals dilated and often crisped above.

Constituents.—The above species possess in the fresh state a very acrid taste, which is gradually lost. Braconnot observed that the acrid principle may be distilled with water and is soluble in fixed oils.

Action and Uses.—All the numerous species of clematis possess essentially the same properties, which are those of an acrid irritant. The juice or the bruised plant applied to the skin is apt to cause blisters, and even ulcers, and its emanations when it is crushed readily make the eyes water and inflame them. In Europe beggars avail themselves of these properties to produce ulcers upon their limbs for the purpose of exciting compassion. Hence, clematis is known as beggar's weed (*l'herbe à gueux*). These irritant properties are very feeble in the dried plant. The American appear to be less acrid than the European species.

An infusion of the flowers and leaves of clematis has been used internally in chronic *rheumatism*, *syphilis*, *scrofula*, *dropsy*, and *quartan ague*. An infusion of the fresh buds of C. vitalba, Gm. 1.00–3.00, in water Gm. 200–250 (gr. xv to gr. xlv in water f℥vj–viij), with the addition of anise or other carminative, when taken in three doses at intervals of an hour, is said to act as an efficient hydragogue cathartic. The dried leaves in weak infusion have been used with advantage as a diuretic in some cases of *dropsy* following intermittent fever. In Europe the peasantry employ the fresh leaves as *vesicants*, and physicians have applied them in the same manner to relieve local *pains*, and also in chronic *rheumatism*, *gout*, and *paralysis*. Even in ancient times this plant was used in the substitutive treatment of chronic *skin diseases*, and much more recently an infusion of it in oil was employed to cure the *itch*. The affected parts, it is said, having been subjected to several frictions, became violently inflamed, but with the subsidence of the inflammation the itch was cured.

COCA, *U. S., Br., It.*—Coca.

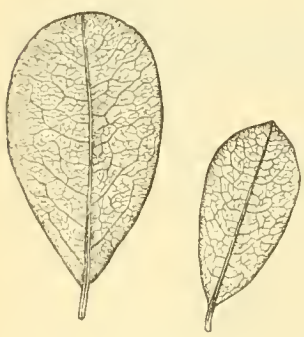
Erythroxylon, U. S. P. 1880.—*Coca-leaves*, E.; *Feuilles de coca*, Fr.; *Cocablätter*, G.

The leaves of Erythroxylon Coca, *Lamarck*. Bentley and Trimen, *Med. Plants*, 40.

Nat. Ord.—Lineæ.

Origin.—Coca is a small shrub 1.2–1.8 M. (4 to 6 feet) high, with numerous spreading purplish-brown branches. It has small, yellowish, five-petalous flowers in axillary clusters of three or four, ten hypogynous stamens, and an oblong, scarlet-red, pointed, and smooth drupaceous fruit containing a single albuminous seed. It is indigenous to the mountains of Peru and Bolivia, and is cultivated in both these countries on the eastern slope of the Andes in damp warm valleys at an altitude of 1524 or 1829 M. (5000 or 6000 feet); also in some parts of Colombia, Brazil, and the Argentine Republic. The leaves of the plant cultivated in Bolivia, although smaller, are nevertheless more highly esteemed than the Peruvian variety. The plants are partly stripped of leaves three times annually after the third year. After carefully drying in the sun to preserve their green color, the leaves are packed in *cestos* weighing 30 pounds; three of these are tied together, forming a *tambor*, a load for the beast of burden. About 40,000,000 pounds are annually produced.

Fig. 76.



Bolivian coca leaves, natural size.

Coca-leaves cultivated in Java and India are considered inferior to those of South America, and are stated to be derived from E. Coca var. Spruceanum, *Burck*.

Description.—The leaves are alternate 2 to 5 or 7 Cm. ($\frac{3}{4}$ to 2 or $2\frac{3}{4}$ inches) long, 25 to 37 Mm. (1 to $1\frac{1}{2}$ inches) broad, ovate, lanceolate or obovate-oblong, rather obtuse, and frequently emarginate, somewhat narrowed into the short petiole, entire on the margin, rather thin, smooth, the lower surface pale bluish-green, reticulate on both sides, with a prominent midrib, on each side of which is a curved line running from the base to the apex, which is due to strands of collenchyme cells. The leaves have a slight but agreeable odor, similar to that of tea, and a somewhat astringent, bitter, and aromatic taste.

There are in commerce two kinds of South American coca-leaves, known as the Huanuco and the Truxillo varieties. The latter is light-green, thin, fragile, and brittle, while the former is darker in color, thicker, and of a leathery texture. They differ also in the shape of the fibro-vascular bundles, those of the Huanuco variety being

spread out and flat, while those of the other variety are more circular in arrangement. The Truxillo variety is identical with E. Coca v. Spruceanum, *Burck*.

Constituents.—Wackenroder (1853) showed the presence in coca-leaves of a peculiar tannin, which reacts with a green color upon iron salts, and has since been called *coca-tannic acid*. Gaedeke (1855) isolated a crystalline alkaloid, which was provisionally named *erythroxyline*, and further examined by A. Niemann (1860), and W. Lossen (1865), the name being changed to *cocaine*. Cocaine, $C_{17}H_{21}NO_4$, when boiled with hydrochloric acid is split into methylic alcohol, CH_4O, benzoic acid, $C_7H_6O_2$, and ecgonine, $C_9H_{15}NO_3$. *Cinnamyl-cocaine*, $C_{19}H_{23}NO_4$, was isolated by Geisel: it forms needle-shaped crystals which fuse at 121° C., and on boiling with hydrochloric acid yields methyl alcohol, ecgonine, and cinnamic acid (sometimes also isocinnamic acid). *Truxil cocaine* (*truxilline* or *cocamine*, Hesse) yields, on saponification with hydrochloric acid, truxillic acid, $C_9H_8O_2$, in several modifications, which are possibly polymeric with cinnamic acid. From Java coca-leaves benzoyl-pseudo-tropeine, $C_{15}H_{19}NO_2$, was obtained by Liebermann; it melts at 49° C., and is easily soluble in alcohol, ether, chloroform, benzene, and benzin; when boiled with hydrochloric acid it yields benzoic acid and pseudo-tropine, $C_8H_{15}NO$, deliquescent rhombic crystals, which are sparingly soluble in ether and freely in chloroform. *Hygrine*, obtained by Maclagan and named by Lossen, is volatile, oily, and readily soluble in water, alcohol, and ether; according to Liebermann, it is a mixture from which can be separated by distillation $C_8H_{15}NO$ and $C_{14}H_{24}NO$. Hesse, however, claims that this is not a constituent of coca, but is obtained from the solvent used in the isolation of the alkaloids.

History.—Coca was used by the aborigines of South America long before their conquest by the Spaniards. They regarded it as a divine gift, employed it in religious ceremonies, and spoke of it as "that heavenly plant which satisfies the hungry, strengthens the weak, and makes men forget their misfortunes." These reasons were sufficient to render it abominable in the sight of the fanatical invaders, who forbade its use and culture. But when they discovered that it enabled the conquered people to perform the work of their taskmasters, they winked at its diabolical origin and virtues.

Action and Uses.—Owing to the small quantity of coca, and that often impaired in activity, which is to be procured in countries where physiological research is practised, the conclusions in regard to its action are somewhat deficient in fulness and precision. Its principal effects are manifested in enabling those who use it to remain for a long time without food, to endure unusual fatigue, and to preserve a cheerful temper. Some of the first historians of its use, as Von Bibra, state that it suspends the appetite for food for some hours, and at the same time greatly increases the muscular strength and endurance. Schroff found that it quickened the pulse and occasioned an agreeable sense of lightness and activity of mind and body, followed by some lassitude and an inclination to sleep. When the proper quantity has been chewed the laborer goes cheerfully to his work and gives no heed to meal-times while the influence lasts. By repeated doses abstinence from food can be maintained for three or four days. In some persons it produces an exhilarating effect. The celebrated traveler Tschudi and more recent observers found that when taken in infusion it conferred a singular immunity from suffering, and prevented the hæmorrhages which are apt to occur in the elevated passes of the Andes, some of which are 17,000 feet high. Christison, who tested its action among the Highlands of Scotland, observed that it entirely prevented the fatigue which follows severe pedestrian exercise, and suspended hunger and thirst during its action. It had no effect upon the mental faculties beyond liberating them from the dulness and drowsiness which fatigue occasions. The most recent testimony quite confirms these statements.

So far as experiments have been undertaken, they do not agree in their physiological results. Ott found that during the use of coca for five days the solid elements of the urine diminished, while the weight of the body slightly increased. During the experiment the urine contained oxalate of lime. Christison states that it increased the saliva and probably lessened the secretion of the urinary solids. Gazeau, on the other hand, observed that it augmented the excretion of urea and lessened the weight. According to him, its power consists in its sustained excitation of the vital functions, along with an anæsthetic power which lessens the sense of fatigue and hunger. The first and the last conclusions are reasonable, and seem to be confirmed by the experiments of Mason, who inferred from them that the effects of coca include stimulation of the nervous system and retardation of metamorphosis.

In its native country, Colombia, coca is used, precisely as Chinese tea is elsewhere, as a mild stimulant and diaphoretic and an aid to digestion. These are mainly the purposes

of coffee, chocolate, and guarana; and experiment has proved that the active constituents of all these productions, "although unlike one another and procured from totally different sources, possess in common prominent principles which are not only almost identical in chemical composition, but also appear similar in physiological action" (Bennett).

Coca has been gravely suggested as a means of appeasing hunger and thirst in armies on forced marches and on voyages with insufficient food and water; but the fact is overlooked that hardly enough of it has hitherto been procurable for laboratory experiments, and that tobacco, coffee, and tea, which are abundant, have closely analogous virtues. It has also been proposed for allaying the canine hunger observed in some cases of *epilepsy* and *insanity*, and to appease the thirst in *diabetes*. Opium has generally been used to fulfil these indications. In *melancholia* it may be employed as opium and also cannabis have been, and probably with as little real advantage. Like tea and coffee, it has been found useful in nervous *headache* and in the *typhoid state* of fevers. It is one of the stimulants that may be substituted for opiates in treating the *opium habit*. It is said to have been used in South America to overcome *uterine inertia* and to allay pain and the discharges in *cholera morbus*. It is reported to have been useful in *spermatorrhœa* and *generative debility*, but no proof exists of so improbable a statement. According to one reporter, it is of use in granular *pharyngitis* and in relaxation of the *vocal* cords.

The Indian coca-chewer always carries a bag of the leaves hanging from his neck and a small flask filled with ashes or lime. After having withdrawn the filaments from a handful of leaves, he chews them until they are reduced to a pulp; this he forms into a ball, which he pierces with a splinter wetted and covered with adhering ashes. The mass has then acquired a pungent taste which excites copious salivation; a part of the saliva is ejected and a part swallowed. The ball is retained in the mouth for about an hour, and then is renewed with a fresh handful of leaves. For medicinal purposes the most convenient form is an infusion made with about Gm. 8 (℥ij) of the leaves in Gm. 120 (f℥iv) of water.

COCAINÆ HYDROCHLORAS, *U. S., Br.*—Cocaine Hydrochlorate.

Cocainum hydrochloricum, P. G.—*Chlorhydrate de cocaine*, Fr.; *Cocainhydrochlorat*, G.

Formula $C_{17}H_{21}NO_4.HCl$. Molecular weight 338.71.

The hydrochlorate of an alkaloid obtained from coca.

Preparation.—Niemann's process (1860) consists in preparing a tincture with alcohol acidulated with sulphuric acid, treating this with milk of lime to remove wax and coloring-matter, neutralizing the filtrate with sulphuric acid, distilling off the alcohol, diluting the residue with water, filtering, adding sodium carbonate, and agitating with ether. The impure alkaloid left on evaporation of the ether is again treated with acidulated water, sodium carbonate, and ether, then decolorized, neutralized with hydrochloric acid, and recrystallized. Lossen's process (1865) differs from Niemann's in that an infusion of the drug is used from which the tannin is separated by lead acetate and the alkaloid taken up with ether. The purification is carried on in the same manner as in the former process. By these processes a mixture of other alkaloids, as are described under Coca, is also obtained. Since Liebermann and Geisel have shown that these can readily be converted into cocaine, they have become rather important. The two processes, which are covered by patents, depend primarily on the decomposition of the alkaloids into ecgonine, and the acids and the alcohols by boiling with strong hydrochloric acid. On cooling the organic acids separate; the solution is then filtered and evaporated to dryness. The residue is washed with warm alcohol and the alkaloid ecgonine liberated with a carbonate or hydroxide. The ecgonine is boiled with benzoic anhydride for a short time, the benzoic acid formed extracted with ether, and the solution allowed to crystallize. These crystals, benzoyl-ecgonine, are dissolved in methylic alcohol, and hydrochloric-acid gas led into the solution, which converts the compound into cocaine or methyl-benzoyl-ecgonine. According to another process the methyl ether of ecgonine is first formed, and this then treated with benzoyl-chloride, yielding cocaine.

Properties.—The salt crystallizes from water in delicate radiating groups of needles, and from alcohol in short and thin prisms. It usually is seen as a white crystalline powder, which is nearly inodorous, has a slight acid reaction and a bitter taste, and produces on the tongue a tingling sensation followed by numbness. At 15° C. (59° F.) it is soluble in 0.48 parts of water and in 3.5 parts of alcohol; very soluble in boiling water and boiling alcohol. It is soluble in 2800 parts of ether and in 17 parts of chloroform, but is insoluble in fixed oils. Cold mineral acids dissolve the salt without

color. A small quantity of the salt rubbed on a dry porcelain slab with an equal bulk of mercurous chloride and then breathed on should assume a dark gray or grayish-black color. If a small quantity of the powdered salt be heated for twenty minutes to 100° C. (212° F.), it should suffer no material loss (absence of water of crystallization).—*U. S.* Heating the salt or its solution for a longer time, decomposition will set in. At 193° C. (379.4° F.) the salt melts, forming a light brownish-yellow liquid, and when ignited burns without leaving a residue. The aqueous solution yields yellow or light-yellow precipitates with gold chloride, platinum chloride, and picric acid, and white precipitates with mercuric chloride, stannous chloride, tannin, and with the alkalies and alkali carbonates, the latter precipitates being soluble in ammonia and ammonium carbonate. A solution of the salt yields a white precipitate with solution of silver nitrate which is insoluble in nitric acid. Giesel (1886) observed that the solution of the salt in water if not too dilute gives with solution of potassium permanganate a violet-purple crystalline precipitate of cocaine permanganate. "If 1 drop of a mixture of 1 volume of decinormal potassium permanganate solution and 2 volumes of water be added to 5 Cc. of a 2 per cent. solution of cocaine hydrochlorate mixed with three drops of diluted sulphuric acid, and contained in a small, clean, glass-stoppered vial, the pink tint produced by the permanganate should not entirely disappear within half an hour (absence of cinnamyl-cocaine and some other bases derived from coca)."—*U. S., P. G.* If 5 drops of a 5 per cent. solution of chromic acid be added to 5 Cc. of a 2 per cent. solution of cocaine hydrochlorate, a yellow precipitate is produced which dissolves on shaking; if 1 Cc. of hydrochloric acid is now added, a permanent orange-yellow precipitate will be formed.—*U. S.* If a few drops of an aqueous cocaine solution are mixed with 2 to 3 Cc. of chlorine-water, and then with 2 or 3 drops of a 5 per cent. solution of palladium chloride, a red colored precipitate, which is slowly decomposed by water, is formed. The precipitate is insoluble in alcohol and ether, but is dissolved by solution of sodium thiosulphate.

Alkaloid and Salts.—The alkaloid *cocaine* when pure forms colorless prismatic crystals of a strongly alkaline reaction. It has a bitterish taste and produces a transient numbness on the tongue. It dissolves in 704 parts of water at 12° C. (53.6° F.) (Liebermann), in 1300 parts of cold water (Paul), and in much less alcohol and ether; it is also soluble in fixed oils. Its composition is $C_{17}H_{21}NO_4$, and on being kept in solution for some time or by boiling with acids or alkalies it is split into methylic alcohol, CH_4O, benzoic acid, $C_7H_6O_2$, and ecgonine, $C_9H_{15}NO_3$, the latter having a sweetish taste, and is soluble in water, but insoluble in alcohol.

Cocaine benzoate may be obtained by combining 2 parts of benzoic acid and 5 parts of cocaine with water and crystallizing at a low temperature. A solution of the salt may be readily prepared from the acid and alkaloid in the proportion given. The salt crystallizes with difficulty in needles, and is very freely soluble in water; its solution yields with ammonia a precipitate of cocaine, and with hydrochloric acid a precipitate of benzoic acid. These reagents do not affect a solution of *benzoyl-ecgonine*, which Paul (1886) observed has been sold in the place of the benzoate; it crystallizes more readily than the latter, is less freely soluble in cold water, and is formed from cocaine by the influence of water and heat, more particularly under increased pressure.

Cocaine phenate forms a yellow viscid mass which is insoluble in water, but soluble in alcohol. It was recommended by Von Oefele as a substitute for the hydrochlorate because it is not absorbed as readily as this, and could be used with better effect on the mucous membrane where simply a local anæsthetic action is desired.

Cocaine nitrate forms large colorless crystals which are readily soluble in water. It was recommended by Lavaux to be used in combination with silver nitrate for rendering the action of the latter painless if used as a caustic.

Action and Uses.—Like many other nervines, cocaine in sufficient dose first excites and then benumbs general sensibility—an effect exhibited by the mouth and throat when the medicine has been applied in a liquid form. If water is taken immediately afterward, it produces an impression of coldness upon these parts, such as is felt after they have been touched with oil of peppermint. General numbness is not observed unless the dose is large, and does not usually follow the primary stimulation as rapidly as in the case of opium or alcohol. The action of cocaine upon the nervous system was first described by Schroff as resembling that of Indian hemp. It occasioned indistinctness or confusion of thought and of the senses, a glow throughout the body, and at first a general sense of cheerfulness and well-being, but later on giddiness, disorder of the senses, buzzing in the ears, dilatation of the pupils with impaired accommodation of the eye, paleness of the skin and conjunctivæ, headache, restlessness, a sense of walking upon air, quickened and then retarded movements of the chest and heart, eructations, occasional vomiting, and sometimes sleep. The comparatively cheerful intoxication pro-

duced by moderate doses was associated with a singular endurance of fatigue and insensibility to hunger. The effects of an internal dose of about 2 grains of the substance may last four or five hours, during which time, says Frend, the muscular power is notably increased (*Lancet*, April 4, 1885). An analysis of 16 cases of cocaine-poisoning which recovered has furnished the following conclusions: The most conspicuous symptom is collapse, in which the skin is pale, cold, and generally moist, especially upon the limbs. In the graver cases it is usually cyanotic. The pulse is always feeble and thready, becoming more so as the case advances, and generally is very frequent, running to 120–200, or else failing entirely. In exceptional cases it is slow, and may fall to 38, and the respiration to 5, as it did in one case (*Practitioner*, xli. 288). The respiration is very characteristic, being shallow, slow, and labored—a condition which is partly explained by the congested state of the lungs, which also accounts for the cutaneous cyanosis. A physician, describing his personal experience, states that he could under cocaine suspend respiration for two minutes without inconvenience (*Therap. Gaz.*, xii. 516). In extreme cases consciousness appears to be lost, but this is sometimes only apparent and due to general anæsthesia. A patient stated that he knew he was being pinched, but he felt no pain. Headache and vertigo are often felt, and occasionally throbbing of the carotid arteries. Delirium, if it occurs, is generally during the reaction, but hallucinations are not unusual. To one patient every object appeared white (*Med. News*, liv. 44). The pupils are generally dilated and insensible, the eye has sometimes a glistening look, blindness occasionally is noted, and almost always the vision is dim. Pain is seldom complained of. The limbs are often tremulous, but are rarely affected by spasm. Formication has been noted. Unless the patient is unconscious he complains of thirst, and the mouth and fauces are very dry. Vomiting is not unusual. Diuresis has several times been observed. Such symptoms as the foregoing may come on immediately after the administration of cocaine, but a case is recorded in which thirty-five minutes elapsed before their appearance (*Med. News*, xliii. 208; for additional cases of cocaine-poisoning see Mattison, *Therap. Gaz.*, xii. 16; and editorial, *ibid.*, p. 373). Mattison (*loc. cit.*) in Nov., 1887, estimated the reported deaths from cocaine at six in number. Since that date one followed the injection of 1 drachm of a 20 per cent. solution of muriate of cocaine into the urethra. The symptoms were muscular twitching, convulsions, staring eyes, dilated pupils, congested face, impeded respiration, followed by slowness and irregularity of the heart, general cyanosis, and death at the end of twenty minutes. After death the brain, lungs, and left side of the heart were filled with blood (*Med. News*, liii. 70). Another was caused by the internal use of Gm. 1.3 (gr. xx) of cocaine (*Lancet*, Feb. 1889, p. 292). During 1889 and 1890 at least 40 cases of poisoning by this preparation were published, of which 2 (*Therap. Gaz.*, xiii. 791; *Med. Record*, xxxvii. 427) were fatal: for later examples see (*Therap. Gaz.*, xv. 202; xvi. 188, 206, 288, 405, 625; xvii. 200.

The chief purpose of cocaine is to prevent or relieve pain by its anodyne or anæsthetic action. It is evident that the number of cases in which these indications may exist is almost endless. We shall enumerate the most important of them. First in point of time, and perhaps in relation to the usefulness of the medicine, are *diseases of the eye* requiring operations, including *strabismus*, *cataract*, *iridectomy*, *wounds* of the eye, etc. It certainly renders general anæsthesia superfluous in operations on the eye, and by preventing pain lessens the patient's alarm and agitation. Therefore it renders many operations easy which were formerly embarrassing to the surgeon and painful to the patient, including all involving the use of cutting instruments, the application of caustics, stimulants, astringents, etc. It does not tend to occasion vomiting, which ether and chloroform are apt to do. The use of this agent in operations for cataract has, however, been charged with certain untoward effects by several oculists, including ulceration and exfoliation, or opacity, of the cornea, tardy healing of the wound made in operating, and flaccidity, and even destructive inflammation, of the globe. These alleged effects are attributed to the constringing action of cocaine, which lowers the vitality of the tissues. But it is denied, on the other hand, that such results are attributable to cocaine when a fresh solution of it is employed, and certainly they are not more frequent than such as attend the use of general anæsthetics. Among the other operations in which this agent has been found valuable are the following: *incision of the lachrymal ducts*, *growths on the conjunctiva and cornea*, and all operations on the *interior of the eye*, including *paracentesis*, *iridectomy*, *prolapse of the iris*, *enucleation* and *evacuation of the eyeball*. In the two operations last mentioned it is necessary to inject the solution behind the globe. The operations for *staphyloma*, *pterygium*, *tenotomy*, *annoying foreign bodies*, *cautery*, and

trachoma have been greatly facilitated by its use. It has been suggested that its association with atropine, so as to obtain a maximum dilatation along with the greatest anæsthesia, is to be preferred in *iritis*, and is indicated in operating for cataract by extraction (atropine gr. $\frac{1}{500}$ and cocaine gr. $\frac{1}{200}$ in solution or in gelatin disks). If the dilating action is excessive, it can be corrected by eserine. This agent has also been used to combat the injurious effects of cocaine in *glaucoma*, as it had already been for a similar purpose when atropine was employed to dilate the pupil. But the dominant opinion is that cocaine is not adapted to the operation for glaucoma. Objection has also been made to introducing it into the anterior chamber of the eye to blunt the sensibility of the iris: it is charged with having in this way caused panophthalmitis. Cocaine is incomparably the best application for relieving *photophobia* in cases of ulcer of the cornea or conjunctiva, and for facilitating *ophthalmoscopic examinations*. An East Indian surgeon states that a 2 per cent. solution reduced greatly the size of *hypopion*. In a word, the most important indication for the use of cocaine is the spontaneous existence or the mechanical production of pain. It is thought by some that the *oleate* is superior to the muriate of cocaine, especially in ophthalmic surgery, on the ground that it is a more powerful anæsthetic, that it causes more prolonged mydriasis, and that it is less liable to be washed away by the tears (*Med. Record*, xxvii. 264).

Cocaine is of singular utility in affections of the *nasal cavity*, owing not only to its anæsthetic virtues, but also to its power of contracting or constringing the Schneiderian membrane and thereby enlarging the nostrils. In ordinary *coryza*, whether acute or chronic, this action is of marked advantage. A roll of fine and soft cambric saturated with a 5–10 per cent. solution of cocaine muriate has been introduced into the nostril, but the mechanical irritation thus produced is very objectionable. Absorbent cotton is preferable to any woven tissue for this purpose. Cocaine mixed with an inert powder and used as a snuff has also been employed, especially in *hay fever*, but it also is irritating to the inflamed membrane. An atomized solution has also been applied. Dr. DaCosta has recognized the truth that in this disease cocaine is rather a palliative than a cure, but still a very valuable remedy. He recommends that from 5 to 8 drops of a 4 per cent. solution should be injected into each nostril with a syringe while the head is thrown backward and care is taken not to irritate the nasal membrane with the instrument (*Trans. Coll. of Phys. Philadelphia*, 3d Ser. viii. 197). Some persons have advised that the solution be applied to the eyes and allowed to reach the nostrils through the lachrymal ducts. But this is an indirect and unpractical method. The constringing and anæsthetic action of the preparation facilitates all examinations within the nose, pharynx, or larynx, the removal of *polypi* and other *tumors*, the reduction of *hypertrophy* of the lining membrane, the overcoming of nasal *stenosis*, the use of *caustics*, etc. It is also valuable as a means of arresting *epistaxis*.

The application of cocaine to the *pharynx* has been of great value in facilitating the use of *instruments* employed in treating affections of this region and of the *larynx*, including the use of the *rhinoscope* and the *laryngoscope*, and also the introduction of the *stomach-tube*. In removing tumors of the larynx the previous great impediments to the operation have in a great measure been overcome by its use. It has also rendered more tolerable the difficulties of *deglutition* which occur in certain cases of pulmonary *tuberculosis*, *syphilis*, *cancer*, etc. Strong solutions are here to be preferred, such as from 4 to 6 per cent., but some German operators have used even 20 per cent. solutions. It has been claimed that a 4 per cent. solution will dissolve the false membranes of *diphtheria* (*Med. News*, xlvi. 455; *Therapeutic Gaz.*, ix. 657). A 20 per cent. solution applied to the tonsils in acute tonsillitis has relieved the pain, permitted deglutition, and hastened the cure (*Practitioner*, xli. 47). *Tonsillotomy* and *uvulotomy* are said to be painless after the enlarged organs are well painted with a 3 per cent. solution. The operation for *cleft palate* is greatly facilitated by it. In *hydrophobia* it is alleged to have enabled the patients to swallow liquids (*Therap. Gazette*, ix. 395). Before the introduction of cocaine infusions of coca were used as gargles, and also as atomized liquids, in various affections of the air-passages and throat, and particularly in the treatment of *whooping cough*; the alkaloid and its preparations have been applied to the same purposes, and with good effect, in palliating the paroxysms and preventing vomiting, but not in shortening the disease. The application of cocaine solutions has been found useful in arresting or palliating inflammatory action in the nostril, pharynx, fauces, and larynx, and their hypodermic injection around the *anus* facilitates the forcible *dilatation* of this opening and the operations that interest it. It may also be used to prevent the pain of *paracentesis* of the pleura or abdomen.

Various painful affections of the *ear* are mitigated by cocaine, such as *inflammation*, *neuralgia*, *tumors* of various sorts, etc. It greatly facilitates specular examination of the *auditory canal*, the use of instruments in this part, the catheterism of the *Eustachian tube*, and all operations upon either. Dr. Burnett (*Med. News*, xlvii. 100) enumerates as follows the limits of its usefulness: "It is not efficient when the pain is due to inflammation in the dense tissues of the external auditory canal, as in furuncles of the part, nor when acute inflammation occurs in chronically-thickened periosteal and mucous tissues in the tympanic cavity. It is, however, efficient to induce local anæsthesia, as a 4 per cent. solution, in cases of not excessive congestion of the skin of the fundus of the auditory canal, and in the membrana flaccida of the drum membrane as it is observed in acute coryza. . . . . But solutions of cocaine are not competent to produce local anæsthesia in the external auditory canal profound enough to permit painless incisions into it." Paracentesis of the membrana tympani is not painful enough to require local anæsthesia. It is, however, very difficult to anæsthetize this membrane: Kircher found that nothing short of a 20 per cent. solution would have this effect; but Zauful, confirming this statement, also mentions that in large perforations the mucous membrane can be reached and anæsthetized (*Philada. Med. Times*, xvi. 4). *Tinnitus* is palliated by cocaine, but, as this symptom usually depends on permanent conditions, palliation is of little value.

A 10 to 20 per cent. solution of hydrochlorate of cocaine is a palliative of the pain and swelling of the lining membrane of the mouth in *mercurial salivation*. It is certain that *toothache* due to exposure of the pulp in a carious tooth is greatly mitigated by filling the cavity with cotton-wool saturated with a solution of cocaine; it is also certain that rheumatic toothache and the pains of dentition are palliated by painting the painful gum with the same solution. The severe aching in the socket of a molar tooth which had just been extracted was at once relieved by filling the cavity with cocaine solution on cotton-wool. On the other hand, its claim to prevent the pain caused by excavating sensitive teeth is denied by some dental surgeons, and it has been suggested that in these cases and in the extraction of teeth the expectation of the patients must be given due weight (*Ephemeris*, i. 762). Dr. Marshall of Chicago, having failed to prevent pain by using muriate of cocaine in excavating carious teeth, employed instead the *citrate*, which had been applied to this purpose in Germany. He found it much more efficient than the muriate, although when first applied it occasioned a stinging pain. The application usually made by him was of $\frac{1}{16}$ grain (*Jour. Am. Med. Assoc.*, v. 290). Martindale and Tuttle report that a 5 per cent. solution of the *oleate* of cocaine rubbed into the gum, and the hypodermic injection of 2 or 3 minims of a 4 per cent. solution of it, enabled him to extract a tooth with little or no pain, and that a carious maxillary bone was painlessly removed after a similar procedure. In extracting teeth about eight minutes should elapse between the application and the operation (*Med. Record*, xxviii. 651). Dr. Marshall, above quoted, on the other hand, did not find the oleate as efficient as the muriate or the citrate. Undoubtedly, the only way of rendering this method efficient is by injecting the solution into the gum in two doses. Viau, Lebrun, and Andina have approved it. They injected about $\frac{2}{3}$ grain into both surfaces of the gum (*Jour. Am. Med. Assoc.*, viii. 572; *Med. Record*, xxx. 475); but toxical effects have often followed (*Lancet*, Mar. 17, 1888). They may be prevented by using a compound injection of cocaine and antipyrine, 1 : 10. In one case, which ended fatally, there was profuse hæmorrhage after the extraction of a large number of loose stumps (*Centralbl. f. Ther.*, vi. 632). In another case the effects only threatened to be serious (*Therap. Gaz.*, xii. 859). Partial or superficial *staphylorraphy* is more conveniently performed under cocaine than with ether or chloroform (*Archives gén.*, Dec. 1886, p. 752). It has succeeded also in the operation for *hare-lip* (*Med. Record*, xxxiv. 479), and in that for *hernia* (*Med. Record*, xxxi. 124). In *diseases of the skin* cocaine is a valuable palliative of *itching* and other morbid sensations, such as exist in eczema, scabies, erysipelas, herpes, etc. For this purpose it is best applied in an ointment or liniment with lanolin. *Pruritus ani*, *vaginæ*, etc. may be treated with cocaine ointments or suppositories. External *neuralgia* may be palliated by muriate of cocaine applied upon the superficial and painful points of the affected nerve, and probably better still by hypodermic injections.

In the various painful affections and operations involving the *urethra* and the *bladder* cocaine is incomparably the best anæsthetic. It renders the passage of all appropriate instruments painless, and therefore lessens the shock of operations requiring this procedure. In some cases, also, its anæsthetic and constringing action renders the urethra pervious to the urine and the use of instruments unnecessary. Hence it has greatly facilitated the treatment of urethral *strictures* by dilatation or by cutting, and operations

for removing *stone* in the bladder by crushing it. In one reported case the bladder was injected with half an ounce of a 4 per cent. solution of cocaine, and the operation was begun and completed painlessly in a quarter of an hour (*Lancet*, Jan. 17, 1885). In another case the solution was only ½ per cent. strong, and yet perfectly efficient (*Bull. de Thérap.*, cxiv. 384). Settier has employed it in various operations on the genito-urinary organs with entire success (*Lancet*, Feb. 25, 1888), but other surgeons have met with alarming effects from it, and, as we have noted above, one instance is recorded of death apparently caused by it. In the operation for hydrocele a solution of cocaine has been used before the injection of iodine or corrosive sublimate to palliate the pain caused by the latter agents. It is the most efficient agent in promoting the reduction of *phimosis* and *paraphimosis*, and in preventing pain in surgical operations for their cure. The operation of *circumcision* may be rendered painless by its use (*Med. Record*, xxx. 345). Suppositories or enemata containing it are very serviceable in cases of enlarged *prostate* causing vesical or rectal tenesmus, and also for *irritable bladder*. *Spasm* in the female as well as in the male urethra has been completely overcome by injections of this preparation; and there is no better remedy for *chordée* than it is when applied by the urethra or the rectum. In that most painfully distressing affection, *vaginism*, this preparation has repeatedly overcome a spasm that had recurred again and again for years, and has permitted the full and painless accomplishment of the generative act. In like manner it has been used in a 4 per cent. ointment, or preferably in a watery solution, to mitigate the pains of *labor*, and especially of its first stage, and in appropriate forms to relieve *dysmenorrhœa* and other uterine pains, such as depend upon endometritis, lacerated cervix, etc. It is best applied with vaseline and glycerin, forming a 10 per cent. mixture, and injected into the uterine end of the vagina; suppositories and tampons may also be used. They are most efficient during the first stage of labor (*Boston Med. and Surg. Jour.*, Feb. 1888, p. 196). It has been employed with like advantage in many operations upon the vagina and uterus, as in those for *lacerated cervix*, *vesico-vaginal fistula*, extraction of a *vesical calculus* through the vagina (*Med. News*, xlvi. 602), etc. This preparation renders all exploratory examinations of the vagina and rectum painless, as well as such operations as those for *fissure*, *ulcer*, *hæmorrhoids*, *fistula*, etc. It is even claimed that it removes the chief objections to the operation of excision of piles. A 4 per cent. solution may be painted over the swellings, and a minim of the same injected into each one at the muco-cutaneous junction. The rectal symptoms of *dysentery* may be greatly palliated by cocaine enemata or suppositories, and cocaine ointments or solutions (1 : 20) are useful palliatives of the pain of rectal *cancer*. Various small *tumors* have been removed without pain under the action of cocaine, which, as in the case of hæmorrhoids, have first been rendered insensitive by injecting a solution of it into the substance of each tumor and around its base. In a like manner *foreign bodies* lodged in the nostrils, in the ears, or in the tissues have been removed; it causes the swollen tissues to shrink as well as to become insensible. It has also been applied to removing *epithelioma* by means of the curette. In January, 1885 (*Med. News*, xlvi. 49), Drs. Randolph and Dixon found that when a saturated solution of cocaine muriate in strong nitric acid was applied to the skin, it produced an eschar such as the acid alone would occasion, but more slowly than usual, and that the process was almost entirely painless. In October of the same year they applied this method to destroying *cancerous* growths by means of a paste formed by cocaine muriate, fused potassa, and vaseline, after having previously bathed the parts with a 10 per cent. solution of the cocaine salt. Gilliam observed that a mixture of cocaine and salicylic acid rendered friable a supposed *epithelioma* of the face, and permitted the curette to be applied painlessly. Doubtless the action was in this, as in other cases, anæmiating as well as anæsthetic. In the operation for *hydrocele*, after the withdrawal of the liquid from the sac, a drachm, more or less, of a 5 per cent. solution of a cocaine salt is injected, which is allowed to bathe the interior during from five to ten minutes, after which the usual iodic solution may be employed. The pain of *burns* is greatly mitigated by a 2 per cent. solution of this preparation; *wounds* of the eye and other delicate parts may in like manner be so benumbed as to bear the necessary manipulation without difficulty; and *fractures* with displacement of the fragments belong to the same category. A strong solution of cocaine is said to neutralize the pain and inflammation of *insects' stings;* injected in the course of a nerve, it controls *neuralgia* beyond the point of injection; *sciatica* has been removed by it when other remedies failed (*Med. Record*, xxx. 544). Fenwick (*Lancet*, May 5, 1888) claims that the milder forms of *neuralgia* of the *urinary organs* may be relieved by injecting a 20 per cent. solution into the urethra; and the statement is con-

firmed by Rosenthal (*Med. News*, liii. 43). According to Dunn, it relieves *migraine* (*Therap. Gaz.*, xii. 516). In a word, it may be used whenever a local anodyne or anæsthetic is required. *Irritable tumor*, or *caruncle*, of the female *urethra* may be also rendered insensible before excision or destruction by cautery. *Abscesses* may be treated in like manner before puncture, and especially that very painful variety, *whitlow*. Even *amputations* have been performed with its aid. Dr. Mott has reported two cases of amputation of the finger treated hypodermically with cocaine, and also by means of Esmarch's bandage; and Dr. Varick, a case of amputation of the thigh, which in this manner was rendered nearly painless (*Med. Record*, xxix. 94; *Amer. Jour. of Med Sci.*, April, 1886, p. 622; for later cases see *Boston M. and S. Jour.*, Jan. 1887, p. 7; *Med. Record*, xxxi. 268, 634). The excruciating pain caused by the operation for *ingrown toe-nail* has been entirely annulled by this anæsthetic applied in a 10 per cent. solution, so as to saturate the raw portions of the part (*Med. Record*, xxvii. 627; xxviii. 257; *Med. News*, xlvii. 34). A 2 per cent. solution of cocaine injected into the urethra renders painless caustic injections and the introduction of the catheter and other instruments into the urethra and bladder. *Vaccination* may be rendered altogether painless by painting a small area of skin with a strong solution of muriate of cocaine, and after a few minutes scraping away the epidermis from the spot and reapplying the anæsthetic. *Pruritus vulvæ* and other analogous affections are greatly palliated by this agent. Profuse *epistaxis* has been arrested by a 20–30 per cent. solution applied on cotton in the nostrils (*Med. News*, lii. 16). In a case of spontaneous *hæmorrhage* from the gums, with ecchymoses elsewhere, bleeding was arrested by a 4 per cent. solution of cocaine after various stypties had failed (*Philada. Med. Times*, xv. 380).

The application of cocaine to the treatment of internal diseases has not hitherto been very extensive, because its action has appeared to be almost entirely local except when it is taken in toxical doses. But for this reason it must have appropriate uses in *cancer*, *simple ulcer*, *neuralgia*, and *hæmorrhage* of the *stomach*, and in the *vomiting* occurring in sea-sickness and in pregnancy. In *sea-sickness* it has been employed with excellent results, according to Manassein (*Med. News*, xlvii. 320). He used the following formula: Muriate of cocaine 0.15 parts, rectified spirits of wine q. s., distilled water 150 parts; of which a teaspoonful was to be taken on starting for sea, and every two or three hours subsequently until the danger of sickness ceased. It seemed to act both as a prophylactic and a remedy. These results were confirmed by Wicherkiewicz (*ibid.*, p. 626) and by Mason (*Med. Record*, xxix. 706). Otto, who employed $\frac{1}{4}$ to $\frac{1}{3}$ grain two or three times a day, was not so uniformly successful (*ibid.*, xxviii. 656); and Bissell, who seems to have fairly tested the medicine, condemned it as worthless, and even injurious (*ibid.*, p. 683). The *vomiting* of pregnancy has been arrested by this medicine administered by the mouth or the rectum, applied as an ointment to the uterus or given hypodermically. It has been found to control the vomiting of *yellow fever* (*Med. Record*, xxxii. 678) and that occasioned by an irritant poison (arsenic) (*Med. Record*, xxxi. 296). Laschkewitch found that the internal use of from one-third to one-half of a grain of cocaine three or four times daily palliated the paroxysms of *angina pectoris*, and sometimes suspended them. He observed that under its use the pulse became slower and stronger, and the urine more copious (*Med. News*, xlix. 352); also Van Noorden (*Bull. de Thérap.*, cxii. 325). Dr. DaCosta has shown the virtues of cocaine as a *heart tonic* in low forms of fever (*Phila. Med. Times*, xvii. 302). A case of *idiopathic tetanus* cured by hypodermic injections of cocaine is reported (*Boston Med. and Surg. Jour.*, July, 1887, p. 21). In *mental disorder*, which it was supposed peculiarly fitted to cure, cocaine has not been successful (*Med. News*, li. 241). Cocaine has been employed, both locally and internally, to reinforce the anæsthesia of *chloroform*, and thereby diminish the vomiting and the dangers of the latter agent by reducing the quantity of it administered (Obalinski, *Centralbl. f. Therap.*, vii. 61). It has been employed to promote a cure of the *alcohol habit*, and also of the *opium habit*, and success has been claimed for it when it was administered hypodermically as well as by the stomach. But Smidt and Rank (*Med. News*, xlvii. 454) state that when given hypodermically, even in doses of $\frac{5}{6}$ gr., it sometimes caused maniacal excitement. It would seem from the cases above cited that this effect is peculiarly liable to occur in the slaves of opium and alcohol. Accurate observers generally agree with Erlenmeyer and Obersteiner that the action of cocaine is too fugitive to be permanently useful to these persons. Moreover, the cocaine habit is not less hurtful than the morphine habit. Mosler claims to have *cured* a number of cases of *asthma* by the hypodermic use of salicylate of cocaine. As coca was originally employed to prevent or relieve excessive *fatigue*, so cocaine has been found to counteract

the exhaustion experienced by *loss of sleep* and anxiety (*Boston Med. and Surg. Jour.*, March, 1885, p. 287); but it may be doubted whether coffee or tea would not have answered equally well. It has also been known to dissipate the gloom of *hypochondria* due to mental or physical causes of a temporary sort. In chronic melancholy with delusions it is useless. If the diuretic action which Drs. DaCosta, Penrose, and Bignon observed should be confirmed to this medicine, it may be added to the several remedies for *dropsy* and other disorders depending upon debility of the *heart;* and in *uræmia*, with scanty secretion of urine, it may be worth a trial.

For the hypodermic use of cocaine a solution of from 2 to 10 per cent. should be preferred, and as a rule the equivalent of 1 grain only administered at a time; the punctures should not be made very close together, nor in an inflamed tissue, nor into a vein. The dose should be smaller in females and children and in persons with diseased heart. When a solution is applied, the part should be cleansed of any secretion or deposit it may hold. For this purpose, especially in operations upon the eye, a solution of boric acid, 1:26, has been recommended. The strength of the solutions of cocaine salts employed has varied greatly. In ophthalmic surgery a 4 per cent. solution is the most usual one, and it should be instilled at intervals of three or four minutes during a quarter of an hour. The portion of the solution used should be held in a vessel apart, to prevent contamination of the body of the liquid, and it should be applied with a dropping-tube rather than with a brush. All acid solutions are to be discarded. Some European ophthalmic surgeons have recommended 8–10 per cent. solutions, but they are generally unnecessary. To economize and concentrate the anæsthetic, small disks, either of filtering-paper or fine linen or cotton fabric, or of gelatin, have been made use of. The last have been made each to hold $\frac{1}{2\frac{1}{5}}$ grain of cocaine muriate. They are objectionable from their liability to grow mouldy. In Vienna solutions applied within the larynx have usually had a strength of from 15–20 per cent. A 4 per cent. solution in almond oil has been used to annoint urethral instruments. A vaseline 2 per cent. ointment may be applied with advantage to the eye when lachrymation is profuse. It is alleged (Corning) that by compressing the veins above the point at which the solution of cocaine is employed its local action may be intensified and prolonged. Absorbent cotton has been used as a vehicle for applying solutions of cocaine.

In poisoning by cocaine, nitrite of amyl is the best antidote, but chloroform and ether are both efficient; chloral is less so. Ether is best when given subcutaneously. Strychnine has proved a physiological antidote to chloral. Ammonia inhalation and caffeine internally have also been used.

COCCUS, *U. S., Br.*—Cochineal.

Coccionella.—Cochenille, Fr., G.; *Cochinilla*, Sp.

The female insect, Coccus cacti, *Linné.*

Class Insecta; Order Hemiptera.

Origin and Collection.—The cochineal insect is indigenous to Mexico and Central America, and has been introduced into and is cultivated in some of the West Indian Islands, the Canaries, Algiers, and Southern Spain. It feeds on different species of cactus, particularly on Opuntia cochinillifera, *Miller*, O. ficus indica, *Haworth*, O. Hernandezii, *De Candolle*, and others. The male insect is very small, has the rostrum or snout in the breast, two large wings, and the red body terminated by two long bristles. The female is nearly twice as large, is furnished with a rostrum, and has a bluish-red body, flattened below, convex above, wingless, and without terminal bristles; they attach themselves firmly to the plant, where they couple, after which they increase considerably in size and lay several thousand eggs; the insect then dies, and the body dries up, still enclosing the eggs, from which the young soon escape. During the rainy season in Mexico the insects are kept under cover upon cactus-branches, and when the weather begins to be favorable they are *sown* upon the plants, and the young ones allowed to develop until the females become fecundated and enlarged, when they are brushed off from the branches, killed by dipping them into hot water, and afterward dried in the sun or near a fire. This process yields the black cochineal, while the silver-gray is obtained by killing and drying the insects by exposure to the hot sun or in suitable ovens. Some females are left upon the plants, and in this way three harvests are made before the rainy season again sets in.

Fig. 77.

Coccus cacti: female insect, natural size; *a*, before, and *b*, *c*, after, impregnation; dry, and soaked in water.

Description.—Commercial cochineal is about 5 Mm. ($\frac{1}{5}$ inch) long, nearly hemispherical, somewhat oblong and angular in outline, convex above, flat or concave on the lower side, transversely wrinkled, readily pulverizable, yielding a dark-red powder of a faint odor and slightly bitterish taste. Immersed in water, it imparts to it a red color, and swells up so that the ringed structure of the insect can be readily examined. There are two varieties met with in commerce—the *silver-gray* and the *black*. The former is of a purplish-gray, the latter of a purplish-black, color; it differs from the former in the absence of the white wool from the furrows between the rings which imparts to the other kind the gray color. Gray cochineal, consisting of young insects, when pure, contains a larger amount of coloring-matter than the black variety. An inferior kind, called *granilla* or *grana sylvestra*, consists of the uncultivated, mostly very small, insects, but is rarely seen in commerce. The United States import annually about 1,500,000 pounds of cochineal.

Adulterations.—Adulterated cochineal is not uncommon, the black being weighted with black lead, ferro-ferric oxide, or manganese dioxide, while the weight of the silver-gray variety is increased by barium or lead salts, talcum, and similar substances. The adulteration is now effected by exposing the cochineal to steam until the insects have attained their normal size without becoming wet, adding the powder, rotating the mixture in a drum, and finally drying by heat, when the adulterant will adhere between the wrinkles. Or an inferior quality of cochineal, moistened with warm water, is superficially colored by a mixture of barium sulphate or lead carbonate and ivory-black. Such frauds are readily detected by macerating some of the insects in water, when the powder is soaked off and the insect may be examined, or the cochineal is incinerated and the adulterant determined in the ash.

Factitious cochineal is said to have been occasionally met with, and to have been made of gums, starch, and various coloring and mineral matters.

A similar product is the *kermes*, *chermes*, or *alkermes*, which consists of the fully-developed females of Coccus ilicis, *Fabricius*, indigenous to the basin of the Mediterranean and living upon Quercus coccifera, *Linné*. By moistening with vinegar and drying in the sun they acquire a brown-red color. They are of the size of a pea, nearly globular, almost smooth, yield a carmine-colored powder, and produce with tin salt, like cochineal, a fine scarlet-red.

Constituents.—Besides fat, about 6 per cent. of moisture, a small amount of volatile acid, mucilaginous and glutinous compounds, cochineal contains *carminic acid*, $C_{17}H_{18}O_{10}$, which Belhomme believes to be also met with in the blossoms of Monarda didyma. It is readily soluble in water, alkalies, and alcohol, little in ether, and insoluble in the fixed and volatile oils. Its alcoholic solution is precipitated by alkalies, but the crimson color of its aqueous solution is succeeded by a purplish-red and precipitated on the addition of alkaline earth. Most metallic salts yield colored precipitates with it; the deposit with aluminum hydroxide is called *lake*. On incineration pure cochineal leaves 0.5 (J. Loewe, 1882), 3 to 6 per cent. (Cl. Mène, 1869) of ash; the British Pharmacopœia requires the ash to weigh not much more than 3 per cent., and the U. S. Pharmacopœia not more than 5 per cent. When decoctions of cochineal containing a little alum, cream of tartar, or salt of sorrel are set aside, they will deposit *carmine*, which in commerce is often found adulterated with starch and other substances; pure carmine should be entirely soluble in ammonia-water.

Action and Uses.—It is very doubtful if cochineal possesses any medicinal virtues. It has indeed been reputed to be stimulant, antispasmodic, and diuretic, and cases are not wanting, especially of *whooping cough* and *neuralgia*, to prove its curative virtues. In Australia the medicine is alleged to have been efficacious during an epidemic of the former disease. Gm. 0.06 (a grain) was given for every year of the patient up to Gm. 0.50 (8 grains) for adults (*Times and Gaz.*, Apr. 1877, p. 418). The beautiful carmine color which it imparts to various medicinal preparations is its only substantial title to a place in the Pharmacopœia.

COCHLEARIA.—Scurvy-Grass.

Herba cochleariæ, P. G.—*Spoonwort*, E.; *Cochléaria, Herbe au scorbut*, Fr. Cod; *Löffelkraut*, G.; *Coclearia*, F. It., Sp.

Cochlearia officinalis, *Linné*.

Nat. Ord.—Cruciferæ, Allyssineæ.

Description.—A native of Northern and Central Europe, where it grows in saline

soil and is occasionally cultivated, having the radical leaves on long petioles, roundish, heart-shaped, or almost reniform, very obtuse and nearly entire; the stem-leaves ovate with few angular teeth, the lower ones petiolate, the upper ones clasping; the flowers white, in terminal racemes; the pods globular-ovate ascending, slightly flattened laterally, and containing four red-brown seeds in each cell. The fresh plant is pungent, acrid, and bitterish.

Constituents.—The plant has been analyzed by Tordeux, Braconnot, Gutret, Winkler, Geiseler, and others; it contains tannin, bitter principle, salts, and other common principles, and yields a volatile oil which does not pre-exist in the tissues, and, according to A. W. Hofmann, is butylsulphocyanide, $CSN.C_4H_9$; its ammonia compound melts at 135° C. (275° F.). An oil obtained synthetically from butylamine had the composition of oil of scurvy-grass, but a different odor, and yielded an ammonia compound fusing at 90° C. (192° F.).

Pharmaceutical Uses.—Spiritus cochleariæ, P. G. Macerate 8 parts of bruised fresh flowering scurvy-grass in 3 parts each of alcohol and water, and distil off 4 parts.

Allied Plants.—The following Cruciferæ (see also Armoracia and Sinapis) have sensible properties similar to those of the preceding plant, and have been occasionally used for similar purposes:

Cardamine pratensis, *Linné* (tribe Arabideæ); Herba nasturtii pratensis.—Cuckoo-flower, *E.*; Cresson des prés, *Fr.*; Wiesenkresse, Kukukskraut, *G.*—A perennial plant, rather scarce in North America from New Jersey northward, more common in Europe and Northern Asia. Leaves pinnate, with 7 to 13 leaflets, the terminal one being nearly reniform, and the lateral ones either short-stalked and roundish or linear and mostly entire; flowers showy, white or rose-colored; pods linear, flattish, and veinless; taste pungent and bitterish, due to a volatile oil.

Cardamine hirsuta, *Linné.*—Small bitter-cress, common in Europe and North America; resembles the preceding, but is smaller; has small white flowers and slender, ascending pods.

Card. amara, *Linné.*—Bitter-cress, indigenous to Europe, has pinnate leaves, with seven or nine roundish-ovate, stalked leaflets, showy white flowers, and purplish-blue anthers. It is less pungent and more bitter.

Barbarea vulgaris, *R. Brown.*—Wintercress, Yellow scurvy-grass, *E.*; Herbe de Sainte-Barbe, *Fr.*; Winterkresse, *G.*—This biennial herb, like the very similar Bar. præcox, *R. Brown*, is sometimes cultivated for salad, and is common in Europe and North America; it has lyrate leaves, with large round or ovate sometimes heart-shaped terminal lobes, the upper leaves obovate, toothed; flowers numerous, yellow; pods somewhat spreading.

Dentaria.—Pepper-root, Toothwort, *E.*; Dentaire, *Fr.*; Zahnwurz, *G.*—The rhizomes have a very pungent taste, and are cylindrical in D. diphylla, *Linné* (North America), and D. bulbifera, *Linné* (Europe), but composed of several tubers in D. enneaphylla, *Linné* (Europe), and in the North American species, D. maxima, *Nuttall*, D. heterophylla, *Nuttall*, and D. laciniata, *Muhlenberg.*

Nasturtium officinale, *R. Brown*, s. Sisymbrium Nasturtium, *Linné.*—Watercress, *E.*; Cresson de fontaine, *Fr. Cod.*; Brunnenkresse, *G.*; Crescione, *F. I.*; Berro, *Sp.*—This perennial herb grows near springs and brooks throughout a large portion of the northern hemisphere, has spreading, angular, hollow stems, and pinnate leaves with obliquely ovate or roundish leaflets, the terminal one being largest and rather wedge-shaped at the base; the white flowers are in racemes, and the pods are linear and on spreading pedicles. The fresh plant is somewhat pungent and bitterish, and yields a sulphuretted volatile oil, probably identical with that of mustard.

Nast. palustre, *De Candolle.*—Marsh-cress, with oblong or ovoid pods, pinnatifid toothed leaves, and small yellow flowers, has similar properties, and grows in wet places.

Anastatica hierochuntica, *Linné*, an annual plant of the Levant, where it is in high repute as a medicine, is occasionally seen as a curiosity. After the seeds are ripe the branches become woody and curl inward, forming a kind of ball, which when soaked in water unfolds like a flower; hence the popular name, *rose of Jericho.*

Sisymbrium (Erysimum, *Linné*) Alliaria, *Scopoli*, s. Alliaria officinalis, *Andrews* (tribe Sisymbryeæ).—Hedge-garlic, *E.*; Alliaire commune, *Fr.*; Knoblauchkraut, *G.*—Pless (1846) obtained from the herb and seeds a mixture of mustard and garlic oil, to which the alliaceous odor is due; they contain also a bitter principle.

Sisymbrium (Erysimum, *Linné*) officinale, *Scopoli.*—Hedge-mustard, *E.*; Erysimum, Vélar. Herbe aux chantres, Tortelle, *Fr. Cod.*; Wilder Senf, Hederich, *G.*; Erísimo, *Sp.*—A common annual herb with runcinate leaves, small yellow flowers in terminal spicate racemes, and linear appressed pods. The seeds have a sharp mustard-like taste, and yield oil of mustard; the herb is milder.

Capsella (Thlaspi, *Linné*), Bursa pastoris, *Moench* (tribe Lepidineæ).—Shepherd's purse, *E.*; Bourse à pasteur, Molette, *Fr.*; Hirtentäschlein, *G.*—A native of Europe, but extensively naturalized in most civilized countries. Root-leaves clustered, more or less deeply serrate or pinnatifid; stem-leaves arrow-shaped, sessile; flowers numerous, small, white, in terminal corymbs, which become much elongated; fruit a triangular obcordate flattened pouch, containing numerous minute brown seeds. It flowers from early in spring to autumn, and has, particularly in summer, an acrid and bitter taste. Daubrawa (1854) found in the herb, besides the ordinary constituents of herbs, 6 per cent. of soft resin, a little sulphuretted volatile oil, and 9 per cent. of

ash. The volatile oil obtained from the seeds was proven by F. Pless (1846) to be identical with oil of mustard. Mulder (1858) obtained from the seeds 28.8 per cent. of fixed oil and 26.5 per cent. of protein compounds.

Lepidium sativum, *Linné.*—Garden cress, Pepper-grass, *E.;* Cresson alénois, Cresson des jardins, *Fr.;* Gartenkresse, *G.*—This annual is indigenous to Western Asia, and is frequently cultivated for salad. The bitterish and slightly acrid herb and seeds, like those of Lep. ruderale, *Linné*, and Lep. campestre, *Linné*, contain myrosin, but, according to Pless, not myronic acid; they yield, however, a sulphuretted volatile oil which dissolves in sulphuric acid with a red color. Lep. virginicum, *Linné*, and Lep. intermedium, *Gray*, the *wild pepper-grasses* of North America, probably yield a similar volatile oil.

Lepidium Iberis, *Linné.*—Pepper-grass, *E.;* Passerage iberide, *Fr.;* Iberiskresse, Pfefferkraut, *G.*—This plant is found from Southern Europe to Siberia; has a branching stem about 2 feet high; petiolate, pinnatifid, or incisely serrate radical leaves about 5 Cm. (2 inches) long; smaller linear-lanceolate or linear entire somewhat grass-like stem-leaves, and minute white flowers in racemose cymes; the fruit is small, ovate, and acute. The plant is smooth and rather glaucous, and has a pungent taste, due to a sulphuretted volatile oil. Leroux (1837) obtained from the flowering-tops and seeds an amorphous bitter principle which he named *lepidin.*

The *broad-leaved pepperwort*, Lepidium latifolium, *Linné*, has similar properties.

Thlaspi arvense, *Linné*, and Thl. campestris, *Linné* (tribe Thlaspideæ).—Pennycress, Mithridate mustard, *E.;* Thlaspi champêtre, *Fr.;* Bauernsenf, Feldkresse, *G.*—The small, compressed, roughish, brown seeds have an acrid alliaceous taste, and yield a volatile oil which Pless found to be a mixture of the oils of garlic and mustard.

Besides the plants named above, the following more or less pungent plants are likewise known as *cress*, namely:

Wart-cress or *swine-cress*, Senebiera didyma, *Persoon;* *wall-cress* or *rock-cress*, Arabis lyrata, *Linné*, of the order Cruciferæ; and *Para cress*, Spilanthes oleracea, *Jacquin*, order Compositæ. The well-known garden plants Tropæolum majus and Tr. minus, *Linné*, order Geraniaceæ, are indigenous to Peru, and known as Indian cress or garden nasturtium, *E.;* Cresson des Indes, Capucine, *Fr.;* Kapuzinerkresse, *G.;* Mastuerzo, *Sp.;* the buds and unripe fruits are sometimes used like capers.

Action and Uses.—Common scurvy-grass is stimulant, diuretic, and antiscorbutic, in virtue chiefly of its acrid essential oil. Its bitter principle also contributes to its medicinal qualities. When chewed it excites the secretion of saliva, and when swallowed a sense of warmth in the stomach; it also tends to relax the bowels. It is everywhere eaten as a salad, generally mixed with water-cresses, and has great popular reputation as a purifier of the blood. It is justly celebrated for its efficacy in *scurvy*, and is either eaten fresh, which is preferable, or its expressed juice is administered. It has also been used with reputed advantage in *scrofula*, *chronic intermittent fever*, and *dropsy* depending upon the latter disease. Externally, the bruised herb has been applied in poultices to stimulate scrofulous and other atonic *ulcers;* and the juice, diluted with water, has been used as a mouth-wash for *spongy gums* and ulcers of the mouth.

Shepherd's purse is astringent, acrid, and aromatic. The herb and the seeds were anciently employed as stimulants to promote *menstruation*, and more recently in *dysury*, *diarrhœa*, *dysentery*, and *intermittent fever*. It is also credited with hæmostatic powers in various *hæmorrhages* (*Lancet*, June, 1889, p. 1157). It is administered in an infusion, Gm. 32 to Gm. 400 (℥j–℥xij), reduced by heat to Gm. 250, or half a pint; a wine-glassful may be given at a dose.

Iberis was known to the ancients, who employed it as a rubefacient in rheumatic and other local affections. Pliny ascribes the discovery of its virtues to a certain physician named Damocrates. Even in recent times its powdered seeds were incorporated in an ointment for purposes like those above mentioned. Internally, it is said to have acted as an irritant, producing nausea and diarrhœa, and to have been useful in *bronchitis*, *dropsy*, *gravel*, squamous *skin diseases*, and *intermittent fever*. It is one of the numerous plants popularly known as purifiers of the blood, and with this belief is eaten as a salad in the spring. *Cardamine* and *Nasturtium* have analogous virtues. The former is also reputed to be vulnerary and antiscorbutic, and some of its allied plants (e. g. *Sisymbrium*) have been applied to cancerous and other sores and given internally for laryngeal and bronchial catarrhs.

CODEINA, *U. S., Br., F. Cod.*—Codeine.

Codeinum.—Codeia, Methyl morphine, E.; *Codéine*, Fr.; *Codein, Kodein*, G.; *Codeina*, It., Sp.

Formula $C_{18}H_{21}NO_3.H_2O$. Molecular weight 316.31.

An alkaloid prepared from opium.

Origin.—Codeine is one of the constituents of opium, and was discovered by Robiquet in 1832. Grimaux (1881) succeeded in preparing it artificially by heating an alcoholic solution of morphine with soda and methyl iodide, thus showing that codeine is the methyl ether of morphine.

Preparation.—In preparing morphine by Gregory's process (see MORPHINA), after precipitating with calcium chloride, the chlorides of morphine and codeine crystallize together, and on redissolving them in water and adding ammonia, morphine alone is precipitated. The ammoniacal filtrate is concentrated, the crystallizing codeine chloride freed from ammonium chloride, then dissolved in hot water, and decomposed by potassa, when a portion of the codeine will crystallize on cooling, but the greater part separate as an oily liquid, which gradually solidifies. The mother-liquor yields a further quantity of the same alkaloid, contaminated with some morphine. The alkaloid is washed with cold water, then dissolved in ether, the ethereal solution mixed with water, and evaporated to crystallize.

Properties.—Codeine is in white or nearly translucent, rhombic prisms or octahedral crystals, somewhat efflorescent in warm air, odorless, having a slightly bitter taste and neutral reaction to litmus-paper, soluble in 80 parts of water at 15° C. (59° F.) and in 17 parts of boiling water, soluble in 3 parts alcohol and in 2 parts chloroform; also soluble in 30 parts of ether and in 10 parts of benzene, but almost insoluble in benzin. When heated to 100° C. (212° F.) codeine loses its water of crystallization, amounting to 5.67 per cent. It melts in boiling water to a transparent oily liquid, but when heated alone it fuses at 155° C. (311° F.), and on ignition is completely dissipated. "Codeine is dissolved by cold concentrated sulphuric acid (free from nitrous) without producing a color. If about 2 Cc. of this solution are poured into a small porcelain capsule, and 1 drop of highly diluted nitric acid (made by adding 1 drop of nitric acid to 100 Cc. of water) added, a bluish or blue tint will be developed. Another portion of this solution, of about 2 Cc., gently warmed, and mixed with 1 drop of a mixture of 1 volume of ferric chloride test-solution and 19 volumes of water, likewise assumes a bluish or blue tint (difference from *morphine*). On adding to 5 Cc. of an aqueous solution of codeine (1 in 100) 10 drops of bromine-water, and shaking so as to redissolve the precipitate formed, the liquid will gradually develop a light claret-red tint. This tint may be developed at once by the addition of ammonia-water. On sprinkling 0.05 Gm. of codeine upon 2 Cc. of nitric acid (spec. grav. 1.200), the crystals will turn red, but the acid, even when warmed, will acquire only a yellow color (difference from and absence of morphine)."—*U. S.* Codeine crystallizes readily from its solutions, the crystals, frequently rhombic octahedrons, being of considerable size when slowly formed. In addition to the solvents mentioned above, the alkaloid dissolves freely in amylic alcohol, methylic alcohol, and carbon disulphide, and in about 85 parts of ammonia-water, but is nearly insoluble in potassa and soda. Its aqueous solution produces precipitates in solutions of the salts of iron, copper, lead, and other metals. Codeine does not separate iodine from iodic acid, and is not colored blue by ferric chloride (difference from morphine). Its solution in absolutely pure sulphuric acid remains colorless for several days, but on heating to 150° C. (302° F.) becomes brown-green, and after cooling reddish; in the presence of traces of nitric acid or of iron the cold solution gradually changes to green and blue, and deposits a blue precipitate. *Erdmann's reagent*, used for this test, consists of 20 Gm. of pure sulphuric acid and 10 drops of a mixture made with 6 drops of nitric acid spec. grav. 1.25 and 100 Gm. of water. Codeine is dissolved by sulphuric acid containing sodium molybdate (*Fröhde's reagent*) to a liquid having at first a dirty-green color, which after a while becomes pure blue, and gradually fades within a few hours to pale yellow. For the testing of alkaloids *Fröhde's reagent* is best prepared by adding 1 Mg. of sodium molybdate to 1 Cc. of pure sulphuric acid. The yellow solution of codeine in nitric acid when heated contains *nitro-codeine*, $C_{18}H_{20}(NO_2)NO_3$. Codeine yields with chlorine-water a colorless solution, which changes to red brown on the addition of ammonia. If codeine is added to a solution of a morphine salt, precipitation of morphine occurs, and if the former alkaloid in powder be added to a solution of ammonium chloride, solution takes place and the odor of ammonia becomes perceptible.

Salt of Codeine.—Codeinum phosphoricum, *P. G.*—Codeine phosphate, *E.*; phosphate de codéine, *Fr.*; Kodeinphosphat, *G.*—This forms white, bitter needles, which are very soluble in water, and difficultly soluble in alcohol. At 100° C. (212° F.) it loses about 8 per cent. It should show the reactions both of codeine, given above, and of phosphoric acid.

Action and Uses.—Codeine is generally represented as exerting a special influence

upon the sympathetic nerve. Its action seems to vary greatly with its dose and mode of administration. Given to man in the dose of 1½ grains, it may create marked gastric disturbance, congestion of the head, dulness of the mind, and tremor; but in the dose of ⅓ grain it usually produces calm and refreshing sleep, and does not cause sweating, eruptions on the skin, nausea, vomiting, or constipation. In the case of a child affected with diabetes and albuminuria it occasioned an inert and drowsy condition (*St. Bart's Hosp. Rep.*, xv. 224). It is probable that the preparation is not of uniform strength or purity, and that it may sometimes contain morphine.

Codeine has been chiefly employed to allay *sleeplessness*, *restlessness*, *cough*, and other symptoms for which opium is generally prescribed and when the latter medicine is not tolerated. In *phthisis* it seems to appease the cough without deranging the digestion (Fischer, *Ther. Gaz.*, xiii. 40). In like manner it has been found to lessen the irritability of the stomach in *cancer* of that organ. In *diabetes* it has been recommended, especially upon the ground that it does not produce the narcotic effects of opium or morphine (*Edinb. Med. Jour.*, xvii. 461). But it is well known that in that disease narcotism is not apt to be produced by those remedies. Apparently under the use of codeine and an appropriate regimen diabetes may be greatly benefited in some instances, but in quite as many it entirely fails. Its power of diminishing the urine and its saccharine contents appears sometimes to be marked (*St. George's Hosp. Rep.*, ix. 679). Bruce (*Practitioner*, xl. 1) has shown that in diabetes morphine is "unquestionably the more powerful of the two drugs," even in one-fourth of the dose of codeine; and Fraser (*British Med. Jour.*, Jan., 1889, p. 118) concluded that in this disease codeine is nothing more than a weak or diluted morphine. Such efficacy as it possesses is exhibited in simple as well as in saccharine diabetes. It has been used as an anodyne and antispasmodic in several diseases attended with paroxysmal *pain* or disordered *muscular action*. Beurmann, who used it internally and hypodermically in *neuralgia* and *rheumatism* in doses of from ⅙ to 1 grain, saw no effects produced by it, and his statement was confirmed by Yvon (*Bull. de Thérap.*, cvi. 496, 548). Brunton found (*Practitioner*, xli. 49) that in the dose of from ½ grain to 1 grain it was distinctly anodyne, without being soporific or constipating, in various painful diseases of the *abdomen*, including *obstruction*, *organic disease*, *enteralgia*, etc. This observation has been confirmed and extended by Freund (*Therap. Monatsh.*, iii. 399), and Lowenmeyer (*ibid.* iv. 207), but it is agreed that it is inferior to morphine as an analgesic. Codeine has been employed with advantage as a substitute for opium or morphine in the treatment of the *opium habit*. The dose may be stated at about Gm. 0.03 (½ grain), to be gradually increased according to its effects. It may be given in pill, powder, mixture, or in suppositories. In a case of diabetes, above referred to, the daily dose attained to from 10 to 15 grains. The muriate and the sulphate of codeine may be given in similar doses. One-sixth of a grain has often been administered hypodermically. A phosphate of codeine has been prepared whose solubility and unirritating quality adapt it to hypodermic use. Its dose is said to be about double that of the morphine salts.

COLCHICUM, *U. S., Br., P. G.*—Colchicum.

Meadow-saffron, E.; *Colchique, Safran bâtard*, Fr.; *Herbstzeitlose, Wiesensafran*, G.; *Colchico*, It., Sp.

The corm and seeds of Colchicum autumnale, *Linné*. Bentley and Trimen, *Med. Plants*, 287.

Nat. Ord.—Liliaceæ.

Official Parts.—1. Colchici radix, *U. S.;* Colchici cormus, *Br.;* Bulbus, s. Tuber colchici.—Colchicum-root or corm, *E.;* Bulbe de colchique, *Fr.;* Zeitlosenknollen, *G.*

The corm (tuber).

2. Colchici semen, *U. S.;* Colchici semina, *Br.;* Semen colchici, *P. G.*—Colchicum-seed, *E.*; Semences de colchique, *Fr.;* Zeitlosensamen, *G.*

The seeds.

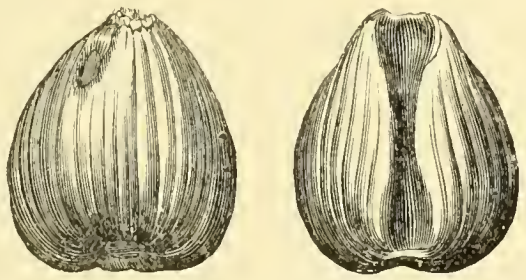
Origin.—The plant is indigenous to Europe, in the southern and central parts of which it is frequently found in pastures and meadows, flowering in September or October and ripening its seeds in June following. In the autumn the subterraneous portion consists of the fully-developed tuber (corm of many writers), bearing at its apex the scar left by the fruit-stem of the preceding summer. A tuft of root-fibres is attached to a lateral projection of the base, above which there is a shallow groove running to the apex of the tuber. In the lower part is a short conical axis with three or four rudimentary leaves,

and bearing upon the apex one or more flowers, with the lower part of their long perianth-tubes resting in the groove. The whole is surrounded by a few brown leaves, forming a sheath above. After flowering the tuber gradually diminishes in size, until by the following summer it is completely absorbed and decayed. In the mean time the upper internode of the short conical axis is gradually developed into a stem rising above ground with the capsules, and at the base is enlarged to an ovoid fleshy tuber, as yet without the lateral groove, but showing in the lower axil the bud, which by the following autumn will be developed into a short conical flowering axis, while in the mean time the lateral groove on the fruit-bearing tuber will have been formed. The development and duration of the tuber embrace, accordingly, a period of 2 years, in the first half of which the tuber produces flowers and fruit, and afterward serves for developing and nourishing its successor.

The flowers resemble those of crocus, have a whitish tube about 12.5 Cm. (5 inches) long, and a six-parted pale lilac or rose-colored border. The ovary remains underground during the winter, and is afterward formed into an obtusely-triangular, oblong-ovate, and inflated capsule, which is three-celled, bears the numerous seeds in the centre, and is surrounded by four or five linear lanceolate leaves. The tubers are collected in July and August, before the appearance of the flowers; but Schroff (1856), and afterward Maclagan, concluded from physiological experiments the proper time for the collection to be the period of flowering and immediately afterward.

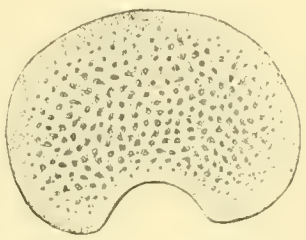
Description.—1. The Tuber. It preserves its properties best if dried entire by exposure to the sun and air, and is then of an ovoid shape, 25 to 38 Mm. (1 to 1½ inches) long, and nearly as thick at the thickest portion, convex on one side, flattened, and with a

Fig. 78.



Tuber of Colchicum.

Fig. 79.

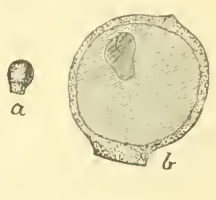


Colchicum, transverse section.

groove on the other. After the removal of the brown membranous teguments the surface is of a brownish or ash color, longitudinally wrinkled and internally white. In our commerce it is usually met with in transverse slices about 3 Mm. (⅛ inch) in thickness, somewhat reniform in shape, and notched on one side, of a white mealy appearance, and breaking with a short and mealy fracture. In the fresh state it has a radish-like odor, which is completely lost on drying. The taste is sweetish, then bitter and somewhat acrid. The tissue is formed of regular parenchyma, filled with more or less angular, mostly compound starch-granules, and of rather delicate scattered fibro-vascular bundles with spiral ducts. The Pharmacopæia of 1880 directed colchicum-tubers exhibiting a blackish color upon the recent fracture to be rejected. From the investigations of T. F. Beckert (1877), however, it appears that the amount of colchicine is scarcely influenced by the color, but decreases in old colchicum-root. In the present revision this requirement is not made.

The Oriental *hermodactyls* resemble this tuber, but have a smooth surface, and vary in color between whitish and blackish, and in taste between insipid and bitter. They have been referred to Colch. variegatum, *Linné*, which is found in Southern Europe and Asia Minor, but are probably obtained from different species indigenous to Asia. Orphanides (1875) enumerates not less than forty-three distinct species.

Fig. 80.



Colchicum-seed: *a*, natural size; *b*, section magnified.

2. The Seeds. They are about 2 Mm. ($\frac{1}{12}$ inch) in diameter, nearly spherical, slightly pointed at the hilum by a crest-like appendage, of a reddish-brown color, finely pitted, somewhat glutinous when fresh, and with a powdery surface when older. They are entirely inodorous, and have a bitter, acrid taste. The finely-punctate testa adheres closely to the whitish-thick horny albumen, which renders the seeds very difficult to powder, and encloses a very small embryo nearly opposite the hilum.

The powdering is effected by grinding them in a mill with hardened plates; or if done in a mortar they should be well dried, or else previously soaked in the menstruum to be used for exhaustion, and while still moist crushed beneath the pestle in small quantities. Rosenwasser (1877) proved that unbroken colchicum-seeds yield to solvents less than one-third the amount of colchicine contained in them; Hübler's observation, that *warm* solvents extract all the active principle from the unbroken seed, was corroborated by L. L. Morris (1881) and by Hertel.

Constituents.—The important constituent of the tuber, flowers, and seeds of colchicum is *colchicine*, which is converted by acids into *colchiceine*. Pelletier and Caventou (1820) supposed it to be veratrine, but Geiger and Hesse (1833) proved it to be distinct. Owing to a case of poisoning by wine of colchicum which occurred in Berlin in 1855, it again attracted attention, and was examined (1857) by Aschoff, Bley, John E. Carter, and others. Oberlin (1856) denied the alkaloidal nature of this body, and regarded (1857) the crystalline *colchiceine* as the poisonous principle of colchicum. The majority of investigators, including Ludwig (1862), Diehl (1867), and Hertel (1881), regarded it as a nitrogenated, non-alkaloidal bitter principle, which is readily altered by chemical reagents, though it is not a glucoside, as was asserted by Walz. But Carter's colchicine (a specimen of which is in the cabinet of the Philadelphia College of Pharmacy) is unmistakably though feebly alkaline, as we have shown in 1867; it affords also precipitates with the usual reagents for alkaloids. Similar results were obtained by Eberbach (1874), who succeeded in crystallizing it from chloroform in silky needles, and by Johanny and Zeissel (1888), who substituted the formula $C_{22}H_{25}NO_6$ for the Hübler formula, $C_{17}H_{19}NO_5$, and proved the same by the decomposition products. Rosenwasser (1877) obtained crystals from benzene, which became amorphous after exposure to the air for several months. According to Hertel, colchicine prepared in the usual manner contains fruit-sugar and other impurities, notably two resins, and also colchiceine; these principles are thus characterized: *Colchicine*, $C_{22}H_{25}NO_6$, is colorless or yellow, amorphous, soluble in water, alcohol, and chloroform, less soluble in ether, of a saffron-like odor and bitter taste, precipitated by tannin, turns moist litmus-paper slowly blue in consequence of incipient decomposition, with formation of ammonia, and its aqueous solution is colored yellow by hydrochloric acid. Colchicine is not affected by cold sodium hydroxide solution: if, however, it be boiled with it or with dilute sulphuric acid, decomposition takes place, methyl alcohol being formed and colchiceine. Colchicine is the methyl ether of colchiceine. *Colchiceine*, $C_{21}H_{23}NO_6.\frac{1}{2}H_2O$, is in white crystals, inodorous, soluble in alcohol, chloroform, and hot water, colored green by ferric chloride, and, after several days' standing, precipitated by tannin; it has a slight acid reaction, and combines with bases, the compounds being mostly insoluble in water, but soluble in alcohol and chloroform. It is easily converted into colchicine by treating a methyl-alcoholic solution of it with hydrochloric acid gas, or by digesting colchiceine with methyl iodide and sodium in methyl alcohol. By treatment with hydrochloric acid, acetic acid and *colchicinic* acid with its di- and tri- methyl homologues are formed. *Colchicoresin*, $C_{51}H_{60}N_2O_{15}$, is brown, amorphous, soluble in chloroform and alcohol, insoluble in ether, and very sparingly soluble in cold water. *Betacolchico-resin*, $C_{34}H_{39}NO_{10}$, is blackish-brown, soluble in strong alcohol and chloroform and insoluble in water and ether. The last two principles are not, or but slightly, affected by tannin, are colored brown-green by ferric chloride, and dissolve in potassa with a brown color. Colchicine and colchiceine yield with potassa a yellow solution. The four principles yield with sulphuric acid and potassium nitrate a deep-blue or purplish-blue color, and when this has disappeared concentrated potassa solution produces a more permanent brick-red color. By heating colchiceine with hydrochloric acid at 115° C. (239° F.), Zeissel (1883) obtained methyl chloride and *apocolchiceine*, which he has since shown to be the colchicic acids noted above, and the hot aqueous or dilute alcoholic solutions of which solidify on cooling to a gelatinous mass. Its salts are amorphous; its solutions in acids are intensely yellow, and are precipitated by the group-reagents for alkaloids. Ferric chloride gives a brown-green precipitate soluble with a green color in hydrochloric acid. The behavior to sulphuric acid and potassium nitrate is similar to that described above.

Colchicine is usually prepared by exhausting with alcohol, evaporating, diluting with water, filtering, precipitating coloring-matter with lead subacetate, removing excess of lead by sodium phosphate, and precipitating colchicine with tannin; the washed tannate is digested with lead oxide and dried, when alcohol dissolves the colchicine. Eberbach's process is a modification of that of Geiger and Hesse: he exhausts with alcohol containing $\frac{1}{4}$ per cent. sulphuric acid; to the tincture calcium hydroxide is added,

and to the filtrate, if necessary, sulphuric acid, to exact neutralization; the alcohol is distilled off, the residue diluted with water, filtered, the filtrate treated with ammonia, and then agitated with chloroform. Hertel's pure colchicine is made by adding magnesia to the tincture of the unbroken seeds, distilling off the alcohol, diluting the cold residue with water, separating the fat, and extracting the principle with chloroform; the yield is 0.4 per cent. Zeissel's method is as follows: Colchicum-seeds are exhausted with 90 per cent. alcohol, evaporated, mixed with water, and then extracted with chloroform. The residue left after the evaporation of the chloroform after again treating with water and chloroform, is treated with absolute ether as long as the precipitate formed is redissolved, and then subjected to a temperature of 0° C. (32° F.). The compound of chloroform and colchicine thus formed is readily freed from the former by distillation with steam.

Action and Uses.—When moderate doses of colchicum have been repeated for several days or a single large dose has been taken, some heat is felt in the epigastrium, with eructations and perhaps nausea. Under its continued action the appetite fails, the tongue becomes coated, and there is some colic, with gurgling and diarrhœa. In doses of from 1 to 4 drachms within twenty-four hours it occasions bilious vomiting, with colic and straining, heat in the anus, and bloody and mucous stools. It is said that the abdomen is not tender under pressure, and cases of colchicum-poisoning indicate that the statement is true.

Poisonous doses of colchicum, apart from the symptom just alluded to, occasion all the signs of violent gastro-intestinal irritation, a true cholera morbus, with griping, vomiting, diarrhœa, prostration, and painful spasms of the limbs and trunk, followed by resolution and collapse, in which death may occur without delirium or coma. It probably is due at last to cardiac syncope.

The chief use of colchicum is in the treatment of *gout*, for which disease it was anciently employed, and only fell into neglect through the prevalence of absurd medical theories which condemned it because their authors could not comprehend its operation. Only within the first quarter of the present century was it revived, after the discovery that the virtues of an unquestionably efficient quack remedy for the cure of gout were due to colchicum. As a general rule, it acts much more favorably upon acute than chronic gout, and upon first attacks than upon those which are frequently repeated; it does not agree with old persons as well as with the young or the middle-aged; and usually, although by no means uniformly, its favorable operation is attended with an increased secretion of bile and urine, free alvine discharges without diarrhœa, and a moist state of the skin. Its curative effects are not to be secured by allowing it to excite vomiting or purging, but are retarded and rendered incomplete by such evacuations. These evils should be avoided by commencing the administration with small doses of the drug. A repetition of the gouty attacks renders larger doses necessary, and in course of time they are apt to resist the medicine completely. Before commencing the use of colchicum in this disease it is profitable to remove the contents of the alimentary canal by means of a purgative. A draught containing sulphate of magnesia, with magnesia or its carbonate, in an aromatic water, is the most appropriate form of prescribing it.

Much has been written of the virtues of colchicum in *rheumatism*, and some reputable physicians have estimated them highly; but a close inquiry leaves no doubt that whatever good may have been achieved was due either to the violent purgative operation of the medicine or to the agents with which it was associated. The recent hypodermic use of colchicine for the same disease is mentioned only to be condemned. The local action of the alkaloid is very irritating. The same remark applies with equal force to the use of the medicine in *cholera*, *tetanus*, *neuralgia*, diseases of the *skin*, etc., but it is possible that it may exert a salutary diuretic action in *dropsy* depending upon congestion or infarction of the kidneys. Its importance in this affection compared with that of digitalis is almost null. Colchicin has been used with alleged advantage in various inflammatory *diseases of the eye* by Darier, in doses of gr. $\frac{1}{64}$ from one to six times a day (*Med. News*, liv. 350).

The *dose* of the dried cormus of colchicum may be stated at from Gm. 0.10–0.40 (gr. ii–viij), and, according to some persons, this form of the medicine is the most efficient. But the wines or the extracts are usually preferred. *Colchicin* is a powerful poison. If used at all, its dose should not exceed gr. $\frac{1}{120}$ two or three times a day.

COLLINSONIA.—Horsebalm.

Richweed, Stone-root, Knob-root, Heal-all, E.; *Guérit-tout, Baume de cheval*, Fr.; *Collinsonie*, G.

Collinsonia canadensis, *Linné.* Meehan, *Native Flowers*, ii. 165.

Nat. Ord.—Labiatæ.

Description.—A perennial herb about .9 or 1.2 M. (3 or 4 feet) high, growing in rich woodlands in North America from South Carolina northward. It has a nearly horizontal and irregularly-branched rhizome, having, together with the branches, a length and width of 7 to 15 Cm. (3 to 6 inches), and on the upper side a very knotty and tuberculated appearance from the numerous short projecting branches and the many shallow concave stem-scars; the lower surface is much less knotty, and bears many thin nearly simple rootlets or their remnants. It is externally of a grayish- or yellowish-brown color, has a very thin bark of a slight nauseous taste, and a very hard, whitish wood. The stem is quadrangular and hairy above; the leaves are opposite, petiolate, 7 to 20 Cm. (3 to 8 inches) long, thin, nearly smooth, ovate, pointed, sometimes rather heart-shaped at the base, coarsely serrate, and somewhat dotted beneath. The flowers are in loose racemes, of a greenish-yellow color, the lower lip of the corolla fringed and with two exserted stamens. The herb has when rubbed a strong and usually disagreeable odor, but occasionally it is more pleasant and anise-like. Its taste is pungent. Like other Labiatæ, it contains a volatile oil, but it has not been chemically examined.

Action and Uses.—From the fact that this plant contains an acrid volatile oil which it loses in drying, and that it has been popularly regarded as a remedy for various forms of debility or oppression, it must be held to possess stimulant virtues. Its special action appears to be upon the urinary organs, since it is esteemed most in *dropsy, gravel*, and *vesical catarrh;* and upon the skin, since it is employed as a diaphoretic in *rheumatism* and *fevers.* Doubtless, the latter object is best secured by a hot, and the former by a cold, infusion of the plant. The essential oil has been used separately, and probably contains all the curative virtues of the herb. The fresh-bruised herb has been employed for the relief of the eruption produced by *poison sumach*, as a vulnerary, and as an anodyne for *colic* and other *local pains*, especially in hot fomentations. Next to the essential oil, an infusion of the bruised fresh plant is to be preferred, which in dropsical affections may be prepared with cider.

COLLODIUM, *U. S., Br., P. G.*—Collodion.

Collodion, Fr.; *Collodium, Kollodium*, G.; *Collodio*, It.

Preparation.—Pyroxylin 30 Gm.; Ether 750 Cc.; Alcohol 250 Cc. To the pyroxylin, contained in a bottle, add the alcohol, and let it stand for fifteen minutes; then add the ether, and shake the mixture until the pyroxylin is dissolved. Cork the bottle well and set it aside until the liquid has become clear. Then decant it from any sediment which may have formed and transfer it to bottles, which should be securely corked. Keep the collodion in a cool place, remote from lights or fire.—*U. S.*

Collodion prepared from 220 grains of pyroxylin, 12 fluidounces of ether, and 4 fluidounces of alcohol will correspond to the official article.

The British Pharmacopœia directs the solution of 1 ounce of pyroxylin in a mixture of 36 fluidounces of ether and 12 fluidounces of rectified spirit. The proportions of the German Pharmacopœia are—1 part of collodion-cotton to 21 parts of ether and 3 parts of alcohol. The Pharmacopœias order the solution to be poured off from any sediment which may form, and which by the U. S. P. 1870 was ordered to be reincorporated by agitation before using the collodion.

Properties.—If the pyroxylin—or, more correctly, *colloxylin*—has been properly made, there is no difficulty in preparing collodion by simply agitating it occasionally with the liquid. It forms a neutral, nearly clear, or slightly opalescent, either colorless or slightly yellowish, liquid having a syrupy consistence and ethereal odor. On evaporation it forms a colorless, glossy, and contractile film, which is more or less white and opaque if applied with the insoluble sediment.

Pharmaceutical Uses.—Collodion and flexible collodion may be used as an excellent vehicle for the local application of medicinal substances soluble in ether, such as aconitine, atropine, tannin, ferric chloride, carbolic acid, the oleoresins of capsicum, pepper, etc., camphor, corrosive sublimate, red mercuric iodide, etc.

Action and Uses.—These are treated of under Collodium flexile.

COLLODIUM CANTHARIDATUM, *U. S., P. G.*—Cantharidal Collodion.

Collodium vesicans, Br.; *Collodium cantharidale.—Blistering collodion*, E.; *Collodion vésicant (s. cantharidé, cantharidal)*, Fr.; *Blasenziehendes Collodium, Kantharíden-Kollodium*, G.

Preparation.—Cantharides, in No. 60 powder, 60 Gm.; Flexible Collodion 85 Gm.; Chloroform, a sufficient quantity. Pack the cantharides firmly in a cylindrical percolator, and gradually pour chloroform upon them, until the cantharides are exhausted. Recover the chloroform by distillation on a water-bath, and evaporate the residue in a capsule, by means of a water-bath, until it weighs 15 grammes. Dissolve this in the flexible collodion, and let it stand at rest for forty-eight hours. Finally, pour off the clear portion from any sediment which may have been deposited and transfer it to bottles, which should be securely corked. Cantharidal collodion should be kept in a cool place, remote from lights or fire.—*U. S.*

If 4 av. ozs. of cantharides be exhausted with chloroform, the resulting tincture evaporated (as directed above) to 1 av. oz., and sufficient flexible collodion then added to make the mixture weigh 6½ av. ozs., the finished product will be about of pharmacopœial strength.

Chloroform is a better solvent for cantharidin or the cantharidin compound contained in old Spanish flies; but if such be used it would seem to be of advantage to treat the powder by Dragendorff's process (see page 398), when cantharidin will be set free, as shown by Fahnestock (1879). Powdered cantharides being much lighter than chloroform, their percolation with this menstruum presents some difficulty unless pressed down by a layer of washed sand. Owing to the volatility of the chloroform, percolation should be performed with an apparatus such as is used for the percolation of ethereal liquids (see Oleoresinæ), and the greater part of the menstruum remaining absorbed in the powder may be recovered by judicious percolation with water. If the proper precautions be observed in distilling the chloroformic tincture, the loss of chloroform will be insignificant. The present formula is similar to that of Procter (1852), in which, however, ether was used for exhausting the cantharides; the inflammability of this liquid and its vapor requires additional precautions in distilling the tincture.

The U. S. P. 1870 directed the exhaustion of the cantharides by means of ether and alcohol, a portion of the ethereal percolate being reserved, while the remaining percolate was evaporated, the residue mixed with the reserved portion, and the preparation finished by adding the requisite amount of pyroxylin, castor oil, and Canada turpentine. For reasons stated under Cantharides their exhaustion is better accomplished by acetic ether than by ether.

Collodium vesicans, *Br.*, is made from blistering liquid 20 fluidounces and pyroxylin 1 ounce.

The German Pharmacopœia directs this collodion to be made by exhausting coarsely-powdered cantharides with a sufficient quantity of ether, evaporating the tincture to a syrupy consistence and adding sufficient collodion to make the total weight of the finished product equal the weight of the cantharides used.

Properties.—Cantharidal collodion has the same physical properties as flexible collodion, except that it is of a brownish-green color, which becomes yellowish on exposure to light; it is therefore best kept in amber-colored vials. The film left on evaporation has also a greenish color.

Action and Uses.—See the following article.

COLLODIUM FLEXILE, *U. S., Br.*—Flexible Collodion.

Collodium elasticum, P. G.—*Collodium élastique*, Fr.; *Elastisches Collodium*, G.

Preparation.—Collodion 920 Gm.; Canada Turpentine 50 Gm.; Castor Oil 30 Gm.; to make 1000 Gm. Mix them and keep the mixture in a well-corked bottle in a cool place, remote from lights or fire.—*U. S.*

This is nearly identical with the formula of the British Pharmacopœia: the German Pharmacopœia directs the dissolving of 1 part of castor oil and 5 parts of turpentine in 94 parts of collodion.

Flexible collodion may also be made by weighing successively, into a tared bottle, 4 av. ozs. of collodion, 95 grains of Canada turpentine, and 57 grains of castor oil.

Properties.—This preparation has the same appearance as collodion, but on evaporation it forms an elastic and scarcely contractile film.

Allied Preparations.—*Collodium Iodatum*, N. F.—Iodized Collodion. Take of Iodine, reduced to powder, 5 parts; Flexible Collodion 95 parts; introduce the iodine into a tared bottle, add the flexible collodion, and agitate until the iodine is dissolved. (400 grains of the finished product will about equal 1 fluidounce.)

Collodium Iodoformatum, N. F.—Iodoform Collodion. Take of Iodoform, 5 parts; Flexible Collodion, 95 parts. Dissolve the iodoform in the flexible collodion by agitation. (400 grains of the finished product will about equal 1 fluidounce.)

Collodium Tiglii, N. F.—Croton Oil Collodion. Take of Croton Oil 10 parts; Flexible Collodion 90 parts; mix them. (400 grains of the finished product will about equal 1 fluidounce.)

Collodium Salicylatum Compositum, N. F.—Compound Salicylated Collodion; Corn Collodion. Take of Salicylic Acid 11 parts; Extract of Indian Hemp 2 parts; Alcohol 10 parts; Flexible Collodion, enough to make 100 parts; dissolve the extract in the alcohol, and the salicylic acid in about 50 parts of flexible collodion contained in a tared bottle. Then add the former solution to the latter, and finally add enough flexible collodion to make 100 parts. (400 grains of the finished product will about equal 1 fluidounce.)

Action and Uses.—When collodion is spread upon the skin the evaporation of its ether causes its dissolved constituents to solidify and contract. As it then becomes very adhesive, the parts to which it is applied are constringed during the process, and therefore are measurably rendered anæmic, so that congestion, inflammation, and pain in them are prevented or reduced. The film formed by collodion in drying is impermeable to air and water, and therefore protects the parts underneath it, while its transparency permits them to be seen. The adhesive, protective, and contractile powers of collodion have been variously applied. In *wounds* of the scalp it serves to attach to the shaven skin slips of parchment, between whose opposite edges sutures are inserted to draw them together. In other simple incised wounds it is applied while the edges of the wounds are kept accurately coaptated, the skin being first made perfectly dry. Collodion is often serviceable as a coating to *ulcers* which will not heal in consequence of the moisture of the locality or its liability to mechanical irritation. Of the former sort are ulcers of the neck of the *uterus;* of the latter, various ulcers of the *skin*. The application should be made first at some distance around the sore, and gradually advance to its centre, which ought to be left open for the escape of the secretions. Its protective and constringing properties are sometimes employed in the treatment of *carbuncles*. As in the case just mentioned, the application should be made widely around the swelling, while its centre should be left free. The same qualities render it available in preventing and in treating *bed-sores* and *sore nipples*. Its protective action has been employed to prevent *abrasions* and other *wounds* from becoming infected during surgical and obstetrical operations and in *dissections*. Its constringing operation enables it to control *hæmorrhage* from leech-bites and other small wounds, to diminish the inflammation produced by the *stings of insects* and the local phenomena of *erysipelas*, *burns*, and *small-pox*, in the last of which it is thought to prevent pitting. For these three purposes it is necessary to modify the action of the collodion so as to render it less rigid when hardened. A mixture of 1 part of castor oil with 15 of collodion is said to have this effect, or the officinal flexible collodion may be used. With a similar object collodion has been applied with more or less success to the treatment of a variety of limited cutaneous eruptions, such as *intertrigo*, *acne*, *eczema*, and *herpes zoster*. In the last-named affection it certainly lessens the pain. It is probable that a death in discrete small-pox following the application of collodion (*Med. Record*, xxx. 295) was due to the non-flexible preparation, and perhaps to its excessive use. In several of these disorders a preparation of collodion has been used containing vegetable and mineral astringents, as tannic acid in the officinal *styptic collodion*. Collodion may be employed to reduce the swelling of gonorrhœal *orchitis*, the skin of the swollen testicle being tensely drawn before the application is made. It has also been used with advantage in the treatment of *varicocele*. Applied halfway around the finger affected with *felon*, it relieves the pain and sometimes arrests the suppuration. In *retracted nipple* a zone of this liquid, applied so as to encircle the nipple at the distance of a quarter of an inch, will sometimes cause it to protrude. Its constringing action and its mechanical support render it efficient in preventing protrusion of the bowel in umbilical *hernia*, and even in some cases of inguinal hernia; and the same is true of its use in cases of *spina bifida*, *vascular nævi*, and *cephalæmatoma* after puncture. It may be used for a similar purpose in the treatment of *sprains* and *fractures* of the nasal or other small bones, its application being renewed as fast as the existing film becomes loose; or cotton saturated with collodion may be applied

and secured with a bandage. It has been employed with alleged success to prevent nocturnal *urination* in children, by closing the orifice of the urethra with it at bedtime; but this is a clumsy expedient. In applying the *actual cautery* its action may be limited by including the skin about to be burned within a broad and thick circle of collodion.

Various substances of a caustic nature, such as cantharides, croton oil, iodine, corrosive sublimate, iodide of zinc, chromic acid, etc., and certain astringents, such as tannin, the salts of iron and copper, etc., have been associated with collodion for local application. Cantharidal, flexible, and styptic collodions are officinal. Some of these compounds require cautious use. Iodine collodion applied to a frostbitten finger caused the loss of this member; painted over a large surface, it produced gangrene of the skin and sloughing; and applied to a swollen gland, it caused sloughing and an ulcer (*Edinb. Med. Jour.*, xxxii. 568).

Before applying collodion the skin should be perfectly dry, and, the liquid having been laid on with a soft brush, the first layer should be allowed to harden before a second is applied. For protective purposes a thin film will suffice; for constriction a thicker coating is required. In dressing wounds a piece of patent lint or of linen cambric saturated with the liquid should be laid upon the part after the edges of the wound are accurately coaptated. If a firm dressing without constriction is desired, flexible collodion is to be preferred.

Phytoxylin, 5 per cent., dissolved in equal parts of alcohol and ether, is said to be preferable to collodion through its adhesiveness, its impermeability to liquids, and its equable compression of the tissues. It is recommended as a dressing for small *wounds* of the face, the genitals, etc. (Penzoldt), and also as a means of closing perforation of the *tympanum* (Guranowski).

COLLODIUM STYPTICUM, *U. S.*—Styptic Collodion.

Collodium hæmostaticum.—Styptic colloid, Xylostyptic ether, E.; *Collodion au tannin, Col. styptique*, Fr.; *Tannin-Collodium*, G.

Preparation.—Tannic Acid 20 Gm.; Alcohol 5 Cc.; Ether 25 Cc.; Collodion, a sufficient quantity; to make 100 Cc. Introduce the tannic acid, alcohol, and ether into a graduated bottle, agitate until the tannic acid is thoroughly incorporated and partially dissolved, then add enough collodion to make up the volume to 100 Cc., and shake occasionally, until the acid is completely dissolved. Keep the product in cork-stoppered bottles, in a cool place, remote from lights and fire.—*U. S.*

Styptic collodion of pharmacopœial strength may also be prepared by using 620 grains of tannic acid, 160 minims of alcohol, 13½ fluidrachms of ether, and sufficient collodion to bring the volume up to 6¾ fluidounces.

This preparation was originally suggested by Dr. Benjamin W. Richardson (1867), who added a small quantity of tincture of benzoin. A somewhat similar but much stronger preparation is the one recommended by Pavesi, consisting of tannin 5 parts, carbolic acid 10 parts, benzoic acid 3 parts, and collodion 100 parts.

Action and Uses.—It is difficult to understand how tannic acid enclosed in an insoluble matrix (which the solution becomes directly it is applied) can operate as an astringent. Such, however, is the purpose supposed to be accomplished by this preparation, already referred to under Collodium Flexile.

COLOCYNTHIS, *U. S.*—Colocynth.

Poma colocynthidis.—Bitter apple, E.; *Coloquinthe*, Fr.; *Koloquinten*, G.; *Colloquintide*, It., Sp.

The fruit of Citrullis (Cucumis, *Linné*) Colocynthis, *Schrader*. Woodville, *Med. Bot.*, plate 175; Bentley and Trimen, *Med. Plants*, 114.

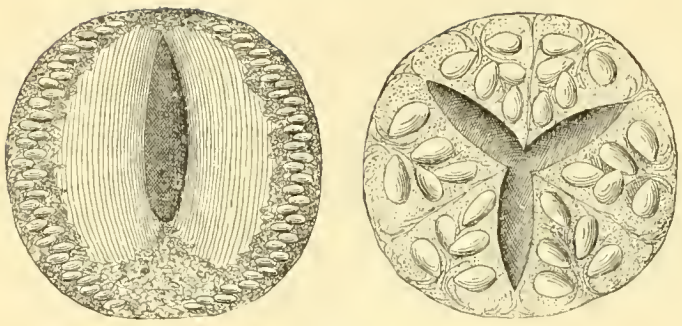
Nat. Ord.—Cucurbitaceæ.

Official Parts.—1. Colocynthis, *U. S.*; Fructus colocynthidis, *P. G.*—Colocynth, *E.*; Coloquintes, *Fr.*; Koloquinten, *G.*—The fruit deprived of its rind.

2. Colocynthidis pulpa, *Br.*—Colocynth-pulp, *E.*; Pulpe de coloquinte, *Fr.*; Koloquintenmark, *G.* The decorticated fruit freed from the seeds.

Origin.—The colocynth-plant has a perennial root, an herbaceous, angular, hispid stem, with many-lobed hairy leaves, short branching tendrils, and solitary axillary uni-

Fig. 81.



Peeled Colocynth: longitudinal and transverse section.

sexual flowers with a yellow corolla. It is said to be indigenous to Japan, and is met with abundantly from the sandy lands of Coromandel north-westward to the Caspian Sea, and westward throughout Western Asia to Greece, throughout Northern Africa, and as far south as Nubia, Senegambia, and the Cape of Good Hope. It is cultivated and naturalized in Spain.

Description.—The fruit, called *gourd* or *pepo*, resembles an orange in size and appearance, is globular, 5 to 10 Cm. (2 to 4 inches) in diameter, and covered with a smooth and thin but firm, parchment-like rind of a light brownish-yellow color. The rind is usually removed, sometimes from the fresh, but more frequently from the dried, fruit. In the former case the white or yellowish-white pulp is considerably shrunk, so as to closely envelop the seeds; in the latter case the fruit has retained its original size and shape, but shows upon the surface of the spongy pulp the smooth cuts with a sharp knife. It is destitute of odor, but has an intensely bitter taste, is very light, and divided into three easily separable cells by the parietal placentæ, which project to near the centre, are then branched, turned back toward the rind, and here curved inward again, so that by the development of each placenta three slightly-united wedges are formed, each being again divided into two parts. The naturally one-celled fruit has therefore the appearance of being six-celled, and the seeds being borne on the incurved ends of the placentæ in two, or sometimes three, rows, there are at least four rows of seeds in each wedge or twelve rows in the fruit. The seeds are flat ovate, with a rounded edge, brownish or yellowish, and contain an oily embryo with two thick cotyledons. The pulp consists of roundish, thin-walled, loosely-united parenchyma-cells, containing a little granular matter and becoming larger toward the centre; the thin fibro-vascular bundles form in the outer layer an irregular circle and are scattered in the interior. Good colocynth yields from 65 to 72 per cent. of seeds and from 28 to 35 per cent. of pulp, the latter alone being employed in medicine. The oily and slightly bitter seeds, freed from the adhering bitter pulp and from the integuments, are used as food in some parts of Africa. According to Flückiger, the dried pulp yields 11 per cent. of ash, and the seeds 2.7 per cent. of ash and 17 per cent. of fixed oil.

Colocynth reaches commerce from Syria, Egypt, Morocco, and Spain. The Syrian variety is often peeled while fresh, and when dry is of a very shrivelled and unsightly appearance, but is rarely met with in our commerce. 27,555 pounds of colocynth were imported into this country in 1867.

Some other cucurbitaceous fruits have a very bitter taste, and are reputed to be purgative, like Cucumis trigonus, *Roxburgh*, Cuc. Hardwickii, *Royle*, of the East Indies, Cuc. prophetarum, *Linné*, of Arabia, and Luffa operculata, *Cogn.*

Constituents.—Colocynth has been analyzed by Braconnot, Vauquelin, Herberger, Meissner, Bastick, and others. The medicinally unimportant constituents are pectinaceous, mucilaginous, and gummy matter, fixed oil, and salts. Walz (1858) first published a process for obtaining the bitter principle *colocynthin* in a pure state by exhausting the alcoholic extract with cold water, precipitating the filtrate with lead acetate and subacetate, removing excess of lead with hydrogen sulphide, precipitating with tannin, diffusing the precipitate in alcohol, and decomposing with plumbic hydroxide. Any lead taken up by the liquid is removed by hydrogen sulphide, the clear liquid evaporated, and the residue washed with ether. The undissolved portion is colocynthin, $C_{56}H_{84}O_{23}$ (?), an amorphous yellow mass which appears to become crystalline on the slow evaporation of its alcoholic solution. On boiling with dilute acids it splits into sugar and resinous *colocynthein*. The portion of the alcoholic extract remaining undissolved by cold water contains a tasteless crystalline principle, *colocynthitin*, which is soluble in ether, alcohol, and hot water. Hübschmann (1858) obtained nearly 3 per cent. of colocynthin by treating the alcoholic extract of colocynth with hot water, concentrating the liquid, precipitating it with excess of potassium carbonate, dissolving the dried precipitate in alcohol, adding 8 volumes of ether, decanting, agitating with animal charcoal, filtering, and evaporating. Henké (1883) prepared apparently a purer colocynthin by precipitating with

strong tannin solution and decomposing with lead carbonate; the yield was only 0.6 per cent. of the pulp. It is a pale-yellow uncrystallizable powder, soluble in 20 parts of cold and 16 parts of hot water, readily soluble in alcohol, sparingly soluble in absolute alcohol, and insoluble in ether, chloroform, benzene, benzin, and carbon disulphide.

Pharmaceutical Uses.—FRUCTUS COLOCYNTHIDIS PRÆPARATI, s. *Trochisci alhandal*, P. G., 1872. It is prepared by triturating 5 parts of colocynth-pulp and 1 part of powdered gum-arabic with sufficient water to form a paste, which is dried and reduced to a fine powder having a yellowish color.

TINCTURA COLOCYNTHIDIS, P. G. Tincture of colocynth is made by macerating for 8 days 1 part of colocynth-fruit, with the seeds, with 10 parts of alcohol sp. gr. 0.832, expressing, and filtering. It is of a yellowish color, very bitter, and becomes opalescent when mixed with water.

For medicinal purposes an *impure colocynthin* has been proposed, to be made by treating the alcoholic tincture with animal charcoal or by mixing the powdered colocynth with and packing it upon some animal charcoal, and then displacing with alcohol; on evaporating, a garnet-colored mass is obtained soluble in water and alcohol and insoluble in ether. It has been used in doses of $\frac{1}{4}$ to $\frac{1}{2}$ grain.

Action and Uses.—The experiments of Rutherford and Vignal led them to the following conclusions: 1. Colocynth is an hepatic stimulant of considerable power; it renders the bile more watery, but increases the secretion of biliary matter. 2. It is also a powerful stimulant of the intestinal glands. In man small doses of it appear to quicken intestinal peristalsis and augment the mucous and biliary secretions. The stools are generally mucous and watery, and are attended with colic. In excessive doses it operates as a violent emeto-cathartic, causing vomiting and serous or bloody stools, severe burning and colicky pains, and muscular spasms, such as are apt to occur in all severe gastro-intestinal irritation. It has been known to cause death with these symptoms or with the addition of peritonitis. Long ago Linnæus declared that the mere emanations from colocynth purged and vomited. A person powdering the dried fruit suffered for ten days with loss of appetite and a bitter taste in the mouth, but had no diarrhœa. It is related that a woman who had made a decoction of a single fruit in urine for destroying bed-bugs was poisoned by its emanations, suffering from diarrhœa and most of the above-mentioned symptoms, and, in addition, swollen face and feet, albuminous urine, and loss of flesh (Jansen, *Ther. Monatsheft.*, Jan. 1889, p. 39). Solutions of colocynth applied to the unbroken skin of the abdomen have occasioned purging, and still more readily when the cuticle was removed.

Colocynth is used as a purgative when it is intended to produce a copious secretion and rapid evacuation from the bowels, and at the same time a derivative operation upon other organs. Thus, it is employed simply as an *evacuant* when fecal or other accumulations obstruct the intestine, and in this way also it becomes a *vermifuge*. In a similar manner, partly, it is used to promote indirectly the absorption and discharge of *dropsical effusions*, these collections being absorbed in proportion as the blood-vessels lose their watery contents through the bowels. It is one of the drastic cathartics which were anciently employed to cure *melancholia*, and which for this purpose are probably undervalued at the present day. In many cases of the affection the scybalous dejections, muddy skin and eye, foul tongue, tender liver, and loaded urine are speedily modified by active purgation, and with their abatement the mental torpor is removed. In *coma*, *apoplexy*, and recent *paralysis* of congestive origin colocynth will often prove a valuable revulsive. On the other hand, its irritation of the bowel, by extending to the bladder, urethra, or uterus, sometimes serves to cure *vesical paralysis*, *chronic urethritis*, and *amenorrhœa* depending upon torpor of the uterine system. Colocynth has been used as a *diuretic* in dropsy, but the proof of its efficacy is insufficient.

Neither colocynth nor its simple extract is, at the present day, often administered alone, but usually in combination with rhubarb, aloes, scammony, and mercurials. As a laxative the *dose* may be stated at from Gm. 0.10–0.30 (2 to 5 grains), and as a drastic purgative at from Gm. 0.30–0.60 (5 to 10 grains), three or four times a day. The tincture (P. G.) is an efficient preparation. Colocynthin has been found to purge in doses of $1\frac{1}{2}$ to 6 grains, and hypodermically $\frac{1}{6}$ to $\frac{1}{3}$ gr. It is painful by the latter method, and should be associated with cocaine.

LUFFA OPERCULATA, a Brazilian plant, bears a fruit as drastic as colocynth, and used in analogous affections. For *dropsy* a fruit is boiled for a time, strained, and beaten until cold into a froth like white of egg. A tablespoonful is given until vomiting or purging

takes place. In some parts of Brazil it is much used by the common people, and sometimes with bad results (*Am. Jour. Phar.*, lvi. 623).

Cucumis myriocarpus, or cacur, is used as an emetic by the natives of South Africa, who heat the fruit, squirt its contents into their mouths, and swallow the pulp. Mr. Armstrong states that he was nauseated after taking 20 grains of the fresh pulp, and four or five hours afterward suffered some griping, and two or three hours later was purged. He administered a pepo weighing 69 grains to a large fasting dog; no sickness followed immediately, but after eight or nine hours a watery diarrhœa began which lasted twenty-four hours. Two pepoes produced very free emesis in twenty minutes, and the last vomit was tinged with blood. Considerable salivation also occurred. In the latter case there was no purging (*Edinb. Med. Jour.*, xxxii. 56). The action of this product is therefore analogous to that of coloeynth.

COLUTEA.—Bladder Senna.

Baguenaudier, *Séné indigène*, Fr.; *Falsche Senna*, G.; *Espanta-lobos*, Sp.

The leaves of Colutea arborescens, *Linné*.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—The bladder senna is a South European shrub about 3 M. (10 feet) high, with small racemes of yellow flowers and greenish inflated legumes containing many roundish blackish-brown seeds.

Description.—The leaflets are in four or five pairs, oval or elliptic, obtuse or emarginate at the apex, regular at the base, thin, smooth, and dark-green above, pale-green beneath, and clothed with appressed hairs. They have a feeble odor and a nauseous and bitter taste. They have occasionally been used for adulterating senna-leaves.

Constituents.—Bladder senna has not been analyzed.

Action and Uses.—The leaves and seeds of this plant are slightly purgative, and the latter were formerly regarded as emetic also. It has been used chiefly as a domestic purgative in some parts of Europe, in an infusion prepared with Gm. 32 to Gm. 500 (℥j to Oj), with the addition of liquorice-root and anise-seed, and taken in divided doses in the morning, fasting. The powder and the extract have also been used, but the former is not tolerated, owing to its offensive taste, and the same objection lies against the infusion. The smoke of the dried leaves is said to act powerfully as an *errhine*. It is employed in the same cases as senna.

COMPTONIA.—Sweet Fern.

Ferngale, *Meadowfern*, E.

The leaves and tops of Comptonia (Myrica, *Blume*) asplenifolia, *Aiton*, s. Myrica Comptonia, *De Candolle*.

Nat. Ord.—Myricaceæ.

Origin.—Sweet fern is a branching shrub about 0.9 M. (3 feet) high, growing in sandy or sterile places in Canada and the United States southward to Virginia, and flowering in April.

Description.—The leaves are scattered, linear-lanceolate, pinnatifid, with alternate, roundish, obtuse lobes, stipulate, resin-dotted, pubescent, thin, and 5 to 10 Cm. (2 to 4 inches) long; the two stipules are small and acuminate. They have a peculiar resinous, aromatic odor, and an aromatic and astringent taste.

Constituents.—A. K. Bowman (1869) determined the amount of tannin contained in the leaves to be 8.20 per cent. R. T. Chiles (1873) found in sweet fern a principle analogous to saponin, resin, volatile oil, gallic acid (?), fat, and other common vegetable principles.

Action and Uses.—Sweet fern is stimulant and astringent; it probably owes the former property to its essential oil, which is also the cause of its grateful fragrance, and the latter to gallic acid. A decoction of it is sometimes used to relieve *colic* and check *diarrhœa* and as a fomentation in *rheumatism*.

CONDURANGO CORTEX, *P. G., F. It.*—Condurango.

The bark of Gonolobus Cundurango, *Triana*, s. Marsdenia Cundurango, *Reichenbach*.

Nat. Ord.—Asclepiadaceæ.

Origin.—The drug which first attracted attention under the above name is known in

Peru as *cundurango blanco*, also as *mata perro*, or "dog-killer," and comes from an asclepiadaceous climber, for which Dr. Ruschenberger proposed the name Pseusmagennetus equatoriensis, and which grows in localities from 900 to 1500 M. above the level of the sea. The shrub is from 3 to 9 M. (10 to 30 feet) high, and has a smooth ash-gray bark, which is more or less mottled with greenish or blackish lichens. The bark is prepared for market by pounding the stem with a mallet to detach it, and then drying it in the sun, generally on skins, during eight or ten days.

Description.—Condurango-bark forms quills and semi-cylindrical pieces, which are about 10 Cm. (4 inches) long, 2 to 6 Mm. ($\frac{1}{12}$ to $\frac{1}{4}$ inch) thick, but are often much broken; the outer surface is brownish-gray, and somewhat wrinkled and warty; the inner surface is grayish or pale brownish-white; the transverse fracture is granular and slightly fibrous, and shows under the thin brown cork a whitish or yellowish-white amylaceous tissue, which is radially marked by wavy bast-wedges and dotted with numerous brownish or yellow stone-cells. When dry it is without odor; its taste is bitter and somewhat aromatic and acrid. A clear infusion (1 to 5) prepared with cold water becomes turbid on heating and clear again when cooled.

Constituents.—Dr. Antisell (1871) ascertained the bark to contain, besides 8 per cent. of moisture, 12 of mineral salts and 80 of vegetable matter, the latter consisting of 0.7 fat, 2.7 yellow resin, 0.5 starch, gum, and glucose, and 12.6 tannin, coloring-matters, and extractive, the remainder being cellulose; the bitter principle was not isolated. G. Vulpius (1872) found a small quantity of a bitter principle, and in 1882 a glucoside, *condurangin*, on which depends the peculiar behavior of the infusion. Kobert (1888) showed that the glucoside of Vulpius was a mixture of at least two glucosides. Carrara (1891) isolated another glucoside, which differs from condurangin especially in regard to solubility. F. A. Flückiger (1882) found in minute quantity an alkaloid possessing a strychnine-like action.

Other Condurangos.—Dr. Jos. G. Ayers, U. S. N. (1871), ascertained that there are at least ten different shrubby vines designated as condurango, said to mean *eagle-vine;* of the majority of these he was unable to collect the flowers and fruit. The origin of the following, however, has been determined:

Gonolobus tetragonus, *De Candolle*, yields *cundurango de paloma*, from Malacatos. It is of a dark-gray or brown color, and on the dry stem is slightly wrinkled longitudinally.

Echites hirsuta, *Ruiz et Pavon* (Apocynaceæ), yields *cundurango de paloma*, from Zaruma. The bark has a soft, pale-yellow, or white corky layer, which is a line or more thick.

Echites acuminata, *Ruiz et Pavon*, yields *cundurango de plátano*. The bark is thin and pale-gray on the outside.

(Most of the above facts have been taken from the valuable *Report on the Origin and Therapeutic Properties of Cundurango*, by W. S. W. Ruschenberger, M. D., U. S. N., Washington, (1873.)

Action and Uses.—Brunton states that it does not seem to have any definite physiological action, but according to Kobert (*Therapeut. Monatsheft.*, iii. 128) condurangin acts upon the central nervous system, producing in animals, according to the dose, weakness or paralysis of the limbs or violent clonic convulsions. Among the other symptoms were noted impairment or loss of appetite, salivation, and vomiting. The circulatory system seemed unaffected. In 1871–72 it was proclaimed to be a cure for *cancer*, and for a short time attracted professional notice. It, however, speedily lost its ephemeral reputation when it was proved to possess no medicinal virtues in cancer or in any other disease, except such as belonged to various aromatic bitters, allaying vomiting and improving the appetite. It was particularly credited with the cure of *cancer of the stomach*, and the observations of Riess in 1887 gave some weight to this opinion (*Centralbl. f. Ther.*, v. 238), for the medicine seems to have palliated the digestive derangements attending that disease as well as of non-malignant obstruction and dilatation of the stomach. As Oser remarked (*Lancet*, May 19, 1888), there is every reason to believe the cases of apparent cure were really instances of mistaken diagnosis; and, more recently (*Bull. de Thérap.*, cxix. 166), Guyenot showed that condurango in powder relieves gastric pain, but exerts no curative action on gastric diseases. According to him, condurangin is a poisonous agent, irritating the stomach and producing nervous disorder in animals. According to some writers, it has been useful in rheumatism and neuralgia. It may be administered in a decoction made with half an ounce of the bark in a pint of water, Gm. xvi in Gm. 500, reduced to half a pint, of which a tablespoonful is given three or four times a day. The same decoction has been used topically. Kobert states that the decoction must be inert, since boiling water coagulates the glucosides on which the virtues of condurango depend.

CONFECTIONES.—Confections.

(*Conservæ* and *Electuaria*).—*Electuaries*, E.; *Conserves*, *Électuaires*, *Saccharolés mous*, Fr.; *Conserven*, *Latwergen*, G.

These preparations are now but little employed medicinally, compared with the extensive use made of them during the past century, when many medicinal substances were preserved and exhibited in the form of soft solids sweetened by sugar or honey. A distinction was then, and in some countries is still, made between *conserves* and *electuaries*, which in the British and U. S. P. Pharmacopœias are now comprised under the title of confections.

Conserves were made by covering fresh drugs with a layer of sugar; afterward by beating fresh vegetable substances with sufficient sugar until the whole was converted into a uniform soft mass. As indicated by the name, the primary object in view was to preserve the medicinal virtues of the plants thus treated, and incidentally their administration was rendered more agreeable. Fresh plants not being at all seasons attainable, it became customary to use some in their dried condition, either in the form of powder or unpowdered, and to beat them with the requisite quantity of water and sugar. Medicinal roots not containing enough moisture were usually steeped in hot water before the sugar was added.

Electuaries differ from conserves mainly in being mixtures of powders with pulps, syrups, or honey, and are made by triturating the ingredients together in a mortar. The powders should be very fine; when extracts are to be added they are previously liquefied by trituration with a little water or other suitable menstruum, and gum-resins, if not pulverizable, are best converted into an emulsion to ensure their uniform distribution. Soluble as well as insoluble salts may be given in this form, but of the latter kind only the lighter ones should be used, since heavy insoluble salts are apt to gradually subside in the soft mixture. Of other insoluble substances, volatile oils should first be rubbed with a portion of the sugar or an absorbent powder, and fixed oils are suspended in mucilage before they are incorporated.

If intended to be kept on hand, electuaries are made of such a consistence that they are rather soft, but at the same time firm enough to prevent the separation of the ingredients. For immediate use they are made somewhat softer, so that the mixture, when taken upon a spatula, will gradually drop off; they are then in a condition to be swallowed without mastication, and if partial separation should have occurred on standing, a uniform mixture is readily obtained again by stirring.

If the main excipients of electuaries are pulps and honey, they will for a long time ensure a proper consistence and prevent the preparation from becoming hard and dry. With sugar as the principal constituent, as in the case with conserves, the gradual evaporation of water will often cause it to become hard and the sugar to crystallize; it should then be worked over, if necessary, with the addition of a little water or glycerin, but the substitution of common for refined sugar should not be resorted to.

Two confections only have been admitted in the U. S. P., and one in the P. G. Formulas for those which have been dismissed will be found under the head of the principal drug contained therein.

CONFECTIO OPII, *Br.*—Confection of Opium.

Electuarium theriaca.—*Électuaire opiacé*, *Thériaque*, Fr.; *Opiumlatwerge*, *Theriak*, G.

Preparation.—Take of Compound Powder of Opium 100 grains (or 1 part), Syrup 300 grains (or 3 parts). Mix.—*Br.* 40 grains of this confection represent 1 grain of opium. The same quantity is contained in 80 grains of confection made by the French Codex, which orders not less than sixty ingredients. The latter resembles the *Mithridatum* and *Confectio Damocratis* of the past century, which preparations contained about one-fourth of the above proportion of opium. Confection of opium has very properly been dismissed from the U. S. P. and P. G.

Action and Uses.—Introduced as a substitute for the ancient compound, theriaca, it is peculiarly useful in simple *diarrhœa* affecting persons of a debilitated and especially a gouty habit of body, and feeble digestion associated with flatulent colic, and during the exhausting heat of summer. 1 grain of opium is contained in 36 grains of the mass, Gm. 0.06 in Gm. 2.40, and therefore, as the bulk of the medicine may be objectionable where a strong anodyne impression is desired, the proportion of the narcotic may be increased extemporaneously.

CONFECTIO PIPERIS, *Br.*—Confection of Pepper.

Electuarium piperis.—Électuaire (Confection) de poivre, Fr.; *Pfefferlatwerge*, G.

Preparation.—Take of Black Pepper, in fine powder, 2 ounces; Caraway-Fruit, in fine powder, 3 ounces; Clarified Honey, 15 ounces. Rub them well together in a mortar.—*Br.*

Action and Uses.—This confection was prepared in imitation of Ward's paste, which acquired great vogue in the treatment of *hæmorrhoids* with ulceration or a discharge of mucus. A piece of the size of a nutmeg may be taken two or three times a day.

CONFECTIO ROSÆ, *U. S.*—Confection of Rose.

Confectio rosæ gallicæ, Br.; *Conserva rosarum.—Conserve de rose rouge*, Fr.; *Rosenconserve*, G.

Preparation.—Red Rose, in No. 60 powder, 80 Gm.; Sugar, in fine powder, 640 Gm.; Clarified Honey 120 Gm.; Stronger Rose-water, 160 Cc. Rub the red rose with the rose-water heated to 65° C. (150° F.), then gradually add the sugar and honey, and beat the whole together until thoroughly mixed.—*U. S.*

Confection of rose may also be prepared of pharmacopœial strength by using—of red rose, in No. 60 powder, ½ av. oz., sugar 4 av. ozs., clarified honey ¾ av. oz., and stronger rose-water 1 fl. oz.

The British Pharmacopœia directs 1 pound of fresh red-rose petals to be beaten in a stone mortar with 3 pounds of sugar.

The formula of the French Codex is similar to the first one, but omits the honey. With a good quality of powdered red-rose petals a very good confection is obtained.

Pharmaceutical Uses.—It is used as an excipient in Pilula aloes barbad., Pil. aloes et assafœtidæ, Pil. aloes et ferri, Pil. aloes et myrrhæ, Pil. aloes socotr., Pil. ferri carbonatis, Pil. hydrargyri, Pil. plumbi cum opio, *Br.*, and is occasionally serviceable for the same purpose in extemporaneous pill-masses.

CONFECTIO ROSÆ CANINÆ, *Br.*—Confection of Hips.

Confectio cynosbati, Conserva cynorrhodi, F. Cod.—*Conserve de cynorrhodon*, Fr.; *Hainbutten-Conserve*, G.

Preparation.—Take of Hips, deprived of their seeds, 1 pound; Refined Sugar 2 pounds. Beat the hips to a pulp in a stone mortar, and rub the pulp through a sieve; then add the sugar and rub them well together.—*Br.*

It is used as an excipient in Pilula quiniæ, *Br.*

Action and Uses.—Confection of rose or of hips is used only as an excipient for substances given in pilular form, and which it is desired to have promptly diffused in the stomach.

CONFECTIO SCAMMONII, *Br.*—Confection of Scammony.

Électuaire (Confection) de scammonée, Fr.; *Scammonium-Latwerge*, G.

Preparation.—Take of Scammony, in fine powder, 3 ounces; Ginger, in fine powder, 1½ ounces; Oil of Caraway 1 fluidrachm; Oil of Cloves ½ fluidrachm; Syrup 3 fluidounces; Clarified Honey 1½ ounces. Rub the powders with the syrup and the honey into a uniform mass, then add the oils and mix.—*Br.*

Action and Uses.—This confection is intended, by the stimulants and carminatives which it contains, to moderate the drastic operation of the associated scammony. The dose is from Gm. 0.60–2.00 (10 to 30 grains).

CONFECTIO SENNÆ, *U. S., Br.*—Confection of Senna.

Electuarium e senna, P. G.; *Electuarium de senna compositum, Electuarium lenitivum.—Lenitive electuary*, E.; *Electuaire de séné composé, Electuaire lénitif*, Fr.; *Senna-Latwerge*, G.; *Elettuario lenitivo*, It.

Preparation.—Senna, in No. 60 powder, 100 Gm.; Cassia Fistula, bruised, 160 Gm.; Tamarind, 100 Gm.; Prune, sliced, 70 Gm.; Fig, bruised, 120 Gm.; Sugar, in fine powder, 555 Gm.; Oil of Coriander. 5 Gm.; Water, a sufficient quantity; to make 1000 Gm. Place the cassia fistula, tamarind, prune, and fig in a close vessel with 500

Cc. of water and digest for three hours by means of a water-bath. Separate the coarser portions with the hand, and rub the pulpy mass, first through a coarse hair-sieve, and then through a fine one, or through a muslin cloth. Mix the residue with 150 Cc. of water, and, having digested the mixture for a short time, treat it as before, and add the product to the pulpy mass first obtained. Then, by means of a water-bath, dissolve the sugar in the pulpy liquid, and evaporate the whole, in a tared vessel, until it weighs 895 Gm. Lastly, add the senna and the oil of coriander, and incorporate them thoroughly with the other ingredients while they are yet warm.

To make 20 av. ozs. of confection of senna the following quantities should be used: Senna, in No. 60 powder, 2 oz.; cassia fistula, bruised, 3 oz. and 88 grains; tamarind, 2 ozs.; prune, sliced, 1 oz. and 175 grains; fig, bruised, 2 oz. and 175 grains; sugar 11 oz.; oil of coriander 46 minims; water a sufficient quantity. For the first treatment with water 10 fl. oz. may be used, and for the second treatment 3½ fl. oz. Before adding the senna and oil of coriander the pulpy mass should be evaporated to 18 av. oz.

Take of senna, in fine powder, 7 ounces; coriander-fruit, in fine powder, 3 ounces; figs 12 ounces; tamarind 9 ounces; cassia-pulp 9 ounces; prunes 6 ounces; extract of licorice 1 ounce; refined sugar 30 ounces; distilled water a sufficiency. Boil the figs and prunes gently with 24 ounces of distilled water in a covered vessel for four hours; then, having added more distilled water to make up the quantity to its original volume, mix the tamarind and cassia-pulp, digest for four hours, and rub the softened pulp of the fruits through a hair-sieve, rejecting the seeds and other hard parts. To the pulped product add the sugar and extract of licorice, and dissolve them with a gentle heat; while the mixture is still warm add to it gradually the mixed senna and coriander powders, and mix the whole thoroughly, making the weight of the resulting confection 75 ounces either by evaporation or by addition of more distilled water.—*Br.*

Mix powdered senna 1 part; simple syrup 4 parts; purified tamarind-pulp 5 parts, and warm by means of a steam-bath. It is greenish-brown.—*P. G.*

The last formula is the simplest, and yields a less pleasant but equally effectual preparation. That of the French Codex is of more complex composition.

Action and Uses.—This confection forms an eligible basis for various purgative compounds, and is itself a mild and efficient laxative in the *dose* of Gm. 8 (120 grains).

CONFECTIO SULPHURIS, *Br.*—Confection of Sulphur.

Electuarium sulphuris.—Électuaire (Opiat) de soufre, Fr.; *Schwefel-Latwerge*, G.

Preparation.—Take of Sublimed Sulphur 4 ounces; Acid Tartrate of Potassium, in powder, 1 ounce; Syrup of Orange-Peel 4 fluidounces; Tragacanth, in powder, 18 grains. Rub them well together.—*Br.*

Action and Uses.—Like confections of senna, this preparation is well adapted to procure copious semi-solid stools without actively purging or causing irritation of the rectum. These qualities adapt it for use as a laxative in hæmorrhoidal cases. The *dose* is from Gm. 4–8 (1 to 2 drachms).

CONFECTIO TEREBINTHINÆ, *Br.*—Confection of Turpentine.

Electuarium terebinthinatum.—Électuaire (Opiat) térébenthiné, Fr.; *Terpentinöl-Latwerge*, G.

Preparation.—Take of Oil of Turpentine 1 fluidounce; Liquorice-Root, in powder, 1 ounce; Clarified Honey 2 ounces. Rub the oil of turpentine with the liquorice, add the honey, and mix to a uniform consistence.—*Br.*

Action and Uses.—In this mixture the repulsive taste of the oil of turpentine is masked by the liquorice-powder more thoroughly than can be effected in an emulsion. It is used occasionally for passive *hæmorrhage*, *flatulence*, *lumbricoid worms*, *rheumatism*, etc. The dose is Gm. 4–8 (1 or 2 drachms).

CONIUM. *U. S., Br., P. G.*—Conium.

Hemlock, Poison or spotted hemlock, E.; *Grand ciguë, Ciguë officinale*, Fr.; *Schierling, Gefleckter Schierling*, G.; *Cicuta maggiore*, It.; *Cicuta mayor*, Sp.

Conium maculatum, *Linné*, s. Cicuta maculata, *Lamarck*. Bentley and Trimen, *Med. Plants*, 118.

Nat. Ord.—Umbelliferæ, Campylospermæ.

Official Parts.—1. Conii folia, *Br.;* Herba conii, *P. G.;* Herba cicutæ majoris. Hemlock-leaves, *E.;* Feuilles de grande ciguë, *Fr.;* Schierlingskraut, Schierlings-Blätter, *G.*

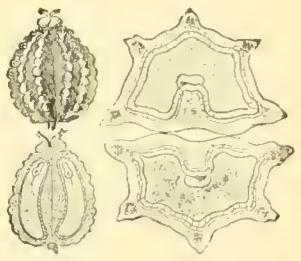
The leaves, also fresh leaves and young branches, *Br.*

2. Conium, U. S.; *Conii Fructus*, Br.—Hemlock-fruits, *E.;* Fruits de grande ciguë, *Fr.;* Schierlingsfrüchte, *G.*

The full-grown fruit, gathered while yet green.

Origin.—Spotted hemlock is indigenous to the temperate countries of Asia, Europe, and Northern Africa, and has been naturalized in some portions of New England and New York and in South America. It grows in waste places and along streams. It has a biennial, whitish, nearly simple or somewhat branched root, and a round furrowed stem, which is 1.8 to 2.4 M. (6 to 8 feet) high, hollow except at the joints, smooth, glaucous, and covered with numerous brown or brown-red spots. The numerous branches are terminated by umbels of ten or twenty rays, with the one-sided involucels of three or four ovate or lanceolate bracts united at the base, and with small white flowers.

Fig. 83.



Conium: fruit and longitudinal section, magnified 3 diameters; transverse section, magnified 8 diameters.

Description.—1. The Leaves. The lower leaves are about 30 Cm. (1 foot) long, upon long, hollow, and sheathing petioles broadly ovate or triangular in general outline, pinnately decompound, with the pinnæ oblong-lanceolate, pinnatifid, or incised, the upper ones toothed, each lobe or tooth terminating with a small whitish point. The upper leaves are smaller, almost sessile, and less decompound; all are smooth. In the fresh state they are of a dull dark-green color above, paler and somewhat glossy beneath, and acquire on drying a dull grayish-green color and a characteristic odor, which has been likened to that of the urine of mice; their taste is nauseous, saline, somewhat bitter and acrid. They are collected from plants in full bloom when the fruit begins to form; on drying they lose about 85 per cent. in weight.

The leaves of Æthusa Cynapium, *Linné* (Bentley and Trimen, *Med. Plants*, 125), Anthriscus sylvestris, *Hoffmann*, and different species of Chærophyllum, have been occasionally collected in place of conium; but the plants have only a superficial resemblance to the latter, and the leaves do not agree with all the characters given above. The first plant is known as Fool's parsley, Small hemlock, *E.;* Éthuse, Petite ciguë, Ache des chiens, *Fr.;* Hundspetersilie, Gartenschierling, *G.* It is indigenous to Europe and Northern Asia, and is somewhat naturalized in North America. The leaves resemble conium-leaves in outline and subdivision, but the secondary pinnæ are rhomboid-ovate and pinnatifid or bipinnatifid, with narrow lanceolate acute segments; they are dark-green above, somewhat paler and glossy beneath, and when bruised have a disagreeable somewhat leek-like odor. The other plants mentioned have pubescent or ciliate leaflets.

2. The Fruit. The fruit is about 3 Mm. (⅛ inch) long, broadly ovate, somewhat compressed at the sides, crowned with the short stylopodium, and readily separating into the two mericarps, each one marked on the back with five wavy crenate ribs, which become nearly smooth in the ripe fruit. The furrows are faintly wrinkled longitudinally, and, like the face, destitute of oil-tubes. The integuments of the fruit are convex upon the face and penetrate into the albumen, which upon a transverse section shows a roundish heart-shaped or reniform outline. The fruit has a green or gray-green color, or is grayish if collected as directed by the British Pharmacopœia. It is nearly inodorous and has but a slight taste: when triturated with an alkali, it evolves the disagreeable odor of the leaves. Conium-fruit has been occasionally observed as an adulteration of anise, to which, when ripe, it bears some resemblance.

Constituents.—The most important constituent of both drugs is the volatile alkaloid coniine, or *conine*, which, according to A. W. Hofmann (1881), has the formula $C_8H_{17}N$. Giseke (1827) obtained it as an impure sulphate; Geiger (1831) prepared it pure. It is contained in the distillate, prepared with an alkali from the drug or its extract, and freed from ammonia by converting it into sulphate and exhausting this with a mixture of strong alcohol and ether, which leaves ammonium sulphate undissolved; coniine may then be liberated by treatment with an alkali and distillation, but, though colorless, is accompanied by *conhydrine* or *conydrine*, and often by methylconiine, the former of which is left in the retort on the careful distillation of the colorless crude coniine. *Conhydrine* forms pearly iridescent laminæ which fuse at 120.6° C. (249° F.), sublime above 150° C. (302° F.), boil at 226° C. (438.8° F.), and have a slight odor of coniine. It was discovered by

Wertheim (1856). Examined by A. W. Hoffmann (1882), it was found to have the composition, $C_8H_{17}NO$, assigned to it by Wertheim; but on treatment with phosphoric anhydride or strong hydrochloric acid it yields an oily distillate of a coniine-like odor, containing several bodies not identical with this base. *Coniine* is a colorless, inflammable, oily liquid, specific gravity 0.88 to 0.89, has a strong alkaline reaction, a penetrating suffocating odor, and when pure the boiling-point is 168° to 169° C. (334.4 to 336.2° F.). It is soluble in all proportions in alcohol, ether, chloroform, benzene, benzin, and fixed oils, is less freely soluble in carbon disulphide, and requires 100 parts of cold water for solution, this solution becoming turbid on warming. Like ammonia, it forms dense white fumes with volatile acids, precipitates most metallic salts, some of the precipitates, like silver, being soluble in excess, and it neutralizes acids, forming salts which are freely soluble in water and alcohol, are usually deliquescent, and occasionally unerystallizable, and are not precipitated by platinic chloride. Its hydrochlorate and hydrobromate are, according to A. W. Hoffmann (1881), easily obtained by dissolving coniine in anhydrous ether and passing into the solution dry hydrochloric or hydrobromic acid gas. The salts, being insoluble in ether, are precipitated in a white crystalline form; both are very soluble in water and alcohol, are not deliquescent, and may be dried at 100° C. (212° F.) without decomposition. Coniine is dextro-rotatory, while *paraconiine*, $C_8H_{15}N$, so called from the supposed identity of its formula with that of coniine, is optically indifferent. This alkaloid was artificially prepared by Ladenburg (1889), it being shown by Hoffmann to be *a*-propylpiperidine.

Conium-fruit contains, besides the usual principles, also a fixed oil, a minute portion of non-poisonous volatile oil having the odor of eumin, and probably malic acid in combination with the alkaloids. The herb contains acetates and malates, and a non-poisonous volatile oil of a disagreeable odor, and yields about 12 per cent. of ash. The amount of alkaloid in the herb is minute, but appears to vary; the mature but still green fruit contains about 0.8 per cent. or less of *coniine;* conhydrine is always present in very minute proportion.

The herb of fool's parsley was stated by Ficinus to contain a crystallizable poisonous alkaloid, *cynapine*, said to be soluble in water and alcohol, but insoluble in ether. But Walz (1859) and Bernhardt (1880) obtained from the fruit a volatile oily base resembling coniine.

Action and Uses.—There is no apparent relation between the physiologieal and the toxical effects of conium on the one hand and its medicinal operation on the other, and in this it resembles a very large number of medicines. It occasions no mental disorder nor drowsiness, the mind remaining calm but active. Dr. John Harley, who studied this subject with peculiar thoroughness, states the following as the effects of a full dose of conium-juice given to palliate chronic muscular spasm: "The whole muscular system is completely relaxed. The orbicularis is incapable of resistance. The movements of the eyeball are very sluggish, and there is more or less complete ptosis. The muscles of mastication and deglutition are nearly paralyzed. Speech is slow and effected with exertion; the voice is gruff, from relaxation of the laryngeal muscles. Withal, the heart and breathing are normal, sensation and intelligence are perfect, and the mind is calm." Even in fatal cases the pulse and respiration may be natural until the approach of death, which often is preceded by convulsions. The face is apt to be pale, and the hands and feet are cold and either pale or bluish. In the case of an infant, aged eight months, 5 grains of extract of conium, 5 grains of potassium bromide, and a teaspoonful of chloroform-water were given in one dose. The lower limbs were paralyzed, the pupils dilated, the face livid, and the breathing diaphragmatic. Death occurred in seven hours (*Lancet*, July 25, 1885). Doubtless the associated medicines modified the operation of the conium, but increased, rather than lessened, its action. The case is related by Schulze of a student who was poisoned by smelling at an open bottle of conium (*Therap. Gaz.*, xi. 572). In this case the headache and the diaphoresis were very great. After death from conium-poisoning no lesions are uniformly found.

Conium has had a wide reputation for its virtues in the treatment of *cancer*, and there is no doubt that it has removed tumors supposed to be cancerous, both when used as a dressing and when given internally. That when applied locally it mitigates the pain and improves the condition of sores regarded as open cancer is certain. It is therefore a medicine not to be lightly neglected in cases of this kind. In *scrofulous* glandular sores similar good effects are sometimes observed. Enlargement and induration of the *liver* by simple engorgement or by a degree of hyperplasia, with the attendant symptoms, jaundice and ascites, appear to have been cured by a prolonged use of the medicine.

During a like use of it the *mammary gland* has been known to become atrophied and its secretion to have been gradually suspended. Conium plasters were formerly used to *dry up the milk*. Dolan has praised it for chronic inflammation of the womb and as an "excellent sedative for backache and for the sexual organs." *Cutaneous affections*, especially those of a strumous nature, appear to be favorably modified by this medicine. The reputed benefits of conium in *melancholy* seem to be attributable rather to the associated treatment, except where the mental disorder depended upon one of the visceral infarctions above alluded to. In *mania* its sedative operation has been used to control violence, and in *erotic insanity* it appears to lessen the evidences of sexual excitement. For the latter purpose it was anciently employed. A plaster containing equal proportions of conium and belladonna extracts is an efficient palliative of intercostal *neuralgia* and of *palpitation of the heart*. An ointment made by mixing the inspissated juice of conium with lanolin is related by Whitla (*Practitioner*, xl. 250) to have palliated pain and itching in various affections of the *anus*. In many *neuralgic* affections conium is reputed to be efficacious, but it is probably in those only in which the paroxysm is due to congestion or other pressure upon nervous trunks. The same may be said of its use in *ophthalmia* with *photophobia*, in *toothache*, *whooping cough*, *asthma*, *spasmodic laryngitis*, *laryngismus stridulus*, and *epilepsy* due to congested conditions of the motor centres. Wolfenden has proposed hydrobromate of coniine in *epilepsy*. He administered it in doses of from Gm. 0.06–0.12 (gr. j–ij) a day to children. It tends to cause giddiness and congestion of the eyes (*Practitioner*, xxxii. 431). Its efficiency in some aggravated cases of *chorea* is still more striking. In this and other spasmodic affections the full development of its physiological operation is essential to the cure. It would seem to be indicated in *puerperal* and *infantile convulsions* and *tetanus*. In the last-named disease it is said to have effected a cure in four out of six cases (Chew, *Med. Record*, xix. 38), and a case of traumatic and one of idiopathic *tetanus* had a similar issue under the care of Demme (*Centralb. f. Ther.*, v. 218; vi. 180). Conium has been used to advantage as an adjuvant to quinine in *malarial* diseases (Newton, *Med. Record*, xxv. 63). Dr. Harley has called attention to the utility of conium-juice in *trismus*, in *spasm of the orbicularis* and of the *gullet*, in *dislocations of the joints* where the action of powerful muscles resists the efforts made to reduce them, and in cases of the *impaction of artificial teeth* in the œsophagus. He dwells upon the important circumstance that patients under its influence are not prevented from assisting the surgeon by their efforts and guiding him by their sensations.

Conium and its preparations are contraindicated in cases of great exhaustion and debility. Diseases interfering with the rhythm of the heart suggest a cautious use of the medicine.

The proper antidotes to conium-poisoning are evacuation of the stomach and the use of alcoholic stimulants, with external warmth.

Supposing the preparation to be good—which it seldom is—the extract of conium may be given in doses of Gm. 0.06 (gr. j), repeated at intervals of an hour or more until its physiological operation begins to appear. The commencing dose of coniine is stated by different physicians at Gm. 0.001 (gr. $\frac{1}{60}$), or even less, and the hypodermic dose of bromohydrate of coniine, Gm. 0.01 (gr. $\frac{1}{6}$). According to Tuloup, Audhouin, and others, no smaller amount than Gm. 0.10 (gr. ij) of the salt in twenty-four hours will have much effect, and this quantity should be used in two doses, and pretty rapidly increased until 5 or 6 grains a day are given. For hypodermic use may be employed a solution of 1 Gm. of bromohydrate of coniine in 18 Gm. of distilled water. Each Gm. will contain about 5 Cgm. of the salt, of which one-eighth may be used for a first injection, but subsequently the quantity may be rapidly increased to 1 Gm., or even 2 or 3 Gm. "The initial dose for hypodermic injections does not differ much from what is necessary by the stomach." By the latter way it is said that if the doses are gradually increased, 5 or even 6 grains of the salt may be given in the course of twenty-four hours without injury (Tuloup, *Annuaire de Thérap.*, 1880, p. 15).

ÆTHUSA CYNAPIUM, *fool's parsley*, has generally been alleged to be poisonous, like conium or aconite (Taylor's *Med. Jurisp.*, 1865, p. 351), and Harley collected a number of cases and statements which were supposed to prove its poisonous action; but an extended series of experiments led him to conclude that the plant is not in any degree poisonous (*St. Thomas's Hosp. Rep.*, N. S. iv. 63; x. 257). In 1882 this conclusion was fully confirmed by Tanret, who believes the erroneous statements referred to arose from confounding Æthusa cynapium with Conium maculatum, which it closely resembles in appearance (*Bull. de Thérap.*, ciii. 22).

CONTRAYERVA.—Contrayerva.

Contrayerve, Br.; *Bezoarwurzel, Giftwurzel*, G.; *Contrayerba*, Sp.

The root of Dorstenia Contrayerva, *Linné*, and D. brasiliensis, *Lamarck*.

Nat. Ord.—Urticaceæ, Artocarpeæ.

Origin.—The first species is indigenous to the West Indies, Central America, and southward to Peru; the second, to Brazil and other parts of South America. Both are acaulescent perennials, with a fleshy quadrangular or circular inflorescence, in which the minute nutlets are imbedded.

Description.—The root has one or two short annulate heads, is fusiform, about 12 Mm. ($\frac{1}{2}$ inch) thick, 50 or 75 Mm. (2 or 3 inches) long, and below divided into fine fibres; that of the second species is globular-ovate, about $\frac{3}{4}$ inch long, annulate, and beset with fine fibres. The color is reddish-brown, internally whitish. The bark is thick, with the inner portion of a punctate appearance, and encloses a brownish-yellow wood which is radiately marked by the medullary rays. The root has a rather unpleasant odor and a bitter and acrid taste.

Dorstenia dracena, *Linné*, D. opifera, *Martius*, D. tubicina, *Ruiz et Pavon*, and perhaps other species, yield similar roots.

Constituents.—Geiger obtained from the root some volatile oil, resin, starch, and an amorphous bitter principle.

Action and Uses.—Contrayerva (meaning "antidotal plant") appears to be a stimulant bitter tonic; in its native country it is used in *low fevers*, very much as serpentaria is elsewhere, and also as a remedy, both internal and local, for the *bites of serpents*. The dose of the powdered root is stated to be Gm. 2 ($\frac{1}{2}$ drachm).

CONVALLARIA, *U. S.*—Convallaria.

Lilium convallium.—Lily of the Valley, E.; *Muguet*, Fr.; *Maiblumen*, G.; *Mughetto*, It.; *Liris de los valles*, Sp.

The rhizome and rootlets of Convallaria majalis, *Linné*.

Nat. Ord.—Liliaceæ, Asparagineæ.

Origin.—This stemless perennial is indigenous to Europe, Northern Asia, and to the Alleghany Mountains of the United States from Virginia southward. It is frequently cultivated in gardens, and has spontaneously appeared in several places. It has a creeping, whitish, much-branching rhizome of the thickness of a quill, two, or occasionally three, elliptic and smooth radical leaves, and a one-sided raceme of about ten nodding white flowers, which are about 6 Mm. ($\frac{1}{4}$ inch) long, bell-shaped, six-lobed, with the lobes recurved, have six stamens inserted near the base of the perianth, and produce globular, few-seeded red berries. The cultivated flowers are somewhat larger. They are very fragrant and have a bitter and acrid taste. The flowers lose on drying about 85 per cent. of their weight.

Description.—The rhizome is of horizontal growth, cylindrical, about 3 Mm. ($\frac{1}{8}$ inch) thick, and somewhat branched; externally it is whitish and wrinkled. The internodes are from 2 to 6 Cm. ($\frac{4}{5}$ to $2\frac{1}{2}$ inches) long, and are marked with a few circular scars; the joints are annulate, and are beset with a circlet of eight or ten rootlets, which are long, branched, and about 1 Mm. ($\frac{1}{25}$ inch) in thickness. The fibrous fracture shows a white interior. The rhizome contains a small number of fibro-vascular bundles enclosed in a thick-walled nucleus sheath, and imbedded in thin-walled parenchyme. Convallaria has a peculiar pleasant odor and a sweetish, bitter, and somewhat acrid taste.

Constituents.—The odorous principle of the flowers was obtained by Herberger (1835) in the form of volatile crystals possessing a strong odor, occasioning headache, but very fragrant when largely diluted. The bitter principle of the plant is the glucoside *convallamarin*, $C_{23}H_{44}O_{12}$, which was isolated by Walz (1858) as a white somewhat crystalline powder, has a bitter-sweet taste, is soluble in water, alcohol, and methylic alcohol, and insoluble in ether, chloroform, and amylic alcohol (Sée); but the last two solvents, according to Dragendorff (1871), take it up from the acidulated solution. It dissolves in sulphuric acid with a brown color, and, after previous moistening with water, with a violet color, the solution becoming colorless by more water. Its aqueous solution is precipitated by tannin, but not by lead salts, and when boiled with dilute acids it yields sugar and *convallamaretin*. Sée (1882) obtained the best results with the plant collected in August; on precipitating the alcoholic tincture with basic lead acetate, evaporating, diluting with water, neutralizing with sodium carbonate, precipitating with tannin, dissolving the pre-

cipitate in 60 per cent. alcohol, and decomposing with zinc oxide, 0.6 per cent. of convallamarin was obtained. He also isolated the acrid principle *convallarin*, $C_{34}H_{62}O_{11}$, in the form of rectangular prisms, which are soluble in alcohol, insoluble in ether, and sparingly soluble in water, but foaming with it like saponin. On being boiled with dilute acids it is split into sugar and *convallaretin*.

Pharmaceutical Preparation.—Extractum convallariæ. The most efficacious extract is prepared with water from the flowers and scapes, mixed with one-third of their weight of roots and leaves, collected in August (Sée).

Allied Plants.—Polygonatum multiflorum, *Allioni* (Convallaria multiflora, *Linné*), and Pol. officinale, *Allioni* (Conv. Polygonatum, *Linné*).—Solomon's seal, *E.;* Sceau de Salomon, Genouillet, *Fr.;* Weisswurzel, Salomon's Siegel, *G.*—The plants are indigenous to Europe and Northern Asia, and have simple stems with alternate sessile leaves, the axils of which contain one to five cylindrical flowers. The rhizome is horizontal, brownish-yellow, about 6 inches long, nearly cylindrical, jointed, and bears on the upper side of each joint a circular concave stem-scar; internally it is whitish, rather spongy, and has a zone of many scattered wood-bundles near the centre. Walz found in the rhizome and herb convallarin, asparagin, mucilage, sugar, starch, pectin, etc.

Polygonatum giganteum, *Dietrich* (Conv. canaliculata, *Willdenow*), and Pol. biflorum, *Elliott* (Conv. biflora, *Walter*), which are North American species, have rhizomes agreeing with the description just given, and are collected here as Solomon's seal.

Smilacina racemosa, *Desfontaines*, likewise indigenous to North America, has a similar rhizome, but with shorter and thicker joints, and is known as *false Solomon's seal*.

Action and Uses.—Convallaria acts upon the heart in nearly the same manner as digitalis, and upon the digestive canal as an emetic or a purgative. The dried flowers of convallaria have been used in powder as a *sternutatory* and errhine, and in fomentations for the removal of *bruises*, *ecchymoses*, and *freckles*, and they, as well as the root, for the cure of *worms*, *intermittent fever*, and *epilepsy*. In Russia several species of convallaria are used as local anodynes, and in that country it was first employed in the removal of *dropsy*. The thorough and systematic observations of competent physicians have demonstrated that convallaria as a remedy for dropsy is indicated in the same cases for which digitalis is commonly employed—cases of dropsical effusion depending upon a positive or a relative inability of the heart to carry on the circulation of the blood through its own cavities, and which are clinically denoted by its palpitation and arhythmical movements, and by signs of obstruction in other organs, such as dyspnœa, hepatic distension, gastric disorder, a diminished secretion of urine, with an excess of solids, œdema of the feet, etc. The diuretic action of this medicine, affirmed by some and denied by others, can hardly be considered as established. Stiller admits only its occasional, and as it were accidental, occurrence (*Times and Gazette*, Jan. 1883, p. 14); Leyden and Pel both deny it (*Centralbl. f. Therap.*, i. 68, 189), Moutard-Martin could not discern it (*Bull. et Mém. Soc. Thér.*, 1882, p. 148); Beverley Robinson did not find convallaria a renal stimulant (*Boston Med. and Surg. Jour.*, Apr. 1883, p. 374); and Dujardin-Beaumetz declared that it failed oftener than it succeeded.

It is remarked by Sée that convallaria is not liable to the objections that exist against digitalis, of having an acrid taste, impairing the appetite, and occasioning nausea or vomiting. Nor does it appear to have caused any of those alarming, and even fatal, results which are chargeable to foxglove. On the contrary, it seems to improve the appetite and digestion and render the stools soluble. The *irregularity of the heart*, which it seems peculiarly fitted to correct, arises from mechanical impediments to the circulation, and especially from mitral lesions, more than from tissue-degradation. In these cases it calms the hurry of the heart and renders its movements rhythmical, and sometimes, although less uniformly, reduces the pulse-rate, unless its acceleration has arisen as compensatory for an insufficient supply of blood. In that case the pulse falls to, or even below, its normal standard. In aortic stenosis or insufficiency convallaria, like digitalis, is of less advantage than in mitral disease. The conclusions of Dr. Pel of Amsterdam may here be quoted, viz.: "As a heart tonic (and diuretic) the medicine seems to be inoperative in failure of the left ventricle as it occurs in chronic renal disease; on the other hand, it displays in special cases of organic heart lesion, as mitral insufficiency with imperfect compensatory changes, a power of stimulating the heart and also of causing diuresis. Nevertheless, digitalis has a more distinct and durable action, and convallaria is not able to rival it." Germain Sée places convallaria and digitalis on nearly the same level, but assigns a superiority to the former, in that it does not suspend the action of the heart like the latter (*Bull. de Thérap.*, cv. 489). It may conveniently be employed when in the course of treatment by digitalis that medicine has

to be suspended. Gottheil (*Med. Record*, xxiv. 226) used this medicine with, to him, inconclusive results, but it does not appear whether in his cases valvular disease existed or not. It is alleged that even when palpitation is due to other than organic causes, irregularity of the heart and its consequences are removed by the medicine; and, although the evidence upon this point is incomplete, the statement appears to be sustained (*Med. Record*, xxiii. 133; also Bruen, *Ther. Gaz.*, ix. 20; Roberts, *Practitioner*, xxxii. 265). It is also claimed that convallaria has been proved clinically to relieve dyspnœa by deepening the inspiratory act; but in cases of valvular or muscular disease of the heart the action of the medicine upon the heart alone is sufficient to explain the relief felt in breathing. A similar remark may be made concerning its diuretic action. It is altogether secondary, and is manfested only when the dropsy, wherever situated, is of cardiac origin. But in such cases, and especially when the kidneys and the heart-muscle are sound, its influence in removing dropsy by diuresis is at least as salutary as that of digitalis, and does not involve the dangers incident to the use of that drug. As might be expeeted from its mode of action, the diuresis to which it gives rise does not cease abruptly on the suspension of the medicine, but is maintained for several (from five to nine) days longer. It causes no change in the constitution of the urine; a slight cloudiness in it, produced by heat and nitric acid, is due not to albumen, but to the resin of the plant; and, indeed, it affects no other function directly than that of the heart. A decoction of the fresh root of C. multiflora in milk has been given internally for the relief of hæmorrhoids with constipation (Hamer).

In the cases which drew attention to the special virtues of convallaria the Russian physicians employed an infusion of the flowers varying in strength from 10 grains to 2 drachms in 6 ounces of water, which was given in tablespoonful doses twice a day, and also an infusion of the whole plant, made with Gm. 8 (℥j–ij) in Gm. 128–192 (f℥iv–vj) of water, of which "3 or 4 spoonfuls" a day were prescribed. Sée found an infusion of the flowers inert. According to him, watery extracts are preferable, the least active being that of the leaves, then the extract of the flowers, and finally the extract made from the flowers, stems, and root. He prescribed for a daily portion from 15 to 20, or even 30, grains of the watery extract of the flowers or of the whole plant, or twice these quantities of extract of the leaves. According to Langlebert and Tanret, the best results are produced by the watery extract of the flowers and stems, along with one-third of their weight of the root and leaves. Of this preparation the average dose is stated to be Gm. 0.50 (8 grains). It is conveniently given in simple syrup flavored with tincture of orange-peel (*Bull. de Thérap.*, ciii. 74, 179). A fluid extract prepared in this country is said by some to be efficient in doses of from 5 to 12 drops every four hours (*Med. Record*, xxii. 281), or, as others say, in doses of not less than 15 or 20 drops. It has been proposed to substitute convallamarin for the preceding preparations, in the daily dose of Gm. 0.10 (gr. 1½), and gradually increased.

Convallaria polygonatum is represented to be emetic and cathartic, and mildly astringent and stimulant when applied topically. It was formerly used as a vulnerary, and more recently to relieve the irritation of the skin produced by *poison-sumach*, etc.

COPAIBA, *U. S., Br.*—Copaiva.

Balsamum copaivæ, P. G.—*Balsam copaiva, Balsam capivi*, E.; *Copahu, Oleo-résine (Baume) de copahu*, Fr.; *Copaivabalsam*, G.; *Balsamo di copaive*, It., Sp.

The oleoresin of Copaiba Langsdorffi (*Desfontaines*), *O. Kuntze*, and of other species of Copaiba. Bentley and Trimen, *Med. Plants*, 93.

Nat. Ord.—Leguminosæ, Cæsalpineæ.

Origin.—With the exception of two African species, the genus Copaiba is indigenous to the tropical part of South America, and there consists of ten species, the majority of which are medium-sized or large trees, with mostly abruptly pinnate coriaceous leaves and racemose whitish apetalous flowers, producing coriaceous obliquely elliptical or obovate one-seeded legumes. The following may be enumerated as having been mentioned as sources of copaiva: Cop. officinalis, *Linné* (C. Jacquini, *Desfontaines*), indigenous to Venezuela, New Granada, and some West Indian islands; Cop. guianensis, *Desfontaines*, found in Guiana and in Northern Brazil near the Rio Negro. Cop. Langsdorffii, *Desfontaines*, Cop. coriacea, *Martius*, and others occur in various parts of Brazil. Cop. multijuga, *Hayne*, is a doubtful species; Cop. bijuga, *Hayne*, is probably identical with Cop. guianensis. Copaiva has been medicinally employed in Europe since the beginning of the seventeenth century.

Collection.—In the interior of the stem ducts, sometimes of large dimensions, are formed, in which the oleoresin collects in such quantities that old stems not unfrequently burst from the internal pressure exerted by the liquid. This is gained from bore-holes or incisions made into the trunk near its base, from which the oleoresin exudes at once so abundantly that 12 pounds are sometimes obtained in the space of 3 hours. If, however, no copaiva should flow, the wound is closed with wax or clay and reopened in a fortnight, when an abundant discharge takes place. Old trees occasionally yield it two or three times a year.

Copaiva is imported in barrels principally from Para, to which place it is brought from the northern tributaries of the Amazon. It is, perhaps, in part obtained from C. guianensis. Notable quantities are brought from Maranham, and some from Rio de Janeiro, the latter supposed to be procured from C. Langsdorffii and coriacea. The copaiva exported from Maracaibo and Carthagena appears to be chiefly procured from C. officinalis.

Description.—Copaiva is a more or less viscid and transparent or translucent liquid, varying in color from very light yellow, to brownish-yellow, having a peculiar aromatic odor and a bitterish, persistently acrid, and nauseous taste. Its specific gravity ranges between 0.94 and 0.99 at 15° C. (59° F.); Flückiger gives the limits between .935 and .998; by keeping it becomes thicker and denser. Unlike gurjun balsam, it is not gelatinized on being heated to 130° C. It is insoluble in water, dissolves in three or four times its weight of strong alcohol, and freely in absolute alcohol, carbon disulphide, ether, volatile and fixed oils, acetone, and petroleum benzin; the latter solution becomes opalescent on the addition of more (3 to 5 volumes) petroleum benzin, and deposits on standing a little resinous matter, at the same time becoming transparent again. With one-third its volume of ammonia-water it yields a transparent mixture. Benzene yields with some varieties a turbid solution. The optical behavior of copaiva varies, as has been shown by Buignet (1861) and Flückiger (1867).

The different kinds are commercially distinguished by their ports of exportation, but even as obtained from the same places are not always identical in every particular. *Para copaiva* is the most limpid and the lightest kind, and frequently contains from 65 to 85 per cent. of volatile oil. *Maranham copaiva* is a little denser, has about the consistence of olive oil, differs somewhat in odor from the preceding, and contains from 40 to 50 per cent. of volatile oil. *Rio Janeiro copaiva* resembles the last. These Brazilian copaivas yield, with one-third to one-half their weight of ammonia, compounds which form perfectly clear solutions in the volatile oils contained in them; a larger quantity of ammonia renders the solution quite milky, but in the presence of a fixed oil clear solutions are not obtained. *Maracaibo copaiva* is the thickest variety, usually of a dark-yellow color and not quite transparent. It contains less volatile oil, and does not always yield a clear mixture with a little ammonia-water; but it solidifies readily with magnesia, and is well adapted for making the officinal Massa copaibæ. According to the German Pharmacopœia, thick copaivas are to be preferred.

Adulterations.—The variable conditions of commercial copaiva, depending on its origin from different species, renders a detection of adulterations by no means an easy task. A copaiva which dissolves clear in strong alcohol, yields with one-third ammonia a transparent mixture, is on heating free from turpentine odor, and on evaporation of the volatile oil from a flat dish, and subsequent cooling, leaves a transparent, hard, and brittle resin, may be considered pure. Fixed oils are left behind with the resin, and render it soft and sticky; if other than castor oil is present, neither the copaiva nor the residuary resin will yield a clear solution with alcohol. Castor oil, being nearly insoluble in petroleum benzin, may be detected by shaking the suspected copaiva with 4 to 5, or even 10, volumes of that solvent, when the adulterant will separate, but the volatile oil present exerts a marked solvent power on the castor oil. Flückiger and Hanbury recommend heating the sample of copaiva with 4 parts of 85 per cent. alcohol and allowing the mixture to cool; the upper layer is then evaporated to expel the alcohol and volatile oil and the remaining castor oil, recognized by heating it with caustic soda and lime, when œnanthol will be formed, recognizable by its peculiar smell; even 1 per cent. of castor oil is stated to be thus detected.

When a drop of pure copaiva is evaporated from a piece of filtering-paper, it will leave a sharply-defined transparent spot of resin behind, which, if a fixed oil is present, will be surrounded by a greasy areola. Tomlinson (1864) has recommended the examination of the cohesion-figures produced by a drop upon water, which are said to be quite characteristic for pure copaiva.

The presence of other volatile oils and turpentines usually becomes quite evident by a

different odor on slowly heating a little of the copaiva. Turpentine, oil of turpentine, resin, rosin oil, etc. are said to be detected by a test admitted into the P. G.: 1 part of copaiva, on being strongly shaken with 5 parts of water of 50° C. (122° F.), should yield a turbid mixture, and this, on being warmed in a water-bath, should separate again into two clear layers. Copaiva mixed with 10 per cent. of gurjun balsam yields by this treatment a permanent emulsion (Flückiger). The U. S. P. gives the boiling-point of the volatile oil (200° C. = 392° F.) as a test. The German Pharmacopœia adds the following determination: To 1 Gm. of copaiva, dissolved in 10 Cc. of absolute alcohol, 10 drops of phenolphthalein solution are added, then sufficient normal potassium hydroxide solution, diluted with three volumes absolute alcohol, until the red color just makes its appearance. After noting the number of Cc. used, 20 Cc. more of the latter are added, and the mixture heated on a warm bath for fifteen minutes, when the amount of free alkali is titrated with normal hydrochloric acid. The amount of acid necessary to effect neutralization should not be very much less than would be required by the 20 Cc. of potassium hydroxide solution last added.

The presence of gurjun balsam in copaiva is stated to be detected by shaking together in a test-tube 19 drops of carbon disulphide and 1 drop of the oleoresin, and adding, with some agitation, 1 drop of a cold mixture of equal parts of concentrated sulphuric and nitric acids; copaiva assumes a faint reddish-brown color and deposits resin on the side of the tube; in the presence of gurjun balsam an intense purplish-red color is produced, changing to violet, the reaction being due to the volatile oil of the adulterant. The oleoresin of Hardwickia pinnata, *Roxburgh*, will under the same circumstances produce a pale greenish-yellow color (*Pharmacographia*).

Constituents.—Copaiva owes its limpidity to the presence of volatile oil (see Oleum Copaibæ), but the acrid and bitter taste is partly due to the brittle resin, partly also to a bitter principle, as shown by Flückiger (*Pharmakognosie*). On boiling copaiva with water, concentrating the aqueous liquid, and filtering from the floccules which are separated, a transparent very bitter solution is obtained, which reddens litmus and yields a copious precipitate with tannin solution. The resin possesses acid properties, and is occasionally deposited from copaiva in a crystalline form, also from a clear mixture of copaiva and ammonia-water when exposed to a low temperature. The crystals are freed from adhering oleoresin by washing with ether, and afterward recrystallized from absolute alcohol, when, according to Schweitzer (1830), *copaivic acid* is obtained free from ammonia. Rush (1879) agitated 1 part of copaiva with 3 parts of solution of soda sp. gr. 1.30; the mixture separates into three layers, consisting of volatile oil, an aqueous alkaline liquid, and the compound of resin; the two upper layers are decanted, the resin compound well washed, dissolved in petroleum benzin, agitated with dilute hydrochloric acid, washed with water, and the benzin solution evaporated. Copaivic acid has the composition $C_{20}H_{32}O_2$, and crystallizes in small soft prisms, which are soluble in alcohol, ether, carbon bisulphide, and in fixed and volatile oils; its salts are uncrystallizable. A deposit from Para copaiva was recognized by Fehling (1841) as distinct from the above; it is *oxycopaivic acid*, $C_{20}H_{28}O_3$. Strauss's (1865) *metacopaivic acid*, $C_{22}H_{34}O_4$, is contained in Maracaibo copaiva, from which it is obtained by agitation with ammonium carbonate and by precipitating the aqueous liquid with hydrochloric acid. When copaiva is kept on hand it gradually becomes thicker, through the alteration of the volatile ail and its conversion into a soft resinous body.

Pharmaceutical Uses and Preparations.—Copaiva is readily emulsified by the aid of yelk of egg or gum-arabic. It is sometimes given in the form of electuary, and requires then some absorbent for the volatile oil, for which purpose powdered marshmallow, liquorice-root, or gum-arabic is adapted; or the copaiva may be preferably fused together with some wax, spermaceti, or cacao-butter, the quantity of which will vary with the amount of volatile oil, between ½ and 1 part. (See also Oleum Copaibæ and Massa Copaibæ.)

Allied Products.—Hardwickia pinnata, *Roxburgh* (nat. ord. Leguminosæ, Cæsalpineæ), is a large East Indian tree, yielding from incisions a thick, dark-brown oleoresin, which in thin layers is greenish or wine-red, transparent, but not fluorescent, and resembles copaiva in both odor and taste. Broughton (1872) obtained from it between 25 and 40 per cent. of volatile oil having the composition $C_{10}H_{16}$, the remainder consisting of several resins, but copaivic acid was not obtained.

Dipterocarpus alatus, *Roxburgh*, D. turbinatus, *Gaertner* (s. D. lævis, *Hamilton*), D. incanus, *Roxburgh* (s. D. costatus, *Gaertner*), and several other species of the same genus (nat. ord. Dipterocarpaceæ) which are indigenous to various parts of India, the East Indian and the Philippine islands, yield *gurjun balsam* or *wood-oil*, obtained by cutting large holes into the lower part

of the stem and charring the wood, after which the oleoresin flows abundantly. It is a viscid liquid, varying in color from greenish-gray to brownish, opaque in reflected light, but transparent and of a dark brownish or reddish tint when viewed in transmitted light; its odor is similar to but weaker than that of copaiva, and its taste is more bitter and somewhat aromatic, but not acrid. It is freely soluble in chloroform, carbon bisulphide, and volatile oils, but only partly soluble in alcohol, fusel oil, ether, and petroleum benzin. When strongly agitated with water, gradually added until 5 parts have been used, gurjun balsam furnishes a very thick emulsion, which does not become clear on warming, but on the addition of the same bulk of water the balsam separates, and the clear watery liquid has a bitter taste and an acid reaction (Flückiger). When heated in a stoppered vial to near 130° C. (266° F.) it has the curious property of becoming gelatinous, the fluidity not being restored on cooling. The amount of volatile oil present in gurjun balsam varies considerably: Werner (1862) obtained 15 per cent., Flückiger 45.5 per cent., and from one specimen even 72 per cent.; it is strongly lævogyre, and has the composition $C_{15}H_{24}$, the density 0.9044 to 0.918 at 15° C., and the boiling-point 255° C. (491° F.). The resin left after distillation of the volatile oil yields to caustic potassa *gurjunic acid*, $C_{22}H_{34}O_4$, which may be obtained pure by adding to the potassa solution an excess of ammonium chloride, filtering, and decomposing with hydrochloric acid. Gurjunic acid dissolves readily in ether and strong alcohol, slowly in benzene, and with difficulty in carbon disulphide; it melts at 220° C. (418° F.), and congeals again at 180° C. (356° F.). A crystalline neutral resin of gurjun balsam, which had been sold as copaivic acid, was found by Flückiger (1878) to have the composition $C_{28}H_{46}O_2$, to melt at 126° C. (258.8° F.), and to dissolve in sulphuric acid with an orange color.

Lagam balsam, minjak-lagam, comes from an unknown tree in Sumatra, and closely resembles gurjun balsam. Examined by Haussner (1883), it was dingy-green in reflected and yellowish transparent in transmitted light, had a bitterish and lastingly acrid taste, and was completely soluble in alcohol, ether, benzene, chloroform, and carbon disulphide; it yields about 33 per cent. of lævogyre volatile oil of the composition $C_{20}H_{32}$, and boiling at about 250° C. (482° F.). The acid resin is uncrystallizable, and has the composition $C_7H_{14}O_3$; the neutral resin, fused with potassa, yields phenols and formic, acetic, butyric, and aromatic acids.

Action and Uses.—In continued or excessive doses copaiva deranges the digestion, impairs the appetite, and causes eructations, nausea, and diarrhœa. It appears to augment the watery element of the urine, rendering this secretion dark, bitter, and somewhat fragrant, as well as more or less turbid from the resin of copaiva which also forms an iridescent pellicle upon its surface. The addition of nitric acid to the urine gives a turbid precipitate which, unlike albumen, is soluble in alcohol. Large doses or the long-continued use of copaiva irritate the bladder, causing micturition and sometimes hæmaturia with feverishness. It appears also to be excreted by the pulmonary and the cutaneous surfaces; the former is shown by the odor it gives to the breath, and the latter by the eruptions of roseola, urticaria, etc. which it occasionally excites. A very peculiar eruption has been attributed to copaiva and cubeb taken together (*Amer. Jour. of Med. Sci.*, Jan. 1881, p. 289). Copaiva impregnates the milk of nursing women, so that their infants refuse the breast. Its diuretic action fails in cases of renal dropsy depending upon tubular nephritis, acute or chronic—a fact which renders it almost certain that the diuresis produced by copaiva is due to its action upon the secreting elements of the kidneys.

The most important uses of copaiva are in the treatment of mucous profluvia, especially of the urinary and the air-passages. There can be no doubt that it acts by modifying the urine in the first, and the bronchial mucous membrane itself in the second, of these cases, and that in both it cures by a substitutive operation. It is well known that copaiva given internally does not often cure vaginal *gonorrhœa*, while it arrests the urethral form of the disease in the female as readily as in the male. It is also known that in hypospadic males affected with gonorrhœa the internal administration of copaiva will arrest the discharge from behind the urethral aperture, but not from that part over which the urine does not flow. Hence an explanation of the clinical rule, to administer as much copaiva as can be taken without disordering the stomach or irritating the urinary organs. In this manner it exerts a stimulant and moderately substitutive action upon the inflamed membrane and causes a diminution of the discharge. According to some, the agent in this operation is exclusively copaivic acid, but, since the resin abundantly appears in the urine, this constituent cannot be denied its share in the cure. It is probable that the essential oil is the most active agent when copaiva cures *bronchitis*, since it is largely eliminated through the bronchia. During the acute stage of gonorrhœa, and also of bronchitis, copaiva is contraindicated, for in the former disease it tends to cause strangury, swelling of the testicle, and other local disturbances, while in bronchitis it is apt to arrest the bronchial secretion and thereby occasion fever and dyspnœa. Besides administering copaiva by the mouth for the cure of gonorrhœa and gleet, it has sometimes been thrown into the rectum—a clumsy, uncertain, and injurious method.

It has also been injected as an emulsion into the urethra, but seldom with advantage, since the urine remaining unmodified continued to irritate the inflamed mucous membrane. The urine passed by the patient taking copaiva has been used as a urethral injection for the cure of gonorrhœa—an unnecessary and barbarous expedient when so many more appropriate injections are available. *Vesical catarrh* is often greatly benefited, and may sometimes be cured by means of this medicine perseveringly administered in moderate doses. Sometimes an emulsion of it injected into the bladder has been serviceable. It is an efficient remedy in many cases of *irritability of the bladder* depending upon previous gonorrhœa or excessive sexual indulgence. In some cases of *leucorrhœa* it is reputed to have been curative, but there is more evidence of its favorable action in the treatment of inflamed and ulcerated *hæmorrhoids* and chronic *dysentery*. In 1863 it was announced as a specific for *membranous croup*, and even in 1875 the same deceptive statement was repeated. In various inflammations of the *eye* it is reputed to have an almost "specific" influence, especially in *iritis*, *sclerotitis*, and *purulent ophthalmia*. In the two first-named diseases it was given internally in drachm doses, but in the last applied upon the skin around the orbit and instilled between the lids (*Med. Record*, xxx. 401). There is more clinical proof of its curative power in *cutaneous scaly diseases*, and its efficacy is rendered more probable by the well-known action of the medicine upon the skin. It has even been alleged to be an efficient remedy in *leprosy* (Simmons). Although the ordinary use of copaiva does not denote its action upon the nervous system, yet the occasional effects attributed to it seem to point in that direction. In corroboration of this view it may be mentioned that, like other terebinthinates, it has produced cures of *sciatica*, even after the failure of numerous other medicines (March, *Times and Gaz.*, Feb., 1881, p. 237). The diuretic operation of copaiva appears to be very decided in certain cases of *dropsy*. This operation has been described in a previous paragraph. A careful examination of the clinical records touching the matter shows that the medicine is of little use in any form of dropsy depending upon renal disease, and least of all in the cases which most require it—viz. those of a scanty secretion of urine due to tubular nephritis. In cardiac dropsy the influence of the medicine is more favorable, but only in proportion as the effusion is due to general causes rather than to mechanical obstruction in the heart. The cases in which copaiva and its resin have produced the most remarkable results are those of hepatic dropsy. In the most successful of them the nature of the hepatic obstruction was only conjectural, but was probably a condition analogous to that of commencing cirrhosis. Certain it is that in many cases of ascites which improved but slightly, or did not improve at all, under the use of the medicine, and which ultimately proved fatal, advanced cirrhosis of the liver was found after death. The dose of copaiva used in hepatic dropsy is about 20 grains three times a day.

Externally, copaiva, like other terebinthinates, serves to stimulate, and at the same time protect, parts to which it is applied. It forms an excellent dressing for *chilblains*, *sore nipples*, *anal* and other *fissures*, etc.

Copaiva is most commonly administered in gelatin capsules, each containing about Gm. 0.60 (gtt. x), which is the minimum dose. The maximum dose ordinarily given is about Gm. 4 (f℥j). Much larger quantities, even as much as an ounce, have been prescribed, but without necessity or advantage. The medicine is sometimes mixed with magnesia, with which it forms a solid and very insoluble mass. Equal quantities of copaiva and liquor potassæ make a perfect solution, which can be diluted and flavored. Next to the capsules, emulsions of copaiva are to be preferred. They are made with the yelk of egg or mucilage and some aromatic water, to which a small proportion of laudanum is usually added. Each tablespoonful should contain from Gm. 0.60–3.0 (gtt. x–xl) of copaiva.

Copal varnish has been recommended to arrest the development of *felons* by applying it previous to the suppurative stage (Isham, *Med. News*, xl. 97). No doubt it acts as other terebinthinates (copaiva, benzoin, oil of turpentine) do in the treatment of frost-bite and various local inflammations, by protecting, and the same time stimulating, the affected part.

Gurjun oil of balsam, which resembles copaiva closely in its constitution, has, like it, been used for the cure of *gonorrhœa*. In 1873 it was applied in one of the British Oriental possessions, the Andaman Islands, to the treatment of *leprosy*. Twenty-four cases were submitted to this method, with the effect of healing the ulcers, while the anæsthesia greatly improved and the tubercles softened and disappeared. It was most efficient

when employed externally in the form of an emulsion made with 3 parts of lime-water to 1 of the oil, with which the affected parts were diligently rubbed twice a day, and each time for the space of two hours. At the same time the oil was administered internally in doses varying from Gm. 0.40–4.0 (gtt. vj–lx), and finally in tablespoonful doses of an emulsion made of equal parts of the oil and lime-water.

Reports of a later date confirm the statements just made. One comes from India, and summarizes the results of using gurjun oil in leprosy thus: "It rapidly heals chronic, leprous ulcers, softens the skin, prevents the collection of flies, and is cheap" (Peters, *Practitioner*, xxiv. 122). The other is by Dr. Milroy, who treated the disease in British Guiana. "Gurjun oil," he says, "is laxative, diuretic, and alterative, and produces perspiration in the anæsthetic parts, followed by a return of sensation. It softens the tubercles. Internally, it purges and acts on the kidneys and urine like copaiva. Of 32 patients under its use, great improvement occurred in 16, and 9 more were benefited" (*Times and Gazette*, June, 1879, p. 643). Like copaiva, it is useful in chronic *bronchitis*.

COPTIS.—Gold Thread.

Coptide, Fr.; *Gelbe* (*Kleinste*) *Niesswurz*, G.

Coptis trifolia, *Salisbury*, s. Helleborus trifolius, *Linné*. Bigelow, *Med. Bot.* i. t. 5; Bentley and Trimen, *Med. Plants*, 3.

Nat. Ord.—Ranunculaceæ, Helleboreæ.

Origin.—The plant is indigenous to the northern half of this continent, from Pennsylvania northward to Greenland and Labrador, and also from the northern portion of Europe and Siberia to Kamtchatka.

Description.—Gold-thread has a filiform creeping rhizome of a golden-yellow color, with very thin fibrous rootlets. The radical leaves originate from a scaly base, are petiolate and trifoliate; the leaflets are about 12 Mm. (½ inch) long, ovate with a wedge-shaped base obtusely three-lobed, and mucronately crenate; the scape is 50–75 Mm. (2 or 3 inches) long, exceeding the petioles, and bears a single yellowish-white flower producing about seven oblong follicles, which are acuminate with the persistent style and contain a few oblong black, and glossy seeds. The whole plant is glabrous, without odor, and has a strongly bitter taste.

Constituents.—Mayer (1862) found in gold-thread berberine and a white alkaloid. Analyzed by E. Z. Gross (1873), the absence of tannin and gallic acid was established; besides some sugar, albumen, fat, and resin, two alkaloids were isolated, *berberine* and *coptine;* the latter is colorless, insoluble in alkalies, neutralizes acids, dissolves in strong nitric and hydrochloric acids without change, and produces with warm concentrated sulphuric acid a purplish color, similar to that of hydrastine. The acids naturally combined with the alkaloids have not been ascertained. The herb yielded between 4 and 5 per cent. of ash, about one-tenth of which was silica.

Allied Drugs.—Coptis Teeta, *Wallich*. The rhizome has the thickness of a quill, contains 8½ per cent. of berberine, and is used in India as a pure bitter tonic.

C. anemonæfolia, *Siebold*. The rhizome of this Japanese plant is about 3 Mm. (⅛ inch) thick, bristly, with short wiry rootlets, externally brown, and internally bright-yellow, and has a bitter taste; it probably contains berberine.

Action and Uses.—Coptis has no ascertained virtues beyond those of other simple bitters, for which, if necessary, it may be substituted. An infusion of it may be made with an ounce of the root to a pint of water, Gm. 32 to Gm. 500, and given in the *dose* of 1 or 2 ounces. It is used as a wash for *aphthous sore mouth*. A tincture is made with alcohol, a pint to an ounce of the bruised root. *Dose*, Gm. 4 (f℥j). Bufalini found that *Coptis teeta* reduced the rate of the frog's heart, and finally arrested it in systole. He classed it with digitalis and squill; but Paschkis regarded it as more analogous with berberin (*Centralb. f. Therap.*, v. 154).

CORALLORRHIZA.—Coral-root.

The rhizome of Corallorrhiza odontorrhiza, *Nuttall*.

Nat. Ord.—Orchideæ.

Origin.—The plant is a parasite, of a purplish-brown color, has a slender stem about 25 Cm. (10 inches) high, and bears from eight to twenty flowers, with their lips nearly entire. It is indigenous to North America east of the Mississippi. It is not unlikely that the more common Corallorrhiza multiflora, *Nuttall*, may furnish some of the com-

mercial coral-root; it is stouter, and has from fifteen to thirty flowers, which are spurred at the base and have the lip deeply three-lobed. It is found westward to the Rocky Mountains.

Description.—Coral-root consists of numerous small fleshy tubers, which are united by their broader sides and form many branches of different length, but of the same articulated appearance, resembling coral in arrangement. It is of a brown color externally, whitish within, and has particularly in the fresh state, a peculiar odor and a bitterish and astringent taste. Its proximate constituents have not been ascertained.

Action and Uses.—There appears to be nothing to be added to the stereotyped account of this plant, to the effect that it is an active diaphoretic and useful in fevers and inflammations. It is administered in powder in the dose of Gm. 2 (30 grains) every two hours.

CORDIALE RUBI FRUCTUS, *N. F.*—Blackberry Cordial.

Preparation.—Blackberry Juice, 3 pints; Cinnamon, in coarse powder, 2 troy ounces; Cloves, in coarse powder, ½ troy ounce; Nutmeg, in coarse powder, ½ troy ounce; Diluted Alcohol, 2 pints; Syrup, 3 pints. Digest the spices with the diluted alcohol for eight days, then mix with the blackberry juice, and strain; lastly, add the syrup.

Our experience with this popular remedy (extending over several years and the manufacture of many gallons of the cordial) justifies the statement that the preparation will be much improved and time saved by percolating the spices, in moderately fine powder, with diluted alcohol to obtain 2 pints of tincture; to this add the blackberry juice and about ½ oz. of precipitated calcium phosphate: set the mixture aside for forty-eight hours, with occasional agitation, and filter; to the clear filtrate add the syrup. Blackberry cordial is apt to become slightly turbid after standing for some time, and should then be again filtered before dispensing.

CORIANDRUM, *U. S.*—Coriander.

Coriandri fructus, Br.—*Coriander-fruit*, E.; *Coriandre*, Fr.; *Koriander*, G.; *Cilantro*, *Culantro*, Sp.

The fruit of Coriandrum sativum, *Linné*.

Nat. Ord.—Umbelliferæ, Cœlospermæ.

Origin.—The plant is probably indigenous to China and to the eastern portion of the northern shore of the Mediterranean, but is now extensively naturalized in the fields of temperate Asia and Europe, where it is also cultivated. It is occasionally cultivated in the United States and in some parts of South America. It is a smooth annual about 60 Cm. (2 feet) high, and of a very offensive odor, somewhat like that of bedbugs. The leaves are decompound, the segments of the lower ones broadly cuneate, and of the upper ones narrow and linear; the umbels are three- to five-rayed, without involucre; the umbellets six- to fifteen-rayed, with an involucel of three linear bracts. The flowers are white or rose-colored. 49,133 pounds of coriander were imported in 1866–67; in the recent returns coriander is included with caraway.

Fig. 82.

Coriandrum: fruit and longitudinal section, magnified 3 diameters; transverse section: magnified 8 diameters.

Description.—Coriander-fruit is a cremocarp nearly globular, about 4 Mm. (⅙ inch) in diameter, smooth, crowned with the unequal calyx-teeth and stylopodium, and of a buff or pale brownish-yellow color. Each of the two mericarps forms a thin hemispherical shell, the two being united at the edge by the thin pericarp, thus enclosing a flattish lenticular cavity and separating only by slight pressure. The five primary ribs of each half-fruit are obsolete, forming merely raised wavy lines; the four secondary ribs are more prominent as straight ridges, and similar ridges are formed at the junction of the mericarps. The longitudinal and transverse sections of each mericarp show the albumen to be of a semilunar shape; upon the latter two oil-tubes are seen on the face and none on the back. On ripening the fruit becomes gratefully aromatic.

Constituents.—Trommsdorff obtained from coriander nearly ½ of 1 per cent. of volatile oil (see Oleum Coriandri) and 13 per cent. of fatty matter, besides a small amount of mucilage, malic acid, and traces of tannin.

Action and Uses.—Coriander is aromatic and stimulant, and is chiefly employed to promote the *digestion* of certain kinds of pastry, and in medicine to correct or assist the action of purgatives, such as rhubarb, senna, and jalap.

CORIARIA.—Currier's Sumach.

Redoul, Sumac des corroyeurs, Fr.; *Gerberstrauch*, G.

Coriaria myrtifolia, *Linné.*

Nat. Ord.—Coriariaceæ.

Origin.—It is a shrub about 1.8 M. (6 feet) high, growing in Southern Europe and Northern Africa.

Description.—The branches are quadrangular; the leaves opposite, 25 to 38 Mm. (1 to 1½ inches) long, on short petioles, ovate-lanceolate, acute, entire, even at the base; smooth, bluish-green, and shining above, pale-green beneath, with a strong midrib and two lateral nerves running to near the apex. The flowers are in small terminal racemes, have a bell-shaped calyx, five fleshy, scale-like petals, five long linear stigmas, and produce each five blackish-brown obliquely ovate nutlets, which are surrounded by the enlarged scales and have a berry-like appearance. The leaves have a strongly astringent, bitter, and somewhat acrid taste.

Fig. 83.

Coriaria-leaf.

Constituents.—The leaves contain tannin, which produces blue-black precipitates with salts of iron. The poisonous principle, *coriamyrtin*, has been isolated and studied by Riban (1864–66), who precipitates the decoction with subacetate of lead, removes the lead from the filtrate, and evaporates to a syrupy consistence; from this residue the principle is dissolved by ether. It is in white or colorless very bitter prisms, which dissolve in 70 parts of water, in 50 of alcohol, and in less ether, chloroform, and benzene. Its composition is $C_{30}H_{36}O_{10}$. It is rendered brown by alkalies, and on being boiled with dilute hydrochloric acid yields a body which reduces Fehling's solution, but differs from sugar.

Action and Uses.—Accidental poisoning has occurred by mistaking the leaves of this plant for senna and the fruit for blackberries. Snails that lived on its leaves have poisoned those who ate them. The toxical phenomena generally consisted of nausea, vomiting, colic, trismus, and general convulsions, ending fatally in some cases within twenty-four hours. Experiments upon various animals gave the same general results, but rabbits were usually unaffected. But the latter animals were destroyed by coriamyrtin in the dose of Gm. 0.10 (1½ grains) given internally, and Gm. 0.008 (⅛ grain) administered hypodermically. Gm. 0.20 (3 grains) of this substance sufficed to bring on fatal convulsions in dogs in periods varying from twenty to seventy-five minutes. The phenomena of poisoning by the plant and its extract resemble those induced by picrotoxin, including spasm, frothing at the mouth, and contraction of the pupils; and the lesions after death present a similar analogy, for they consist of a normal appearance of the gastro-intestinal mucous membrane, congestion of the meninges, rapid occurrence of rigor mortis, distension of the heart with dark blood, and ecchymoses in the lungs. The toot poison of New Zealand has been proved to be furnished by one or more species of Coriaria. C. ruscifolia, eaten by animals, renders them "stupid and lethargic until roused into a fit of frenzy by any trivial circumstance." Death takes place by exhaustion. The goat, however, has an immunity from these effects (*Am. Jour. Phar.*, lvi. 439).

CORNUS, *U. S.*—Cornus.

Dogwood-bark, E.; *Écorce de cornouiller à grandes fleurs*, Fr.; *Grossblüthige Kornelrinde, Hornbaumrinde*, G.

The bark of the root of Cornus florida, *Linné.* Bigelow, *Med. Flora*, t. 28; Bentley and Trimen, *Med. Plants*, 136.

Nat. Ord.—Cornaceæ.

Origin.—The tree is found in woodlands from Canada and Southern New England southward throughout the United States, and westward to Minnesota, Eastern Kansas, and Texas: it is usually from 4.5 to 6 M. (15 to 20 feet) high, and in favorable localities attains double that height. The opposite leaves are ovate, pointed, about 10 Cm. (4 inches) long, and become crimson in autumn; the small greenish flowers are in capitate clusters surrounded by four large involucral leaves, which are notched at the apex, of a white color, sometimes tinged with purple, and quite showy. The drupaceous fruit is bright red. Cornus Nuttallii of the Pacific States resembles this species, and probably has similar properties.

Description.—The bark of the root, which is preferred, is usually met with in commerce, and is in broken somewhat curved pieces, about 3 Mm. (⅛ inch) thick and rarely

over 5 Cm. (2 inches) long and wide. The furrowed corky layer is dark ash-colored or brown-gray, in the young bark smooth and marked with small oblong white spots. The Pharmacopœia directs the corky layer to be removed, when the outer surface is of a pale reddish- or light reddish-brown color, and rather darker than the inner surface, which is of a rusty rose-color and striate; the longitudinal as well as the transverse fracture is short, of a whitish color, and with brown-yellow striæ of stone-cells. It is almost without odor and has an astringent and bitter taste.

Constituents.—Geiger (1836) separated the bitter principle, *cornin* or *cornic acid*, by treating the cold infusion with plumbic hydroxide, evaporating the filtrate, treating the extract with absolute alcohol, adding ether, and crystallizing. Frey (1879) found it difficult to obtain the principle pure without loss. It is in white, silky bitter needles, readily soluble in water and alcohol, slightly soluble in ether, colored dark by alkalies, and precipitated by silver nitrate and basic lead acetate, but not by other normal salts. We observed (1859) that the bitter principle when in aqueous solution containing a little ammonia is altered and destroyed by exposure to air and heat. Geiger separated also a tasteless resinous body crystallizing in shining needles. Cockburn (1835), besides some unimportant principles, recognized the presence of gallic acid and tannin, producing a bluish-black color with iron. Bowman (1869) obtained only 3 per cent. of tannin. Frey, in addition to these principles, isolated a bland inodorous orange-colored fixed oil, and ascertained that the resin dissolves with an orange color in cold sulphuric acid.

Allied Plants.—1. Cornus circinata, *L'Heritier.*—Round-leaved dogwood, *E.*; Cornouiller, à feuilles arrondies, *Fr.*; Canadischer (Rundblätteriger) Kornel, *G.*—This shrub is met with in Canada, and in the United States as far south as Virginia and west to Iowa, growing in copses in rich soil. It attains a height of 1.8 to 3.0 M. (6 to 9 feet), has greenish warty dotted branches and orbicular or broadly ovate opposite leaves, which are 12 Cm. (5 inches) or less long, abruptly pointed and white woolly beneath. The white flowers are in flat cymes; the fruit is drupaceous, light blue. The bark is in thin, irregular pieces or short quills, which are externally greenish and warty when from young branches, or from older branches of a brownish-gray color, with the warts confluent in slightly-raised longitudinal lines of a glossy brown. The inner surface is cinnamon-brown, even, and very finely striate. The bark breaks with an even scarcely fibrous fracture through the pale-reddish inner layer. The odor is slight, the taste not unpleasant, somewhat astringent, and bitter. Rob. Gibson (1880) found it to agree in composition with the official bark.

2. Cornus sericea, *Linné.*—Swamp dogwood, Silky cornel, Red hosier, Kinnikinnick, *E.*; Cornouiller soyeux, *Fr.*; Sumpfkornel, *G.*—This common shrub is found in moist woods, on the margins of streams and swamps, from Canada south to Florida, and westward to Texas and Dakota. It is 1.8 to 3 M. (6 to 10 feet) high, has purplish branches and opposite, elliptic-ovate, and pointed leaves, which are covered underneath with rust-colored silky down. The yellowish-white flowers, having conspicuous calyx teeth, are in close, flat, and woolly pubescent cymes, followed by pale-blue fruits. The bark is usually in much-broken pieces, resembling the preceding, but having a distinct purple tint and being less warty. Its constituents are probably the same.

3. Cornus mascula, *Linné.*—Cornelian cherry, *E.*; Cornouille, *Fr.*; Kornelkirsche, Dürlitze, Herlitze, *G.*; Corniolo, *It.*—A shrub or small tree indigenous to Southern and Central Europe, and somewhat cultivated in the United States for ornament. It is 3 to 6 M. (10 to 20 feet) high, and produces, preceding the leaves, capitate umbels of yellow flowers surrounded by a four-leaved dingy-yellow or greenish involucre. The bright-red glossy elliptic drupe is about 2 Cm. ($\frac{4}{5}$ inch) long, in the green state strongly astringent, but when ripe of an acidulous sweet and slightly astringent taste, and edible.

Action and Uses.—Dogwood is tonic, astringent, and slightly stimulant, and in the recent state is apt to produce nausea. Like other vegetable bitters, it has been popularly used as a remedy for *intermittent fever*. Its virtues as a stomachic *tonic* are more demonstrable. The dose of the powdered bark as a tonic is about Gm. 1.30 (gr. xx), and three times that quantity, repeated six or seven times during the apyrexia, may be given in intermittent fever. A decoction or the officinal fluid extract is to be preferred.

Swamp dogwood (C. sericea) is less, and round-leaved dogwood (C. circinata) more, bitter than this species, while the first-named excels in astringency. The former is stated to be used medicinally in decoction as an emetic and expectorant by the Indians of the Pacific North-west (Holmes; Spaydon).

CORYDALIS.—Turkey Corn.

Squirrel corn, *Turkey pea*, E.

The tubers of Dicentra canadensis, *De Candolle*, s. Dielytra eximia, *Pursh*.

Nat. Ord.—Fumariaceæ.

Origin.—The plant is a perennial, has bi-ternate somewhat glaucous radical leaves, with the leaflets dissected into linear-oblong segments and several scapes bearing about four greenish-white flowers, which are tinged with purple, nearly 12 Mm. (½ inch) long, heart-shaped, and have two short and rounded spurs. It grows in rich rocky woods as far south as Kentucky, but is more frequent farther north and in Canada.

Description.—The thin subterranean shoots bear small tubers, which are collected. They are depressed globose, 6 to 10 Mm. (¼ to ⅜ inch) thick, of a tawny-yellow color, nearly smooth, with a scar on each of the depressed sides, internally yellow or yellowish-white. The tuber breaks with a somewhat horny or slightly mealy fracture, is nearly inodorous, and has a bitterish and rather persistent taste.

Constituents.—W. T. Wenzell (1855) obtained from it corydaline, fumaric acid, yellow bitter extractive, an acrid resin, starch, and other common principles of plants. The alkaloid was obtained by evaporating the tincture, separating the resin by filtration, precipitating the filtrate with ammonia, and exhausting the precipitate with alcohol. This solution was evaporated, the residue treated with dilute hydrochloric acid, the salt thus formed again precipitated by ammonia, and the alkaloid purified by repeated crystallization. *Corydaline* was discovered by Wackenroder (1826) in the tubers of Corydalis tuberosa and fabacea. It is a white amorphous powder, crystallizing from alcohol in colorless prisms and scales, its solution having a very bitter taste. It is soluble in alcohol, ether, chloroform, and in the fixed and volatile oils, fuses at about 70° C. (158° F.), yields mostly amorphous salts, and is colored dark-red by sulphuric acid and yellow by nitric acid, or, if it contains resin, blood-red by the last-named agent.

Allied Plants.—Corydalis tuberosa, *De Candolle.*—Fumeterre bulbeuse, *Fr.*; Hohlwurzel, Helmwurzel, *G.*—It is indigenous to the hilly woodlands of Europe. The tubers vary from 1 to 4 Cm. (½ to 2 inches) in thickness, are roundish, gray-brown, internally greenish-yellow or whitish, firm; when old, hollow and frequently lobed.

Cor. fabacea, *Persoon*, another European plant, has small tubers which are never hollow.

Dicentra eximia, *De Candolle*, s. Corydalis formosa, *Pursh*, indigenous to the United States, has a scaly rhizome and a compound raceme of oblong purplish flowers, which are about 18 Mm. (¾ inch) long and have two very short saccate spurs.

Action and Uses.—As long ago as 1855 it was stated that "the root of C. formosa is supposed to be tonic, diuretic, and alterative, and is given in syphilitic, scrofulous, and cutaneous affections in the dose of from 10 to 30 grains." Since then there appears to have been nothing more definite made known respecting the virtues of this plant. The resin which it contains, and on which depend whatever virtues it may possess, is probably worthy of being suitably tested. Numerous species of Corydalis occur in Europe, from one of which a resin is obtained, by precipitation from a tincture, which is alleged to have cured *intermittent fever*; and another, C. tuberosa, is regarded as emmenagogue, anthelmintic, etc.

CORYLUS.—Hazel.

Noisetier, Fr.; *Hasel*, G.

Nat. Ord.—Cupuliferæ.

Description.—The following species have been used:

Corylus avellana, *Linné*, is a shrub 3 to 4.5 M. (10 to 15 feet) high, common in woodlands and thickets in Europe and Northern Asia, and cultivated to some extent in the United States. It has somewhat hairy, roundish-ovate, and pointed leaves, with a heart-shaped base, flowers in March, and ripens its fruit in autumn. It has bony nuts, which are enclosed in a bell-shaped involucre, are nearly 25 Mm. (1 inch) long, and have a smooth, light-brown, woody shell enclosing a white, oily, and sweetish kernel. The nut is known as *filbert*. The seeds contain over 50 per cent. of fixed oil. *Hazelnut oil* is pale-yellow, inodorous, has a mild nutty taste, and congeals at about — 17.8 C. (0° F.); it consists of olein, arachin, palmitin, and stearin. By nitric acid it becomes greenish, and by sulphuric acid bluish-green and gray.

Corylus americana, *Walter*, is common in thickets in North America, has obovate-cordate and acuminate leaves, and yields a fruit about 13 Mm. (½ inch) long and wide, which is enclosed in an open involucre of about twice the length of the fruit.

Corylus rostrata, *Aiton*, grows in Canada, in the northern part of the United States, and along the Alleghanies, and is about 0.6 to 1.5 M. (2 to 5 feet) high. The leaves are oblong-ovate, pointed, and somewhat heart-shaped. The fruit is enclosed in a long hirsute involucre, which above is contracted into a long tubular beak.

Action and Uses.—The spiculæ which cover the involucre of C. rostrata have been used with alleged effect as a substitute for those of mucuna in the treatment of *intestinal worms.*

COTULA.—May-weed.

Herba chamomillæ fœtidæ.—*Wild chamomile, Dog chamomile,* E.; *Chamomille puante, Herbe de maroute,* Fr.; *Hundskamillen,* G.

The herb of Maruta Cotula, *De Candolle,* s. Maruta fœtida, *Cassini,* s. Anthemis Cotula, *Linné.*

Nat. Ord.—Compositæ, Anthemideæ.

Description.—This nearly smooth annual is originally indigenous to Europe, but is now a very common weed in many parts of North America, growing along roadsides, in neglected fields, and in waste places. The stem is about 30 Cm. (1 foot) high, with ascending branches from the base, cylindrical, furrowed, somewhat hairy above. The sessile leaves are obovate in outline, thrice pinnately divided, with linear subulate lobes, pale-green, and slightly hairy beneath. The flower-heads terminate the branches upon soft hairy peduncles. The numerous involucral scales are somewhat imbricate, ovate, with whitish scarious margins. The receptacle is conical, not hollow; chaff nearly subulate, shorter than the florets; ray-florets white, ligulate, three-toothed, neutral; disk-florets tubular, yellow; akenes obovoid, ribbed, and without pappus. The plant begins to flower in June, and has an unpleasant aromatic odor and a bitterish acrid taste.

Constituents.—The flowers were analyzed by Wm. H. Warner (1858), and found to contain a little volatile oil, some tannin, valerianic and oxalic acids, an acrid fatty substance, bitter extractive, etc. Pattone (1859) announced the discovery of an alkaloid, *anthemidine,* and of a crystallizable bitter acid, *anthemidic acid,* the latter of which is dissolved from the aqueous extract by alcohol and is also soluble in ether. The undissolved portion of the extract, taken up with water and treated with ammonia, is said to yield the alkaloid, which, however, has not been obtained since.

Action and Uses.—May-weed, or wild chamomile, resembles officinal chamomile in most of its qualities and uses, but its smell is different in being fetid, and its juice is capable of blistering the skin. Its rank odor and acrid qualities probably led to its being used as a nervine stimulant in such cases as those for which valerian is usually employed, and especially for the relief of flatulent *colic* and *dysmenorrhœa.* Its excitant properties adapted it to popular use as a sudorific and antispasmodic. The leaves are commonly applied externally, but an infusion of the flowers is preferable for internal use.

COTYLEDON.—Navelwort, Pennywort.

Cotylet, Nombril de Vénus, Fr.; *Nabelkraut,* G.; *Ombligo de Venus,* Sp.

Cotyledon Umbilicus. *Linné,* s. Umbilicus pendulinus, *De Candolle.*

Nat. Ord.—Crassulaceæ.

Description.—A perennial herb of Southern and Western Europe, growing on rocks and old walls. It has a fleshy, tuberous root and an erect stem about 15 Cm. (6 inches) high. The leaves are smooth, fleshy, peltate, concave, roundish, and repand-crenate, about 25 Mm. (1 inch) broad, the upper ones smaller, roundish, wedge-shaped, and on shorter petioles. The numerous small flowers are greenish-yellow and tubular, bell-shaped, with a five-parted corolla, ten stamens, and five many-ovuled ovaries. The dry plant is inodorous and has a mucilaginous taste.

Constituents.—Navelwort was analyzed by Hétet (1864) with the following results: The fresh plant contains 95 per cent. of water, 0.001 per cent. of salt of *trimethylamine,* the same quantity of ammonia salt, 0.9 per cent. potassium nitrate, 2.063 per cent. of other salts, the remaining 2.035 per cent. being sugar, mucilage, starch, cellulose, etc.

Action and Uses.—Between 1849 and 1855 several English practitioners abounded in eulogies of this plant as a remedy for *epilepsy.* They were, for the most part, gentlemen of good, and even of eminent, professional standing, and their opinions for a time led physicians astray; but when the medicine had been tried by experts both in England and upon the Continent, it was adjudged to be utterly worthless. Against this sentence there has been no appeal. Formerly the mucilaginous leaves of the plant were applied to *contusions.*

CREOSOTUM, *U. S.*—Creosote.

Creasotum, Br.; *Kreosotum*, P. G.—*Créosote*, Fr.; *Kreosot*, G.; *Creosoto*, It.

A mixture of phenols, chiefly guaiacol and creosol, obtained during the distillation of wood-tar, preferably of that derived from the beech, Fagus sylvatica, *Linné*.

Nat. Ord.—Cupuliferæ.

Origin and Preparation.—Creosote, which was prepared by Reichenbach (1830), is one of the numerous products resulting from the dry distillation of wood. According to Voelckel, it is not produced from cellulose, but rather from the incrusting layers of the wood-cells. Crude wood vinegar is stated to contain about 1 per cent., but beech-wood tar occasionally 25 per cent. of it; the latter is therefore the best material for its preparation. To obtain it the tar is distilled until about one-half is passed over and dense vapors of paraffin, etc. make their appearance. The distillate separates into a heavy and light oily layer, with an intervening aqueous stratum of an acid reaction. The light oil contains *eupion*. The heavy oil is treated with a concentrated solution of sodium carbonate, and the separated oily liquid is distilled, that portion of the distillate only being collected which is heavier than water. This distillate is treated with potassa solution spec. grav. 1.12, whereby the creosote is dissolved and *eupion* separated. The potassa solution is now supersaturated with sulphuric acid, and the precipitated creosote well washed with water and rectified, the product distilling at and above 203° C. (397° F.) being collected. The treatment with potassa and sulphuric acid is repeated until the potassium creosote solution does not turn brown on being heated in the air.

To obtain it from crude pyroligneous acid the oily constituents are first separated by saturating the crude acid with sodium sulphate at about 70° C. (158° F.), and while warm skimming off the supernatant layer. The cold thick oil is distilled, treated with sodium carbonate, and further purified as above.

Properties.—Creosote is a colorless oily liquid; age renders it slightly yellowish, but even exposure to direct sunlight should scarcely render it brown (*P. G.*); but the U. S. P. permits it to turn reddish-yellow or brown by exposure to light from the presence of tar-oils. It is very refractive to light, neutral to test-paper, of a peculiar penetrating smoky odor, and of a caustic and burning taste. Its specific gravity should not be below 1.070 at 15° C. (59° F.), *U. S.*, *P. G.*; 1.071 *Br.* "Soluble in about 150 parts of water at 15° C. (59° F.), but without forming a perfectly clear solution. With 120 parts of hot water it forms a clear liquid, which becomes turbid on cooling and separates oily droplets. The filtrate from this yields a reddish-brown precipitate with bromine test-solution (distinction from carbolic acid). It is also soluble, in all proportions, in absolute alcohol, ether, chloroform, benzin, carbon disulphide, acetic acid, fixed and volatile oils. It begins to boil at about 205° C. (401° F.), and most of it distils over between 205° and 215° C. (401° and 419° F.). When it is cooled to —20° C. (— 4° F.) it becomes gelatinous, but does not solidify (difference from carbolic acid.). It is inflammable, burning with a luminous, smoky flame. It is neutral or only faintly acid to litmus-paper."—*U. S.* It takes up 50 per cent. of glycerin or 15 per cent. of ammonia sp. gr. 0.940. When agitated with an equal bulk of ammonia-water it separates unchanged on standing, but it dissolves in potassa solution, the liquid giving off creosote when heated to boiling. It causes precipitates with solutions of gum and albumen, but not with gelatin, and does not render collodion gelatinous (difference from carbolic acid). It preserves meat, probably in consequence of its behavior with albumen, and is present in the smoke of burning wood. Creosote is decomposed by strong nitric and sulphuric acids, and in contact with silver nitrate the latter is reduced.

Composition.—That creosote is a mixture of a number of different compounds has been long known, but their isolation has been a matter of great difficulty. In 1867, Gorup-Besanez recognized the presence of *guaiacol*, $C_7H_8O_2$, and *creosol*, $C_8H_{10}O_2$, in beech-wood tar creosote; both are oily liquids of the general properties of creosote, the former boiling at 200° C. (392° F.), the latter between 220° and 224° C. (428° and 435° F.) (Tiemann and Koppe, 1881). Heated with hydriodic acid, both yield methyl iodide, and in addition thereto *pyrocatechin*, $C_6H_6O_2$, is produced by the former, and by the latter a non-crystallizing body isomeric with orchin, $C_7H_8O_2$. Tiemann and Mendelssohn (1876) proved also the presence of *phlorol*, $C_8H_{10}O$, which had been previously supposed to exist in it and in impure carbolic acid, the so-called *coal-tar creosote*. They dissolved the portion obtained by fractional distillation near 220° C. (428° F.) in ether, and added concentrated potassa solution, whereby its compound with creosol was separated, while the phlorol remained in the mother-liquor. Reimer observed (1876) that guaiacol, treated

with chloroform and soda, and afterward with an acid, is converted into *vanillin*, the aldehyde of *vanillic acid*, which latter was obtained from creosol by converting it first into acetyl-creosol and oxidizing this with potassium permanganate (Tiemann and Mendelssohn, 1877).

Besides the three principles named, others are likely to be present in creosote from different sources, such as *methyl-creosol*, $C_9H_{12}O$ (boiling-point 215° C. = 419° F.), and *methyl-guaiacol*, $C_8H_{10}O_2$ (boiling-point 205° C., 401° F.) The creosols and phenols boiling below 200° C. (392° F.) should be absent (see page 40).

Tests.—"On mixing equal volumes of creosote and collodion in a dry test-tube, no coagulum should form. If 1 volume of creosote be mixed with 1 volume of glycerin, a nearly clear mixture will result, from which the creosote will be separated by the addition of 1 or more volumes of water. On adding to 10 Cc. of a 1 per cent. aqueous solution of creosote 1 drop of ferric chloride test-solution, the liquid will aquire a violet-blue tint which rapidly changes to greenish and brown, with formation, usually, of a brown precipitate. (The preceding three tests show difference from and absence of notable quantities of carbolic acid.) On mixing 2 Cc. of creosote with 8 Cc. of a 7½ per cent. solution of sodium hydroxide, a clear, pale yellowish liquid results, which becomes turbid when diluted with water, but clears up after 50 Cc. have been added (absence of neutral oils). If 1 Cc. of creosote be mixed with a 20-per-cent. solution of potassium hydroxide in absolute alcohol, a solid crystalline mass will form upon cooling. If 1 Cc. of creosote is shaken with 2 Cc. of benzin and 2 Cc. of freshly prepared barium hydroxide test-solution, upon separating, the benzin should not be blue or muddy, and the aqueous layer should not have a red tint (absence of cœrulignol and some other high-boiling constituents of wood-tar."—*U. S.*

Fröhde's reagent, prepared by dissolving 1 part of molybdic acid in 100 parts of sulphuric acid, has been found by E. W. Davy (1878) to be a reliable test for detecting an admixture of carbolic acid in creosote, the former producing with the reagent a yellowish or brownish tint, passing into maroon or reddish-brown, and finally into beautiful purple; the latter causes a brown or reddish-brown color, which becomes fainter, and finally light yellowish-brown. The test is applied by adding 1 or 2 drops of the aqueous solution of the substance to 3 or 4 drops of the reagent; warming the mixture gently will hasten the production of the final coloration. If the creosote contains but a small quantity of carbolic acid, 10 drops of it are dissolved in ½ ounce of water and the solution distilled. The first portion of the distillate will give the creosote reaction, and the last portion that of carbolic acid.

It should be stated that much of the commercial creosote is coal-tar creosote, and readily recognizable as such by its behavior with ferric chloride.

Action and Uses.*—Applied pure to a mucous membrane or to the raw cutis, it excites severe burning pain, coagulates the albumen of the secretion, and may even produce ulceration. Its taste is very penetrating and peculiar, and may be detected in a solution of 1 part of creasote in 1000 of water. In doses of 1 or 2 drops it causes burning in the throat and œsophagus. Larger medicinal doses, if continued, are apt to occasion a sort of intoxication, with giddiness, dulness, debility, frequent pulse, and dyspnœa. The urine is increased and blackened, and exhales the odor of the medicine; sometimes there is strangury. The vapor, when inhaled, is soporific. Applied externally to an ulcer, creasote has occasioned faintness, palpitation, etc. The case is reported of a man who applied to his hair creasote instead of oil, and changed its color to gray (*Amer. Jour. Phar.*, lix. 114). Excessive doses may cause severe abdominal pain and bloody stools. A case in which 2 drachms were taken ended fatally. Another case is reported in which an infant a year old is said to have taken a teaspoonful of creasote, and recovered after having exhibited great debility, pallor, a hoarse, croupy cough, and stertorous breathing (Grinnell, *Med. News*, xl. 344). A fatal case occurring in an infant was remarkable for the severe lesions of the mouth, throat, etc. (*Edinb. Med. Jour.*, xxviii. 655).

The first medicinal use of creasote was to check *vomiting* in cholera, and subsequently it was found to relieve this symptom produced by reflex irritation by exhaustion in alcoholism, by sea-sickness, by Bright's disease, by malignant disease of the stomach, and by certain forms of dyspepsia, probably of the fermentative sort. It is alleged to have cured *tapeworm*, as carbolic acid has also been. Its manifest hæmostatic powers

* The almost complete substitution in commerce of carbolic acid for creasote, and the very close analogy in their operation, render unnecessary a more detailed account of the latter than is given in the text.

in external *hæmorrhage* led to its use in bleeding from the lungs, stomach, bowels, kidneys, bladder, and uterus, and its analogous operation was employed to correct excessive secretion in *diabetes*, *polyuria*, *bronchorrhœa*, chronic *bronchitis*, and *laryngitis*. When first introduced by Reichenbach in 1833, it was reputed by him to be a remedy for *phthisis*, and Elliotson, in the following year, published cases of its efficacy in this disease (*Med.-Chir. Trans.*, xix. 221). In 1836, Carmack confirmed the previous statements, and added a long list of diseases in which the virtues of creasote were displayed. It soon, however, fell into discredit, and so remained until 1876, when Imlay recommended its use in an atomized solution for the relief of phthisis (*Lancet*, Nov. 1876, p. 514). The following year Bouchard renewed the vogue of the medicine, and cited Verbeck as having "cured" consumption by its internal use (*Bull. de Thérap.*, xciii. 289). Thenceforth it attracted more attention in Germany than elsewhere, where it was extolled by Sommerbrodt (*Centralb. f. Therap.*, v. 255; *Therap. Monatsh.*, iii. 298), Fræntzel (*Centralb. f. Therap.*, v. 440), Lublinski (*ibid.*, v. 631), Engel (*Centralb. f. Therap.*, iii. 501), and many others. In Great Britain it seems to have inspired little confidence, and in the United States to have met with a very limited acceptance (Robinson, *Trans. Asso. Amer. Physicians*, iii. 365; Flint, *Amer. Jour. Med. Sci.*, Jan. 1889, p. 75; Nov. 1890, p. 500). Indeed, a survey of the reports made by its advocates show —1. That the percentage of cures attributed to it is exceedingly small. 2. That its virtues were displayed only in the forming stage of the disease. 3. That the patients said to have improved were using, besides creasote, cod-liver oil and other medicines, as well as undergoing various dietetic and hygienic modes of treatment. 4. That the hypothetical rational ground of its use—viz. that it destroyed the bacilli of tubercle—was proved a delusion by Bogdonovitch (*Med. News*, lii. 401), since they abounded in the sputa of patients using the medicine. Moreover, Dr. Driver, after three years' use of the medicine, concluded that it had little to do with the improvement of patients who were taking it (*Centralb. f. Therap.*, vi. 604). It was also found that its assiduous use frequently inspired the patient with an invincible disgust, and occasioned anorexia, nausea, retching and vomiting, gastric irritability and oppression, and diarrhœa. There is no better agent for the relief of *toothache* due to caries and inflammation of the dental pulp. For this purpose it should be applied upon a small and dense wad of cotton or lint. Creasote-water is sometimes used as an injection to cure *leucorrhœa* and *gleet;* it is an excellent application to *burns* and *chilblains* and to all forms of *ulcers* requiring stimulation, but especially to such as present flabby and bloody granulations and a fetid discharge, as in *cancer*, *gangrene*, mercurial *stomatitis*, chronic *glanders*, *ozæna*, etc. Like other stimulants, it has been used, in a diluted form, as a lotion in *erysipelas*. It is a useful stimulant in certain cases of *deafness* due to dryness of the external auditory canal. The antiputrescent power of this substance has caused it to be used to preserve dead animal matter for *dissection*, etc. Creasote has been given, like carbolic acid, for its antizymotic virtues in the treatment of *typhoid fever*, but, however it may seem to be theoretically fitted for the cure of that disease, its efficacy has not been generally admitted. Indeed, if it act in the manner supposed, its advantages are not very explicable when it is administered by enema, as Dujardin-Beaumetz advises. If given at all, it should be in the form of creasote-water, and by the mouth in the dose of a fluidrachm. It has been applied as a means of allaying *itching* in numerous diseases of the skin, but in a concentrated form it is more efficient in causing the shrivelling and destruction of *lupus*, *warts*, *condylomata*, and *nævi materni*. Among these affections *lupus* is claimed to be most efficiently treated by plasters containing salicylic acid and creasote in various proportions (Unna, *Lancet*, Sept. 25, 1886). If carbolic acid were not so universally used instead of creasote, it would still be preferable as having a less persistent and disagreeable smell. This may be removed from the body or clothing by chlorinated lotions. The poisonous effects of creasote may be combated with wine, coffee, and other stimulants and by magnesium sulphate.

The *dose* of creasote is Gm. 0.05–0.10 (gtt. j–ij). It may be given in pill or emulsion or in the form of creasote-water. It is rendered more miscible with water by the addition of an equal quantity of solution of potassa. Its taste may be disguised by aromatic waters. It may also be used by inhalation, dissolved in from 1 to 3 parts of rectified spirit. When applied to carious teeth, etc. it may be solidified with collodion.

Probably the least offensive way of administering it is in capsules containing Gm. 0.05 (1 grain) of creasote and Gm. 0.02 ($\frac{1}{2}$ grain) of Tolu balsam, and gradually increasing the quantity until in the fourth week six capsules a day are taken. Fraentzel preferred a mixture as follows: Creasote, 13.5 parts; tinct. of gentian, 30 parts; spirit of wine,

250 parts; sherry wine to make 1000 parts. Others have given it with cod-liver oil. Schetelig administered it hypodermically in almond oil (*Cent. f. Therap.*, vii. 278), and Rosenbach (*Med. News*, lii. 462) and Stachiewicz (*Med. Record*, xxxiv. 508) ventured to inject it through the chest-walls into the tissue of the lung. Neudörfer holds that creasote is "of equal value in *cancer* and phthisis" (*Med. Record*, xxxv. 95—a judgment that does not encourage its use in either disease.

CREOLINUM.—Creolin.

Creoline, Fr.; *Kreolin*, G.

Composition and Properties.—Creolin, which was first introduced about 1887, is a product of the dry distillation of coal, and is said to be obtained by freeing that portion of coal-tar boiling between 180° and 220° C. (356° and 428° F.) from carbolic acid. The composition of commercial creolin varies considerably, two different preparations being sold under the same name—Pearson's creolin in England (probably identical with Jeyes' disinfectant) and Artmann's creolin in Germany. The latter variety is but little soluble in ether in which Pearson's creolin is perfectly soluble, and also differs from it in depositing upon standing for some time, particularly when cooled with ice, hard, white crystals of naphtalene, which are sublimable and melt at 79°–80° C., boiling at 216°–218° C. Published analyses by Weyl, Fischer, Beckurts, and Otto point to the presence in the English creolin of about 60 per cent. of hydrocarbons boiling between 190° and 350° C., from 10 to 22 per cent. of phenols boiling between 200° and 300° C., about 0.8 per cent. of pyridine bases, 2 to 4 per cent. of soda, and variable quantities of abietic acid and water. Artmann's creolin was found to contain less phenols, but a much larger percentage (85 per cent.) of hydrocarbons. In both preparations the phenols are combined with soda and it is probable that the hydrocarbons are held in solution by the compounds thus formed. The method of preparing both products is kept secret by the manufacturers. Creolin occurs as a dark-brown syrupy alkaline liquid, miscible with water and soluble in alcohol, fixed oils, and chloroform; mixed with water it forms milk-like emulsions.

Action and Uses.—Thomesco noted no injury after doses of Gm. 0.50 (gr. viij), and Spaeth and two associates each took as much as Gm. 8 (ʒij) in a day without injury (*Bull. de Thér.*, cxv. 552). Yet it is certainly poisonous in excessive doses. Eight ounces of it taken with suicidal intent caused unconsciousness, followed by vomiting, and, after treatment, by recovery. Thirst was suffered, but not pain, and there was no caustic action. The urine smelled of carbolic acid, and contained albumen and blood. Later on there was slight jaundice (*Berlin. klin. Wochenschr.*, Aug. 1889). A 1 to 2 per cent. uterine douche after delivery has caused collapse and death (*Therap. Monatshefte*, Oct. 1889). A 2 per cent. solution applied to the wound made in operating for strangulated hernia has occasioned a scarlatinoid eruption, thirst, fever, a small and rapid pulse, and a discharge of urine smelling of carbolic acid (Cramer). A drop or two of a 2 per cent. solution placed on the tongue or in the nasal passages or throat occasions a burning irritation, and its taste clings to the mouth and pharynx. (For cases of poisoning by creolin see *Therap. Monatsh.*, iii. 434, 578; *Lancet*, Oct. 1889, p. 811). When taken internally it deodorizes the stools, but is apt to provoke diarrhœa. It neutralizes the fetor of gangrenous ulcers, which it also stimulates and heals. Its application to such sores and to open wounds does not usually occasion toxical phenomena; but some exceptions have been noticed above. It also sometimes causes eczema. It does not corrode metallic instruments, but it acts rapidly on caoutchouc and gutta-percha. It has been pronounced the best deodorant yet discovered (Otis). Objections to its use are that it makes an opaque mixture with water, and that instruments dipped in it become slippery. It also within wounds retards their healing. Moreover, it discolors the hands and makes the skin rough. In 1887, when a veterinary professor brought into notice the antiseptic action of creolin, it was employed in surgery by V. Esmarch, who pronounced it superior to carbolic acid as a deodorizing, disinfecting, and antiseptic agent, and found that in a soap it was more efficient than corrosive sublimate for these purposes (*Lancet*, Oct. 15, 1887), and did not burn or smart. His observations were soon confirmed by Kortüm (*Centralb. f. Ther.*, v. 708), who employed a 1 per cent. watery solution to correct the fetor of puerperal discharges and of foul *ulcers*. For the latter he employed a 1–2 per cent. solution on gauze compresses, and also used it to repress suppuration and promote healing, and, in fact, for all the similar purposes to which corrosive sublimate was then applied, with equal advantage and less danger. These results were confirmed by

Neudörfer (*Centralb. f. Ther.*, vi. 227), who also found that creolin relieved pain, checked *hæmorrhage*, and limited *suppuration*. He applied a ½ per cent. solution on thick gauze compresses, which were allowed to remain until cicatrization. Eisenberg's experiments (*ibid.*, p. 372) proved that a 2–5 per cent. solution destroyed various morbid germs more rapidly and thoroughly than carbolic acid. These results have been confirmed by Otis and others (*Boston Med. and Surg. Jour.*, June, 1889, p. 599). A disadvantage attending its use as a dressing for wounds, especially in children and in females with a delicate skin, is its tendency to produce an eczematous eruption, with swelling of the lymphatic glands and fever (Wackez, *Therap. Monatshefte*, iii. 264). In veterinary medicine it has been used in 5 per cent. alcoholized solutions, in baths and lotions, to cure the *itch* of hogs and sheep, and also to destroy vegetable parasites.

Among the various applications of creolin the following may be mentioned: One of its earliest uses was in the treatment of *vesical catarrh* by the injection of a ½ per cent. solution. It caused a transient burning sensation, but speedily destroyed the fetor of the secretion and removed its turbidness (*Lancet*, Jan. 14, 1888). In cases of *putrefaction* within the *uterus* from retained placenta, membranes, fœtus, etc.—cases in which tympanites existed and blood-infection was imminent—the danger was prevented by irrigating the uterus with solutions containing 1 to 2 per cent. of creolin. A stronger solution (according to Baumm) is apt to painfully irritate the vagina and render its walls rigid. In chronic *metritis* and *vaginitis* a 4 per cent. solution has been used or a weaker one applied by means of a double canula. Minapoulos used a ½ to 2 per cent. solution to irrigate the vagina during and after *labor* (*Med. News*, liii. 718). Others have considered such injections objectionable. Rosni reported a case of death (referred to above) with symptoms of carbolic-acid poisoning in a woman who had used a 2 per cent. emulsion of creolin as a uterine douche (*Boston Med. and Surg. Jour.*, Jan. 1889, p. 8), and Hiller thought the apparent harmlessness of the preparation was due to its slight solubility in water.

One per cent. solutions of creolin are alleged by Amon to be useful in various forms of *ophthalmia*; but Kazaouroff and others found that sometimes they either quite failed or else acted as irritants (*Bull. de Thérap.*, cxv. 375). Mergel declared it to be most efficient in acute *conjunctivitis*, but also to act well in *trachoma*. In ulcerated *cornea* its effects seemed uncertain (*Med. News*, liii. 590). One reporter (*University Med. Mag.*, i. 117) stated that the results he obtained with it were inferior to those furnished by ordinary methods; Grossmann, Purtscher, and others were about equally divided in opinion; and some regarded the application as so painful that they suggested its being made only along with or after the use of cocaine. A solution of from 2 to 10 drops in a pint of water has been injected into the middle *ear* through the Eustachian tube, but is not to be recommended. Injections into the auditory canal, it has been claimed, are well borne, and are useful in various forms of *otorrhœa*, but in the Halle clinic only unfavorable results were observed (*Amer. Jour. Med. Sci.*, 1889, i. 527). The chronic and fetid sort are benefited by solutions of 1 : 100–1 : 1000. In follicular *tonsillitis* with *fetid breath*, in ulcerated *pharynx*, in *diphtheria*, etc. gargles and injections (1 : 100–500) containing creolin are of service. Koehler states that for diphtheria he used 2–3 per cent. solutions with advantage (*Med. Record*, xxxv. 65), and these or even weaker preparations are preferable for various fetid affections of the *nostrils* and *throat*. The solution may be applied by swabbing, irrigation, spray, or vapor. The inhalation of a 1 per cent. atomized solution is recommended by Amon in *phthisis*. Like a great many other substances similarly administered, it palliates cough and may heal existing ulcers. It has been injected into the pleural cavity after the operation for *empyema*. Hiller states that he cured a case of *tænia solium* and one of *oxyuris vermicularis* by doses of Gm. 1 (xv. grs.) three times a day, enclosed in capsules; and others have recommended it for *flatulence* (gastric or intestinal). Enemas containing it have been found useful in *dysentery*. Neudörfer applied pure creolin to *erysipelas* of the face, arresting its development and causing the general symptoms to subside (*Brit. Med. Jour.*, xxi. 88). A 2 per cent. ointment of creolin has been applied to local eruptions of *eczema* and *impetigo;* and an alcoholic solution or a vaseline ointment containing it (1 : 10–20) has been used successfully in *parasitic* diseases of the skin.

Creolin is but little used internally, but, as above stated, its dose need not be very small. It may be given in pill or capsule in the primary dose of 2 or 3 drops. Its smell is not offensive to all persons, but may be masked by other odorous substances, among which peppermint has been recommended. For topical uses, as for injections into mucous cavities and wounds, a watery solution of ½–2 per cent. may be employed; for disinfect-

ing the hands and wounds a solution of 3–5 per cent. An ointment containing 2 per cent. of the preparation has been used. Creolin gauze, cotton, vaseline, etc. are usually prepared with a solution of 1 : 200. As already stated, the opacity of the liquid is a hindrance to its use, especially in surgical operations. If the instruments are immersed in it, it covers them with a soapy film, which lessens the firmness of the grasp upon them.

CRETA PRÆPARATA, *U. S., Br.*—Prepared Chalk.

Creta lævigata.—Craie préparée, Craie lavée, Fr.; *Präparirte Kreide, Schlämmkreide*, G.; *Creta preparada*, Sp.

Formula $CaCO_3$. Molecular weight 99.76.

Native friable calcium carbonate freed from most impurities by elutriation.

Origin.—Neither the U. S. nor the Br. Pharmacopœia now gives a process for the preparation of prepared chalk, but the last-named authority adds to the above definition that it is "afterward dried in small masses, which are usually of a conical form," and, mainly for the purpose of producing carbon dioxide gas, recognizes

Creta, *Br.*; Chalk, *E.*; Craie, *Fr.*; Kreide, *G.*

Chalk is a mineral found in many parts of the world and very abundantly on the coasts of the English Channel. It consists mainly of the microscopic shells of Foraminifera, and, chemically, is calcium carbonate, generally containing a little silica, aluminum, iron, magnesium, and organic matter. It is usually soft and earthy, but occasionally compact and rather hard, often of a yellowish-white, or even red, color, due to ferric oxide; as met with in commerce it is nearly white. Its specific gravity is about 2.5. It is much used for making marks which are readily effaced. Freed from the hard, silicious portions by pulverization and diffusion in water, it constitutes *whiting*, and if prepared from very white and soft chalk it is known as *Spanish* or *Paris white* (Blanc d'Espagne, Blanc de Troyes, *Fr.*). The latter, mixed with coloring matters and moulded into pencils, forms the main ingredient in *pastil* colors. Being very rapidly and almost completely dissolved by hydrochloric acid, chalk is not adapted for generating a continuous stream of carbon dioxide. To be suitable for medicinal purposes it requires to be purified or *prepared*.

Preparation.—"Take of chalk a convenient quantity. Add a little water to the chalk and rub it into fine powder. Throw this into a large vessel nearly full of water, stir briskly, and after a short interval decant into another vessel the supernatant liquid while yet turbid. Treat the coarser particles of chalk remaining in the first vessel in a similar manner, and add the turbid liquid to that previously decanted. Lastly, let the powder subside, and, having poured off the water, dry it."—*U. S.* 1870.

The directions given here explain the *process of elutriation*, which consists in separating the finer and lighter from the coarser and heavier particles by suspending them in water, and, after the latter have subsided, pouring off the water, holding the former still in suspension, which are then allowed to subside. The powder, while still moist, is then often dried in the form of small nodules, which are usually made by putting the sediment, still moist, into a funnel-shaped vessel and depositing it in small quantities upon the surface prepared for it, either by striking the lower end of the funnel against it or by pushing the soft mass through the funnel-tube by the aid of a suitable rod. The surface used for drying is either glass or a smooth calcareous stone, the latter serving for the rapid absorption of the moisture; the dry powder adheres loosely in the form of small cones. The heavy portion, which subsided first, is again triturated, *levigated* with some water, and again subjected to elutriation.

Bismuth subcarbonate and subnitrate and other pulverulent mineral salts are sometimes dried in the same manner.

Properties and Tests.—Prepared chalk is in conical nodules, forming a white, amorphous, insipid powder, and, being nearly pure calcium carbonate, has all the physical properties of that compound (see page 370), except that the color is usually of a less bright tint, and that, viewed under the microscope, the particles do not present a crystalline appearance. The chemical behavior is likewise the same, except that on dissolving prepared chalk in diluted hydrochloric, nitric, or acetic acid a trifling insoluble residue is usually left, and that the rapid and copious effervescence of carbon dioxide gas produces a more permanent foam. "When heated to redness, prepared chalk loses carbon dioxide and is converted into lime. The solution in diluted acetic acid yields, with ammonium oxalate test-solution, a white precipitate insoluble in acetic, but soluble in hydrochloric,

acid. If from the solution in diluted acetic acid the calcium be completely removed by precipitation with ammonium oxalate test-solution in slight excess, the filtrate should not be rendered very turbid on addition of sodium phosphate test-solution and a little ammonia-water (limit of magnesium). Another portion of the solution in acetic acid should not assume more than a slight bluish tint upon addition of potassium ferrocyanide test-solution (limit of iron). Another portion of the same solution should not be rendered turbid by the addition of barium chloride test-solution (absence of sulphate). In another portion no precipitate should occur upon the addition of potassium dichromate test-solution (absence of barium)."—*U. S.*

Substitution.—*Powdered gypsum*, calcium sulphate, has been during the past thirty years repeatedly sold in place of prepared chalk. It is of a whiter color, does not effervesce with acids, and yields with a large quantity of distilled water a neutral solution giving white precipitates with barium chloride and ammonium oxalate, the latter being soluble in diluted hydrochloric acid.

Allied Drugs.—1. CORALLIUM.—Coral, *E., Sp.;* Corail, *Fr.;* Koralle, *G.*—Oculina virginea, *Lamarck*, and Corallium rubrum, *Lamarck* (s. Isis nobilis, *Pallas*). Class, Polypiphera.—Corals are polypipherous animals inhabiting the sea, and consisting of a skeleton and a fleshy portion. Those which were formerly, and are still occasionally, employed in medicine have a calcareous skeleton which branches considerably, assuming the form of a tree or shrub, on the branches of which the individual animals are located in tube-like apertures. Of the numerous species which have been distinguished, the skeletons of only two have been used. The first one mentioned above has a milk-white color, the second is of a dull-red. Besides a small quantity of organic matter, coral consists almost exclusively of calcium carbonate, with a little magnesium carbonate. The color of red coral is due to about 4.25 per cent. of ferric oxide.

2. LAPIDES (s. OCULI, s. CALCULI, s. LAPILLI) CANCRORUM.—Crabs' eyes, Crabs' stones, *E.;* Yeux (Pierres) d'écrevisses, *Fr.;* Krebsaugen, Krebssteine, *G.;* Ojos de cangrejos, *Sp.*—They are concretions contained in the stomach of the *crayfish*, Astacus fluviatilis, *Fabricius*, class Crustacea, and are obtained in Russia by allowing the animals to putrefy and washing the mass with water. They are circular, 3 to 9 Mm. ($\frac{1}{8}$ to $\frac{3}{8}$ inch) in diameter, plano-convex, with a concentric groove on the flat side, consist of several layers, acquire in boiling water a rose-red color, and dissolve partly with effervescence in hydrochloric acid, leaving a cartilaginous mass of the shape of the crabs' stones. They contain about 63 per cent. of calcium carbonate and 17 per cent. of calcium phosphate, the remainder being various animal matters with small quantities of other salts. Factitious crabs' stones, which are sometimes met with, are completely dissolved or disintegrated by hydrochloric acid.

3. OS SEPIÆ.—Cuttlefish-bone, *E.;* Os de sèche, *Fr.;* Sepie, Weisses Fischbein, *G.;* Hulsas de Xibia, *Sp.*—It comes chiefly from the Mediterranean, from Sepia officinalis, *Linné*, class Cephalopoda, and is the calcareous bone contained in the mantle of the animal. It is oval-oblong in shape, both sides slightly convex, the rear surface being smooth, hard, and glossy, the remainder porous in texture and friable. It is of a white color, and consists of 80 to 85 per cent. of calcium carbonate, with traces of phosphates, 12 to 16 per cent. of animal matter, and about 4 per cent. of moisture.

4. TESTA PRÆPARATA, *U. S.* 1870; CONCHÆ PRÆPARATÆ, *P. G.* 1872.—Prepared oyster-shell, *E.;* Magistère de coquilles (d'écailles) d'hûitres, *Fr.;* Präparirte Austerschalen, *G.*—From the shell of Ostrea edulis, *Linné*. Class Acephala (Conchifera), ord. Lamellibranchia, Fam. Ostracea.—The oyster inhabits the Atlantic and Indian Oceans and adjacent seas in the neighborhood of the coasts, and is abundant in the bays and on the coast of North America. It consists of a soft, fleshy, suborbicular body, which is enclosed in a calcareous shell opening by two valves, the deeper one being adherent to the rock. Oysters are caught by dredging, and are often planted in creeks and rivers near the sea-shore. The flesh is a nutritious article of food, but the officinal parts of oysters are the shells. Oyster-shells are of an irregular shape, and vary between roundish, obovate, and oblong in outline. The lower valve is deeper than the upper one, which is nearly flat, the two being united by a toothless hinge. The shells are composed of imbricate foliaceous layers, are externally rough, uneven, and of a gray or brownish color, and have their internal surface smooth and white. The principal constituent of oyster-shells is calcium carbonate, which, according to Schlossberger, varies in the different layers between 88 and 98 per cent., the pearly inner layer containing the largest quantity. The analyses of Bucholz and Brandes, Phipson (1860), How (1866), and others indicate that the organic matter present in oyster-shells may vary between 0.5 and 4.5 per cent. The remaining inorganic constituents are small amounts of calcium phosphate and sulphate, magnesium, silica, oxide of iron, and alumina.

For medicinal use oyster-shell is freed from extraneous matter by washing it with boiling water, removing the colored external layer with a knife, and rubbing the clean white inner layer into a powder, either in a mortar or upon a slab by means of a muller; the finest powder is then separated from the coarser particles by elutriation, and dried like prepared chalk. It has a close resemblance to the latter, but is rather rough as compared

with it when taken between the teeth, and under the microscope is seen to consist of minute irregular and angular but not crystalline fragments.

Coral, crabs' eyes, crabs' claws, etc. consist essentially of chalk or carbonate of lime, but their action is modified, and perhaps rendered somewhat gentler, by the animal matter which they contain. Powdered cuttlefish-bone is used as an ingredient of dentifrices on account of its hardness.

Action and Uses.—All of these medicines are antacid and absorbent, and thereby astringent. Externally, they are applied as dusting powders to absorb and neutralize the *cutaneous secretions* and those of *superficial ulcers*, and to protect *erythematous inflammations*, including *burns*, *scalds*, *abrasions*, etc. An ointment made with chalk is sometimes used, but the combination in some degree defeats the purpose of the chalk. Sir D. Duckworth advises for *erysipelas* an ointment made by mixing equal weights of melted lard and precipitated chalk (*Practitioner*, xxxviii. 1). Internally, prepared chalk is in common use, and is a most valuable remedy for the cure or palliation of almost every form of *diarrhœa*, but especially of those forms in which the intestinal discharges are acid. As a rule, its use in these cases should be preceded by an evacuant to remove undigested food or other irritating substances. There is no better remedy for the premonitary diarrhœa of *cholera* than this simple preparation. It is usual to associate chalk with opiates and astringents; thus, to chalk mixture (*Mistura cretæ*) are added the tinctures of opium, kino, catechu, etc. Richter, in noticing the general substitution of mineral for animal preparations of lime, expresses a doubt of its expediency. Prepared chalk, he remarks, is by no means a substitute for cretaceous preparations derived from the animal kingdom, which contain phosphate as well as carbonate of lime, are more acceptable to the stomach in moderate doses, constipate less, and are more readily absorbed into the system. This writer ascribes a diaphoretic virtue to crabs' eyes, and alleges that they may produce urticaria, and that they tend to excite hæmorrhage. The latter qualities may perhaps be hypothetical, but the belief that the animal carbonates in general derange the stomach less than other cretaceous medicines, and are on that account preferable for infants and delicate persons generally, cannot, it is believed, be successfully controverted.

The *dose* of prepared chalk or of prepared oyster-shell is Gm. 0.30–4.00 (gr. v–lx), according as its antacid or its astringent operation is chiefly sought.

CROCUS, *U. S., Br., P. G.*—Saffron.

Stigmata croci.—*Safran*, Fr., G.; *Azafran*, Sp.

The stigmas (and top of the style, *Br.*) of Crocus sativus, *Linné*. Bentley and Trimen, *Med. Plants*, 274.

Nat. Ord.—Irideæ.

Origin.—The saffron-plant is indigenous to Oriental countries, probably from Greece and Asia Minor eastward to Persia; it has been cultivated from an early period, and grows spontaneously in some parts of Southern Europe. At the present time commerce is supplied with saffron chiefly from Spain (Alicante and Valencia) and France (Gatinais). It is also grown in Austria, and to a limited extent in some of the south-eastern counties of Pennsylvania. Asia Minor, Persia, Cashmere, and China are the principal countries which supply the Oriental regions with it. The plant has a depressed tuberous bulb or corm, which, in the latter part of summer or early in autumn, produces about nine grass-like, keeled, and dark-green leaves, and afterward a few pale-purplish, red-veined, six-lobed flowers with three stamens and a filiform style, which is whitish below, yellow above, and divided into three orange-red stigmas.

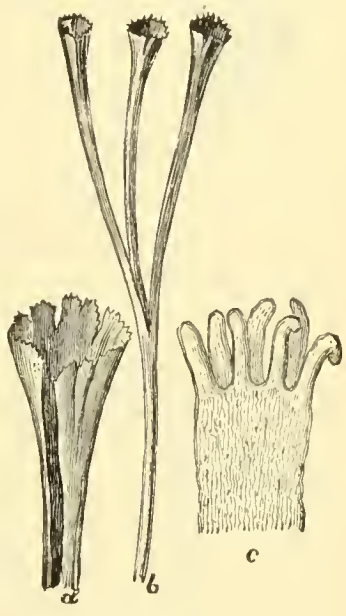
Description.—Each stigma is 25 to 31 Mm. (1 to 1¼ inches) long, flattish-tubular, almost filiform below, gradually enlarged above, slit on the inner side, and with several roundish teeth on the edge. The three stigmas are usually united, and occasionally are collected with a considerable portion of the yellow style. Dried saffron is flexible and tough, of a brownish-red or orange-brown color, somewhat unctuous to the touch, of a peculiar aromatic odor and a bitter, aromatic, and warm taste. After the moisture is expelled it becomes friable and more readily pulverizable. When chewed it tinges the saliva deep orange-yellow.

Cake-saffron is now not met with in commerce. In its loose condition it is sometimes called *hay-saffron*. Several varieties are distinguished. *Spanish saffron* is usually collected with considerable portions of the styles, which are easily distinguished by their yellow color. *French* or *Gatinais saffron* is mostly of a better quality. The handsome

saffron collected in Austria is rarely if ever seen in our markets. The excellent saffron collected in Eastern Pennsylvania is known there as *American saffron*—a term which in other parts of the United States is used to designate the florets of Carthamus tinctorius. Heinitsh (1866) calculated that 33 to 36 pounds of saffron may be raised to an acre, and found 300 stigmas to weigh 13 to 14 grains, which requires over 50,000 flowers to obtain a pound.

Constituents.—Saffron contains gum, albumen, wax, fat, about 1 per cent. of volatile oil, and coloring matter, called *polychroit*, or by some authors *crocin*. Weiss (1867) prepared polychroit, $C_{48}H_{60}O_{18}$, by exhausting saffron first with ether, afterward with water. The infusion is precipitated by strong alcohol, and the filtrate by ether. The precipitate contains a little sugar, is very deliquescent, and dries over sulphuric acid to a hard ruby-colored mass, which is inodorous, of a sweetish taste, readily soluble in water and dilute alcohol, slightly in absolute alcohol, and insoluble in ether and benzene. On being treated with dilute sulphuric acid in an atmosphere of hydrogen, polychroit is decomposed into a volatile oil having the composition of carvol, $C_{10}H_{14}O$, sugar, $C_6H_{12}O_6$, and *crocin* (*crocetin* of some authors), $C_{16}H_{18}O_6$. The latter is a red powder insoluble in ether, scarcely soluble in water, and freely soluble in alcohol and diluted alkalies. Warm concentrated potassa evolves from it vapors of a pungent odor; concentrated sulphuric acid produces a deep-blue color, changing to violet and brown; nitric acid colors it green, then yellow and brown. The same colors are produced by sulphuric and nitric acids with polychroit. The volatile oil obtained by the decomposition of polychroit has the odor and general properties of the volatile oil obtained from saffron by distillation with water. Quadrat (1851) observed that polychroit (his crocin) yielded with concentrated solution of alkalies a neutral volatile oil which was lighter than water and had an odor distinct from saffron. Lagrange and Vogel (1811) obtained from saffron 7.5 (Aschoff (1818) 1.4 and Hagan 1.25) per cent. of volatile oil; the first result must have been mostly the volatile oil formed from the polychroit. Saffron contains about 12 per cent. of moisture (14 per cent. limit of *U. S. P.*), and yields from 5 to 6 per cent. of ash (7.5 per cent. *U. S.*).

FIG. 85.



Crocus sativus, *Linné*: *a*, stigma, upper part, magnified four diameters; *b*, style with stigmas; *c*, papillose margin of stigma, magnified 120 diameters.

Adulterations.—The occasional admixture in true saffron of considerable portions of the yellow style has been noticed above. The appearance of inferior saffron is sometimes improved by oil or by glycerin; it then leaves a greasy stain on being slightly pressed between paper. Partially exhausted (mixed with good) saffron is recognized by the lighter and more uniform color of the stigmas. The tubular florets of Carthamus are easily distinguished by their five-toothed corolla and the projecting anthers with style. The styles of crocus, suitably dyed, have appeared in commerce as *feminelle*, a name also given to the dyed ligulate florets of Calendula officinalis, *Linné*; the latter are strap-shaped, with a three-toothed margin, and are easily distinguished from true saffron after soaking in water, or in dilute ammonia should the coloring matter of the dye be insoluble in water. The cut petals of the pomegranate, and the stamens of crocus and perhaps other flowers, are by the same means easily recognized from their different shape. About 1860, and again since 1870, Spanish (Alicante) saffron has often appeared adulterated with chalk, gypsum, or heavy spar, the powders having been rendered glutinous by some honey and mixed with the saffron; they then become yellowish and of the appearance of pollen. Powdered emery is said to be used in the same manner. The amount of such adulteration is sometimes 20 per cent., and may be estimated by incineration. Adrian (1889) noticed saffron heavily adulterated with soluble alkali salts and yielding 26 per cent. of ash; and Holmes observed saffron similarly weighted, which deflagrated when ignited and yielded a readily fusible ash. The adulteration is detected without difficulty by throwing a pinch upon water, when the mineral matter will subside, and may be identified by appropriate tests. "On agitating 1 part of saffron with 100,000 parts of water the liquid acquires a distinct yellow color. No color is imparted to benzin agitated with saffron (absence of picric acid and some other coal-tar colors.)"—*U. S.* "If 1 part of saffron be macerated in 10 parts of water, a yellow-red liquid is obtained free from sweet taste, and which, diluted with 10,000 parts of water, has a distinct yellow color. Saffron on being dried at 100° C. (212°F.) should lose less than 14 per cent.

of moisture, and on being now incinerated should leave not over 7.5 per cent. of ash."—*P. G.* These two tests will probably answer for determining the genuineness of saffron. The first, based upon its tinctorial power, requires that 22 fluidounces of water be colored yellow by 1 grain of saffron ; a single grain of saffron rubbed to a fine powder with sugar will impart a distinct tint of yellow to 700,000 grains (10 galls., *Br.*, or 12 galls., *U. S.*) of water (*Pharmacographia*).

An article has sometimes (1872) been offered as *African saffron;* it is mostly safflower, but occasionally it consisted of the corolla of Lyperia crocea, *Ecklon*, a scrophulariaceous plant indigenous to Southern Africa.

Pharmaceutical Preparation.—Syrupus croci, Syrup of saffron.—25 parts of saffron are exhausted with sufficient Malaga wine to obtain 440 parts of tincture in which 560 parts of sugar are dissolved.—*F. Cod.*

Allied Drugs.—Gardenia grandiflora, *Loureiro*, G. florida, *Linné* and G. radicans, *Thunberg.*—Nat. ord. Rubiaceæ.—These shrubs are indigenous to Eastern and Southern Asia, and produce obconical four- or six-sided somewhat winged berries, which attain a length of 4 Cm. ($1\frac{3}{5}$ inches) and contain numerous flat and finely-pitted seeds imbedded in a red pulp. The coloring matter of the latter, according to Rochleder and L. Mayer (1858), is identical with that of crocus. The fruits are regarded as possessing demulcent and refrigerant properties, and are largely used in the East for dyeing yellow.

Action and Uses.—Saffron is generally regarded as a stimulant aromatic. Like other powerfully odorous vegetable substances, its emanations occasion headache, sleep, stupor, and even death. It also displays anodyne and antispasmodic properties. Its aromatic quality is exhibited in its general use as a condiment in tropical countries, where the heat enfeebles digestion and vegetable food is chiefly used. Like other agents of its class, it sometimes appears to stimulate the pelvic organs, as shown by its employment from remote periods as an emmenagogue and also as an aphrodisiac. During its use the urine is colored yellow.

As just indicated, it is most commonly employed to prevent or relieve flatulent *dyspepsia* and its accompanying *colic*, for by expelling the gaseous contents of the digestive canal it enables that organ to perform its functions more perfectly. It may be prescribed, like other aromatics, to allay the pain of *dysmenorrhœa*. Hot infusions of saffron are sometimes given to promote *exanthematous eruptions*. It has long been reported to be efficacious in spasmodic *coughs* and *asthma*, but its value in these affections is very slight. Yet the preparations of saffron may be conveniently employed as vehicles for more powerful drugs. Like the flowers of other plants containing a volatile oil, those of saffron have long entered into various compounds in popular use to relieve *rheumatic* and *neuralgic pains*, to remove the soreness and discoloration of *bruises*, and to promote the healing of *abrasions* and superficial *sores*. A collyrium of saffron has been employed in subacute and chronic inflammations of the *conjunctiva*, and saffron ointment has been reputed to be anexcellent palliative of *hæmorrhoids*. A strong infusion of saffron applied to the gums is said to allay the pain of *dentition*.

Saffron has been omitted from most of the officinal preparations into which it formerly entered—a change justifiable, if at all, upon economical rather than upon medical grounds.

The *dose* of saffron is from Gm. 0.30–2.00 (gr. v–xxx), the former quantity sufficing as a gastric, the latter as a general, stimulant. But the dose should be repeated at short intervals. Only pure and well-preserved,s pecimens can be depended upon. An infusion may be made with Gm. 8 (℥ij) of saffron to Gm. 500 (a pint) of boiling water, of which Gm. 125 (f℥iv) may be given at intervals of half an hour or an hour.

CUBEBA, *U. S., Br.*—Cubeb.

Cubebæ, P. G. ; *Fructus* (*s. Baccæ*) *cubebæ*, *Piper caudatum.*—*Cubebs*, E. ; *Cubèbe*, *Poivre à queue*, Fr. ; *Kubeben*, G. ; *Pepe cubebe*, It. ; *Cubebas*, Sp.

The unripe fruit of Cubeba officinalis, *Miquel*, s. Piper Cubeba, *Linné filius.* Steph. and Church, *Med. Bot.*, plate 175 ; Bentley and Trimen, *Med. Plants*, 243.

Nat. Ord.—Piperaceæ.

Origin.—The cubeb-plant, which is indigenous to Java and some of the adjacent islands, is a climbing diœcious shrub about 6 M. (20 feet) high, with ovate or ovate-lanceolate, leathery, and shining leaves upon short petioles about as long as the peduncles of the spikes. The pistillate spikes are about 4 Cm. ($1\frac{3}{5}$ inches) long, cylindrical, with the fruit at first sessile, afterward stalked. The plant is cultivated chiefly in coffee plantations, and the fruit collected before it is ripe.

Fig. 86.

Cubeba officinalis, *Miquel.*

Description.—Cubebs are of the size and general appearance of black pepper, about 4 or 5 Mm. ($\frac{1}{6}$ or $\frac{1}{5}$ inch) in diameter, at the base contracted into a kind of stalk 8 or 10 Mm. ($\frac{1}{3}$ or $\frac{2}{5}$ inch) long, very slightly pointed at the apex from the remnants of the stigmas, of a brown-gray to blackish-gray color, and a reticulately wrinkled surface. The integuments of the fruit consist of a thin, dried, fleshy layer and a smooth lighter-colored shell, surrounding a globular cavity with an undeveloped whitish seed at the base. The epicarp and endocarp consist of stone-cells, those of the former being cubical in one interrupted row, those of the latter radically elongated, and in two or three rows. The mesocarp is formed of thin-walled parenchyma and larger oil-cells, both containing crystals of cubebin, the former also starch-granules in the outer layer. The fruit has a strong spicy odor and a pungent aromatic and bitterish taste, is frequently mixed with, and should be freed from, the nearly inodorous rachis or common axis, which is from 25 to 40 Mm. (1 to $1\frac{3}{5}$ inches) long and has a pitted surface.

Constituents.—Cubebs contain from 5 to 15 per cent. of volatile oil (see Oleum Cubebæ), fixed oily, waxy matter, resin, cubebin, gum, malates, etc. The medicinally most important constituents are the *indifferent resin* and *cubebic acid;* they were isolated by Bernatzik (1863), and further examined by E. A. Schmidt (1870), 1873). *Cubeb resin* is amorphous, slightly soluble in ether, carbon disulphide, or chloroform, but dissolves freely in caustic alkalies and alcohol; it is not precipitated from the spirituous solution by lead acetate. *Cubebic acid*, $C_{14}H_{16}O_4$, is an amorphous, yellowish mass, soluble in alkali, ether, chloroform, carbon disulphide, benzene, and petroleum benzin, and is precipitated from its alcoholic solution by lead acetate; its sodium salt crystallizes from hot alkaline liquids and from alcohol. Both resinous compounds are colored red by sulphuric acid. The indifferent resin has been obtained in quantities of 2.5 to 3.5 per cent., and the cubebic acid in amounts of 0.96 to 3.4 per cent.

Cubebin, $C_{10}H_{10}H_3$, according to Weidel (1877), was first obtained pure by Soubeiran and Capitaine (1839), and forms the principal portion of the deposit in the ethereal extract. It crystallizes in tasteless and inodorous white needles or pearly scales, which melt at 128° C, (257° F.), are colored red by sulphuric acid, and dissolve in 26.6 parts of ether, readily in benzene and in chloroform, and in 30 parts of cold and in 10 parts of boiling alcohol; the alcoholic solution has a bitter taste. By melted potassa cubebin yields carbon dioxide, acetic, and protocatechuic acids. Medicinally, it appears to be inactive; its percentage varies between 0.4 and 2.5.

Potassium chloride has been found among the saline constituents of cubebs.

Impurities and Substitutions.—The presence of cubeb-stems (the rachis) has been alluded to before. Black pepper and other piperaceous fruits occur sometimes as accidental, rarely if ever as intentional, impurities. The fruit of Rhamnus catharticus has only a very superficial resemblance, and is at once distinguished by the true pedicel and its four seeds. Allspice is much larger, has no pedicel, contains two seeds, and is crowned with the calyx limb.

The following two species are mentioned in *Pharmacographia* as yielding fruits extremely cubeb-like: Cubeba Lowong, *Miquel* (Piper Lowong, *Blume*), and Cub. Wallichii, *Miquel* (Pip. ribesioides, *Wallich*). The fruit of Cub. canina, *Miquel* (Pip. caninum, *Dietrich*), is smaller than cubeb, and contracted below into a stalk of only half the length of the globular portion. In 1863 a fruit was sold as cubeb which by Groenewegen was referred to Piper anisatum, *Humboldt et Bonpland;* it is probably the same which Flückiger and Hanbury refer to Cubeba crassipes, *Miquel* (Pip. crassipes, *Korthals*). The fruit of Cub. Clusii, *Miquel*, of Western Africa, resembles cubeb, but, according to Stenhouse (1855), it contains piperine instead of cubebin.

Action and Uses.—Cubeb is a local irritant. Taken into the stomach, it stimulates the whole intestinal tract, after the manner of black pepper, thereby exciting more or less irritation of the rectum and other pelvic organs. At the same time, its active

principle is absorbed, causing flushing of the face and diffused warmth, and increasing the urinary secretion as well as giving it a peculiar odor. It does not derange the digestion like copaiva. Its direct and indirect operation upon the genito-urinary apparatus may be attended with painful irritation of those parts if the medicine is given when they are actively inflamed. Excessive doses may occasion vomiting, gastro-intestinal irritation, and a general feverish condition. Cubeb sometimes produces an erythematous eruption on the skin (*Amer. Jour. Med. Sci.*, Jan. 1881, p. 289).

The chief medicinal application of cubeb is to relieve inflammation of the urinary passages. It has long been used for the cure of *gonorrhœa*, but at present, like copaiva, it is in a great degree superseded by the local treatment of that affection. In efficacy it is inferior to copaiva, but it is more readily tolerated by the digestive organs. The cases of gonorrhœa to which it is most appropriate are those in which the attack is recent and the inflammation moderate, but more inflammatory conditions, accompanied by chordee, scalding urine, and even swelled testicle, do not contraindicate the medicine, although they call for caution in its use—that is to say, for the administration of small, rather than large, doses. The former may be represented by about Gm. 1 (gr. xv) three times a day; the latter, which usually should be reached by gradual increase, may be stated to be Gm. 2 (gr. xxx) or more. Few persons can long tolerate so large a dose, which is apt to cause vomiting and diarrhœa, besides inspiring invincible disgust. It should not be continued longer than a week or ten days, unless the gonorrhœal discharge declines, in which case the dose should be gradually reduced. It is asserted that the efficient element of cubeb in the cure of gonorrhœa is cubebic acid, which appears capable of curing the acute affection when given in doses of Gm. 0.10–0.15 (gr. ij–iij) every two or three hours; but, on the whole, it seems to be less successful than cubeb itself.

Irritability of the urethra in females, with accompanying vesical tenesmus and scalding of the urine—a condition often associated with catamenial congestion—is apt to be mitigated by cubeb in doses of from 20 to 30 grains two or three times a day. *Vesical irritability* and *tenesmus* produced by cold or by cantharidal irritation, and nocturnal *incontinence of urine*, may often be cured in the same manner. Chronic *cystitis* and *vaginal discharges* are favorably influenced by cubeb, and, like copaiva, but less surely, this medicine may be used in *chronic bronchitis*. Its local stimulant action seems to have been advantageous in certain cases of *pseudo-membranous angina*, when cubeb was given finely powdered in the dose of Gm. 8–12 (ʒij–iij), mixed with syrup. It was also administered with powdered sugar, which itself was probably not without influence on the result. But, while stimulating the fauces and the system generally, it also prevented the meddlesome medication which has not a little to answer for in this disease. A like remark may be applied to the use in this disease of inhalations of watery vapor charged with cubeb. Cubeb has been thought to be efficacious in certain nervous disorders, comprising *headache*, *vertigo*, *fainting*, *impaired memory*, and even *paralysis*; doubtless, such symptoms, depending upon exhaustion of the nervous centres, may be ameliorated by whatever stimulates them primarily, while it secondarily improves the digestion, and therefore the composition of the blood.

Cubeb is administered in *doses* of Gm. 0.60 (gr. x) and upward, either mixed with water or with powdered sugar or enclosed in wafers. In the last case it should be followed by a mouthful of water.

CUCUMIS.—Cucumber.

Concombre Fr.; *Gurke*,, G.; *Cohombro*, Sp.

The fruit and seed of Cucumis sativus, *Linné*.

Nat. Ord.—Cucurbitaceæ.

Origin.—The cucumber is indigenous to Southern and Central Asia, but is now extensively cultivated in most civilized countries. It has a roundish hispid stem, climbing by simple tendrils, alternate, heart-shaped, and somewhat five-lobed rough leaves, and unisexual yellow flowers.

Description.—The fruit is at first rough and somewhat verrucose, but becomes smooth on ripening. It is cylindrical-oblong, somewhat triangular, obtuse at both ends, sometimes curved, and varies considerably in size and color. It has a slight but quite characteristic odor and a slightly saline and rather harsh taste.

The seeds are about ⅓ inch (8 Mm.) long, oblong-ovate, flat, rather acute on the edge, and with a short point above. They are white, inodorous, and of an oily taste. The embryo is of the shape of the seed, and consists of two plano-convex white cotyledons,

with a short radicle in the pointed end. The seeds contain about 30 per cent. of a bland light-yellow fixed oil.

Pharmaceutical Uses.—Prof. Procter (1853) gave a formula for *cucumber ointment*, which is prepared by grating 7 pounds of green cucumbers, expressing the juice, and incorporating it, about one-third at a time, with 15 ounces of suet and 24 ounces of lard, the fats having been previously fused together and allowed to cool until the mixture commences to thicken. After all the juice has been in contact with the fat, the latter is melted, strained, and preserved in glass jars covered with a layer of rose-water; the jars should be well closed. When intended for use a portion of the ointment is triturated with a little rose-water until it becomes white and creamy.

Allied Plants.—The following plants are indigenous to Southern Asia, and at present cultivated in many warm countries:

Cucumis Melo, *Linné.*—Muskmelon.—The seeds resemble cucumber-seeds, but are somewhat larger and rather more blunt on the edge; they contain an inodorous yellowish fixed oil.

Cucumis (Cucurbita, *Linné*) Citrullus, *Séringe*, s. Citrullus vulgaris, *Schrader.*—Watermelon.—The seeds are about 12 Mm. (½ inch) long, blackish or brown and marbled, broadly ovate, flat, blunt on the edge, near the pointed end with two thin converging ridges. They yield by pressure about 30 per cent. of a thin light yellow bland oil.

Lagenaria vulgaris. *Séringe*, s. Cucurbita Lagenaria, *Linné.*—Gourd.—The seeds are 18 Mm. (¾ inch) long, oblong, obtuse at both ends, thickened and with two furrows near the margin, the surface yellowish-white and soft felt-like.

Momordica balsamina, *Linné.*—Balsam-apple.—The fruit is ovate in shape, narrowed at both ends, somewhat angular, warty, bright-red or orange-colored, and separating laterally. It contains numerous flat, oval, and wrinkled brownish seeds, which are surrounded with a fleshy red arillus.

Action and Uses.—The ointment prepared with cucumber-juice is supposed to be peculiarly mild, emollient, and healing when freshly made and applied to *abrasions* and other analogous lesions.

The juice of the watermelon increases somewhat the secretion of urine—an effect which is perhaps due to the sugar it contains. An infusion of the whole seeds is decidedly diuretic, and that of the bruised seeds is also demulcent. No better drink than the latter infusion can be used in all cases of irritation of the *kidneys* or *bladder*, and especially in those of *retention of urine* produced by cold. A syrup made with the inspissated juice is alleged by Popoff to be powerfully diuretic (*Med. News*, xlix. 289).

The root as well as the fruit of *balsam-apple* is an active purgative. Gm. 8 (℥ij) of the latter given to a dog are said to have killed it within sixteen hours. In the Philippine Islands a decoction of it is employed as an emetic. An infusion of the seeds in olive or almond oil has been used as a vulnerary and also to relieve hæmoptysis (Strumpf, *Handbuch*, ii. 214).

CUMINUM.—Cumin.

Fructus cumini s. cymini.—Cumin, Fr.; *Kreutzkümmel, Mutterkümmel, Römischer* (*langer, scharfer*) *Kümmel*, G.; *Comino*, Sp.

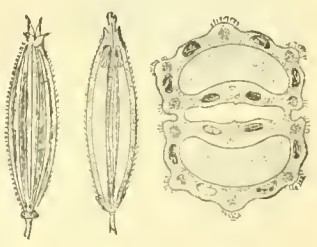
The fruit of Cuminum Cyminum, *Linné.*

Nat. Ord.—Umbelliferæ Orthospermæ.

Origin.—The cumin-plant is indigenous to Egypt and other parts of Africa, and is cultivated in various parts of Asia and Europe, in the latter continent chiefly in Southern Italy and the neighboring islands. It is an annual about 30 Cm. (1 foot) high; the leaves are divided into narrow linear segments; the umbels are small, and the umbellets have about five white or purplish flowers.

Description.—The fruit is about 6 Mm. (¼ inch) long, oblong, narrowed at both ends, slightly compressed laterally, and of a yellowish-brown color. The two mericarps are usually united; each has five light-colored filiform ribs, which are beset with soft short hairs and are separated by broad brown furrows, each containing a pale-brown rather broad, rough, hairy, secondary rib and covering one oil-tube. Two oil-tubes (vittæ) are contained on the face or six in each mericarp. The strong aromatic odor and taste somewhat resemble those of caraway. Cumin is very prone to the attacks of insects, which eat the entire seed, leaving only the fruit-shell.

Fig. 87.



Cumin: fruit and longitudinal section, 3 diameters; transverse section, 8 diameters.

Constituents.—Examined by Bley (1829), cumin was found to contain 7.7 per cent. of fat, 13.5 of resin, 15.5 of protein compounds, 8 of gum, and only 0.24 of volatile oil, the remainder being extractive, salts (mainly malates), cellu-

lose, and 9 per cent. of moisture. Raybaud obtained nearly 3 per cent. of volatile oil. The latter consists of several hydrocarbons—one having the composition $C_{10}H_{16}$, another being *cymol* or *cymene*, $C_{10}H_{14}$, which at 15° C. (59° F.) has the specific gravity 0.860, boils at 175° C. (347° F.), and has a lemon-like odor (Gerhardt and Cahours)—and of an oxygenated body, *cuminol* or *cumin-aldehyde*, $C_{10}H_{12}O$, which has the density 0.972, boils at about 230° C. (446° F.), has a caraway-like odor, and yields with nitric acid crystallizable *cuminic acid*, $C_{10}H_{12}O_2$. Volatile oils identical with *oil of cumin* have been obtained by Trapp (1858) from the fruit of Cicuta virosa, *Linné*, and by Haines (1856) from the fruit of Ptychotis (Carum, *Bentley*) Ajowan, *De Candolle*; the latter, however, was shown by Stenhouse to contain thymol.

The *ajowan* (Bentley and Trimen, *Med. Plants*, 120) is largely cultivated in Oriental countries; the fruit is about 1.5 Mm. ($\frac{1}{16}$ inch) long, ovate, laterally flattened, rough, gray-brown, has broad ribs, and in each mericarp six oil-tubes.

Action and Uses.—Cumin is mildly stimulant and carminative in the same manner as anise and caraway, and may be used for the same purposes. It has been regarded as a galactagogue, but Dolan failed to detect any such action in it (*Practitioner*, xxvii. 164). It is, however, very seldom employed. The *dose* may bs stated at from Gm. 1–2 (gr. xv–xxx). AJAVA, or ajowan, seeds are stated by Waring to combine stimulant, antispasmodic, and tonic qualities, and to mitigate the desire for alcoholic drinks

CUPRI ACETAS.—COPPER ACETATE.

Cuprum aceticum, *acetas cupricus*, *Æruga crystallisata s. destillata*, *Flora virides aëris.*—*Copper verditer*, *Crystallized verdigris*, E.; *Acétate de cuivre*, *Verdet crystallisé*, *Crystaux de Vénus*, Fr.; *Kupferacetat*, *Gereinigter* (*krystallisirter*, *destillirter*) *Grünspan*, G.

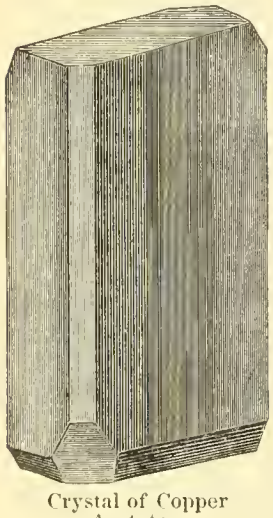
Formula $Cu(C_2H_3O_2)_2.H_2O$. Molecular weight 198.86.

Origin.—Verdigris was already known to Theophrastus about 300 B.C., when it was prepared from copper and various refuse products obtained in making wine. Crystallized copper acetate was probably first prepared by the Arabian chemists in the eighth century by dissolving verdigris in vinegar. At present it is manufactured in the same manner, or from copper sulphate and lead or calcium acetate.

Preparation.—Verdigris is dissolved in about 4 parts of warm wood vinegar; the clear decanted liquid is concentrated by evaporation in copper vessels and allowed to crystallize in wooden tanks; or, solutions of 2 parts of copper sulphate and 3 parts of lead acetate are mixed, the liquid decanted from the insoluble lead sulphate, acidulated with a little acetic acid, and evaporated to crystallize.

Properties.—This salt is met with in deep blue-green rhombic prisms, which are nearly opaque or somewhat translucent, glossy, superficially effloresccnt on exposure to the atmosphere, and have the spec. grav. 1.914, an acetous odor, and a disagreeable metallic taste. The effloresced surface is dull and of a light bluish-green color, the powdered crystals of a bright blue-green, resembling verdigris. When kept over sulphuric acid the crystals turn white from the loss of water, but become blue-green again in the air. On the application of heat water is given off, and at 110° C. (230° F.) also traces of acetic acid, the loss in weight up to 140° C. (284° F.) amounting to about 10 per cent.; the water of crystallization is 9.04 per cent. The residue left is of a blue-green color, soluble in water, and on being heated to between 240° and 260° C. (464° and 500° F.) yields about 36 per cent. of glacial acetic acid, and above 270° C. (518° F.) acetone, carbon dioxide, and other products of decomposition, while chiefly metallic copper is left behind. The salt dissolves at 15° C. (59° F.) in 15 parts of water and in 135 parts of alcohol, and at the boiling temperature in 5 parts of water and in 14 parts of alcohol. The aqueous solution is blue-green, gives off acetic acid on boiling, depositing at the same time a basic salt, and changes to a deep-blue color with excess of ammonia or ammonium carbonate. Sulphuric and other strong acids decompose the salt, liberating acetic acid.

FIG. 88.



Crystal of Copper Acetate.

Tests.—The salt should be completely soluble in excess of solution of ammonium carbonate (absence of lead, calcium, etc.). If dissolved in diluted nitric acid, no precipitate should be produced with silver nitrate or barium nitrate (absence of chloride and sulphate). If the aqueous solution of the salt be treated with hydrogen sulphide until

all the copper is precipitated, the filtrate should leave no residue on evaporation (alkalies, alkaline earths, and iron). If the aqueous solution be heated to boiling with solution of soda in excess, it yields a filtrate which should not be clouded by hydrogen sulphide (absence of lead, zinc).

Pharmaceutical Preparation.—TINCTURA CUPRI ACETICI RADEMACHERI. Dissolve 1 part of copper acetate in 10 parts of warm water, and add 8 parts of alcohol.

Allied Salt.—CUPRI SUBACETAS, *U. S.* (1870); Ærugo, Viride aëris, Subacetas cupricus.—Verdigris, Copper subacetate, *E.*; Acétate basique de cuivre, Vert-de-gris, Verdet gris, *Fr.*; Grünspann, Spagrün, Basischessigsaures Kupfer (Kupferoxyd), *G.*—Formula of pure verdigris $Cu_2O(C_2H_3O_2)_2$. Molecular weight 260.04.—In the wine districts of Southern Europe, and particularly in the neighborhood of Montpellier, verdigris is prepared by the aid of the marc of the wine-press. These grape-husks are allowed to undergo the acetic fermentation, and are then stratified in earthen vessels with sheets of copper, which, if new, have been previously superficially corroded by a solution of copper acetate. After having been thus kept at a temperature of 8° or 10° C. (46° or 50° F.) for three or four weeks, the plates are removed, placed upright to dry, and for the following six or eight weeks are occasionally dipped into water and exposed, until the neutral acetate at first formed has been converted into a thick layer of verdigris, which is scraped off. The sheets are then replaced in the grape-husks, and the process repeated until the copper has been completely corroded. The scrapings are formed with water into cakes of convenient size and dried. Verdigris of inferior quality is said to be made in the cider districts of England in a similar manner from pommage or apple-marc, and in some places it is obtained by exposing the copper to the vapors of vinegar or pyroligneous acid or by treating impure cupric oxide with the latter. The annual importation of verdigris into the United States during seven years averages about 203,902 pounds; in 1880 it reached 305,792 pounds. Verdigris is met with in commerce in heavy and hard bluish-green masses containing a considerable number of small crystals and breaking with an earthy somewhat crystalline fracture. It varies in composition, but always consists mainly of hydrated oxyacetate of copper, and contains between 45 and 50 per cent. of cupric oxide. It is decomposed by, and but partially soluble in, water, insoluble in alcohol, but completely soluble, the impurities excepted, in ammonia and dilute sulphuric, acetic, and hydrochloric acids. Acids should produce but little effervescence, showing the absence of carbonate. The presence of chalk as an impurity is determined by the copious effervescence when dissolving a sample in warm acetic acid, and by the precipitate occurring in the solution on the addition of ammonium oxalate.

CUPRI NITRAS, *Br.*, $Cu(NO_3)_2.3H_2O$, a deep-blue deliquescent salt, is made by dissolving copper in diluted nitric acid.

Action and Uses.—Acetate of copper has been used in lotions for various local inflammations, including *gonorrhœa*, in solutions of $\frac{1}{5}$ to 1 per cent., and internally, in pill or potion in doses of $\frac{1}{5}$ to 1 grain, in several chronic *skin diseases*, *scrofula*, *intermittent fever*, and *epilepsy*; but in the latter affection it is now quite obsolete, and in the former is superseded by the sulphate. Acetate of copper has been employed, like acetate of zinc, in *collyria* and for stimulating *aphthous ulcers* of the mouth.

Subacetate of copper is very rarely used internally, and seldom as a local application. Its stimulant or escharotic action, according to the strength of the solution employed, is sometimes taken advantage of in the treatment of indolent *ulcers* and chronic tuberculated affections of the *skin*, and to remove condylomata and *warts*, especially the soft warts due to *syphilis*. These excrescences, and also condylomata, may be destroyed by a mixture of equal parts of verdigris and powdered savine.

CUPRI SULPHAS, *U. S., Br.*—COPPER SULPHATE.

Cuprum sulfuricum, P. G.; *Sulfas cupricus*, *Cuprum vitriolatum*.—*Cupric sulphate*, *Blue vitriol*, *Bluestone*, E.; *Vitriol bleu*, *Sulfate de cuivre*, Fr.; *Kupfervitriol*, *Blauer Vitriol*, *Schwefelsaures Kupfer* (*Kupferoxyd*), G.; *Solfato di rame*, It.; *Solfato de cobre*, Sp.

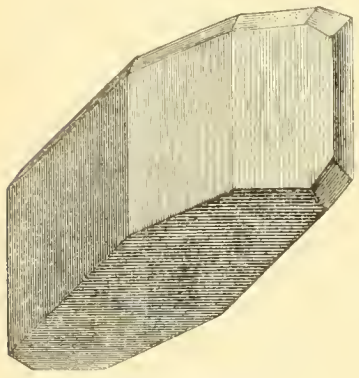
Formula $CuSO_4.5H_2O$. Molecular weight 248.8.

Preparation.—Blue vitriol is obtained on a large scale from the native (*copper pyrites*) or artificially-prepared sulphide by converting it through oxidation into the sulphate; for this purpose the sulphide is obtained by heating sheet copper to redness and throwing sulphur upon it. The water accumulating in copper-mines contains the sulphate in solution, formed by the oxidation of the native sulphide. The iron contained in this is removed either by digesting with copper oxide or carbonate or by evaporating to dryness and heating until the iron salt is decomposed. The same salt is also formed in the preparation of sulphurous acid from copper and hot oil of vitriol, and in the extraction or purification of silver by precipitating this metal from its sulphuric acid solution by means of copper; also by dissolving the black scales obtained in coppersmithing in weak sulphuric acid (chamber acid).

Purification.—Copper sulphate cannot by recrystallization be separated from the sulphates of the allied and of the alkali metals, owing to the formation of double salts. The so-called *double vitriol* (vitriol de Salzbourg, *Fr.;* Doppelvitriol, *G.*) contains 70 to 80 per cent. of ferrous sulphate, and the *vitriol mixte de Chypre* contains zinc sulphate; these were formerly, but now are rarely, employed in the arts. If iron alone is present, it may be conveniently removed by oxidizing with nitric acid and digesting the solution with barium carbonate; ferric hydroxide and barium sulphate will be precipitated with the excess of the carbonate, and the filtrate will yield pure crystals. If contaminated with other metals its purification will be difficult, and it is more convenient to prepare the salt directly by heating 3 parts of copper with 10 parts of sulphuric acid, or with 5 parts of sulphuric acid, 50 of water, and 4 or 5 of nitric acid.

Properties.—Copper sulphate crystallizes in transparent azure-blue oblique triclinic short prisms, which are without odor, and have a disagreeable styptic metallic taste, the specific gravity 2.274, and an acid reaction. On trituration they yield a whitish-blue powder, and on exposure to a dry atmosphere they effloresce superficially. "When carefully and continuously heated to 30° C. (86° F.), the salt loses 2 of its 5 molecules of water (14.43 per cent.), and is converted into a pale-blue, amorphous powder. Two more molecules of water are lost at 100° C. (212° F.), while the fifth is retained until 200° C. (392° F.) is reached, when a white, anhydrous powder remains (63.9 per cent.). At a still higher temperature sulphur dioxide and oxygen are given off, and a residue of black cupric oxide is left."—*U. S.* The salt is insoluble in alcohol, but dissolves in 400 parts of diluted alcohol sp. grav. .940. 1 part of the crystallized salt dissolves in about 2.6 parts of water at 15° C. (59° F.), *U. S.* (3.5 parts *P. G.*), and in 0.5 part of boiling water, *U. S.* (1 part, *P. G.*). The solution has a pale-blue color, which is changed to green on the addition of a soluble chloride, and yields a white precipitate with barium chloride and a blue one with ammonia-water, soluble in excess of the latter. Commercial blue vitriol (Cuprum sulfuricum crudum, *P. G.*) is sometimes quite impure, but there is no difficulty in finding in our market very good and pure copper sulphate.

Fig. 89.



Crystal of Copper Sulphate.

Tests.—"If ammonia-water be added to the solution, drop by drop, a pale-blue precipitate of cupric hydroxide is formed, which redissolves in an excess of ammonia-water, forming a deep azure-blue solution, leaving no trace of residue undissolved (absence of iron, aluminum, etc.). If the aqueous solution (1 in 20) be heated to boiling with an excess of sodium hydroxide test-solution, until all the copper has been converted into black cupric oxide, it will yield a filtrate which, after acidulation with acetic acid should not be colored or rendered turbid by an equal volume of hydrogen sulphide test-solution (absence of arsenic, lead, zinc, etc.) If hydrogen-sulphide gas be passed through 10 Cc. of the solution slightly acidulated with hydrochloric acid, until all of the copper is precipitated as sulphide, the filtrate should, on evaporation, leave not more than a trace of fixed residue (limit of iron, aluminum, alkaline earths, etc.)."—*U. S.*

Pharmaceutical Preparations.—Cuprum aluminatum, *P. G.*, s. *Lapis divinus*, Kupferalaun, *G.* It is prepared by powdering 17 parts each of pure cupric sulphate, potassium nitrate, and alum, fusing the mixture in a porcelain capsule at a moderate heat, adding a previously prepared mixture of finely-powdered camphor and alum each 1 part, stirring well, and immediately pouring upon a porcelain slab or plate to cool and harden, when it is broken into pieces and preserved in well-stoppered bottles. The *pierre divine* or *pierre ophthalmique* of the French Codex contains a trifle less of camphor. In dispensing the *aluminated copper* it should be well triturated in a mortar with a few drops of water before the remaining ingredients are added, to facilitate the solution of the camphor. A collyrium, *Collyre de pierre divine* (*F. Cod.*), is made by dissolving 4 parts of aluminated copper in 1000 parts of water, and filtering.

Allied Compounds.—Cuprum ammoniatum, Cuprum sulfuricum ammoniatum.—Ammoniated copper, Ammonio-sulphate of copper, *E.;* Sulfat de cuivre ammoniacal, Cuivre ammoniacal, *Fr.;* Schwefelsaures Kupferroxyd-Ammeniak (Kupfer-Ammonium, Cuprammonium) *G.*—Formula of crystals $Cu(NH_3)_4SO_4.H_2O$; molecular weight 245.—Rub together in a glass mortar copper sulphate 4 parts and ammonium carbonate 3 parts until effervescence ceases; wrap the product in bibulous paper, dry it with a gentle heat, and keep it in a well-stoppered bottle.—*U. S.* 1870. This preparation contains an excess of ammonium carbonate. It is obtained pure and in crys-

tals by dissolving copper sulphate 1 part in ammonia-water 3 parts, filtering, and pouring upon the solution 6 parts of alcohol; in proportion as the latter abstracts the water from the solution, prismatic crystals will be deposited. The salt will be at once separated as a crystalline powder on mixing the alcohol with the aqueous solution. Ammonio-sulphate of copper has a deep azure-blue color and an ammoniacal odor; exposed to the air, it loses ammonia and gradually changes to light blue. It dissolves in 1½ parts of cold water; the solution has an alkaline reaction and metallic taste, and on the addition of more water becomes turbid and produces a sediment. With a solution of arsenous acid a green precipitate (Scheele's green) is produced. When the salt is heated to 150° C. (302° F.) ammonia and water are given off, and an apple-green powder remains having the composition $Cu(NH_3)_2SO_4$, being a cupro-diammonium sulphate, while the medicinal salt is a cupro-tetrammonium sulphate; this contains 27.10 per cent of ammonia and 32.38 oxide of copper. Berzelius obtained 26.40 and 34.0 per cent.

Cupri oxidum, Cuprum oxydatum.—Cupric oxide, *E.;* Oxyde de cuivre, Safran de Vénus, *Fr.;* Kupferoxyd, *G.*—CuO; mol. weight 79.14.—Dissolve copper sulphate 10 parts and sodium carbonate 15 parts each in hot water 50 parts; mix the solutions, and continue the heat until the voluminous precipitate becomes dense; collect this, wash it well, and expose it to a moderate red heat. It is a soft, black, amorphous, heavy powder, which dissolves in dilute nitric acid without effervescence (absence of carbonate); this blue solution may be tested for iron and other metals by ammonia and hydrogen sulphide in the same manner as copper sulphate. If to 1 Gm. of copper oxide be added 1 Cc. of solution of ferrous sulphate, and afterward, without mixing, 1 Cc. of strong sulphuric acid, a brown color should not be produced between the liquids (absence of nitrate). By precipitating a solution of copper sulphate with an excess of potassa or soda, and boiling, a brownish-black powder is obtained having the composition $Cu(OH)_2 + CuO$ (molecular weight 255.38); by red heat it is converted into anhydrous oxide, CuO.

Action and Uses.—Taken in small doses by man, sulphate of copper may be regarded as astringent and tonic. It does not act on healthy tissue as a caustic. In emetic doses its action is prompt and rapid, and it leaves no nausea or depression behind it. Even in very large (and in what may be called poisonous) doses it is rarely fatal to life, and recovery is usually rapid and complete, although in some cases derangement of the digestive function, with diarrhœa, may for a time continue. The symptoms of acute poisoning by this substance are headache, convulsions, colic, vomiting, collapse, suppression of urine, and sometimes jaundice. In the rare cases of death following directly upon poisoning by sulphate of copper congestion of the gastro-intestinal mucous membrane was the only discoverable lesion; in some instances of death occurring at a later period ulceration, and even sloughing and perforation, of the bowel have been found.

The power of copper to neutralize the infectious agent of *cholera*, which was supposed to have been proved by the immunity from this disease of workers in the metal, has not been sustained by experience. The emetic operation of sulphate of copper is peculiarly appropriate to the treatment of pseudo-membranous *croup*, on account of its sustained mechanical and expulsive action, unaccompanied by nausea or other cause of depression. It has no specific operation whatever upon the seat of the plastic exudation, and therefore it can only be useful when the membrane has become spontaneously loose or been loosened by other agents—such, for instance, as mercury, inhaled lime-water or lactic acid, and possibly in some cases by depletion. In *malignant sore throat* a solution of 2 grains to the ounce has been given in tablespoonful doses every ten or fifteen minutes with alleged success. It is probable that the local application by means of a sponge of this or of a stronger solution would be, at the least, as efficient. There is some reason to think that *quartan agues* have been cured by sulphate of copper in doses of ¼ grain three times a day. It has been alleged that sulphate of copper is a more certain remedy than mercury for constitutional *syphilis*, but this claim of Martin and Oberlin does not appear to have been confirmed. Solutions of the salt form efficient injections for *gleet* and *leucorrhœa*. They should have a strength of 1 or 2 grains to the ounce. In leucorrhœa they may be applied on tampons. *Dysentery* and *diarrhœa* in their chronic forms, but especially the former disease, are often materially benefited by enemas of a pint of tepid water holding in solution from 10 to 20 grains of sulphate of copper. All forms of *ulcers* are very advantageously modified by it, as ulcers of the cornea, nostrils, mouth, vagina, and general surface, especially when they present an indolent aspect or arise in vitiated states of the system; for example, in ulcerative *stomatitis*, gangrene of the *pharynx*, *mercurial sore mouth*, etc. In *conjunctivitis*, especially of the chronic, and most of all of the granular, form, this salt is of great service. When the granulations are large a crystal of sulphate of copper should be used. The same agent will sometimes suffice to arrest *hæmorrhage* from bleeding surfaces; for this purpose also it is sometimes used in the form of a powder, which may be mixed with an equal quantity of powdered gum arabic. The stimulant and astringent action of the salt has been applied to the cure of

various local affections of the skin, such as *acne rosacea*, *ichthyosis*, *alopecia*, etc. In 1866, Bamberger proposed sulphate of copper as an antidote to *acute poisoning by phosphorus*, upon the ground that the phosphorus reduces the metal, which coats the remaining phosphorus and renders it innocuous. He recommended that sulphate of copper should be given first in an emetic dose, and then continued in smaller quantities. A critic of this method (1872) remarked that it was certainly very ingenious, but there was no proof of its efficiency; and Eulenberg and Landois, who used carbonate of copper for the same purpose in experiments upon animals, found that the alleged antidote delayed their death, but did not prevent it. Charpentier claimed that a 1 per cent. solution of sulphate of copper made an efficient antiseptic solution for vaginal injection after childbirth. Sternberg's observations on various bacilli led him to conclude that this agent has but little effect on spore-bearing pathogenic organisms, but that it is a valuable germicide and disinfectant of material not containing spores (*Med. News*, xlvii. 204).

Sulphate of copper is the basis of the most usual and convenient tests for *diabetic* sugar. They all essentially consist of oxide of copper, held in solution by an alkali through the medium of organic matter which, unlike sugar, has not the property of deoxidizing copper salts during ebullition (Pavy). The most usual form of the solution is as follows: Sulphate of copper 320 gr.; neutral tartrate of potash 640 gr.; caustic potash or soda 1280 gr.; distilled water 20 f℥. Dissolve the sulphate of copper in 10 ounces of the water, and the tartrate of potash and the caustic potash or soda in the remainder. If on being boiled any deposit occurs, a little excess of potash or soda must be added. When this solution is heated in a test-tube and a drop or two of diabetic urine is added, a more or less copious deposit of suboxide of copper forms as a yellow, orange-yellow, orange-red, or brownish-red precipitate. It is said that 1 grain of sulphate of copper dissolved in an ounce of glycerin forms a solution of which 1 drachm will reduce 1 grain of grape-sugar in a caustic alkali: 2 or 3 drops of the mixture are put into a test-tube and half an ounce of liquor potassæ added; the whole is then boiled, a few drops of urine added, and the whole boiled again" (Oppenheimer, *Med. Record*, xix. 27).

Ammoniated copper in medicinal doses does not produce any immediately sensible effects upon the healthy system, but in large doses it occasions nausea, giddiness, confusion or dimness of sight, vomiting, colic, constipation, or diarrhœa, and, if persisted in, is said to cause muscular spasms or paralysis, wasting of the body, and death. It was once reputed to be an efficient remedy for *epilepsy*, but more accurate and continued observation has not sustained its character. It is one of the many medicines to which cures of *chorea* have been ascribed, and sometimes with such emphasis and detailed proofs that some faith in its efficacy cannot easily be withheld. If employed in this disease, it should be given at first in doses of Gm. 0.03 (½ grain) three or four times a day in an aromatic vehicle, with a small proportion of laudanum, and rapidly but gradually increased until it begins to disturb the stomach. It should be administered when the stomach contains food. It is stated by Féréol to have cured trigeminal neuralgia that had resisted all the most accredited medicines. The medium dose employed by him was about 2 grains, and was given after meals for ten or fifteen days (*Monthly Abstract*, Aug. 1879, p. 349). Locally, it has been employed for the same purposes as sulphate of copper in solution and in ointments.

Oleate of copper, from one to 6 parts in an ounce of cosmoline, is stated to have been very efficient in the various forms of *tinea*, even the most obstinate.

Arsenite of copper (Scheele's green) has been used in minute doses with apparent advantage by Reed (*Med. Register*, Sept. 1888, p. 230) and by Aulde and others (*Therap. Gaz.*, xiii. 459; *Med. News*, lv. 517) in the treatment of *cholera infantum* and *diarrhœa*. The dose suggested is $\frac{1}{100}$ grain dissolved in 4 to 6 ounces of water, of which a teaspoonful is given at intervals of ten minutes at first, and later of an hour.

As an emetic, sulphate of copper may be given in doses of from Gm. 0.10–0.60 (gr. ij–x) of the powdered salt mixed with pulverized sugar, and repeated every ten or fifteen minutes if necessary. As a tonic or astringent the dose is from Gm. 0.016–0.12 (gr. ¼–ij) in pill. For local application solutions containing Gm. 0.6–0.60 (gr. j–x) to the ounce of water may be used. Pencils of sulphate of copper are made by fusing together 2 parts of this salt with 1 of alum. They are also produced by first depriving the sulphate of its water of crystallization, reducing it to a fine powder, and then, after placing it in paper moulds, surrounding them with wet cloths, which restores the water of crystallization.

CUPRUM, *Br.*—Copper.

Cupreum filum.—Copper wire, E.; *Cuivre, Fil de cuivre*, Fr.; *Kupfer, Kupferdraht*, G. *Rame*, It.; *Cobre*, Sp.

Symbol Cu. Atomicity bivalent. Atomic weight 63.18.

Fine copper wire, about No. 25.

Origin.—Copper, which has been known from the earliest times, is often found in the metallic state as native copper, notably near Lake Superior; occasionally it is met with in the oxidized state as black and red copper ore or as a carbonate in malachite, and frequently as sulphide in copper pyrites, copper glance, and gray copper ore, etc. It is a natural constituent in minute quantities of some mineral springs and of many vegetable and animal organisms. The smelting process is rather complicated for many ores, and depends mainly upon the oxidation of the sulphurets by roasting and the reduction of the metal by means of charcoal or by fusing a mixture of oxide and sulphide of copper. Arsenic and antimony, which are often present, are expelled by the repeated roastings, together with the sulphur, and the iron is made to enter the slag.

Properties.—Copper is a very sonorous, malleable, and ductile metal of a reddish color, having the specific gravity 8.92 or when hammered 8.95. It melts at a bright-red heat, first becoming brittle, and expands in volume on congealing. It is inferior to iron in tenacity or strength and in hardness, but superior to it as a conductor of electricity and heat and in resisting the chemical action of moist air. Copper is not acted upon by cold concentrated or hot dilute sulphuric acid, but it dissolves readily in nitric acid. The most important of the numerous alloys of copper are *brass*, containing about 28 to 36 per cent. of zinc; *bronze*, containing 8 to 12 per cent of tin, and sometimes a little zinc and lead; *bell-metal*, containing 20 to 25 per cent. of tin; and *German silver*, composed of 8 copper, 3½ zinc, and 3 or 4 nickel.

Chemical Characteristics.—Copper forms two series of salts—*cuprous* and *cupric*, the former of which are of little importance. The anhydrous cupric salts are usually white, the hydrated green or blue; the soluble ones have an acid reaction, and their solutions are decomposed by iron, zinc, and the earth metals, with the precipitation of copper. Potassa precipitates voluminous blue hydroxide, $Cu(OH)_2$, which when boiled turns to black, $Cu(OH)_2 + CuO$. Potassium carbonate precipitates green oxycarbonate of copper, the precipitate turning black on boiling. Ammonia-water and ammonium carbonate occasion bluish-green precipitates which dissolve in an excess, forming deep azure-blue solutions. Potassium ferrocyanide yields a brown-red precipitate, which is insoluble in dilute acids. Hydrogen sulphide separates from acid solutions brown-black copper sulphide. Potassium iodide produces a grayish-white precipitate of cuprous iodide, one-half of the iodine being at the same time liberated.

Pharmaceutical Uses.—Copper wire is employed in the preparation of Spiritus ætheris nitrosi for generating nitrous acid.—*Br.*

Copper Pigments.—Bremen blue or Bremen green is cupric hydroxide, prepared by precipitating a copper salt with an alkali and drying the precipitate below 40° C (104° F.) Used as a water-color, it remains blue, but if used as an oil-color it becomes green from the formation of a copper soap. Basic cupric carbonate is sometimes sold under the same name.

Brunswick green is either copper oxycarbonate or oxychloride.

Mountain green or Mineral green is powdered green malachite or artificially-prepared copper oxycarbonate.

Scheele's green. Copper sulphate is precipitated by a solution of arsenous acid in sodium carbonate; its composition, according to Sharples (1877), is $Cu_3As_2O_6.2H_2O$.

Schweinfurt Green or Paris green is copper aceto-arsenite, prepared by boiling the mixed hot solutions of cupric acetate and arsenous acid.

Most of these pigments are also sold under other names than those given above. As met with in commerce, they are frequently mixed with alumina or calcium and barium compounds, and thus constitute lower grades. Mixtures of chrome-yellow and Prussian blue are likewise sold under several of the above names.

Action and Uses.—Copper in the metallic state is not known to exercise any specific action upon the economy. Workers in the metal, although constantly covered with its dust and receiving such large quantities of it into the system through the lungs and digestive apparatus that it is readily detected in the urine, do not appear to be liable to any special disease, although they have a more or less anæmic appearance and are subject to giddiness, lassitude, and dyspepsia. They are apt to lose their teeth early, and their gums present a green or olive-colored line, and the teeth are discolored in the same manner. In 1869, Dr. Clapton pointed out the absolute freedom of the workmen in copper from

cholera or choleraic diarrhœa (*Trans. Clin. Soc.*, iii. 7). And in 1880, Dr. Burq (*Bull. de Thér.*, xcviii. 330) not only maintained this opinion, but also alleged that these workmen are equally insusceptible of contracting typhoid fever, and that musicians who play on brass instruments are not liable to either disease. On the other hand, there can be no doubt that persons who work at trades in which copper-leaf is employed in the form of "bronze powder" may suffer from it. The symptoms do not seem to be uniformly alike, for diarrhœa or constipation may exist; but in all cases there are abdominal pain and tenderness, nausea and vomiting, an anæmic appearance of the skin, and a purplish discoloration of the gums. Copper has been found in the fæces. In one case death was ascribed to peritonitis. The treatment of such poisoning should be by gentle but repeated purgation with salines, warm baths, and a milk diet (*British Med. Jour.*, July 24, 1880; *Phila. Med. Times*, xi. 457).

CURARE, *Fr. Cod.*

Urari, Wourari, Wourali, Woorara.

Preparation.—Dr. Jobert, writing from Belen de Para to the French Academy (1878), made the following statement concerning the preparation of this South American arrow-poison: The principal ingredients are *urari u va* (probably Strychnos Castelnæana, *Weddell*) and *eko*, also called *pani du maharâo* (probably Cocculus toxiferus, *Weddell*). The young bark of these plants is well scraped, and the scrapings are mixed in the proportion of 4 parts of the former and 1 part of the latter; the mixture is well kneaded with the hands, and, in a funnel made of palm-leaf, exhausted with cold water, the liquid being returned seven or eight times. The red infusion is boiled with fragments of *taja* (an Aroidea) and *mucura-ea-ha* or *eone* (probably Didelphys cancrivora). After about 6 hours the liquid has acquired a thick consistence, and is mixed with the scrapings of three species of pepper (Artanthe?) and *tauma-gere*, and again boiled and allowed to cool, when it will have the consistence of a thick paste.

Dr. Richard Schomburgk (1879) observed the following ingredients to be used in the preparation of *urari* or *urati* in British Guiana: Bark of Strychnos toxifera, *Schomburgk*, 2 pounds; Str. Schomburgkii, *Klotzsch*, Str. cogens, *Bentham* (*aurimaru*), and *wakarimo*, of each $\frac{1}{4}$ pound; roots of *tariteng* and *tararemu*, of each $\frac{1}{2}$ ounce; four small pieces of wood of a species of Xanthoxyleæ called *manuca*. An extract is made by boiling these articles with water, straining, and adding to the thick liquid the slimy juice pressed out of the fleshy root of a species of Cissus, called *muramu;* the mixture is further evaporated by exposing it to the sun.

Planchon (1879) added to the above-named species Strychnos Gubleri, *Planchon*, which is used on the Rio Negro; Str. Crevauxii, *Planchon*, in Upper French Guiana; and Str. Yapurensis, *Planchon*, on the Yapura River. In addition to these, Rouhamon (Strychnos, *Martius*) guianensis, *Aublet*, Str. cogens, *Bentham*, Paullinia Cururu, *Linné*, and other plants have been named as being used in the preparation of this poison in different parts of South America.

Properties.—Curare is a blackish-brown extract, brittle or hygroscopic, of a very bitter taste, and almost completely soluble in dilute alcohol; cold water dissolves about 75 per cent.; this portion contains the poisonous alkaloids, and is insoluble in ether and very sparingly soluble in absolute alcohol.

Constituents.—Boussingault and Roulin (1828) separated from curare some fat, brown resin, red coloring matter, gum, clay, and the alkaloid *curarine*, which was previously discovered by A. Buehner (1827). It was examined by Preyer (1865), Dragendorff, Koch (1870), and Sachs (1878), and appears to exist in curare as sulphate and to have the composition $C_{18}H_{35}N$. It has a very bitter taste, but less persistent than strychnine; is freely soluble in alcohol and water, less soluble in chloroform and amylic alcohol, insoluble in absolute ether, carbon disulphide, and benzol; colored deep-red by nitric acid, and by concentrated sulphuric acid acquires a carmine-red color, which, on the addition of potassium bichromate, becomes violet, the reaction being very similar to that produced by strychnine under the same treatment, but the coloration is more permanent. It yields precipitates with all the group-reagents for alkaloids, and is precipitated yellow by potassium ferricyanide, and white by potassium ferrocyanide, sulphocyanate, and iodate, and by sodium phosphate and arsenate. R. Böhm (1887) found curarine to have a neutral reaction; to not neutralize acids; to be non-deliquescent, amorphous, and yellow; to yield a greenish fluorescent solution in water, and on evaporating this with a mineral acid to form needles which are not poisonous. Curare contains a non-toxic alka-

loid, *curine*, which crystallizes from ether, is precipitated by metaphosphoric acid, and on treatment with methyl iodide yields an alkaloid having the effects of curare. It seems probable that the composition of the active principle may vary with the origin of curare.

Action and Uses.—The effect of curare and curarine on animals is mainly to produce paralysis, first of the voluntary and then of the involuntary muscles, and to cause death by asphyxia. On man it acts locally as a powerful irritant of the denuded cutis. Internally, it may cause sweating and saccharine urine; but its most characteristic effect is to occasion general paralysis of the voluntary muscles by its action upon the ends rather than upon the origins of the motor nerves. Lehmann produced such effects in himself by Gm. 0.007 (gr. $\frac{1}{9}$) of curarine sulphate, given hypodermically, but they were slight and transient (*Therap. Gaz.*, ix. 542; compare *Lancet*, Apr. 1889, p. 739). Curare has been employed chiefly in the treatment of several grave diseases attended with nervous spasms, and especially tetanus, epilepsy, chorea, and hydrophobia. It is well known that *tetanus*, even of the traumatic form, has been treated successfully with various medicines which control muscular action, and this one is reported to have cured thirteen out of thirty-three cases (Demme; Busch). Other persons have published similar results, but in isolated cases. There can be no doubt that, appropriately administered, it effectually controls the spasms, probably by its direct action upon the muscles, and thereby spares the patient the exhaustion which the spasms produce. Practically, however, curare is seldom employed in the treatment of tetanus. Vulpian even comes to the conclusion that it does not favorably influence the termination of that disease (*Leçons sur les Substances toxiques*, p. 396); and the later observations of Karg do not modify his conclusion. In *epilepsy* Kunze claims to have cured nine out of thirty-five cases by this medicine, but in a later report only six cases out of eighty (*Med. Times and Gaz.*, Nov. 1878, p. 523); and Eddlefsen three out of thirteen cases, using hypodermic injections with a primary dose of $\frac{1}{3}$ grain (*Edinb. Med. Jour.*, xxvii. 842). Bourneville and Bricou, after sufficient trial, concluded that it was worthless in the treatment of epilepsy (*Med. News*, xlvii. 8). In *chorea* it also appears to be useless. It has been tried in *rabies*, uniformly with the result of appeasing or suspending the spasms, and in at least three cases it is said to have cured the disease. A critical examination of these leaves a doubt as to their nature. The reporters do not always seem to have been aware of the distinction between rabies canina and hydrophobia, nor of the alleged cure of the disease by various remedies, such as Xanthium spinosum, the hot vapor-bath, oxygen, etc. It should also be noted that in several cases the medicine appears to have been thoroughly employed without the least advantage. At the same time, its possible inertness in these instances should not be lost sight of, and in no case should any of it be used that has not first been tested upon an animal. Curare is best administered hypodermically in a filtered watery solution of the strength of 1 per cent., each injection containing about Gm. 0.006 ($\frac{1}{10}$ grain). But in a remarkable case of cure (Offenburg, 1877) about Gm. 0.02 ($\frac{1}{3}$ grain) was administered as often as the spasms threatened to return. Within 4 hours seven injections, amounting to Gm. 0.19 ($2\frac{1}{2}$ gr.) were given hypodermically in a 5 per cent. solution (*Arch. f. Exp. Pathol.*, xi. 308). In all cases it must be repeated so as to maintain complete muscular relaxation. It has also been used endermically and by the rectum. Curarine has been employed as a sulphate in from one-twentieth to one-tenth of the dose of curare, but according to Sachs this pretended *curarine* is really phosphate of lime.

CURCAS.—Purging-Nut.

Semen ricini majoris.—*Physic-nut*, *Barbadoes-nut*, E.; *Pignon d'Inde* (*des Barbades*), *Semence du médicinier*, Fr.; *Purgirnuss*, *Schwarze Brechnuss*, G.

The seed of Curcas purgans, *Adanson*, s. Jatropha Curcas, *Linné*.

Nat. Ord.—Euphorbiaceæ.

Origin.—A medium-sized monœcious shrub indigenous to the West Indies and South America, but naturalized in other tropical countries. It has smooth, angularly three- or five-lobed, cordate leaves, paniculate cymes of greenish-yellow bell-shaped flowers, the pistillate ones few and largest, and tricoccous, obtusely triangular, and blackish capsules, each cell containing one seed.

Description.—The seeds are about 2 Cm. ($\frac{4}{5}$ inch) long, ovate-oblong, flattened from the back, with a broad whitish hilum and caruncle at one end, black, not glossy, somewhat rough, and marked with numerous small cracks. The kernel has the shape of the seed, and consists of an oily albumen which encloses the embryo. The seeds are inodorous; the kernels have a sweetish and oily taste, which gradually becomes acrid and burning.

Constituents.—The principal constituent is the fixed oil, of which Arnaudon and Ubaldini (1858) obtained 37.5 per cent. It is light yellow or colorless, of spec. grav. 0.92, congealing to a butyraceous mass at −8° C. (17.6° F.), inodorous, and nearly insoluble in alcohol. When distilled with potassa, caprylic alcohol is obtained. Bouis (1854) separated a liquid and solid fatty acid, and named the latter *isocetic acid*, $C_{15}H_{30}O_2$. Cadet de Gassicourt (1824) found in the seeds also an acrid resin.

Allied Seeds.—Anda Gomesii, *Jussieu*, s. Anda brasiliensis, *Raddi*, s. Joannesia principis, *Vellozo*. A large tree of Brazil, known there as *anda-assú*, bearing a heart-shaped, obtusely quadrangular drupe, the seeds with a white fleshy arillus. The seeds resemble chestnuts, are somewhat reniform, dark-brown, and of an almond-like taste; they yield about 50 per cent. of a reddish inodorous crude drying oil, which is an active purgative in doses of 10 Gm., and is more limpid than, and free from the mawkish odor and unpleasant taste of, castor oil. One or two seeds act as a violent cathartic, often also as an emetic.

Curcas multifidus, *Endlicher*, s. Jatropha multifida, *Linné*, is a South American shrub, the seeds of which resemble the purging-nut, but are smoother and brown. According to Soubeiran, the oil of these seeds is very similar to, if not identical with, that of the latter.

Euphorbia lathyris, *Linné*, s. Tithymalus Lathyris, *Scopoli*.—Caper spurge, Garden spurge, *E.*; Epurge, Catapuce, *Fr.*; Wolfsmilch, Springkraut, *G.*—A South European herb, cultivated in gardens and somewhat naturalized in North America, the seeds of which were formerly officinal as *semen cataputiæ minoris*. They are about 3 Mm. ($\frac{1}{8}$ inch) long, oval, obtuse, on one end with the hilum and caruncle, brown, marbled with gray and rugose. The oil separates a crystalline mass on standing.

Action and Uses.—It is said that the expressed oil of curcas-seeds acts chiefly as a purgative, and that in the dose of about 12 drops it produces effects like those of an ounce of castor oil. It is more like croton oil in its operation. The acrid emetic principle resides chiefly in the embryo. It is stated that if the embryo is wholly removed, four or five of the seeds may be used as a purgative without producing either vomiting or griping. A number of cases have occurred of poisoning by eating the seeds entire. In one case a man who had eaten five of them soon complained of burning in the mouth and throat, and the whole abdomen felt distended and sore. In a few minutes vomiting occurred, and was repeated five times in the course of an hour, accompanied with active purging. The pain continued; the patient complained of feeling hot and giddy; he then became delirious, and afterward insensible. On regaining consciousness several hours later his face was pale, his hands cool, the pulse 110 and weak. He recovered. In 1854, at Birmingham, Eng., more than thirty boys were poisoned by eating these seeds. In some of them, besides the symptoms just mentioned, there was a hot skin and an appearance of drowsiness, which may, however, have been due to exhaustion produced by the evacuations. They all made good recoveries. The oil applied to the skin irritates it.

In the East Indies the juice of the plant and the oil are said to be used locally in the treatment of *cutaneous eruptions*, *rheumatism*, and *hæmorrhoids*, and in liniments to stimulate the secretion of *milk*. The freshly-prepared juice has been used topically to control *hæmorrhages*. The oil has been employed internally in *constipation*, *dropsy*, *worms*, etc., and externally in the diseases mentioned, and also in *paralysis*, pain in the *ears*, *deafness*, etc. In a word, it has, in a less degree, the qualities and medical virtues of croton oil, and appears to be purgative in about the same dose.

The uses of the oil of *Anda Gomesii* are stated under Oleum Ricini. The oil obtained by expression from *Euphorbia Lathyris*, and the seeds themselves, were formerly used in the south of France and in Italy as purgatives. Five seeds caused vomiting and diarrhœa in one experiment, but ten were required to produce a like effect in another. The expressed oil acted purgatively, and the seeds which furnished it were no longer purgative in the same degree as at first (Husemann, *Toxikologie*, p. 447).

CURCUMA.—Turmeric.

Rhizoma curcumæ.—*Curcuma*, Fr., Sp.; *Souchet des Indes*, Fr.; *Kurkuma*, *Gelbwurz*, G.

The rhizoma of Curcuma longa, *Linné*, s. Amomum Curcuma, *Jacquin*, s. Curcuma rotunda, *Linné*. Woodville, *Med. Bot.*, 252; Bentley and Trimen, *Med. Plants*, 267.

Nat. Ord.—Scitamineæ.

Origin.—The plant yielding turmeric is a perennial indigenous to India, and is extensively cultivated throughout Southern Asia and in many islands of the Indian Ocean. It produces a tuft of radical leaves, which are about 90 Cm. (3 feet) long, and have a

prominent midrib; the scape bears a few sheathing bracts below, and terminates with a spike of 15 Cm. (6 inches), bearing orange-colored flowers in pairs from the axils of spreading bracts. The United States import annually about 1,000,000 pounds of turmeric.

Description.—The central portion of the rhizome of the different species of curcuma is tuberous, and sends out nearly cylindrical branches, some of which become fusiformly thickened toward their ends, and then contain a very pure starch. Aside from these spindle-shaped, amylaceous tubers, the subterraneous stem is of two forms, and the commercial turmeric must vary as one or the other or both forms are collected, which were formerly supposed to have been produced by two distinct species.

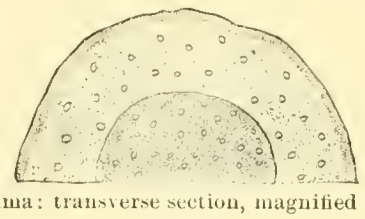
FIG. 90.

Round Turmeric.

FIG 91.

Long Turmeric.

FIG. 92.



Curcuma: transverse section, magnified 3 diam.

Curcuma rotunda, or round turmeric, attains a length of 38 to 50 Mm. (1½ to 2 inches) with a diameter of 25 Mm. (1 inch) or more; it varies in shape between globular, oblong, and pyriform, has annular marks from the scars of the leaf-sheaths, and is beset with root-scars, and a few fibres or their remnants. Curcuma longa, or long turmeric, is 25 to 50 Mm. long (1 to 2 inches), 6 to 12 Mm. (¼ to ½ inch) thick, straight or curved, mostly simple, nearly cylindrical, and somewhat annulated by the leaf-scars. The two varieties are externally covered with a yellowish-gray, soft, and friable corky layer, and break with a short and smooth fracture of a horny or resinous lustre. The interior is of a gamboge- to brown-yellow color, the centre usually of a deeper tint, and separated from the outer portion by a circular line, indicating the nucleus-sheath. The fibro-vascular bundles are scattered throughout the entire rhizome, and are more numerous near the nucleus-sheath; the polyhedric parenchyma-cells of the cortical and inner layer contain starch, resin, and drops of volatile oil. The nearly uniform color and glossy appearance of the interior are due to the scalding of the rhizomes previous to drying, whereby the starch has been converted into a pasty mass. The quality of turmeric is approximately judged by the brightness of the tint and the degree of lustre upon the fracture. Turmeric has a peculiar aromatic odor and a warm, aromatic, and bitterish taste.

The principal commercial varieties are—*Chinese turmeric*, which consists of many central rhizomes with well-developed branches; *Bengal turmeric*, mostly in slender branches of a deep reddish tint; *Madras turmeric*, in thick lateral branches, mixed with transversely-cut tubers of a gamboge tint; *Java turmeric*, which consists of rather small tubers and branches that are often transversely and longitudinally cut; and *Cochin turmeric*, in sections or slices of a larger tuber, some being marked with rather large depressed stem-scars; they are probably derived from another unknown species.

Constituents.—The investigations of Bolley, Suida, Lange (1868), Gajewsky (1870, 1872), Kachler (1870), and Flückiger (1876) have been supplemented and partly modified by C. L. Jackson and A. E. Menke (*Am. Chem. Jour.*, 1882–83, iv.). By distillation with water about 1 per cent. of volatile oil is obtained. Treatment with cold ligroin yields 11 per cent. of viscid oil, a small portion of which distils, under diminished pressure of 60 Mm., under 193° C., and a second portion, *turmerol*, $C_{19}H_{28}O$, between 193° and 198° C. (379° and 388° F.), leaving a viscous body. Turmerol is pale-yellow, agreeably aromatic, dextrogyre, of the density .9016 at 17° C., and boils under ordinary pressure at 285°–290° C. (545°–554° F.), with partial decomposition. The *curcumol* of other chemists was stated to have the formula $C_{10}H_{14}O$ and the boiling-point 245° C. (473° F.).

The coloring matter, *curcumin*, is best obtained pure after removing the oil by exhausting the powder with ether and recrystallizing from alcohol; the yield, involving much loss, was only 0.3 per cent. The yellow crystals, $C_{14}H_{14}O_4$, have a vanilla-like odor, fuse at 165° C. (329° F.), are readily soluble in alcohol, chloroform, and ether, very little in

cold benzene and benzin, and freely and with a red-brown color in alkalies. Oxidation by potassium permanganate or other weak oxidizing agents yields vanillin (melting-point 79° C.); by chromic acid the products are carbonic and acetic acids; and with nitric acid oxalic acid is obtained. The carmine-colored potassium compound is insoluble in strong alcohol and ether; the zinc compound is soluble in water; the insoluble lead and silver compounds are easily altered. By boiling an alcoholic solution of curcumin with boric acid and decomposing the compound with hot water, Schomberger (1866) obtained yellow *pseudo-curcumin*, which is not reddened by boric acid, and is soluble in alkalies with a greenish-gray color. Boiling as before, but in the presence of sulphuric acid, *rosocyanin* is formed, which is crystalline, insoluble in water, benzene, and ether, and soluble with a beautiful red color in alcohol. Alkalies color it blue; the solution on boiling turns blood-red, then yellow, and now contains pseudo-curcumin.

The other constituents of turmeric are starch, gum, resin, and others of no medicinal importance. Kachler (1870) separated from the infusion a notable quantity of *acid potassium oxalate*. Tincture of turmeric shows a blue fluorescence, due to curcumin.

Pharmaceutical Uses.—Turmeric is employed for the detection of alkalies and of borates. Paper saturated with the tincture is colored brown-red by alkalies, the yellow color being restored by acids. Soluble borates likewise produce a brown-red color, which is not altered on the addition of dilute acids. It is occasionally employed for coloring pomades and ointments, as in the *Unguentum flavum s. Ung. althææ* (P. G. 1872), which is made by digesting for half an hour 1 part of turmeric with 50 parts of lard, fusing together with yellow wax and Burgundy pitch, each 3 parts, and straining.

Action and Uses.—Turmeric has no medicinal properties that require notice. Its sole use is to prepare a test-paper. In India and China it is employed as a condiment.

CUSSO, *U. S., Br.*—Kousso.

Brayera, U. S. 1880; *Flores koso*, P. G.—*Kusso*, E.; *Kousso*, Fr.; *Koso, Kusso, Cusso*, G.; *Cosso*, It.

Fig. 93.

Hagenia abyssinica, *Gmelin*: *A*, lowest branch of panicle, ⅔ size; *B*, staminate flower; *C*, section of pistillate flower; magn. 4 diameters.

The female inflorescence (flowers and tops, *Br.*) of Hagenia abyssinica, *Gmelin*, s. Banksia abyssinica, *Bruce*, s. Brayera anthelmintica, *Kunth*. Bentley and Trimen, *Med. Plants*, 102.

Nat. Ord.—Rosaceæ, Roseæ.

Origin.—This is a handsome tree, attaining a height of 12 to 18 M. (40 to 50 feet); it produces an abundance of large oddly pinnate leaves, at the base with a sheath formed by the large adnate stipules; the inflorescence is abundant, axillary, unisexual, and paniculate. The tree, which flowers in October and November, is indigenous to the table-land and mountainous districts of Abyssinia, and is generally planted near towns and villages.

Description.—The panicles are about 30 Cm. (12 inches) long, much branched; axis and branches zigzag, hairy, and glandular, each branch supported by a ciliate sheathing bract; flowers very numerous, 6 to 8 Mm. (¼ to ⅓ inch) broad, each with two large roundish membranous-veined bracts at the base, which are green in the staminate flowers, but become purplish-red in the pistillate flowers; calyx shortly stalked, top-shaped, hairy, and with ten membranous and veined segments arranged in two alternating whorls. The sepals of the outer whorl of the male flowers are greenish-yellow, small, and

nearly linear; but in the female flowers they are finally about 10 Mm. ($\frac{2}{5}$ inch) long, and much larger than the inner row of sepals, and when fully developed are obovate and of a red color. The five linear petals are inconspicuous and much shorter than the inner sepals, with which they alternate. Stamens between fifteen and thirty, very small and shrivelled in the female flowers, equalling the petals in the male flowers, inserted in the contracted throat of the calyx. Carpels two, or occasionally three, distinct, enclosed in the calyx-tube; styles projecting from the tube; fruit a small membranous akene, pointed by the persistent short base of the style, and containing a straight fleshy embryo with two plano-convex cotyledons.

The female inflorescence being most frequently collected, the commercial article should have a pale brownish-red hue, and is often distinguished as *red kousso*. It is collected before the fruit has ripened, and either the entire inflorescence is dried loosely, or *before quite dry* a number of panicles are formed into cylindrical rolls, measuring about 25 to 50 Cm. (10 to 20 inches) in length weighing about 120 to 240 Gm. (4 to 8 ounces) and tied by split culms of Cyperus articulatus; the loose panicles are usually much broken. The male inflorescence has in the dry state a light greenish-brown color, and is sometimes known as *kousso-esels*. The odor of both varieties is not strong, but pleasant and tea-like; the taste is gradually developed, mucilaginous, bitterish, acrid, and disagreeable.

The drug reaches commerce mostly by way of Aden and Bombay, or partly through Egypt to Southern Europe. It should be kept in a dark and dry place. "For medicinal use the drug should be freed from the stalks."—*P. G.*

Constituents.—According to Wittstein (1840), kousso contains as principal constituents 6.25 per cent. of a bitter acrid resin and 24.4 per cent. of tannin, consisting of two kinds; he also obtained 15.71 per cent. of ashes and some tasteless resin, besides the common constituents, chlorophyll, wax, sugar, and gum. The acrid resin appears to be the medicinally active principle, and has been variously called *brayerin*, *kwosein*, *koussin*, and *kosin*. As prepared by Dr. C. Bedall (1872) by Pavesi's process, it was found to be an efficient tænifuge. Kousso is repeatedly treated with alcohol to which slaked lime has been added; the residue is boiled with water, the different liquids mixed, filtered, and distilled, and the remaining liquid treated with acetic acid, which separates about 3 per cent. of koussin as a white flocculent precipitate, becoming denser and resin-like, and on drying yellowish or at a higher temperature brown; in larger quantities it has a peculiar odor of Russian leather, a persistent bitter and acrid taste, and is of a distinct crystalline appearance when viewed under the microscope. Dr. E. Merck has subsequently further purified it, probably by crystallizing it from boiling alcohol. Flückiger and E. Bury (1874) describe it as forming yellow rhombic crystals, which are readily soluble in benzene, carbon disulphide, chloroform, and ether, less freely in glacial acetic acid, sparingly in cold alcohol, and are insoluble in water; alkalies dissolve it readily, and acids precipitate it again; it fuses at 142° C. (287.6° F.), and congeals to a transparent yellow mass, which when touched with a trace of alcohol is converted into stellate tufts of crystals; its composition is $C_{31}H_{38}O_{10}$, and it is probably an ether of isobutyric acid. Prof. Buchheim found this *pure kosin* to be very inferior in its anthelmintic action.

By distillation with water, kousso yields traces of valerianic and acetic acids and a little solid volatile oil having the odor of the drug.

Action and Uses.—Cusso has been employed from time immemorial in Abyssinia for the expulsion of tape-worms, which there prevail extensively. But it is stated by Johnson that the operation of it is so severe that it often produces miscarriages, and even death, in pregnant women. In Europe it is said sometimes to have occasioned severe colic, but generally its operation is not distressing, and consists only of slight nausea, followed by feculent and then by liquid stools. According to Arena, these differences depend upon an alteration which the resin undergoes by time. Of all the remedies for tape-worm (Tænia solium, T. bothriocephalus), none is more efficient or certain, provided that the flowers are fresh, but they deteriorate rapidly. The parasite is generally discharged dead.

The Abyssinian mode of using it is thus described: An infusion is made with water or beer, or the flowers are mixed with honey to the amount of from Gm. 16–24 (℥iv–vj), and the whole is taken in the morning, fasting, and no food is eaten during the day. Generally, the worm is discharged in the course of twenty-four hours without purging, pain, or colic. This description by Aubert and by Engleman contradicts the one given above. In Europe and in this country an infusion is prepared with Gm. 8 (℥ij) of the powdered drug in Gm. 128 (f℥iv) of boiling water, which, when cold, is drunk without

having been strained. Kraus recommends Gm. 25 (ʒvj) in lemonade on an empty stomach, and followed an hour later by castor oil. As its taste and smell are disagreeable, resembling somewhat those of senna tea, it has been proposed to administer the powder in granules made with sugar and swallowed with some aromatic infusion. The following mode of preparing the dose has been recommended: Treat by displacement ½ ounce of cusso in powder with 6 drachms of boiling caster oil and 1½ ounces of boiling water. Express the liquid, and make an emulsion with it and the yelk of egg; add 40 drops of sulphuric ether, sweeten, and flavor with oil of anise. This emulsion should be taken, fasting, at one dose. In all cases the patient should fast the day before using the medicine.

CYCLAMEN.—Cyclamen.

Sow-bread, E.; *Arthanite*, *Pain de pourceau*, Fr.; *Erdscheibe*, *Erdbrot*, *Schweinebrot*, G.; *Pan de Puerco*, Sp.

The tuber of Cyclamen europæum, *Linné*.

Nat. Ord.—Primulaceæ.

Origin.—The species grows in shady places and rocky woodlands of Southern Europe, and is met with in cultivation. It has a few roundish, heart-shaped leaves of a dark-green color, marked with white above and purplish beneath, and several stalks, each bearing a nodding, fragrant, pink-colored flower, and coiling up after flowering so as to bring the capsule to the ground.

Description.—The tuber is 25 to 50 Mm. (1 to 2 inches) thick, flattish circular or depressed globose, dark-brown externally, internally white, mealy, with a rather thin bark, and with narrow and short fibro-vascular bundles arranged in irregular circles. In the fresh state it has a burning, acrid taste; after drying this is milder.

The similar tubers of Cyclamen hederæfolium, *Aiton*, and C. persicum, *Miller* (s. C. latifolium, *Sibthorp*), which are indigenous to Southern Europe and the Levant, have similar properties; these plants are also cultivated for ornament.

The pyriform or spindle-shaped tubers of Lathyrus tuberosus, *Linné*, which are of the size of a walnut, are said to be occasionally substituted for those of cyclamen; they have a mucilaginous taste.

Constituents.—Aside from starch, gum, pectin, and other common principles, Saladin (1830) isolated *cyclamin* or *arthanitin*, $C_{20}H_{24}O_{10}$. It is white, amorphous or in minute crystals, of a bitter and acrid taste, soluble in carbon disulphide, chloroform, alcohol, and in water, and insoluble in ether and fixed and volatile oils. Its aqueous solution foams like soap-water, is precipitated by tannin, and when boiled with dilute acids yields glucose and resinous *cyclamiretin*.

Action and Uses.—Experiments made by Claude Bernard led him to the conclusion that cyclamin resembles curarin in its action; Schroff compared it rather with smilacin, senegin, and saponin. Cyclamen-root loses much of its acrimony by keeping, and has been recommended under such circumstances as a purgative in the dose of Gm. 0.60 (gr. x) triturated with powdered gum. On the other hand, the fresh root has sometimes occasioned alarming effects. Bulliard states that "in the north of France, where it is much used as a purgative, it often produces violent vomiting, followed by cold sweats, vertigo, ringing in the ears, and gyratory or convulsive movements; often blood is ejected by vomiting or purging, and sometimes there is even fatal hypercathartsis." Formerly it entered, with other drastic purgatives, into a liniment which caused purgation when applied to the abdomen in cases of *worms* and of *dropsy*. Externally, the fresh tuber has been proposed as a stimulating cataplasm for *carbuncles*, *abscesses*, enlarged *glands*, etc. Dose, Gm. 0.30 (gr. v). A decoction is prepared with Gm. 4–12 (ʒj–iij) in Gm. 500 (a pint) of water.

CYDONIUM.—Cydonium.

Semen cydoniæ.—Quince-seed, E.; *Semences* (*Pépins*) *de coing*, Fr.; *Quittensamen*, *Quittenkerne*, G.; *Membrillo*, Sp.

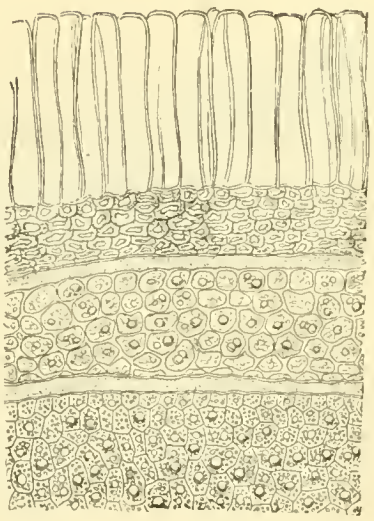
The seed of Cydonia vulgaris, *Persoon*, s. Cyd. europæa, *Savi*, s. Pyrus Cydonia, *Linné*, s. Sorbus Cydonia, *Crantz*. Woodville, *Med. Bot.*, 182; Bentley and Trimen, *Med. Plants*, 106.

Nat. Ord.—Rosaceæ, Pomeæ.

Origin.—The quince tree, which attains a height of 6 M. (20 feet) or remains

shrubby, is probably indigenous to Asia Minor and Persia, but was anciently cultivated, and is now naturalized, in the Mediterranean basin, and cultivated in the temperate parts of Asia, Africa, Europe, and America. It has shortly petiolate, entire, ovate or obovate leaves, which are woolly beneath; ovate, glandular, and denticulate stipules; handsome, pale rose-colored flowers; and a pyriform or subglobular golden-yellow fragrant fruit, with five cells, each containing about twelve closely-packed seeds.

Fig. 95.



Quince-seed: section through epithelium, testa, tegmen, and portion of cotyledon; magnif. 150 diam.

Description.—The seeds are 6 to 10 Mm. ($\frac{1}{4}$ or $\frac{3}{8}$ inch) long, of an oblong or oval shape, but flattened and three-sided by mutual pressure; the somewhat pointed hilum at the narrow end is connected by the ridge-like raphe along the sharper edge with the chalaza at the other slightly-beaked end. The testa is of a brown color, covered with a mucilaginous epithelium, by which the seeds of one cell are united into a mass. The embryo is of the size and shape of the seed, consists of two plano-convex oily cotyledons, with a thick straight radicle pointing toward the hilum, and possesses the taste of bitter almonds. The unbroken seeds are mucilaginous. The mucilage is contained in the epithelial cells, which form the grayish or whitish covering of the seed, and when immersed in water swell up considerably, forming a thick jelly-like mass with 40 parts of water to 1 of seeds.

Fig. 94.

Quince-seed and section.

Constituents.—Quince-seeds yield about 20 per cent. of dry mucilage, which has the composition $C_{12}H_{20}O_{10}$ and contains some calcium salts and albumen. Treated with nitric acid, it yields oxalic acid. The mucilage has little adhesive power, is not affected by solution of borax, and is precipitated by alcohol and by metallic salts.

Allied Plant.—Cydonia (Pyrus, *Thunberg*) japonica, *Persoon*. This frequently-cultivated ornamental shrub is smooth throughout, has oval serrate leaves and bright-red flowers, and bears globular fruits of an aromatic acidulous taste.

Action and Uses.—The pulp, and especially the rind, of the fruit have a certain astringency, which has caused them to be used in cases of *mucous profluvia* and passive *hæmorrhages*, but particularly in *leucorrhœa* and *uterine* hæmorrhage, and also in *diarrhœa*. They are rather domestic than officinal medicines.

CYPRIPEDIUM, *U. S.*—Cypripedium.

Rhizoma cypripedii.—Ladies'-slipper root, E.; *Racine de cypripède jaune, Valériane américaine*, Fr.; *Gelbfrauenschuh-Wurzel*, G.

The rhizome and rootlets of Cypripedium pubescens, *Swartz*, and of Cypripedium parviflorum, *Salisbury*.

Nat. Ord.—Orchidaceæ.

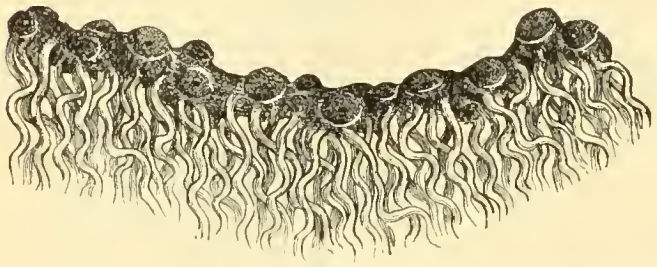
Origin.—These herbaceous plants are indigenous to Canada, and to the United States as far south as North Carolina; they grow in low woodlands and boggy localities and flower in May and June. The two plants are distinguished from each other by their size, Cypr. pubescens being the taller, growing about 60 Cm. (2 feet) high, and by their flowers, which in the species named have lanceolate sepals and a laterally-flattened lip which is arched above, while the flowers of Cypr. parviflorum are smaller, with lance-ovate sepals and the lip flattened from above. In both species the lip of the yellow flowers forms an inflated obtuse sac which is likened to a slipper.

Description.—The rhizomes are horizontal, bent up and down, nearly cylindrical, about 3 to 5 Mm. ($\frac{1}{8}$ to $\frac{1}{5}$ inch) in diameter, nearly 10 Cm. (4 inches) long, above beset with broad, circular cup-shaped scars of the overground stems, the more recent ones with fibrous tufts of ligneous tissue; the numerous simple rootlets are mainly attached on the lower half of the rhizome, attain a length of 15 to 20, occasionally even 45 or 50, Cm. (6 to 8, even 18 or 20 inches). The rhizomes and rootlets of Cypr. parviflorum are rather slender and shorter, and after drying of an orange-brown color, while the coarser parts of Cypr. pubescens dry of a black-brown. Both are brittle and break with a short

fracture, which is white with scattered wood-bundles, have a peculiar slight but heavy odor, and a sweetish, bitter, and pungent taste.

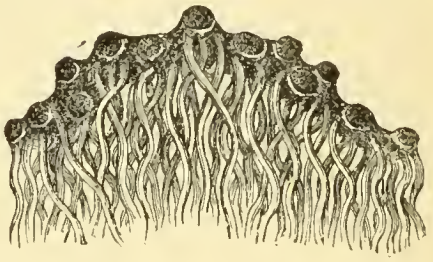
The rhizome of Hydrastis canadensis is not unfrequently mixed with the commercial

Fig. 96.



Cypripedium pubescens.

Fig. 97.



Cypripedium parviflorum.

Portion of rhizome and rootlets, natural size.

cypripedium; it is readily distinguished by its different shape, its yellowish-gray color externally, and by its transverse section, which is bright-yellow and shows a circular arrangement of the wood-wedges.

Constituents.—Cypripedium was analyzed by H. C. Blair (1866), who found a minute quantity of volatile oil, a volatile acid, two resins, tannin, starch, etc. The rhizomes of both species deserve to be again carefully analyzed.

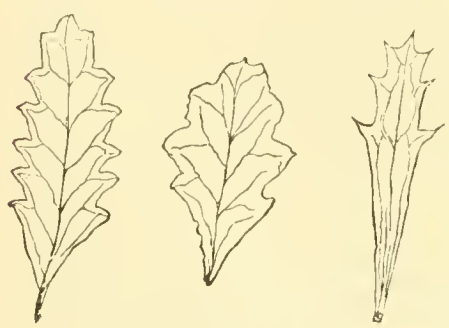
Action and Uses.—Cypripedium was among the medicinal plants used by the aborigines of this country, and subsequently it was resorted to by the country-people for the relief of nervous affections, such as *chorea* and *hysteria*. It is one of the numberless agents said to cure *epilepsy*. In its action and uses it is generally supposed to resemble valerian. The *dose* is stated to be Gm. 1 (gr. xv) of the powdered root, or the equivalent of that quantity in tincture or infusion, three times a day. The oleoresin precipitated from the tincture by water may be prescribed in doses of Gm. 0.06 (gr. j).

DAMIANA.—Damiana.

Origin and Description.—Since 1874 the leaves of two or three Mexican plants have appeared in commerce under the above name, attention to the difference being called by Wellcome (1875). According to E. M. Holmes (1876), they come from the following species:

Turnera microphylla, *De Candolle* (Fig. 98). Nat. Ord. Turneraceæ. This species is common in Western Mexico and Lower California, and is found also in Starr Co., Texas. The leaves are alternate, obovate, entire at the base, and above on each side with three or four teeth, light-green, rather rough, and nearly smooth, or along the midrib covered with short, whitish hairs. They readily fall off the much-branched stems, which, if present, have some resemblance to broom-tops. The calyx of the flowers has five three-nerved lobes, and bears in the throat five yellow obovate petals and five stamens; the ovary has three styles, and ripens to a globular or oval one-celled and many-seeded capsule. The leaves have an aromatic taste, suggesting that of confection of senna. Leaves of the shape seen in Fig. 97 belong either to a variety of the same or to a closely-allied species. They are usually of a darker green, smooth, and have a somewhat mint-like flavor. Turnera aphrodisiaca, *Ward*, is the name given to the plant, in allusion to its asserted properties. Turnera diffusa, *Ward*, has rather shorter leaves, which are finely hairy above and tomentose beneath.

Fig. 98. Fig. 99. Fig. 100.



Damiana, natural size.

Aplopappus (Haplopappus) discoideus, *De Candolle*. Nat. Ord. Compositæ. The leaves are lanceolate above, with about three sharp teeth on each side, the lower half entire, rather coriaceous, roughish on the surface, light-green, with occasional black dots, and with minute resin-like granules or scales. The flowers, which are usually present, have an imbricated involucre, yellow florets, and a white hairy pappus. The drug has a distinct balsamic odor and taste. Dr. Rothrock (1876) gives the following synonyms for this plant: Linosyris mexicana, *Schlechtendal;* Baccharis veneta, *Kunth;* and Bigelovia veneta, *Gray*.

The two genera mentioned above belong to Western North America and parts of South America. A species of Turnera, T. ulmifolia, *Linné*, grows in the West Indies, where its aromatic leaves and flowers have been used for their tonic properties.

Constituents.—Turnera damiana yielded to H. B. Parsons 8 per cent. of volatile oil, with soft resin and chlorophyll, 7 per cent. of a bitter substance, 6.4 per cent. of hard resin, and 3.5 per cent. of tannin, the remainder being sugar, gum, albuminoids, etc., with 8.4 per cent. of ash. In making a fluid extract of the Aplopappus damiana, and using 76 per cent. alcohol, crystals of potassium chloride were obtained by Prof. Wayne (1876).

Action and Uses.—Damiana appears to have stimulant, tonic, and laxative properties, and has been supposed by the inhabitants of Western Mexico to be a specific stimulant of the pelvic organs. In support of this statement it has been affirmed that the use of damiana occasions hæmorrhoids. It has been widely and shamelessly advertised as a remedy for *sexual impotence* or indifference in either sex, but there is not the slightest reason for confiding in this statement of its virtues. Still less can it be credited with the restoration of an atrophied testis to its normal size and function, which has been set to its account. It is best administered in a fluid extract, of which the average dose is Gm. 2 (f℥ss).

DECOCTA, *U. S., P. G.*

Decoctions, E; *Décoctés, Tisanes par décoctions*, Fr.; *Abkochungen*, G.; *Decotti*, It.

When the active principles of vegetable drugs are exhausted by boiling with water decoctions are obtained. Such preparations are obviously not adapted to drugs the activity of which depends upon principles of a resinous nature which are insoluble in water, nor to such as contain volatile oils or other volatile substances which would be dissipated with the vapor of water, and should be restricted to those drugs the active constituents of which cannot be extracted by water below 100° C. (212° F.) Formerly, decoctions were usually made by using a large quantity of water and boiling it down to one-half or even to a less amount. No obvious advantage was gained by this method, and in many instances it proved to be decidedly disadvantageous, owing to the alteration and darkening of the extractive matters, and in some cases to changing the nature of the active principles. The pharmacopœias have very properly, in nearly all cases, reduced the time of boiling to 10 or 15 minutes, the general directions given by the present U. S. P. being as follows: "An ordinary decoction, the strength of which is not directed by the physician nor specified by the pharmacopœia shall be prepared by the following formula: Take of the substance, coarsely comminuted, 50 Gm.; water a sufficient quantity, to make 1000 Cc. Put the substance into a suitable vessel provided with a cover, pour upon it 1000 Cc. of cold water, cover it well, and boil for fifteen minutes; then let it cool to about 40° C. (104° F.) strain the liquid, and pass through the strainer enough cold water to make the product measure 1000 Cc. This represents about 23 grains of drug in each fluidounce. *Caution.*—The strength of decoctions of energetic or powerful substances should be specially prescribed by the physician.

By following the directions of the P. G., to keep the mixture of drug and cold water for half an hour in a bath of steam arising from boiling water, the time is practically still more reduced; the proportion of very mucilaginous drugs to be used in a decoction is left to the dispenser; but the physician is required to state the quantity of such drugs for which a maximum dose is given by the pharmacopœia; other drugs may be used in the proportion of 1 part for 10 parts of decoction.

The use of cold water to begin with ensures the complete exhaustion from the drug of all its soluble principles by the gradually-heated water, the albuminous principles being subsequently coagulated as the heat is increased to near the boiling-point. If, on the other hand, the drug be at once immersed in boiling water, the albumen contained in cells would be coagulated, and thus seriously interfere with the extraction of the other principles. In preparing compound decoctions all the drugs may be added to the cold water, with the exception of those which, like senna, are injured by long-continued heat or which contain aromatic or other volatile principles. Such should be added when the decoction is ready to be removed from the fire or steam-bath, and allowed to digest until it is sufficiently cooled for straining. The material should in all cases be cut or bruised, the degree of fineness depending upon the nature of its tissue. Woody drugs may be

reduced to a moderately fine powder; leaves, however, and other drugs consisting mainly of loose parenchyma, are better used in the form of a moderately coarse or very coarse powder.

Unless the liquid is to be considerably boiled down, decoctions are best prepared in a vessel provided with a cover which may be loosely put on until the boiling is completed, when the vessel should be well closed, particularly if additions have been made at the close of boiling. Porcelain is undoubtedly the best material for vessels used for preparing decoctions, since it is not acted upon by the various vegetable principles; for similar reasons glass flasks will answer a useful purpose in making small quantities of these preparations. As a rule, it is best to avoid metallic vessels, except when made of block-tin and used in connection with a steam-bath. As many drugs contain tannin, vessels made of iron are not adapted for preparing their decoctions, and the usually imperfect covering of galvanized (or zinc) or tinned sheet iron renders the vessels lined with such material but little better suited for this purpose, and still inferior to properly-enamelled iron vessels.

As a rule, decoctions should be allowed to cool to below 50° C. (122° F.) before they are strained; principles which are soluble only in hot water are then mostly precipitated, and removed without, in most cases, weakening the medicinal effects of the preparations. But even with this precaution the strained liquid may become unsightly in appearance by the further deposition, on cooling, of apotheme or matter soluble only in hot water. In such cases the pharmacist should be guided by the directions of the pharmacopœia or by the intentions of the physician, and not sacrifice effect to elegance. With some exceptions, decoctions which were formerly made at the house of the patient have gradually fallen into disuse through the introduction of fluid extracts and similar permanent preparations, by which the medicinal properties can be preserved unaltered for months, or even years, while decoctions cannot be depended upon for more than one or, at the utmost, a few days.

DECOCTUM ALOES COMPOSITUM, *Br.*—Compound Decoction of Aloes.

Tisane (Décocté) d' aloès composée, Fr.; *Zusammengesetztes Aloedecoct*, G.

Preparation.—Take of Extract of Socotrine Aloes ½ ounce; Myrrh, Saffron, Potassium Carbonate, of each ¼ ounce; Extract of Liquorice 2 ounces; Compound Tincture of Cardamoms 15 fluidounces; Distilled Water a sufficiency for 50 fluidounces. Reduce the extract of aloes and myrrh to coarse powder, and put them together with the potassium carbonate and extract of licorice, into a suitable covered vessel with a pint of distilled water; boil gently for five minutes, then add the saffron. Let the vessel with its contents cool, then add the tincture of cardamoms, and, covering the vessel closely, allow the ingredients to macerate for two hours; finally, strain through flannel, pouring as much distilled water over the contents of the strainer as will make the strained product measure 50 fluidounces.—*Br.*

The alkali carbonate is added for the purpose of aiding the solution of the resinous principles of aloes and myrrh; the tincture of cardamom, saffron, and licorice act as correctives, the latter serving more especially for partially covering the nauseous taste of the aloes. The air should be excluded from this preparation as far as possible.

Action and Uses.—The active agents in this preparation are essentially the same as in the tincture of aloes and myrrh. It is a useful purgative in numerous cases for which the alcoholic preparation just named would be too stimulating; and it is probable that the permanent solution of its ingredients renders its purgative operation milder—an effect which is enhanced by the liquorice and cardamom it contains. It is an appropriate medicine when purgation is indicated in *amenorrhœa* due to an atonic state of the system, or simply in constipation with a tendency to hæmorrhoidal engorgement. Like the tincture, it is much less used than the corresponding pill (*Pilula aloes et myrrhæ*), but it may be prescribed in doses of Gm. 15–60 (f℥ss–ij).

DECOCTUM CETRARIÆ, *U. S.*, *Br.* Decoction of Cetraria.

Decoction of Iceland moss, E.; *Tisane (Décocté) de lichen d'Islande*, Fr.; *Isländisch-Moos-Absud (Decoct)*, G.

Preparation.—Cetraria 50 Gm.; Water a sufficient quantity to make 1000 Cc.

Cover the cetraria, in a suitable vessel, with 400 Cc. of cold water; express after half an hour, and throw away the liquid. Then boil the cetraria with 1000 Cc. of water for half an hour, strain, add enough cold water, through the strainer, to make the product measure 1000 Cc.—*U. S.*

Decoction of cetraria, of official strength, may also be prepared by macerating 365 grains of cetraria with 6 ounces of cold water for half an hour, expressing and boiling the cetraria with 1 pint of water as directed above.

The maceration with cold water is intended to remove at least a portion of the bitter principle present; this treatment is denounced by many.

The decoction of the Br. P. is identical with this, 1 ounce av. of Iceland moss being used for 1 Imperial pint of decoction; the boiling is continued for ten minutes only, which is ample for the purpose. The tisane of the Fr. Cod. is made in the proportion of 1 to 1000.

Action and Uses.—This is the best form for administering Iceland moss. It retains the bitter principle as well as the demulcent elements of the moss, and it is on the former that the therapeutical qualities of that substance chiefly depend. It should be taken in doses of from Gm. 60–130 (f℥ij–iv) three or four times a day.

DECOCTUM CINCHONÆ, *Br.*—Decoction of Cinchona.

Decoctum de cinchona, Decoctum chinæ.—Tisane (Décocté) de quinquina rouge, Fr.; *Chinaabsud*, G.

Preparation.—Take of Red Cinchona Bark, in No. 20 powder, 1¼ ounces; Distilled Water 1 pint. Boil for 10 minutes in a covered vessel. Strain the decoction when cold, and pour as much distilled water over the contents of the strainer as will make the strained product measure 1 pint (Imperial).—*Br.*

If strained while hot, a turbid preparation is obtained from the deposition, after cooling, of cinchonic red and cinchotannate of the alkaloids; these insoluble compounds are removed by straining *when cold*. The whole of the alkaloids may be kept in solution by the addition of some acid.

Action and Uses.—*Dose*, Gm. 60 (f℥ij), to be repeated every two, three, or four hours in acute diseases, and three times a day before meals as a tonic.

DECOCTUM GRANATI RADICIS, *Br.*—Decoction of Pomegranate-Root.

Decoctum corticis radicis granati.—Tisane (Décocté) d'écorce de la racine de grenadier, Fr.; *Granat-Wurzel-Rinden-Absud*, G.

Preparation.—Take of Pomegranate-Root Bark, sliced, 2 ounces; Distilled Water 2 pints. Boil down to a pint and strain, making the strained product up to a pint (Imperial), if necessary, by pouring distilled water over the contents of the strainer. —*Br.*

The tissue of the bark is not firm enough to require so long-continued a boiling.

Action and Uses.—This decoction may be used for all the purposes to which vegetable astringents of moderate power are applied, such as passive *hæmorrhages* and mucous and serous *profluvia*, as a wash for open *sores* accompanied with a profuse discharge, for *relaxed states* of the mouth, vagina, rectum, etc. It is, however, most useful as a *tæniafuge*. (For the mode of employing it see Granati Radicis Cortex.)

DECOCTUM HÆMATOXYLI, *Br.*—Decoction of Logwood.

Tisane (Décocté) de bois de Campêche, Fr.; *Blauholz-Absud*, G.

Preparation.—Take of Logwood, in chips, 1 ounce; Cinnamon-Bark, in coarse powder, 55 grains; Distilled Water 1 pint. Boil the logwood in the water for 10 minutes in a covered vessel, adding the cinnamon toward the end. Strain the decoction, and pour as much distilled water over the contents of the strainer as will make the strained product measure a pint (Imperial).—*Br.*

A longer-continued boiling of logwood in chips would improve the result of this formula.

Action and Uses.—Although this decoction may be used for most of the disorders for which vegetable astringents are indicated, it is chiefly employed internally for the relief of *diarrhœa*, but much less so than the cognate medicines. Its mildness adapts it to the treatment of infantile diarrhœa. The *dose* for an adult is about Gm. 60 (f℥ij); for infants and children, Gm. 4–8 (f℥j–ij).

DECOCTUM HORDEI, *Br.*—Decoction of Barley.

Barley-water, E.; *Tisane (Eau) d'orge perlé*, Fr.; *Gerstenschleim*, G.

Preparation.—Take of Pearl Barley 2 ounces; Distilled Water 1½ pints (30 ounces). Wash the barley in cold water, and reject the washings; boil the washed barley with the distilled water for 20 minutes in a covered vessel, and strain.—*Br.*

The washing of the barley with cold water is intended for the removal of extraneous matters and of any unpleasant odor and taste. Mustiness is still better removed by washing with hot water, or by boiling the barley with the water for 1 or 2 minutes and throwing this liquid away. By this time the barley will be considerably swollen, and the decoction, when completed, will be mucilaginous, and measure about 20 fluidounces.

Action and Uses.—Barley-water, the most ancient of fever-drinks, continues to be the most generally employed. Highly nutritious, extremely digestible, unirritating, tending to promote the *intestinal* and *urinary* secretions, and soothing irritation in the *throat* and *air-passages*, barley seems better adapted to these purposes than rice or any other cereal. According to the state of the patient the decoction may be rendered more or less nutritious by longer or shorter boiling. If no contraindication exists, it should be sweetened and flavored with the juice of lemon or other acidulous fruit.

DECOCTUM PAPAVERIS, *Br.*—Decoction of Poppies.

Tisane de pavot, Fr.; *Mohnkapseln-Absud*, G.

Preparation.—Take of Poppy-Capsules, bruised, 2 ounces; Distilled Water 1½ pints. Boil for 10 minutes in a covered vessel, then strain, and pour as much distilled water over the contents of the strainer as will make the strained product measure a pint (Imperial).—*Br.*

The Pharmacopœia does not direct the removal of the seeds, the oil of which will to some extent remain suspended in the mucilaginous liquid.

Action and Uses.—This preparation possesses slight anodyne virtues, and is also emollient in consequence of the oil and mucilage it contains. It has, however, no demonstrable advantage over preparations of flaxseed, slippery elm, and many mucilaginous substances to which oil or glycerin and laudanum have been added. This remark applies particularly to its use in poultices and fomentations.

DECOCTUM PAREIRÆ, *Br.*—Decoction of Pareira.

Tisane de pareira brava, Fr.; *Pareirawurzel-Absud*, *Grieswurzel-Absud*, G.

Preparation.—Take of Pareira-Root, sliced, 1½ ounces; Distilled Water 1 pint. Boil for 15 minutes in a covered vessel, then strain, and pour as much distilled water over the contents of the strainer as will make the strained product measure a pint (Imperial).—*Br.*

Action and Uses.—(For the action and uses of this preparation see Pareira.) The *dose* of the decoction is Gm. 30–60 (f℥j–ij) three or four times a day.

DECOCTUM QUERCUS, *Br.*—Decoction of Oak-Bark.

Tisane (Décocté) d'écorce de chêne, Fr.; *Eichenrinden-Absud*, G.

Preparation.—Take of Oak-Bark, bruised, 1¼ ounces; Distilled Water 1 pint. Boil for 10 minutes in a covered vessel, then strain and pour as much distilled water over the contents of the strainer as will make the strained product measure a pint (Imperial).—*Br.*

The tannin is readily extracted by the boiling water, and the strained liquid will cause precipitates with most salts of the heavy metals, with solutions of alkaloids, etc. Alkaline liquids will hasten the decomposition of the astringent principles.

Action and Uses.—This preparation is seldom administered internally, but may be used to restrain passive *hæmorrhages* and *chronic fluxes* of the bowels and bronchia.

Externally, it is sometimes employed to control *bleeding* and also *suppuration*, and to diminish excessive local *sweats*, but more frequently to constringe relaxed mucous membranes and lessen their secretion, as in cases of *flaccidity of the uvula*, *pharynx*, or *larynx*, *prolapsus* of the *rectum*, *hæmorrhoids*, and *leucorrhœa*. It may be used to promote contraction of the *relaxed skin* of the abdomen, scrotum, etc.; to prevent the formation of *bed-sores* and the chafing of surgical apparatus; to heal flabby and ill-conditioned *ulcers*; to restrain *gangrene* and prevent its fetor; and finally, in a bath, to counteract extreme relaxation of the general integument. The *dose* of this decoction is Gm. 60 (f℥ij). For external purposes a decoction of twice the officinal strength is preferable.

DECOCTUM SARSÆ, *Br.*—Decoction of Sarsaparilla.

Decoctum sarsaparillæ.—Tisane de salsepareille, Fr.; *Sarsaparilla-Absud*, G.

Preparation.—Take of Jamaica Sarsaparilla, cut transversely, 2½ ounces; boiling Distilled Water 1½ pints. Digest the sarsaparilla in the water for an hour, then boil for 10 minutes in a covered vessel, cool and strain, pouring distilled water, if required, over the contents of the strainer, or otherwise making the strained product measure a pint (Imperial).—*Br.*

The formula is an improvement on the older ones, by which long-continued boiling was directed. The French preparation is made from 6 parts of sarsaparilla to 100 of liquid, by first macerating, then heating to boiling, and finally digesting for 2 hours.

Action and Uses.—The purpose of this preparation is the administration of sarsaparilla without the associate ingredients in the compound decoction. It is, however, very little used. Its *dose* is from Gm. 60–120 (f℥ij–iv) three or four times a day.

DECOCTUM SARSAPARILLÆ COMPOSITUM, *U. S.*, *P. G.*—Compound Decoction of Sarsaparilla.

Decoctum sarsæ compositum, Br.; *Tisane (Apozème) sudorifique, décocté de salsepareille composé* Fr.; *Zusammengesetztes Sarsaparilla-Decoct*, G.

Preparation.—Sarsaparilla, cut and bruised, 100 Gm.; Sassafras, in No. 20 powder, 20 Gm.; Guaiacum-wood, rasped, 20 Gm.; Glycyrrhiza, bruised, 20 Gm.; Mezereum, cut and bruised, 10 Gm.; Water a sufficient quantity; to make 1000 Cc. Boil the sarsaparilla and guaiacum-wood for half an hour in a suitable vessel with 1000 Cc. of water; then add the sassafras, glycyrrhiza, and mezereum; cover the vessel well, and macerate for two hours; finally strain and add enough cold water, through the strainer, to make the product measure 1000 Cc.—*U. S.*

To make 1 pint of this decoction will require 730 grains of sarsaparilla, 146 grains each of sassafras, licorice and guaiacum-wood, and 73 grains of mezereum.

Take of Jamaica sarsaparilla, cut transversely 2½ ounces; Sassafras-root in chips, Guaiacum-wood turnings, Dried Licoriee-root, each ¼ ounce; Mezereon-bark ⅛ ounce; boiling Distilled Water 1½ pints. Digest the solid ingredients in the water for an hour, then boil for ten minutes in a covered vessel, cool and strain, pouring distilled water, if required, over the contents of the strainer, or otherwise making the strained product measure a pint (Imperial).—*Br.*

The P. G. directs that 20 parts of sarsaparilla cut moderately fine, shall be digested with 520 parts of water at a temperature of 35°–40° C. for twenty-four hours; 1 part each of sugar and alum are then added, and the mixture exposed to the heat of a boiling water-bath for three hours, after which 1 part each of bruised anise and bruised fennel, 5 parts of senna, cut moderately fine, and 2 parts of licorice-root, crushed, are added, and the heat continued for fifteen minutes longer. After settling the liquid is decanted and the weight brought up to 500 parts by addition of water.

Much of the oil of sassafras is lost by boiling; the first formula has been constructed upon that of the French Codex, which directs boiling 3 parts of sarsaparilla and 6 parts of guaiacum-wood with 100 parts of water, then adding 1 part of sassafras and 2 of licorice-root, and macerating for two hours. It will be observed that this last is much the weaker preparation, and that mezereon-bark is not used in it. The first two are simplified formulæ for the *Lisbon diet-drink* or *Decoctum lusitanicum*, which was formerly much employed. The latter may also be said of *Zittmann's decoction*, of which a *stronger* and a *milder* one are used together. *Decoctum Zittmanni fortius:* Take sarsaparilla-root, cut, 100 parts; digest in water 2600 parts for twenty-four hours, and add enclosed in a linen bag, powdered sugar and alum, each 6 parts, calomel 4 parts, and cinnabar 1 part;

then heat in a covered vessel placed in a steam-bath for three hours, stirring frequently, and near the end of the boiling add anise and fennel, bruised, each 4 parts, senna, cut, 24 parts, and licorice-root, cut, 12 parts. Express, strain, set aside for some time, and decant to obtain 2500 parts of clear liquid. 2500 Gm. of this are to be divided into 8 parts. *Decoctum Zittmanni mitius:* Take the residue left from the preceding and 50 parts of sarsaparilla, heat with water 2600 parts for three hours in a covered vessel placed in a steam-bath, stirring frequently, and when near the end of boiling add lemon-peel, Chinese cinnamon, cardamom, and licorice-root, each cut and bruised, 3 parts. Express and operate as before to obtain 2500 parts.—*P. G.* 1872.

Action and Uses.—The virtues of this preparation are chiefly due to sarsaparilla and mezereon, slightly reinforced by the sassafras, which, with the liquorice, serves to mask the acrid flavor of the mezereon. It is chiefly employed in the treatment of chronic *rheumatism*, *scrofula* of the bones, chronic *cutaneous diseases*, and, above all, constitutional *syphilis*. Whatever good it effects is mainly due to its promoting the secretions of the skin and kidneys. (See SARSAPARILLA.) The *dose* is Gm. 130–160 (f℥iv–v) three or or four times a day.

DECOCTUM SCOPARII, *Br.*—DECOCTION OF BROOM.

Tisane de genêt à balais, Fr.; *Besenginster-Absud*, G.

Preparation.—Take of Broom-Tops, dried, 1 ounce; Distilled Water 1 pint. Boil for 10 minutes in a covered vessel, then strain, and pour as much distilled water over the contents of the strainer as will make the strained product measure a pint (Imperial).—*Br.*

Action and Uses.—The decoction of broom is apt to excite irritation of the kidneys and urinary passages, and decidedly to increase the quantity of urine. It is the best form in which broom can be administered for the removal of *dropsical effusions*. It should be given in doses of Gm. 60 (f℥ij), repeated at intervals, so that from Gm. 250–500 (f℥viij–xvj) may be taken during the day. A compound decoction may be prepared by boiling broom-tops, dandelion, and juniper-berries, of each ℥ss in Oiss of water to a pint. *Dose*, Gm. 30–60 (f℥j–ij).

DECOCTUM TARAXACI, *Br.*—DECOCTION OF DANDELION.

Tisane de pissenlit, Fr.; *Löwenzahnwurzel-Absud*, G.

Preparation.—Take of dried Dandelion-Root, sliced and bruised, 1 ounce; Distilled Water 1 pint. Boil for 10 minutes in a covered vessel, then strain, and pour as much distilled water over the contents of the strainer as will make the strained product measure a pint (Imperial).—*Br.*

Dandelion-root, if properly cut and bruised, is readily extracted by hot water.

Action and Uses.—This preparation represents all the virtues of taraxacum, and is the most suitable mode of exhibiting the medicine. As it is apt to ferment, it should be freshly made when used. The *dose* is Gm. 60–90 (f℥ij–iij), and should be taken about half an hour before meals. Its efficacy is increased by simple bitters, such as gentian and columbo, or by a little orange-peel added near the end of ebullition.

DECOCTUM ULMI.—DECOCTION OF ELM-BARK.

Décocté d'orme, Fr.; *Ulmenrinden-Decoct*, G.

Preparation.—Take of Elm-Bark, cut in small pieces, 2½ ounces; Distilled Water 1 pint. Boil for 10 minutes in a covered vessel, then strain and pour as much distilled water over the contents of the strainer as will make the strained product measure a pint (Imperial).—*Br.* 1867.

Action and Uses.—The decoction of this elm-bark is mucilaginous, bitter, and astringent. It is probably not much used in this country. The *dose* is from Gm. 60–120 (f℥ij–iv).

DIGITALIS, *U. S.*—DIGITALIS.

Digitalis folia, Br.; *Folia digitalis*, P. G.—*Foxglove-leaves*, E.; *Feuilles de digitale pourprée (de grande digitale)*, Fr.; *Fingerhutkraut*, G.; *Digitale*, It.; *Dedalera*, Sp.

The leaves of Digitalis purpurea, *Linné* (D. tomentosa, *Link et Hoffmann*), collected

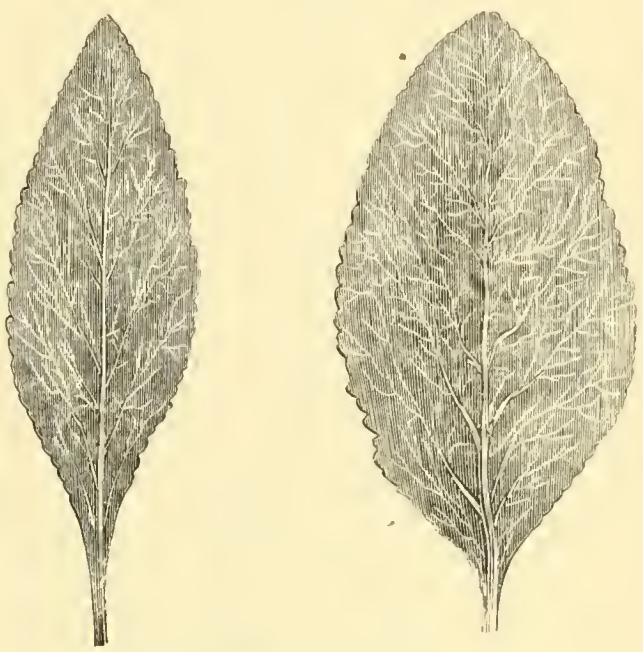
of plants of the second year's growth. Woodville, *Med. Bot.*, plate 24; Bentley and Trimen, *Med. Plants*, 195.

Nat. Ord.—Scrophulariaceæ.

Origin.—Foxglove is a biennial plant indigenous to Southern and Central Europe, particularly in the western section, and grows wild as far north as Norway, likewise in Madeira and the Azores. It is found on the edges of woodlands and thickets in rather sandy soil, and is generally absent from calcareous districts. It is well known as an ornamental garden-plant. The stem is 0.6 to 1.5 M. (2 to 5 feet) high, has alternate leaves, and a long terminal raceme of handsome purplish-crimson and tubular bell-shaped flowers, producing an ovoid glandular pubescent capsule with numerous small seeds. The leaves, which on drying diminish in weight about 75 per cent., should be collected from wild plants growing in mountainous regions when in the second year, and about two-thirds of the flowers are expanded; the leaves of plants grown in plains proved to be less active, according to W. Mayer (1880) and others. F. Schneider (1869) found the radical leaves collected in September of the first year to be very efficacious.

Description.—The radical leaves are 15 to 30 Cm. (6 to 12 inches) long, ovate or oblong-ovate, rather obtuse, at the base contracted into a winged petiole 10 to 15 Cm. (4 to 6 inches) long. The margin is rather irregularly doubly crenate, the upper surface is wrinkled, dull-green, and soft-downy; the lower surface is of a grayish color, densely pubescent and prominently reticulate; the midrib is broad toward the base, and of a slight purplish tint. The stem-leaves are gradually reduced in size, and upon shorter petioles, the uppermost being sessile, oblong-lanceolate, and obscurely crenate. The dried leaves have a faint tea-like odor and a bitter rather disagreeable taste. In cultivation the plant usually becomes less hairy, and the radical leaves of the first year's growth are usually narrower and more oblong-lanceolate in outline. The following reactions may be used for determining the absence of leaves containing tannin, and the presence of a proper amount of digitalin: "An infusion prepared with 1 part of digitalis and 10 parts of boiling water (should be of a brownish color, of an acid reaction, of a peculiar odor, and of a nauseously but not aromatic taste.—*P. G.*) and allowed to cool, has a peculiar odor, turns blue litmus-paper red, and upon the addition of a few drops of ferric-chloride test-solution acquires a darker tint, a brown precipitate appearing after several hours (absence of leaves containing tannin, giving blue-black or black-green precipitates.) The infusion, diluted with 3 parts of water, becomes turbid on the addition of a few drops of tannic-acid test-solution.—*U. S.*, *P. G.* In the undiluted infusion tannic-acid solution should produce a copious precipitate, which is dissolved only with difficulty by an excess of tannin (digitalin-tannin).—*P. G.*

Fig. 101.



Digitalis purpurea *Linnê*: leaf of the first and of the second year's growth.

Constituents.—The medicinally active principle has been named digitalin, and is described below.

Digitalinum.—Digitalin, *E.*, *G.*; Digitaline, *Fr.*—The following directions are given for its preparation: Take of Digitalis-leaf, in coarse powder, 40 ounces; Rectified Spirit, Distilled Water, Acetic Acid, Purified Animal Charcoal, Ammonia-Water, Tannic Acid, Lead Oxide, in fine powder, and Pure Ether, of each a sufficiency. Digest the digitalis with a gallon of the spirit for twenty-four hours at a temperature of 48.8° C. (120° F.); then put them in a percolator, and when the tincture has ceased to drop pour a gallon of spirit on the contents of the percolator, and allow it slowly to percolate through. Distil off the greater part of the spirit from the tincture, and evaporate the remainder over a water-bath until the whole of the alcohol has been dissipated. Mix the residual extract with 5 ounces of distilled water, to which ¼ ounce of acetic acid has been previously added, and digest the solution thus formed with ¼ ounce of purified

animal charcoal; then filter, and dilute the filtrate with distilled water until it measures a pint. Add ammonia-water nearly to neutralization, and afterward add 160 grains of tannic acid dissolved in 3 ounces of distilled water. Wash the precipitate that will be formed with a little distilled water; mix it with a small quantity of the spirit and ½ ounce of the lead oxide, and rub them together in a mortar. Place the mixture in a flask, and add to it 4 ounces of the spirit; raise the temperature to 71.1° C. (160° F.), and keep it at this heat for about an hour; then add ½ ounce of purified animal charcoal; put it on a filter, and from the filtrate carefully drive off the spirit by the heat of a water-bath. Lastly, wash the residue repeatedly with pure ether.—*Br.* 1867.

The process of the U. S. P. 1870 was nearly identical with the foregoing. Thus prepared, digitalin forms a white or yellowish-white powder, or it may be obtained in porous mammillated masses or scales. It is inodorous and has an intensely bitter taste; is soluble in alcohol, but almost insoluble in water and in ether. It dissolves slightly in dilute acids without neutralizing them; its solution in concentrated hydrochloric acid is yellowish, but rapidly becomes green, and after some time deposits a green powder. Its dust is irritating and sternutatory. Heated upon platinum-foil, it burns with a sooty flame, finally leaving no residue. The readiness with which the active principle of digitalis as it exists in the plant is altered has been repeatedly pointed out. The properties given by both the former British and United States Pharmacopœias are those mentioned by Homolle (1844) and Quevenne, and by the French Codex for a digitalin prepared, according to Homolle's process, by precipitating gummy and coloring matter from the cold prepared aqueous infusion with lead subacetate, removing the excess of lead by sodium carbonate, precipitating with tannin, and treating further in a manner somewhat similar to the preceding process. But the process as described above is that of O. Henry (1845), which yields a different product. Lefort (1864) pointed out that two kinds of digitalin are in the market—namely, *French* or *insoluble digitalin*, which is that of Homolle; and *German or soluble digitalin*, which is readily soluble in water, also in concentrated hydrochloric acid, the solution becoming yellow, brown, and finally a dull green; exposed to the vapor of hydrochloric acid, it turns brown, while insoluble digitalin turns green. Soluble digitalin is made in Germany by processes analogous to that of Henry, and by modifications as suggested by G. F. Walz in his investigations of digitalis (1851 to 1858). Kosmann (1875) endeavored to explain the discrepant results as follows: The active principle of digitalis, which is freely soluble in water, has been named by various authors *digitasolin*, *digitaletin*, *digitalein*, and *digitalin;* it exists in the leaves and seeds, is $C_{27}H_{45}O_{15}$, a compound of 1 molecule of digitalretin and 2 of glucose, and is readily altered even in the plant by saline and acid bodies, and converted into glucose and *insoluble digitalin* (*digitaletin* of Walz), which is $C_{21}H_{33}O_9$, and represents 1 molecule each of digitalretin and glucose. Both digitalins are very bitter and energetic medicinal agents. By the further action of hot dilute acids insoluble digitalin is split into glucose, and *digitalretin* (*paradigitalretin*), $C_{15}H_{25}O_5$, which is slightly bitter, is soluble in alcohol, slightly so in ether, but insoluble in water and alkalies. The continued action of dilute acids results in the production of *dehydrated digitalretin*, $C_{15}H_{21}O_3$, which is resin-like, insoluble in water, soluble in alcohol, ether, and ammonia-water, and has an acrid taste; it has likewise been called *paradigitalein*. Kosmann considers Nativelle's *crystallized digitalin* as being intermediate in composition between insoluble digitalin and digitalretin.

Nativelle's process (1874) is as follows: 1000 Gm. of powdered digitalis-leaves are macerated for 24 hours in a solution of 250 Gm. of lead acetate in 1000 Gm. of water, then displaced with 50 per cent. alcohol, the percolate treated with 20 Gm. of sodium bicarbonate, and distilled and evaporated to 2000 Gm.; when cool it is mixed with 2000 Gm. of water, and after several days decanted. The precipitate is drained, pressed, mixed with 1000 Gm. of 80 per cent. alcohol, and heated to boiling; 10 Gm. of neutral lead acetate are added, the boiling continued for a few minutes, and when cool the liquid is filtered. The filtrate is mixed with 50 Gm. of powdered wood-charcoal, and distilled, the charcoal exposed to expel the alcohol, drained, dried, and percolated with chloroform. The impure digitalin left on evaporation is dissolved in 100 Gm. of 90 per cent. alcohol, the solution mixed with a concentrated solution of 1 Gm. of lead acetate and with 10 Gm. of granular animal charcoal, boiled for a few minutes, cooled, filtered, and distilled. The granular crystals are drained, dissolved in 10 Gm. of hot alcohol; 5 Gm. of ether and 15 Gm. of water are added, and the whole well shaken together. The ether removes a colored fixed oil, and crystalline digitalin is deposited, which, if necessary, is again subjected to the same process of purification. It crystallizes from hot alcohol in the form of white slender brilliant needles. This is the Digitalina cristallisata, *F. Cod.*

A *digitalin* obtained from the seeds was found by Delffs (1858) to have the composition $C_{17}H_{30}O_7$, and to be colorless, crystalline, readily soluble in alcohol, ether, or chloroform, and not colored by concentrated mineral acids. Schmiedeberg (1875) obtained *digitoxin*, another active principle, from the leaves previously exhausted by water; it is entirely insoluble in water, benzene, or carbon disulphide, very sparingly soluble in ether, slowly soluble in chloroform, and readily in alcohol, and crystallizes from the saturated solution in hot spirit of chloroform; its solutions are intensely bitter; its composition is $C_{31}H_{33}O_7$. It is not a glucoside, but acids convert it into *toxiresin*, which, like digitoxin, has a powerful action on the heart. Schmiedeberg examined also a commercial digitalin made from the seeds, and found in it *digitonin*, *digitalin* (Kosmann's insoluble digitalin?), and *digitaleïn*. The latter is yellowish, not colored red by boiling hydrochloric acid, and freely soluble in water, yielding a frothing solution; otherwise it resembles digitalin. This compound is $C_5H_8O_2$, forms soft colorless grains, is nearly insoluble even in boiling water, sparingly soluble in ether and chloroform, dissolves freely in alcohol, spirit of chloroform, and acetic acid, and with warm sulphuric acid strikes a yellow or yellowish-green color, turning red with potassium bromide. Digitonin, $C_{31}H_{52}O_{17}$, Schmiedeberg ($C_{27}H_{44}O_{13}$, Kiliani, 1890), is colored red by boiling dilute sulphuric acid, and dissolves in alcohol, spirit of chloroform, and water, this last solution being frothing and precipitated by baryta-water, like saponin. By heating digitonin with dilute hydrochloric acid it is split into galactose, dextrose, and digitogenin, which is insoluble in water and has the formula $C_{15}H_{24}O_3$. Oxidized with chromic acid it forms digitogenic acid, $C_{14}H_{22}O_4$; oxydigitogenic acid $C_{14}H_{20}O_4$, and digitic acid $C_{16}H_{16}O_4$. Duffield (1868) obtained by the official process 0.8 to 0.9 per cent. of digitalin from European and American digitalis leaves.

Schmiedeberg's digitalin is regarded by Kiliani (1892) as a distinct substance and gives it the formula $C_{29}H_{46}O_{12}$. It is in the market as *digitalinum verum*, and forms a white amorphous powder, the particles of which swell up when placed in water. It is soluble in about 1000 parts of water, and 100 parts of alcohol. When an almost saturated solution in hot 80 or 90 per cent. alcohol is allowed to cool, it becomes almost solid from separated granules of digitalin. It melts toward 217° C. (422.6° F.) and becomes yellow. 2 Cc. of a 10 per cent. solution of caustic potash should not color a few granules when placed in it. Hydrochloric acid splits it into digitaligenin, glucose, and digitalose.

W. Engelhardt (1862) obtained a physiologically active volatile alkaloid from the leaves; it was also noticed by F. F. Mayer in the leaves, but not in the extract of digitalis. An acrid principle, *scaptin*, was obtained by Radig (1835) in a very impure state, and purer by Walz (1858) as *digitalacrin*. Walz (1852) separated *digitalosmin*, a pearly acrid stearopten of the odor of digitalis. Morin's (1845) *antirrhinic acid* likewise possesses some odor. The *digitoleic acid* of Kosmann and *digitaloic acid* of Walz are volatile and fatty, and probably identical. Schmiedeberg observed a yellow coloring matter which is probably identical with chrysophan.

The other constituents of digitalis are not of medicinal or pharmaceutical importance; they comprize chlorophyll, mucilage, albumen, various salts, and *inosite*, observed by Marmé (1864).

Adulterations and Substitutions are said to have occasionally occurred, but the physical characters of digitalis-leaves are so marked that they cannot easily be confounded with other leaves, even if they are in a broken condition; the rugose upper surface, the crenate margin, and the densely-pubescent lower surface, with its well-defined meshes of white prominent veins, are not met with in any other officinal leaf. As accidental impurities have been mentioned the nearly smooth leaves of Digitalis ochroleuca, *Jacquin*, the stellately hairy and mucilaginous leaves of species of Verbascum, and the nearly entire, obscurely reticulate, and (upon the upper side) rough leaves of Conyza squarrosa, *Linné* (s. Inula Coniza, *De Candolle*), and Symphytum officinale, *Linné*.

Action and Uses.—The symptoms produced by digitalis have been described in substantially the same terms by nearly all observers. The following summary, by Koppe, is complete in its details: In about an hour after taking 2 Mg. ($\frac{1}{33}$ gr.) of *digitoxin* he began to experience malaise, depression, faintness, nausea, and repugnance to food; in three or four hours the pulse fell from 80 to a point varying between 30 and 58; nausea was intense and indescribably distressing, and only momentarily relieved by a profuse vomiting of dark-green bile, and later of yellow bile; the pulse was intermittent, the features pale and collapsed. In seven or eight hours prostration was so extreme that without assistance it was impossible to stand; vision was so confused by an indefiniteness of outline that familiar objects and persons were not recognized, but

the latter were known by their voices and the whole field of vision was yellow. During the night bilious vomiting recurred at intervals, and was excited even by iced champagne. The following day the same symptoms continued; the pulse was 54 and intermittent, with a sense of præcordial sinking, and the sphygmographic tracing showed diminished force of the pulse, with inequality. The second night was disturbed with restlessness and nightmare. On the third day small quantities of water were retained, but the vision and the pulse remained as before. It was not until the fourth day that the experimenter was able to walk leaning on a friend's arm, and that the disorder of vision gradually subsided; sleep, which now was refreshing, and an almost voracious appetite, enabled him speedily to renew his strength (*Archiv f. Exp. Pathol.*, iii. 289). In other cases in which digitalis or digitalin has been taken in excessive doses the symptoms were essentially the same as these; and even in medicinal doses it sometimes causes cloudy vision (*Med. Record*, xxvii. 432). The reduction of the pulse-rate has also been illustrated by Dr. Joseph Leidy, Jr., *Thérap. Gaz.*, xii. 661).

As regards the heart, digitalis and its preparations in small doses primarily increase the pulse-rate and tension, and, if continued, lower the rate without diminishing the tension. It is an error to suppose that the increased force of the arterial blood-currents, as measured by the dynamometer, denotes an increased volume of that current; on the contrary, the arteries and the heart both experience tonic contraction under the influence of digitalis, and the supply of arterial blood is everywhere diminished. That digitalis does not give a real increase of power to the heart is shown by the fact that when the pulse-rate is slowest a comparatively slight muscular exertion, such as changing the recumbent for the erect posture, will sometimes cause the pulse to rise from the lowest point reached under the influence of the medicine to one far above the normal rate. This effect, however, is said to be produced only when the tonic action of the medicine is about to be replaced by exhaustion. The tendency to rigid contraction does not affect all the heart-muscles in an equal degree, but chiefly those of the left ventricle. It is this power which in certain cases of positive or relative debility of that ventricle renders the medicine a valuable remedy while its action is maintained within certain bounds, but beyond them it tends to obstruct the cardiac circulation, and by suddenly preventing the free passage of blood through the heart to cause death by syncope. The so-called cumulative action of digitalis, by which its sedative poisonous effects are suddenly developed, appears to be due to the sudden or rapid diminution of the blood-supply to the brain when the contraction of the heart and arteries has reached its maximum. The study of digitaline by Vulpian, Lafon, and others (*Bull. et Mém. Soc. de Thérap.*, 1887, p. 14) appears to show that this substance does not adequately represent digitalis, and is therefore not reliable as a medicine.

Digitalis is totally destitute of direct diuretic properties. The cases which led to a belief in its possessing them were those in which a diminished secretion of urine was produced by obstructive heart disease, with positive or relative debility of that organ. In a healthy state of the heart digitalis diminishes the amount of urine secreted, as well as the proportion of solid excrementitious matter contained in it. There is no reason to suppose that by its direct operation it stimulates any one of the functions. It certainly, in doses which exhibit its physiological operation, depresses the entire nervous system, impairs the digestion, diminishes urination, lowers the animal temperature, retards the respiration, and may for a time annihilate the activity of the genital organs. Its diuretic action, which, along with its power of regulating the asystolic heart, is the strongest ground of its claim to merit as a medicine, appears, then, to be altogether indirect.

As was just stated, the diuretic virtues of digitalis are the most conspicuous, and long before its mode of action had been experimentally investigated it was established as the most efficient remedy for *dropsy* depending directly upon disease of the *heart* and upon that form of *renal disease* which consists of congestion, and tubal obstruction depending upon obstacles to the cardiac circulation. On closer examination the affections which produce dropsy by hindering the cardiac circulation, particularly *valvular obstruction*, and notably *stenosis of the mitral valve*, and positive or relative *weakness of the heart-muscle*, were found to be most readily relieved by this medicine. By rendering the action of the heart stronger, as well as more tranquil and regular, and perhaps by producing contraction of the capillary arteries, the venous congestions which directly occasion dropsy are removed, degeneration of the liver or kidneys is retarded, and the absorption of the effused liquid necessarily follows. When dropsy depends upon a congested state of the kidneys, and to the prevented escape of water through these emunctories, and is cured by digitalis, the medicine probably acts by contracting the renal capillaries,

and thereby lessening the engorgement which prevented their normal secretion from taking place. In general dropsy of whatever form debility of the circulation, whether it be due to cardiac embarrassment or to renal obstruction, is the essential condition for securing the diuretic operation of digitalis.

No particular lesion of the heart is by itself an indication or a contraindication for the use of digitalis; it is the phenomena which accompany, and usually are caused by, certain lesions that furnish an indication for the medicine. Nor is it indicated by mere irregularity of action due to nervous disorder of the heart itself, or to disease elsewhere acting by a reflex operation upon the heart. *Dilatation*, slight muscular *degeneration*, and *mitral obstruction* and *insufficiency* are the lesions whose effects are favorably influenced by digitalis, which increases the blood-supply to the heart itself, thereby improving its nutrition, renders the irregular heart rhythmical in its movements, and gives a tonic contractility to its flaccid muscles. But this very power is not without its danger if the weakness of the heart is excessive, especially through fatty degeneration. To slow the heart when its muscular structure is greatly impaired is to increase its embarrassment. To slow it when its muscle is simply hypertrophied is to counteract the conservative agency by which the hypertrophy was established, as in cases of *aortic* obstruction or insufficiency, or of both united. But even in these cases Balfour contends that digitalis is beneficial (*British Med. Jour.*, Jan. 4, 1892). So long as the heart's movements are not arhythmical, or do not tend to become so during excitement of the organ, there is no indication for the use of digitalis. Whenever the rhythm of the heart is perverted, especially when its impulse is irregular in force as well as time, and this irregularity is associated with a corresponding irregularity in the duration and intensity of the murmurs and of the pulse, and when at the same time the arterial system is deficient in blood, while the veins are overloaded with it, as shown by the feeble and usually irregular pulse, the dropsical limbs, the difficult breathing, the discolored face, and perhaps bloody expectoration and scanty urine, digitalis is clearly indicated. By its means the hurried pulsations are reduced to the normal rate, and gain in regularity what they lose in frequency, and the dropsy, if that is present, begins to decline along with the disorder of the circulation. According to Fernet, it is usually on the third or fourth day that diuresis begins, especially in persons who have not become habituated to the drug, and continues for several, or indeed many, days after the medicine has been discontinued. It should not be resumed until either the heart falls again into disorder or the dropsical symptoms recur. (Compare Wood, *Med. News*, lvi. 109; Huchard, *Bull. et Mém. Soc. Thérap.*, 1890, p. 138.)

The false and absurd theory according to which the treatment of *fever* should consist of means tending directly and solely to reduce the pulse-rate has been illustrated by the use of digitalis in *typhoid fever*. Even its advocates have not shown that it abridges the disease or lessens its mortality, while it certainly tends to impair the digestion and reduce the strength, and may even occasion sudden death. The use of digitalis in other forms of fever is equally unsatisfactory, and justifies the judgment of Traube, that the true field of action for digitalis is not fever. That it is practically useful in febrile conditions with a feeble heart, as in *typhoid pneumonia* and *relapsing fever*, has been asserted (Fothergill), but has not been proved. Indeed, Liebermeister condemns digitalis in fever, both because its antipyretic operation is uncertain, and because, when it does take place, it is apt to be accompanied by disquieting symptoms. He even remarks that it can do no harm while the heart is strong (a case in which it is not indicated) unless it brings on vomiting, as it often does, and should then be discontinued, but that where the heart is feeble it must be very circumspectly used. Indeed, the more frequent the pulse is in fever the less indication is there for digitalis. "A tendency to heart-paralysis is not neutralized, but rather promoted, by digitalis. It is only in an advanced stage of the attack, when the fever has subsided, and yet the pulse continues frequent and the heart weak, that an indication for digitalis arises similar to that in heart disease, and then it will reduce the frequent pulse and strengthen the heart for its work." Upon which it is sufficient to remark that food and cordials have always been found efficient in such conditions, and that they expose the patient to no possible risk, as digitalis does. The recent use of digitalis in fever is only a revival of the old application of it by Rasori to the treatment of *inflammations;* it has also been employed by some who were perhaps ignorant of the history of its vogue and of its condemnation. The results of its revival have been to prove, in spite of contrary affirmations (*Therap. Gaz.*, xii. 684), that digitalis does not in the least modify favorably any acute inflammation, and especially *pneumonia*, *pleurisy*, and *pericarditis*, but that, on the contrary, it exposes the

patient to the risk of sudden death. The only inflammatory affection in which it may be advantageously used is chronic *bronchitis* with profuse secretion, which is often confounded with consumption. There is no doubt that in this disease it has been found to lessen the pulmonary congestion and secretion, and thereby the dyspnœa, sweating, and wasting of strength which they cause. Doubtless cases of this kind were formerly reported by Beddoes and others as of pulmonary consumption benefited by digitalis. Recently one eminent physician at least, who knows well what he says, has declared that "the local and general effects of digitalis are invaluable in all the stages of phthisis" (*Med. Record*, xxv. 199). His experience seems to have been exceptional. There is good reason for believing that certain forms of hæmorrhage may be controlled by digitalis, more particularly *uterine hæmorrhage*, whether due to congestion, to vascular relaxation, or to organic diseases of the uterus. Its utility in *pulmonary hæmorrhage* is less demonstrable. The mode of action of digitalis in these cases may be presumed to be analogous to that of ergot—viz. it causes a contraction of the arteries. The same mode of action may be attributed to the medicine in *delirium tremens*, in which it is reputed to be highly efficient if given in large doses, such as Gm. 16 (f℥ss) of the tincture, and even as much as Gm. 100 (f℥iij). More frequently, however, doses of Gm. 4–8 (f℥j–ij), repeated every three or four hours, have been employed. It would appear that there is something in this affection which ensures a singular toleration of the medicine. But the necessity of using it at all, and thereby incurring a risk which experience has shown to be occasionally a fatal one, is not apparent in relation to a disease which nearly always recovers under judicious hygienic treatment when the patient's constitution is sound. Digitalis was formerly esteemed as a remedy for *epilepsy*, and recently it has been used by Gowers along with belladonna to reinforce the action of the bromides, and was found by him distinctly more useful than the bromides alone (*Times and Gaz.*, April, 1880, p. 447; compare Wiggins, *Phila. Med. Times*, xvii. 181). The anaphrodisiac virtue of digitalis has been found useful in preventing *erections of the penis* due to local irritation, and also nocturnal *seminal emissions* and other effects of genital excitement. In *poisoning by aconite* digitalis is physiologically indicated, and published cases are supposed to furnish clinical evidence of its value. A man had taken an ounce of strong tincture of aconite, had cold hands and feet, a dusky and moist skin, frothed at the mouth and nose, and was pulseless. An emetic caused vomiting and purging; 20 drops of tincture of digitalis were injected subcutaneously, and galvanism applied to the cardiac region and kept up for twenty minutes. The patient being now able to swallow, some ammonia and brandy, with a teaspoonful of tincture of digitalis, was given, and he recovered perfectly (*Brit. Med. Jour.*, Dec. 1872, p. 680). The use of galvanism, emetics, and diffusible stimulants in this case lessens the value of the evidence in favor of digitalis. In a later case (*Boston Med. and Surg. Jour.*, Oct. 1879, p. 544) of recovery under similar treatment it is stated that the hypodermic injection of 15 drops of tincture of digitalis was "followed at once by quite a decided increase in the volume of the pulse," and the patient recovered.

Digitalis has been used as a local application to promote the resolution of *enlarged glands*, and also in infusion or tincture applied to the abdomen, especially in cases of *renal dropsy*. In the former case iodine is preferable, and in the latter the medicine should rather be given internally.

Digitalis is given in doses of Gm. 0.06–0.12 (gr. j–ij) twice or thrice daily until its effects begin to appear, when it should be at once suspended or diminished The infusion or the fluid exract or the tincture is preferable, and of these the first is by far the most efficient. Besides the officinal infusion, one may be prepared daily with about Gm. 0.20 (gr. iij) of digitalis in about Gm. 200 (f℥ vj) of hot water, sweetened, and flavored with tincture of cinnamon, bitter orange, or mint. This quantity should be given in three or four doses at regular intervals. There is no doubt that small are preferable to large doses, for if they produce their proper medicinal effects a little later, it is without risk. And it should be understood that these effects are not to be expected for several days. Poisonous effects are to be combated by distilled alcoholic liquors, wine, ether, carbonate of ammonium, opium, and strong coffee. Strychnine has been recommended as a physiological, and tannin as a chemical, antidote. If a poisonous dose has been recently swallowed, ipecacuanha, mustard, and other prompt emetics should be administered. It has been suggested to precede their use by a copious draught of milk. The variable strength of *digitalin* requires that it should be used very cautiously, beginning with the minimum dose, which may be stated at Gm. 0.001 (gr. $\frac{1}{60}$). This dose may be repeated at intervals of six or more hours, and gradually and continuously increased, but so as not to exceed Gm. 0.01 (gr. $\frac{1}{6}$) during twenty-four hours.

Echujin, an African arrow-poison, belongs to the digitalis group. It slows the heart and arrests it in systole, producing general convulsions. It does not raise the blood-pressure in cats and rabbits (*Therap. Monatsch.*, iv. 361).

CORONILLA (scorpioides) furnishes a glucoside which is alleged to act like digitalis in slowing the heart and causing diuresis, but for a much briefer period. Its efficient dose is not determined. (Compare *Therap. Gaz.*, xiii. 516; xvi. 179; *Practitioner*, xliv. 379; *University Med. Mag.*, xvi. 179.)

DIOSCOREA.—WILD YAM, COLIC-ROOT.

The rhizome of Dioscorea villosa, *Linné*.

Nat. Ord.—Dioscoreaceæ.

Origin.—Wild yam is a diœcious climbing perennial growing in thickets in moist localities of the United States south to Florida and west to the Mississippi. The leaves are alternate, opposite or whorled, broadly ovate-cordate, acuminate, nine- to eleven-ribbed, nearly smooth above, downy and paler beneath. The fruit is a triangular winged capsule growing in pendulous bunches.

Description.—The rhizome is horizontal, about 13 Mm. (½ inch) thick, somewhat flattened above, repeatedly forked or branched and bent, 15 Cm. (6 inches) or more in length, on the lower side with distant simple wiry rootlets from 5 to 10 Cm. (2 to 4 inches) long. The rhizome is externally of a pale yellowish-brown color, and breaks with some difficulty, showing internally a compact white tissue with numerous scattered yellowish wood-bundles. It is inodorous, and has a taste at first insipid, and afterward strongly acrid. In Virginia it is known as *rheumatism-root*.

Constituents.—Wild yam contains much starch. The acrid principle, allied to saponin, appears to be gradually altered on boiling the rhizome with water.

Other Species.—Most species of Dioscorea which are indigenous and cultivated in the East and West Indies and in other tropical countries have large farinaceous edible tubers, which are known as *yam*, E., G.; *igname*, Fr. The following are the most important: D. ALATA, *Linné*, *White negro yam*: D. TRIPHYLLA, *Linné*, *Buck yam*; D. TRIFIDA, *Linné*, *Indian yam*; D. BULBIFERA, *Linné*, *Ceylon white yam*: and D. SATIVA, *Linné*, *Common yam*.

The smaller cylindrical tuberous rhizomes of D. JAPONICA, *Thunberg*, and D. QUINQUELOBA, *Thunberg*, are eaten in Japan. The former is about 10 Cm. (4 inches) long, farinaceous and white; the latter is smaller, externally pale-brown, internally dingy-white, and has a bitterish taste.

Action and Uses.—Time has not increased our knowledge of the medicinal qualities of wild yam more than it has that of many other indigenous plants which were long ago reputed to be valuable medicines. We are therefore compelled to repeat, with little addition or modification, the old-time statement that, according to Riddell, "a decoction of it is eminently beneficial in bilious colic," and that Dr. Neville "places much reliance on the tincture as an expectorant, and also that it acts as a diaphoretic, and in large doses as an emetic." In Iowa it is known as "colic-root." If the "bilious colic" referred to signifies the pain caused by biliary concretions in passing through the ducts of the liver, then the claims made for dioscorea as a specific cure (Shoemaker, *Jour. Am. Med. Assoc.*, xiii. 407) for this affection have not been substantiated by any published record. The same may be said of the statement that it has "an especial effect upon the liver." The resin precipitated by water from the tincture is said to produce effects analogous to those above enumerated, and has been prescribed in doses of from Gm. 0.06–0.30 (gr. j–v). A fluid extract and also a decoction have been employed.

DIOSPYROS.—PERSIMMON, DATE-PLUM.

Fruits de plaqueminier de Virginie, Fr.; *Persimmonfrüchte*, *Dattelpflaumen*, G.

The unripe fruit of Diospyros virginiana, *Linné*.

Nat. Ord.—Ebenaceæ.

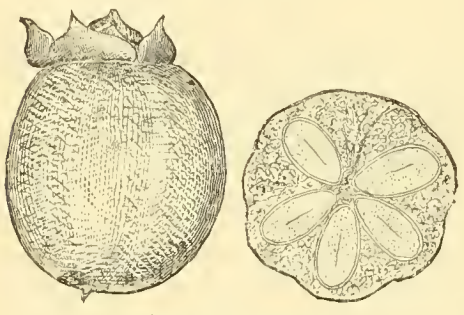
Origin.—The persimmon tree is indigenous to the United States, and grows in woodlands, in low grounds, and along streams from the New England States west to Illinois, and in the Southern States. It attains a height of 15 to 18 M. (50 to 60 feet), is irregularly branched, has nearly smooth, subcoriaceous, ovate-oblong leaves, and produces in May and June axillary and solitary fertile flowers with eight stamens and clustered ster-

ile flowers with sixteen stamens. The fruit ripens in November, but should be collected not later than October, while green.

Description.—The fruit is a globular berry about 25 Mm. (one inch) in diameter, with a short foot-stalk, and the permanent four-lobed calyx at the base, green, smooth, and four- to six-celled, each cell containing a single flat ovate-oblong seed. The unripe persimmon has a short remnant of the style attached, is of a pleasant but weak odor, and contains a viscid juice of a very astringent taste, which is retained when carefully dried, but becomes acidulous-sweet after the fruit has been exposed to the frost.

Constituents.—B. R. Smith (1846) found the unripe fruit to contain tannin, malic acid, and sugar. J. E. Bryan (1860) detected also pectin, and regards the tannin as distinct from the tannin of galls. Charropin (1873), however, considers it identical with the latter, and isolated also a yellow coloring matter which is insoluble in water, but readily soluble in ether.

Fig. 102.



Diospyros virginiana: fruit and transverse section, natural size.

The ripe fruit is edible. Mixed with flour, a pleasant bread or cake is made of it. When kneaded with half its measure of wheat-bran and well baked in an oven, a bread is obtained which in the Southern States is preserved for making *persimmon beer* by fermenting it with some hops. Such beer is also made from the fresh fruit, and by distillation alcohol may be obtained.

Allied Plants.—Diospyros obtusifolia, *Willdenow*, of Mexico, is called *Zapote prieto* or *Z. negro;* the leaves and bark are astringent and tonic. Diospyros embryopteris, *Persoon* (Bentley and Trimen, *Med. Plants*, 168). The orange-yellow fruit is about 5 Cm. (2 inches) in diameter, about ten-celled, very astringent in its unripe state, and is used in India like persimmon.

Diospyros kaki, *Linné filius*, a medium-sized tree of China and Japan, has a sweet, reddish fruit, which, preserved with sugar, is occasionally seen in our market, being sold as *Chinese or Japanese persimmon.*

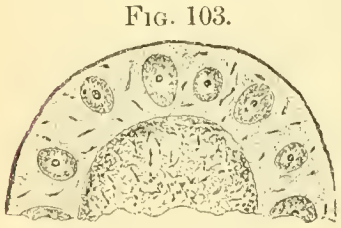
Action and Uses.—The unripe fruit, and also the inner bark, are astringent and bitter, and are used, like other products of the same nature, in the treatment of chronic and subacute *diarrhœa*, *leucorrhœa*, *sore throat*, and *uterine hæmorrhage.* It is also sometimes employed as a tonic and febrifuge. The most convenient preparation is an infusion or a vinous tincture, which may be made by percolation with an ounce of the dried unripe fruit or of the bark to half a pint or less of the menstruum. It may be prescribed in doses of from Gm. 15–60 (f℥ss–ij).

DRACONTIUM.—Dracontium.

Skunk-cabbage, *Skunk-weed*, *Polecat-weed*, E.; *Pothos fétide*, Fr.; *Stinkende Drachenwurz*, G.

The rhizome and roots of Dracontium fœtidum, *Linné*, s. Ictodes fœtidus, *Bigelow*, s. Symplocarpus fœtidus, *Salisbury*, s. Pothos fœtida, *Michaux.* Meehan, *Native Flowers*, i. pl. 15.

Fig. 103.



Dracontium fœtidum: section through one-half of upper part of rhizome, natural size.

Nat. Ord.—Araceæ.

Origin.—This common North American perennial grows in bogs and moist grounds, and flowers in April and the early part of May. The spathe, which precedes the leaves, is hooded-shellform, pointed, rather fleshy, of a variegated purplish-brown and yellow color, and encloses a short oval spadix which is densely tessellated with fleshy flowers, and enlarges finally to a spongy mass superficially covering the globular seeds. The leaves are radical, 45 to 60 Cm. (1½ to 2 feet) long, on short petioles, smooth, ovate, and heart-shaped. All parts have a very fetid odor, which on bruising is more decided.

Description.—The rhizome, which should be collected early in the spring, is tuberous, truncate above and below, 7 to 10 Cm. (3 to 4 inches) long, and about 5 Cm. (2 inches) in diameter, of a gray-brown color, the upper half beset with numerous long fleshy rootlets, which in drying become much shrivelled and longitudinally wrinkled, and are of a lighter color and weaker taste than the rhizome. The latter is white internally, or gray when old, has the fibro-vascular bundles scattered, but rather crowded within the

nucleus-sheath, and possesses a very acrid and biting taste, which is gradually lost when long kept.

Constituents.—The root was analyzed by J. M. Turner (1836) who did not succeed in isolating the acrid principle, which appears to be altered by heat, and who obtained from it a volatile fatty matter, a little volatile oil, resin, wax, fixed oil, sugar, gum, and starch.

Action and Uses.—Dracontium, when chewed, produces irritation of the mouth, and, applied to a freshly-blistered surface, augments its secretion. Internally, it occasions vertigo, nausea, and frequently vomiting. Its fetid smell probably suggested its employment as an antispasmodic, and reports are not wanting of its having cured *hysteria*, *chorea*, and spasmodic *asthma*, and even *chronic bronchitis*, *chronic rheumatism*, and *dropsy*. The *dose* is from Gm. 0.60–1.20 (gr. x–xx) of the recently-dried root. An infusion made with Gm. 32 (℥j) of the dried root to a pint of water may be prescribed in doses of 1 or 2 tablespoonfuls. A saturated tincture made in the same manner may be given in the dose of 1 or 2 teaspoonfuls.

DROSERA.—Sundew.

Herba rorellæ.—Rossolis, *Rosée du soleil*, Fr.; *Sonnenthau*, G.

The entire plant, Drosera rotundifolia, *Linné*.

Nat. Ord.—Droseraceæ.

Fig. 104.

Drosera rotundifolia, natural size.

Description.—This little perennial is frequently met with in peat-bogs and near swamps in Europe and North America, particularly in the northern section of this continent. It has a tuft of petiolate radical leaves which are nearly orbicular, fleshy, and upon the upper surface covered with numerous whitish or, toward the margin, purplish glandular bristles. The scape is about 10 Cm. (4 inches) high, and bears a circinate one-sided raceme of small flowers with five white petals, five stamens, and three styles. The plant flowers in July and August, is inodorous, and has an acidulous, bitterish, and acrid taste. According to Vigier (1878), the plant loses on drying 85 per cent. of moisture, and when dry yields 25 per cent. of extract with 60 per cent. alcohol.

The nearly-allied D. longifolia, *Linné*, s. D. intermedia, *Hayne*, likewise a native of both continents, is chiefly distinguished by its spatulate-oblong leaves.

Constituents.—The juice of sundew was examined by Trommsdorff (1833), who found in it free malic acid, various salts, and a red coloring matter, which is precipitated by lead acetate. Hager believed the acid to be a mixture of citric and malic acids. Lugan (1878) succeeded in crystallizing it, and regards it as peculiar; but G. Stein (1879) showed it to be citric acid. By treatment with chloroform, Lugan extracted a greenish-brown, odorous, and very acrid resin; the juice contains also glucose, and the viscous exudation of the glands has a neutral reaction, and does not contain formic and butyric acids, the presence of which was reported by Reiss and Will.

Action and Uses.—Two species which have been used in medicine, D. rotundifolia and D. longifolia, appear to be identical in their qualities. In Europe for several centuries they had a popular reputation as remedies in chronic bronchitis and asthma, and externally the juice was applied to remove warts. In 1860 some attempts were made to revive the use of this medicine by employing its expressed juice, which, however, it was found, might be taken to the extent of 3 or 4 ounces daily without producing any distinct effects. Some cases of *bronchitis* were reported to be benefited by it, and in *whooping cough* it appeared sometimes to exert a palliative influence, particularly by lessening the tendency to vomit during the paroxysms. This effect has been very plausibly attributed to the preparation employed—viz. one made by macerating the plant in alcohol. Murrell, however, alleges that while 5-drop doses of a "one-in-ten tincture" aggravated the cough in a case which he treated, ½-drop doses palliated, and then arrested, the cough (*Lancet*, Apr. 17, 1880).

DULCAMARA, *U. S.*—Dulcamara.

Stipites dulcamaræ.—Bittersweet, Woody nightshade, E.; *Tiges de douce-amère (de morelle grimpante)*, Fr.; *Bittersüss-Stengel*, G.; *Dulcamara, Gloria*, Sp.

The young branches of Solanum Dulcamara, *Linné* (s. Dulcamara flexuosa, *Moench*). Woodville, *Med. Bot.*, plate 33; Bentley and Trimen, *Med. Plants*, 190.

Nat. Ord.—Solanaceæ, Solaneæ.

Origin.—The bittersweet is a somewhat shrubby and climbing plant which grows throughout the greater part of Europe, in Northern Africa, and from Asia Minor east to North-western India and to China. It is naturalized in North America, and in many places is abundant. It grows around dwellings and in hedges and thickets on moist banks. The stem, when supported by shrubs, is sometimes 4.5 to 6 M. (15 to 20 feet) long, woody at the base, and divided into many flexuose branches dying back during the winter; the leaves are alternate, petiolate, and slightly pubescent beneath, the lower ones ovate with a heart-shaped base, the upper ones halberd-shaped or with two ear-like lobes at the base; the flowers are in small cymes, and have a deeply five-lobed, purple, sometimes whitish, corolla. The berries are oval, bright-red, and contain many minutely-pitted seeds.

Description.—The branches which are one or two years old are collected in the autumn after having shed their leaves, or in the spring before the leaves appear. They are 5 Mm. ($\frac{1}{5}$ inch) and less thick, cylindrical or somewhat angular, longitudinally striate or furrowed, and more or less warty. The corky layer is pale greenish- or yellowish-brown, separates easily, and covers a dark-green bark, which is lighter-green in the bast-layer; and this consists of thin-walled parenchyma, containing in the inner layer minute crystals of calcium oxalate, and in the outer zone a circle of tough bast-fibres, either single or in small groups. The greenish (afterward yellowish) wood is porous, striate by the fine medullary rays, and consists of one or two annual rings; the whitish pith has been usually absorbed. The odor is unpleasant, somewhat narcotic, weak in the dried stalks; the taste is bitter, afterward sweet. Bittersweet is generally met with in the market cut into short sections.

Fig. 105.

Solanum Dulcamara, *Linné*.

Fig. 106.

Transverse section of branch.

Constituents.—The bittersweet principle has been variously named *picroglycion, dulcarin*, and *dulcamarin*. Desfosses (1821) separated from the drug *solanine*, an alkaloid previously discovered by him in Solanum nigrum, and he, as well as Pelletier, regarded the picroglycion as solanine mixed with glucose. Winckler (1841), Moitéssier (1856), and others considered the alkaloid of dulcamara as distinct from the solanine of potatoes; but since the discovery of the glucoside nature of solanine in 1859 the supposed solanine from bittersweet does not appear to have been again examined.

Wittstein (1852) isolated from bittersweet *dulcamarine*, an alkaloid having a resinous appearance and the odor and taste of the plant. E. Geissler (1875) obtained this product, but recognized it as a mixture. He obtained *dulcamarin*, $C_{22}H_{34}O_{10}$, by digesting the aqueous infusion of bittersweet with granular animal charcoal, washing the latter, and exhausting it with boiling alcohol, evaporating, dissolving in water, precipitating with ammonia, and the filtrate therefrom with lead subacetate, digesting the washed precipitate with alcohol, and decomposing it with hydrogen sulphide. It forms a yellowish powder of a strongly bitter and then sweet taste, is soluble in alcohol and water, insoluble in ether, chloroform, benzene, carbon disulphide, and petroleum benzin, and is decomposed by diluted acids into sugar and brown, tasteless *dulcamaretin*.

The other constituents, gummy, resinous, and waxy matters, are not of medicinal importance.

Admixtures.—The cut stems of Humulus Lupulus, *Linné*, and Lonicera Periclymenum, *Linné*, are said to be occasionally mixed with dulcamara in Europe; they have none of the characteristics of the latter.

Allied Plants.—Lycium vulgare, *Dunal*, s. L. barbarum, *Linné*. *Nat. Ord.*—Solanaceæ. Matrimony-vine, *E.* This shrub is indigenous to the countries bordering on the Mediterranean, and is cultivated and wild in the United States. It is from 3–6 M. (10 to 20 feet) high, and has numerous slender, recurved branches, which are covered with a smooth brownish-gray bark and armed with few thorns. The leaves are 2–5 Cm. (1 or 2 inches) long, alternate, oblong-lanceolate, entire, smooth, shortly petiolate, and often clustered. The greenish-purple flowers have a tubular five-lobed corolla and produce oval red two-celled berries containing many reniform seeds. The bark and leaves have a sweetish and slightly bitter and acrid taste. Husemann and Marmé (1863) obtained an alkaloid, *lycine*, $C_5NH_{11}O_2$, in white prisms, which are deliquescent, sparingly soluble in ether, and have an acrid taste free from bitterness. Husemann (1875) proved it to be identical with *betaine*, an alkaloid isolated by Scheibler (1866) from beet-root juice, and, like it, not preexisting in the plant, but formed from it during the process by the action of free acid. The leaves of lycium yielded a larger proportion than the branches.

Lycium Afrum, *Linné*, of Northern Africa, and L. umbrosum, *Humboldt et Bonpland*, of South America. The infusion of the leaves is used in erysipelas and skin diseases. Berberis Lycium, *Royle*, contains berberine.

Action and Uses.—In large doses dulcamara is stated by some reporters to cause dryness, heat, and constriction and stinging in the throat, thirst, and sometimes diarrhœa. Feeble persons, it is said, are apt to experience twitching of the eyelids and lips, with tremulousness of the limbs; the head is heavy and giddy, and a cyanotic hue of the face and hands may be observed, and sometimes an erythematous eruption of the skin, with a tendency to diaphoresis. The action of dulcamara upon the heart is not definitely determined, but it probably renders the circulation slower and more languid. Dulcamara, it has been alleged, produces itching and heat in the female organs of generation, with painful strangury, and sometimes even venereal desires; while, on the other hand, to it has been attributed a power of subduing the morbidly-active sexual appetite. It is proper to state that Dr. John Harley experimented upon man with the expressed juice, and also with the tincture, in small and large doses, without any appreciable physiological effect.

So-called scientific therapeutists have denied any curative virtues to dulcamara, because they were unable to explain those it is alleged to possess according to their notions of its mode of action. Such a reason may, in a logical sense, be called impertinent. The claims of dulcamara rest on the same grounds as those of opium, mercury, and cinchona—the ground of clinical experience. It was long used as a popular remedy, and subsequently by physicians, for *cutaneous eruptions*, both internally and externally, and especially for psoriasis and other scaly diseases of the skin, and also for acne, impetigo, chronic eczema, and ecthyma. It is said to be most apt to cure those diseases when they occur in persons of a strumous habit. It has had considerable repute as a remedy for chronic muscular *rheumatism*, and also in chronic *bronchitis*, *whooping cough*, and other chronic pulmonary affections in which cough is a prominent symptom. An anaphrodisiac property was ascribed to dulcamara by Dr. W. P. Dewees, who observed that a patient who was taking it for a disease of the skin lost his venereal desire. On discontinuing the use of the medicine the patient's normal function was restored, but on resuming its use again the original effect was repeated. In five cases in which Dr. Thomas Harris employed it the venereal appetite was suspended during its use. Dr. Dewees prescribed it successfully in cases of *nymphomania* and *satyriasis* (*Amer. Cyclopædia of Med. and Surg.*, ii. 23).

Dulcamara is best used in decoction, which is made from the fresh young branches (℥j to q. s. of water, reduced by boiling for fifteen minutes, then adding water to make a pint). The infusion and the fluid extract may also be employed. It must be long continued to produce its curative effects.

Solanine has been alleged to control the *vomiting* of pregnancy, to lessen the cough and expectoration in chronic *bronchitis*, and to palliate spasmodic *asthma* and the pain of muscular *rheumatism*. As an analgesic it has been recommended by Geneuil and others in various *neuralgiæ*, including those due to spinal disease; but the greater number pronounce its action uncertain or valueless (Guinard, *Bull. de Thérap.*, cxiii. 21). An exception to this statement occurs in Sarda's conclusions from clinical observation. He asserts that solanine is an excellent analgesic, especially in chronic neuralgiæ following

neuritis; that it allays gastric pains and those of locomotor ataxia and other motor disorders of spinal origin, such as tremor due to insular sclerosis of the cord, and the exaggerated reflex movements of epileptoid tremor (*ibid.*, cxiv. 433). Muriate of solanine may be given internally in doses of Gm. 0.5–0.10 (gr. j–ij) in pill, wafer, or in liquid vaseline. The dose may be rapidly increased to Gm. 0.40–0.50 (6 or 8 grs.) a day. It has been given hypodermically, but with less advant.ge; the sulphate so administered has proved very irritating.

Solanum paniculatum is said to be used by South American physicians as a tonic, antiblennorrhagic, antisyphilitic, diuretic, antiperiodic medicine, but particularly in vesical catarrh and as a drastic. Other species are also employed medicinally. A conclusive examination of the subject has not yet been made (*Therap. Monatsheft*, iii. 125). Solanum carolinense was once reputed to be useful in idiopathic tetanus, and Porcher states that it has some reputation among the negroes of South Carolina as an aphrodisiac. According to Napier (*Virginia Med. Monthly*, Sept. 1889), it has cured convulsions of different sorts when given in a tincture to the production of drowsiness.

ECBALLII FRUCTUS, *Br.*—Squirting-Cucumber Fruit.

Cucumis asininus, *Cucumis agrestis*.—*Wild cucumber*, E.; *Concombre sauvage* (*purgatif d'âne*), Fr.; *Springgurke*, *Esels-Kürbis*, *Spritzgurke*, G.; *Cohambrillo amargo*, Sp.

The fruit of the squirting cucumber, Ecballium (Momordica, *Linné*) Elaterium, *A. Richard*, s. Ecb. officinale, *Nees*, s. Ecb. agreste, *Reichenbach*, s. Elaterium cordifolium, *Moench*. Step. and Church, *Med. Bot.*, plate 34; Bentley and Trimen, *Med. Plants*, 115.

Nat. Ord.—Cucurbitaceæ.

Origin.—The plant is a common weed in dry and waste places in Southern Europe, and eastward thence to Persia. It has a perennial, fleshy, white root, a trailing, succulent, bristly stem 0.6 to 1.2 M. (2 to 4 feet) long, alternate, bristly, bluntly-triangular, and cordate leaves, and unisexual monœcious flowers with deeply five-lobed, yellow, and veined corollas. The plant is cultivated to a small extent for medicinal purpose in Germany, France, and at Mitcham and Hitchin in England, the seeds being sown about March, the seedlings planted out in June, and the nearly ripe fruit collected in August or early in September.

Description.—The fruit is nodding from the recurved stalk, 5 Cm. (2 inches) or less in length, about 25 Mm. (1 inch) thick, oblong, and somewhat tapering above, pale-green, beset with fleshy prickles, three-celled, and contains a bitter watery, mucilaginous juice in which the numerous oblong, compressed, polished, light-brown seeds are immersed. When mature the fruit becomes yellowish, and separates suddenly from the stalk, at the same time violently expelling the juice and seeds from the orifice formed at the base. The fruit is collected with the stalk when almost ripe for preparing elaterium.

Fig. 107.

Ecballium officinarum, *Richard.*

Elaterium, *Br.*—Elaterium, *E.*, *Fr.*, *G.*; Elaterio, *Sp.* The following process is given for its preparation: Take of Squirting-Cucumber fruit, very nearly ripe, 1 pound. Cut the fruit lengthwise and lightly press out the juice. Strain it through a hair-sieve and set it aside to deposit. Carefully pour off the supernatant liquor, pour the sediment on a linen filter, and dry it on porous tiles with a gentle heat. The decanted fluid may deposit a second portion of sediment, which can be dried in the same way.—*Br.*

This is essentially the process recommended by Dr. Clutterbuck (1820), except that he directs the surface of the fruit to be moistened with cold water, thus preventing the juice from adhering, and the split fruit to be rinsed in cold water for recovering the juice adhering to the inside. With an increased pressure a larger amount of juice and of deposit is obtained, but the latter is then of inferior quality. The deposited elaterium may be dried with a very moderate heat, but exposure to the sunshine should be avoided. Clutterbuck obtained

only 6 grains of elaterium from forty specimens of squirting cucumber; with slight pressure 40 pounds of the fruit will generally yield ½ ounce, and in warm, dry seasons even ¾ ounce, of elaterium.

Elaterium is in light, friable, flat, or slightly incurved, cake-like fragments, frequently marked on their surfaces with the impression of the linen or paper on which they were dried. When fresh it has a pale-green color, changing by age to gray, and then often containing minute sparkling crystals on the surface. It breaks with a fine granular fracture, and has a slight tea-like odor and an acrid and bitter taste. It does not effervesce with acids; a cooled decoction of it is not colored blue or is but slightly tinged by solution of iodine, showing the nearly complete absence of starch. It yields half its weight to boiling rectified spirit; and this solution, on being concentrated and added to warm solution of potassa, deposits on cooling not less than 20 per cent. of elaterin in colorless crystals.—*Br.*

Constituents.—The analyses of Braconnot, Paris, Marquart, Landerer, and Koehler indicate the presence in the fruit of resin, pectin, and albuminous and gummy matters, but besides *elaterin* no compound of importance. (See ELATERINUM.) According to Koehler (1869), the juice contains only 3.5 per cent. of organic and 1.5 per cent. of inorganic constituents.

Walz (1859) obtained from the entire plant collected with the root the following principles, which are stated to be present likewise in elaterium:

Prophetin, also found in the fruit of Cucumis prophetarum, *Linné*, a yellowish powder, slightly soluble in water, more in alcohol, freely in ether; precipitated by tannin; is a glucoside; *ecbalin* or *elateric acid*, resin-like, bitter, and acrid, soluble in alkalies, alcohol, ether, and in 20 parts of water; *hydro-elaterin*, amorphous, soluble in water, alcohol, ether, and alkalies; is not a glucoside; *elaterid*, very bitter, insoluble in water and ether, soluble in alcohol and alkalies, also in concentrated acids.

ELASTICA, *U. S.*—INDIA-RUBBER.

Resina s., Gummi elasticum.—Caoutchouc, E., Fr. Cod.; *Kautschuk, Federharz*, G.; *Cahuchu, Goma elastica*, Sp.

The prepared milk-juice of various species of Hevea, known in commerce as Para rubber. *Nat. Ord.*—Euphorbiaceæ.

Origin.—Caoutchouc exists in the milk-juice of a very large number of plants in the form of minute or larger granules, frequently associated with starch-granules, and kept in suspension by mucilage. Plants capable of yielding caoutchouc are found in all parts of the world, and belong mostly to the natural orders of Euphorbiaceæ, Urticaceæ, Apocynaceæ, and Asclepiadaceæ, but only species growing in the tropics yield the product in large quantity.

HEVEA GUYANENSIS, *Aublet*, s. Siphonia, (Jatropha, *Linné filius*) elastica, *Persoon*. This is a handsome tree about 18 M. (60 feet) high, with alternate trifoliate leaves, the leaflets being obovate, about 10 Cm. (4 inches) long, dark green and glossy above and whitish-green beneath. It is a native of Guiana and Northern Brazil, and yields the Para rubber, which is regarded as one of the best varieties. Manihot Glaziovii, *Müller*, is the source of Ceara rubber; Hancornia speciosa, *Gomez* (Apocynaceæ), yields Mangabeira rubber. Similar products are obtained from Hevea (Siphonia, *Kunth*) brasiliensis, *Müller*, Hevea discolor, *Müller*, and other euphorbiaceous trees of Brazil, and in Central America from Castilloa elastica, *Cervantes*, Cast. Markhamiana, *Collins* (Artocarpeæ), and others.

FICUS (Urostigma, *Miquel*) ELASTICA, *Roxburgh* (Urticaceæ, Artocarpeæ). It is a handsome East Indian tree, and is not unfrequently seen here in hot-houses. It has large, leathery, oval, and entire leaves, which are dark-green and glossy above. Ficus indica, *Linné*, F. religiosa, *Linné*, and several other species also furnish caoutchouc which is considered inferior to that of the preceding and following species:

URCEOLA ELASTICA, *Roxburgh* (Apocynaceæ). It is a large climbing shrub indigenous to the Malayan Archipelago, and has opposite, ovate-oblong, and pointed leaves. Together with Urceola (Chavannesia, *De Candolle*) esculenta, *Bentham*, and other species, it yields Penang and Borneo caoutchouc, while Chittagong caoutchouc is prepared from Willughbeia edulis, *Roxburgh*, and allied Apocynaceæ.

Landolphia gummifera, *Lamarck* (Apocynaceæ), of South-eastern Africa, Landolphia florida, *Bentham*, Urostigma Vogelii, *Miquel* (Artocarpeæ), and other plants of Western Africa, yield also caoutchouc.

Preparation.—In South America the white milk-juice, obtained from incisions made through the bark, is dried upon clay moulds which are dipped into the liquid, and suspended over a fire; the dipping is repeated until the layer of caoutchouc has the desired thickness, when it is removed from the mould. In India the juice is allowed to dry in masses or is formed into balls.

Description.—Occasionally the natural exudation is seen as a white or yellowish milk-like liquid, having a cream-like consistence and an unpleasant odor; it contains about 32 per cent. of caoutchouc. This is more generally met with either in the form of hollow clavate or hollow-shaped pieces, or in layers 5 or 8 Cm. (2 or 3 inches) thick, externally of a blackish or dark-brown color, and internally pale-brownish or whitish, and somewhat porous. In this condition it is tough and very elastic, the elasticity being increased at a somewhat elevated temperature, and considerably lessened near the freezing-point, though caoutchouc does not thereby become brittle. Its density varies between 0.92 and 0.96. When heated to 125° C. (257° F.) or a little higher India-rubber melts, but on cooling remains soft and adhesive, and ultimately congeals to a brittle mass; heated to a still higher temperature, it is decomposed, and in the open air burns with a luminous sooty flame. India-rubber has a faint, peculiar odor, and is nearly tasteless. It is insoluble in water and in dilute acids and alkalies; it softens and swells when treated with hot alcohol or with amylic alcohol, and dissolves to a soft jelly-like mass in carbon disulphide, stronger ether, oil of turpentine, and other hydrocarbons, notably in petroleum benzin, benzene, and in the empyreumatic oils obtained in the destructive distillation of India-rubber; it dissolves more readily and completely in chloroform, and may be melted together with fats and fixed oils. When pure or nearly so India-rubber floats on water. Rubber tubing is apt to become brittle by use and on exposure—a change which Mareck (1881) found can be prevented by keeping the tubing under water, which is to be occasionally renewed; the outer layer of the rubber assumes a fatty appearance, becomes lighter, then darker, and is improved for practical purposes. A strong solution of India-rubber or an ammoniacal solution of shellac may be employed as a *cement* for fastening rubber upon other material.

When finely divided, mixed with sulphur, and afterward heated *vulcanized* rubber is obtained; this, however, is more generally prepared by softening or dissolving India-rubber and combining it with sulphur. Vulcanized rubber is insoluble in the ordinary solvents of India-rubber, and its elasticity is not materially affected by a low temperature. Compounds of India-rubber and sulphur, with which tar, white lead, chalk, or other substances have been incorporated, form *hard rubber and ebonite*, which at an elevated temperature may be moulded or rolled into sheets.

Composition.—India-rubber is a hydrocarbon, $C_{20}H_{32}$, and on destructive distillation yields *caoutchoucin*, which consists of two or more polymeric volatile oils. C_9H_8.

Pharmaceutical Uses.—As an addition to plasters.

Uses.—The utility of this substance in medicine depends chiefly upon its elasticity and impermeability to air and liquids, and, in the vulcanized condition, upon the numerous mechanical purposes which it subserves. Its elasticity, especially when woven into textile fabrics, adapts it to exert a modified pressure upon various parts of the body, limiting their enlargement and their movements, as in cases of *varicose veins*, *pendulous abdomen*, *hydrocele*, *varicocele*, *prolapsus ani*, *umbilical hernia*, etc. Dr. Wm. Barton Hopkins recommends the use of narrow strips of "bandage gum" to compress *swelled-testicle* in a manner devised by himself (*Phila. Med. Times*, xv. 350). "Rubber cloth" and thin sheets of caoutchouc are very commonly used to protect bedding and clothing from the discharges of the sick, and, when worn next the skin, to prevent the exhalation of the perspiration, and thus keep the skin constantly moist or to restrain the evaporation of liquids applied to it. In this manner, caoutchouc has been extensively used in treating *eczema* and *psoriasis* and various cutaneous diseases, as well as *burns*, *ulcers*, and other analogous lesions, and in protecting parts liable to *neuralgia* or *rheumatism* from the influence of vicissitudes of weather. It is unnecessary to enumerate the various surgical instruments constructed with this material in its more or less flexible and elastic and its hard or vulcanized condition—the bougies, catheters, pessaries, nipple-shields, specula, syringes, stomach, rectal, drainage, and other tubes, and countless instruments which combine lightness, firmness, durability, insusceptibility to corrosion, and at the same time cheapness, in a degree unequalled by any metal. A similar statement might be made of numerous articles of surgical apparatus, orthopædic and others, including artificial ears, noses, hands, etc. Caoutchouc can scarcely be used for any strictly medicinal purpose; even the application of it dissolved in chloroform to prevent the

development of *small-pox pustules* is really mechanical in its action, and, moreover, is less efficient than it was claimed to be.

ELATERINUM, *U. S., Br.*—Elaterin.

Elatérine, Elatine, Fr.; *Elaterin*, G.; *Elaterina*, Sp.
Formula $C_{20}H_{28}O_5$. Molecular weight 347.20.

Preparation.—Elaterin is a neutral principle prepared from elaterium, and discovered by Hennell and by J. D. Morries (1831). The latter prepared it by evaporating the tincture of elaterium to an oily consistence, and, while still warm, pouring it into a warm solution of potassa; in place of which he afterward recommended boiling water. The chlorophyll adhering to the crystals was recommended by Marquart (1833) to be removed by careful washing with ether, or by Power (1875) preferably by agitating the alcoholic solution with benzin. It is not unlikely, however, that in this way a portion of the principle may be lost, for Buchheim (1872) observed that on adding potassa to a hot alcoholic solution of elaterin a compound soluble in water is formed. According to him, elaterin is the anhydride of elateric acid, and converted into the latter by heat alone; hence the importance of avoiding heat in the preparation of elaterium. The best method of obtaining elaterin is to exhaust elaterium with chloroform, from which solution white crystals will be immediately deposited on the addition of ether; after washing with a little ether and recrystallizing from chloroform pure elaterin will be obtained (*Pharmacographia*). The yield varies to some extent; Morries (1831) obtained between 15 and 26 per cent.; Flückiger and Hanbury (1874), 27.6 and 33.6; Walz (1859), even 50 per cent. It was observed by Marquart (1833), Walz (1859), and Köhler (1869) that the amount of elaterin diminishes very considerably in the fruit as the season advances.

Properties.—Elaterin is in colorless, shining, hexagonal scales or prisms, which are not altered on exposure, are inodorous, and have a somewhat acrid and extremely bitter taste. They have a neutral reaction to test-paper, are soluble at 15° C. (59° F.) in 4250 parts of water, in 1820 parts of boiling water, in 337 parts (over 120 parts of alcohol, Golding Bird 1840) of alcohol, and in 34 parts of boiling alcohol, also in 543 parts (290 parts, Hennell) of ether and in 2.4 parts of chloroform, and insoluble in benzine. Elaterin is likewise soluble in amylic alcohol, carbon disulphide, hot olive oil, and oil of turpentine. The effect of potassa has been referred to above; the acid body thereby produced is inert, since 1.0 Gm. of it produced no effect. Elaterin is not a glucoside, and its solutions are not precipitated by tannin. At 190° C. (374° F.) the crystals begin to agglutinate, and at 209° C. (408.2° F.) they melt to a grayish-brown transparent liquid, which on cooling congeals to an amorphous mass; at a higher heat it gives off white somewhat acrid vapors, and burns with a sooty flame, leaving no residue. According to Power (1875), elaterin is not changed by chlorinated alkalies. Solutions of the alkalies dissolve it, but on the addition of an acid it is precipitated. Nitric acid produces, after several hours, a pinkish tinge, but when heated at once a red coloration. Sulphuric acid dissolves it with a deep-red color, the solution yielding a brown precipitate with water; the color of the solution gradually changes to deep-brown, and ultimately to light-green, on the addition of a fragment of potassium bichromate; when dissolved in cold concentrated sulphuric acid, it causes the latter to become yellow at first, which color gradually changes to a scarlet.—*U. S.* Elaterin added to a few drops of melted carbolic acid, followed by sulphuric acid, produces a magnificent crimson color, changing to orange and scarlet.

"An alcoholic solution of elaterin should not be precipitated by tannic acid, mercuric chloride, or platinic chloride test-solutions (absence of and difference from, alkaloids)."—*U. S.*

Action and Uses.—Elaterium, however it may be given to dogs and rabbits, does not vomit or purge them, but destroys them with tetanoid phenomena. In some other animals the subcutaneous use of elaterium produces profound and fatal exhaustion. In man its internal use causes more or less vomiting, severe griping, and profuse watery stools, with a sense of great debility. It is used as a purgative in those cases only in which a drastic operation, with profuse serous discharges, is desired. Hence it may be prescribed with great effect to relieve the brain or the lungs threatened with the dangers of *congestion*, provided no contraindication exists in the patient's debility or in diseases of the digestive canal. It was one of the most renowned of the ancient remedies for *dropsy*, and in recent times it has shown its power by evacuating serous collections which

other purgatives and all diuretics failed to remove. It is, however, most frequently used in primary abdominal dropsy. Yet it is not less useful in dropsy of cardiac or renal origin (provided that the strength of the patient suffices) to remove the accumulations of fluid in the connective tissue or in the serous cavities.

The variable strength of elaterium suggests caution in its use. Gm. 0.004 (gr. $\frac{1}{16}$) may be given in a pill made with the extract of hyoscyamus or confection of roses, and repeated every hour until the effects begin to appear. Elaterin is more active in alcoholic solution, or it may be given in the officinal (1882) trituration of elaterin. The *dose* is Gm 0.002–0.005 (gr. $\frac{1}{30}$–$\frac{1}{12}$).

Mormordica buchu, a cucurbitaceous plant of Brazil, is said to resemble M. elaterium in its action, which, however, is much harsher (*Brit. Med. Jour.*, May 28, 1887).

ELEMI, *Br.*—Elemi.

Resina (*s. Gummi*) *Elemi.—Elémi*, *Resine élémi*, F.; *Elemi*, G.; *Goma de limon*, Sp.

A concrete resinous exudation, the botanical source of which is undetermined, but is probably Canarium commune, *Linné* (*Rumph. Amb.*, vol. ii. plate 47). Chiefly imported from Manilla. *Br.* Bentley and Trimen, *Med. Plants*, 61.

Nat. Ord.—Burseraceæ.

Origin.—The name of elemi has been given to various resinous products which have from time to time appeared in commerce, and which, it is believed, are all derived from trees of the Nat. Ord. Burseraceæ. The British Pharmacopœia refers Manilla elemi, a product of the Philippine Islands, to the species named above, a tall tree indigenous to the Moluccas and to other parts of tropical Asia, while Blanco (1845) states that it is obtained from Icica abilo, a tree scarcely known. Perrottet (1821) sent specimens of the elemi tree to Paris and to Senegambia, and stated (1823) that the tree is scarified twice a year, and the flow of the oleoresin promoted by kindling a fire near the tree. Baup (1851) believed Canarium album, *Rœnschel*, to be Perrottet's tree (Flückiger, *Pharmakognosie*. Elaphrium (Bursera) elemifera, *Royle*, is the source of Mexican elemi.

Description.—Manilla elemi is in soft granular, transparent masses when fresh, but is generally met with in the shops in solid pieces, which are externally pale lemon-yellow and clear, internally opaque, nearly white, and mixed with chips and other impurities. It breaks with a dull granular fracture and readily fuses to a transparent liquid. Moistened with alcohol, it disintegrates and shows a large number of small acicular crystals. It has a strong aromatic somewhat terebinthinate odor and a warm, aromatic, and acrid taste.

Constituents.—Flückiger and Hanbury (*Pharmacographia*) obtained from the drug 10 per cent. of a colorless, neutral, fragrant, and strongly dextrogyre volatile oil. An oil of elemi obtained by H. St. Claire-Deville (1849) had a strong rotatory power to the left and the composition $C_{10}H_{16}$.

On treating elemi with alcohol, Maujean (1823) obtained a soluble amorphous resin, which Baup (1851) named *breïn*, and succeeded in crystallizing by the very slow evaporation of its alcoholic solution. Maujean's insoluble resin was by Bonastre (1824) crystallized from its solution in boiling strong alcohol; it is Baup's *amyrin*, and, like breïn, is readily soluble in ether and insoluble in water. The same author obtained also *bryoïdin* and *breïdin*, both fusible, the former having a bitter and acrid taste; it is easily soluble in alcohol, ether, and volatile and fixed oils, slightly soluble in cold water, but crystallizes from boiling water, from alkaline solutions, or from dilute acetic acid in silky threads or in moss-like masses. *Breïdin* is likewise crystalline, readily soluble in alcohol, less in water or ether. E. Buri (1876) gives to amyrin the formula $(C_5H_8)_5.2H_2O$. He found it to be soluble in ether, chloroform, and carbon bisulphide, to be fusible at 177° C. (350.6° F.), and to sublime when carefully heated in thin layers. The mother-liquors of amyrin yielded him (1878) *elemic acid*, $(C_5H_8)_7O_4$, the potassium salt of which crystallizes from its strong alkaline solution in needles.

Varieties.—The following resinous products are sometimes met with as distinct varieties of elemi:

Mauritius Elemi, obtained from Colophonia mauritiana, *Commerson*, a large tree of Mauritius; it is at first liquid, and resembles the Manila elemi.

Mexican Elemi, is in light- or dark-yellow somewhat greenish masses, of a waxy lustre, translucent or opaque, friable, but readily softening in the mouth.

Brazilian Elemi, collected from Icica Icicariba, *De Candolle*, and other species of the same genus; it forms soft yellowish-white or solid pale or greenish-yellow masses.

All these varieties have a similar though not identical odor, and disintegrate when treated with cold alcohol, with the separation of small crystals, which are probably identical with *amyrin*.

The *decamalee resin* of India, which resembles elemi, is the exudation of Gardenia gummifera, *Linné*, and G. lucida, *Roxburgh*, Nat. Ord. Rubiaceæ.

Action and Uses.—The qualities of elemi are analogous to those of the turpentines, and it might probably be used for the same purposes internally. It is, however, only employed as an external application, in plaster or ointment, as a dressing for *blisters*, *issues*, *indolent ulcers*, etc. In this country it is rarely prescribed. Oil of elemi is analogous in its action to oil of turpentine.

ELIXIRIA.—Elixirs.

Elixirs, Fr.; *Elixire*, G.

The word "elixir" is of ancient origin, and according to Dr. Rice, was derived by the Arabs from the Greek word ξήριον: it was formerly used by alchemists to designate the wonderful transformation-powder, a pinch of which would suffice to convert large quantities of base metal into silver and gold. Gradually the term was also applied to liquids claimed to possess the same magical powers, and still later the word "elixir" was used to designate certain compound tinctures possessing rare medicinal properties, as for instance, Elixir ad longam vitam, which was supposed to induce longevity. In this latter sense the term elixir is still used to some extent in continental Europe, and, as a rule, such preparations are characterized by an unpleasant taste. In modern American pharmacy the word has come to mean an entirely different class of preparations, the distinguishing features of which are a pleasantly aromatic sweet taste and the presence of alcohol, varying from 20 to 25 per cent. by volume. Prior to 1865 only two elixirs of this kind were used to any extent in this country—namely elixir of calisaya and elixir of ammonium valerianate. Through the efforts of enterprising manufacturers the list of elixirs was rapidly augmented, and reached its height between 1870 and 1875. Gradually, however, a reaction set in, and at the present day many once-popular elixirs have fallen into disuse. There can be no doubt that a sweet, aromatic, and slightly alcoholic liquid forms a pleasant vehicle for many remedies, but the presence of alcohol in some instances is positively injurious, and moreover the active ingredients are frequently present only in minute quantities. The U. S. Ph. recognizes but two elixirs—the aromatic elixir and elixir of phosphorus, the former chiefly as a base for the ready preparation of many others. In the National Formulary, published by the American Pharm. Association (a book which every physician and pharmacist should have), will be found no less than 86 formulas for elixirs, and a still larger number (nearly 275) have been published by J. U. Lloyd in his *Elixirs and Flavoring Extracts* (1892).

As it is desirable in many instances to impart a color to the elixir, it should be borne in mind that not all coloring agents are equally well suited for acid and alkaline liquids; for the former class as well as for neutral liquids, the National Formulary recommends the simple or compound tincture of cudbear, of either of which 2 drachms will suffice to color a pint of elixir. For alkaline liquids it is best to use a solution made as follows: Carmine No. 40, 60 grains; Glycerin and Distilled Water, each 4 fluidounces; Ammonia-water, a sufficient quantity; triturate the carmine with the water, gradually adding ammonia-water until the carmine has all been dissolved and a dark-red liquid is obtained; to this add the glycerin and mix (Lloyd).

ELIXIR AROMATICUM, *U. S.*—Aromatic Elixir.

Simple Elixir, E.; *Elixir aromatique*, Fr.; *Aromatisches Elixir*, G.

Preparation.—Compound Spirit of Orange, 12 Cc.; Syrup, 375 Cc.; Precipitated Calcium Phosphate, 15 Gm.; Deodorized Alcohol, Distilled Water, each of a sufficient quantity to make 1000 Cc. To the compound spirit of orange add enough deodorized alcohol to make 250 Cc. To this solution add the syrup in several portions, agitating after each addition, and afterward add in the same manner 375 Cc. of distilled water. Mix the precipitated calcium phosphate intimately with the liquid, and then filter through a wetted filter, returning the first portions of the filtrate until it passes through clear. Lastly, wash the filter with a mixture of 1 volume of deodorized alcohol and 3 volumes of distilled water, until the product measures 1000 Cc.—*U. S.*

To prepare 2 pints of aromatic elixir will require 3 fluidrachms of compound spirit of

orange, 12 fluidounces of syrup, 8 fluidounces of deodorized alcohol, ½ an oz. of calcium phosphate, and sufficient distilled water to make the volume 32 fluidounces.

Uses.—This preparation is an aromatic flavoring agent, and may be used as a carminative.

ELIXIR PHOSPHORI, *U. S.*—Elixir of Phosphorus.

Preparation.—Spirit of Phosphorus, 210 Cc.; Oil of Anise, 2 Cc.; Glycerin, 550 Cc.; Aromatic Elixir, a sufficient quantity to make 1000 Cc. To the spirit of phosphorus, contained in a graduated bottle, add the oil of anise and glycerin, and mix them by repeatedly inverting the bottle until they form a clear liquid. Then add enough aromatic elixir, in several portions, gently agitating after each addition, until a clear mixture results. Keep the product in dark amber-colored, well-stoppered bottles in a cool and dark place. Each Cc. of elixir of phosphorus represents about 0.00025 Gm. of phosphorus.—*U. S.*

To prepare 1 pint of elixir of phosphorus will require 3½ fluidounces of spirit of phosphorus, 16 minims of oil of anise, 9 fluidounces of glycerin, and sufficient aromatic elixir to make the volume 16 fluidounces. Each fluidrachm of the finished elixir will contain about $\frac{1}{65}$ grain of phosphorus.

Uses.—This aromatised alcoholic solution of phosphorus may be prescribed in doses of Gm. 4 (f℥j).

EMPLASTRA.—Plasters.

Emplâtres, Fr.; *Pflaster*, G.; *Empiastri*, It.; *Emplastos*, Sp.

Plasters are solid tenacious preparations intended for external use, considerably harder than cerates, so that they cannot be spread at the ordinary temperature, yet of such a composition that they will be pliable and adhesive at the temperature of the body. According to their composition they are distinguished into two classes—namely, *plasters* properly so called (*stéaratés* of the French), the base of which consists of a fusible and insoluble lead soap; and *resinous plasters*, which owe their adhesiveness to a resin mixed with some wax or fat, and for this reason are called *ointment-plasters* (*onguents-emplâtres* by the French); they are the *rétinolés solides*, or hard resin-fats, of Guibourt.

The *preparation* of all plasters containing more than one ingredient is effected in a manner similar to that of the cerates, with such modifications as are necessitated by their greater firmness and higher fusing-point. The simple plaster or the resin is first liquefied, care being taken to avoid too high a heat; the wax, fat, or other fusible substances are then added, and lastly oleoresins and aromatic products which would be injured by long-continued heat, and gum-resins or other substances which are infusible and must be mechanically incorporated with the solidifying plaster. The latter may be accomplished in several ways, according to the nature of the substances to be added: they are either rubbed fine and to a perfectly smooth paste with some fat, volatile oil, or oleoresin, or they are finely powdered and passed through a sieve into the cooling plaster, which is then to be stirred until firm enough to prevent the mechanical admixtures from separating. If extracts are to be incorporated, they should, if possible, be prepared with strong alcohol, so as to be fusible with the other ingredients of the plaster. Most gum-resins are not completely fusible or readily pulverizable, and are therefore best converted into a smooth paste in the manner indicated above. The use of some petroleum benzin during the trituration will often be found advantageous for accomplishing the object in view.

Straining is best avoided in preparing plasters. Should it be found necessary, it is never to be deferred until the infusible ingredients have been added, but performed with the smallest possible bulk and with those portions of the material having the lowest fusing-point. On the whole, however, it will be found more advantageous and expeditious, more particularly for the extemporaneous preparation of plasters, to use only purified ingredients, so that straining may not be required.

For convenience in handling and dispensing plasters are rolled into cylinders of convenient thickness. A slab or thick board is suitable for the purpose. The melted plaster is allowed to cool until it is of a soft, pliable consistence, when a convenient quantity is transferred to the slab previously moistened with water, and then kneaded with the moistened hand and rolled out to the desired thickness; when larger quantities are thus

to be rolled out a smooth and straight board will be convenient as a roller, with its ends supported by ledges, whereby uniform thickness is secured. Plasters which contain vegetable powders or other substances soluble in water are treated in the same manner, except that the water is replaced by olive or a similar bland and non-drying oil. The most convenient size of such rolls or sticks is, for dispensing purposes, about the thickness of a finger or even smaller. They keep well if they are wrapped in wax- or paraffin-paper. The soft plasters are sometimes poured into boxes or kept in square cakes, the latter being cast in tin or paper moulds, as described under CERATES (see page 432).

Plasters are usually spread upon white sheepskin; for particular purposes chamois-skin, linen, muslin, or even paper (see CHARTÆ, page 442), may be used. The leather is extended and fastened upon a smooth board, and the desired size and shape are marked upon it either by pasting strips of paper on it or using tin frames of the requisite size and shape. Sometimes an apparatus is used consisting of a block of hard wood with an even or somewhat convex surface, over which a sheet-iron frame is fitted, cut out to the dimensions and shape of the plaster to be spread, and covering sufficient leather to serve for a margin. For rectangular plasters it is convenient to have two L-shaped pieces of sheet tin, each side of which is graduated in inches, commencing from the angle; by bringing the angle of one diagonally opposite to that of the other piece a rectangular or square outline of any desired size may be formed. When the leather has been properly prepared, a sufficient quantity of the plaster is to be fused by a moderate heat and with frequent stirring to avoid burning, and while still liquid is poured upon the leather and spread by means of a warm stout pallet-knife, with sufficient pressure to obtain a smooth and even surface. Various plaster-spreaders, with long and short, straight and curved handles, have been constructed, the spreader generally being a solid square or triangular piece of iron, which, once heated, will remain warm for a sufficient length of time to soften such portions of the plaster as may become hard until the whole has been evenly spread. Sometimes the spreader or blade is made hollow, for the purpose of introducing boiling water or a heater to maintain the necessary temperature. But with some practice the pallet-knife will be found quite sufficient for the ordinary sizes of plaster. The consistence at which the fused mass should be poured upon the leather is of importance; if it be too thin, it will partly pass through the material and stain the outer surface; if too thick, it will congeal before it can be spread out, and require reheating by means of the plaster iron, and is then apt to become too fluid. For true plasters a temperature of 50° to 55° C. (120° to 130° F.) will be found to give the proper consistence; resinous plasters containing wax or fats should be cooled to a still lower degree. So-called *porous plasters* have been used for some years past. To perforate spread plasters extemporaneously, Prof. Remington (1878) devised a tool consisting of a brass wheel ¾ inch wide, and studded with sixteen punches in two alternating rows ½ inch apart. The wheel revolves around a steel axle, which is connected with a handle 9 inches long, by means of which the requisite pressure is obtained.

The *amount* of plaster necessary for spreading a given area will depend partly upon the nature of the plaster and partly upon the thickness to which it is spread; on an average, 10 grains will be found sufficient for 1 square inch of surface. To prevent the clothes from becoming soiled, and to facilitate the removal of the plaster, a margin of about ¼ inch is left around the spread surface.

In European pharmacy the term *sparadrap* is used to designate plasters which, like adhesive, court, and similar plasters, consist of adhesive substances thinly spread upon certain kinds of muslin, silk, or paper. They are prepared in various ways, according to the nature of the adhesive material; two of these, capsicum plaster and court plaster, have now been admitted into the U. S. P. True plasters, to be made into sparadraps, require an apparatus generally consisting of a smooth board, upon which rests in an upright position a kind of trough into which the melted plaster is put; the trough is provided below with a slit through which the plaster escapes; the cambric or other material is guided by rulers while being drawn underneath the trough, which must be kept sufficiently warm to prevent the plaster from becoming too firm, and should be so constructed as to act not merely as a scraper, but likewise to press upon the material beneath sufficiently for spreading the plaster thinly but evenly. Paper sparadraps are made in the same manner. (See also CHARTA, page 442.) (For a figure and description of an apparatus suitable for the purpose see *Amer. Jour. Pharmacy*, 1869, p. 455.)

When kept for a long time plasters are apt to become brittle. With rolled plasters the cause may be found partly in the removal of the glycerin. If not otherwise injured, they may be usually restored by fusing them carefully over a little water and incorpor-

ating with the melted mass ½ to 1 per cent. of olive oil. To restore the adhesiveness of spread plasters is often a difficult matter, and must in all cases depend upon the nature of the plaster. Heating the surface of the plaster until it becomes soft, covering the softened surface with a solution of turpentine or Canada balsam, and then laying aside the plaster for a day, will usually accomplish the object. Manufacturers of plasters on a large scale make use of rubber or caoutchouc as a base, which has the tendency to keep the plasters pliable and adhesive. For this purpose the crude rubber is first freed from foreign matters by continuous washing for several days with warm water, after which it is repeatedly passed between steel rollers kept at a temperature of about 95° F.; during this kneading process the rubber gradually softens and assumes that plastic condition which fits it admirably for the subsequent incorporation of very finely powdered olibanum and rosin or Burgundy pitch, this being also effected between warm rollers. The plaster-base thus prepared is ready for future medication as required. Chicle is likewise used for this purpose, and is incorporated by melting it with the plaster. (See GUTTA-PERCHA.)

If non-resinous extracts and fixed or volatile oils are ordered in such quantities as to interfere with the adhesive properties of the plaster, Shael (1873) recommends them to be incorporated with powdered tragacanth. This mixture is spread upon adhesive plaster, of which a sufficient margin is left uncovered.

EMPLASTRUM AMMONIACI CUM HYDRARGYRO, *U. S., Br.*—Ammoniac Plaster with Mercury.

Ammoniacum and mercury plaster, E.; *Emplâtre de gomme ammoniaque mercuriel*, Fr.; *Quecksilber und Ammoniak-Pflaster*, G.

Preparation.—Ammoniac, 720 Gm.; Mercury, 180 Gm.; Oleate of Mercury, 8 Gm.; Diluted Acetic Acid, 1000 Cc.; Lead Plaster, a sufficient quantity; to make 1000 Gm. Digest the ammoniac with the diluted acetic acid in a suitable vessel, avoiding contact with metals, until it is entirely emulsified; then strain, and evaporate the strained liquid by means of a water-bath, stirring constantly until a small portion taken from the vessel hardens on cooling. Triturate the oleate of mercury with the mercury gradually added until globules of the metal cease to be visible. Next add gradually the ammoniac while yet hot; and, finally, having added enough lead plaster, previously melted by means of a water-bath, to make the mixture weigh 1000 Gm., mix the whole thoroughly. —*U. S.*

To make one pound of the plaster the following quantities should be used: Ammoniac, 11½ av. ozs.; mercury, 2 av. ozs. and 385 grains; mercuric oleate, 56 grains; diluted acetic acid, 1 pint; and finally sufficient lead plaster to bring the finished product up to the desired weight.

Take of ammoniacum 12 ounces; mercury 3 ounces; olive oil 56 grains; sublimed sulphur 8 grains. Heat the oil, and add the sulphur to it gradually, stirring till they unite. With the mixture triturate the mercury until globules are no longer visible; and, lastly, add the ammoniacum, previously liquefied, mixing the whole carefully.—*Br.*

The use of mercuric oleate in place of olive oil and sulphur for the purpose of extinguishing the globules of mercury seems to be a decided improvement on the formula of 1880. If the official directions be closely followed a good plaster will result, but some care is necessary to insure the proper evaporation of the ammoniac emulsion. Water-bath heat only should be used, so as to avoid overheating. In the British formula the directions are incomplete, as the method of liquefying the ammoniac is omitted.

Action and Uses.—The mercury in this plaster is supposed to add to its discutient effects, and to render it a suitable application to swellings of a *syphilitic* nature. The presence of a syphilitic element is not necessary to render it more efficient than the simple plaster of ammoniac. Its prolonged application sometimes excites ptyalism.

EMPLASTRUM ARNICÆ, *U. S.*—Arnica Plaster.

Emplâtre d'arnique, Fr.; *Arnikapflaster*, G.

Preparation.—Extract of Arnica-root, 330 Gm.; Resin Plaster, 670 Gm. Add the extract to the plaster, previously melted by means of a water-bath, and mix them thoroughly.—*U. S.*

If avoirdupois weight is preferred, the extract and plaster may be mixed in the proportion of 5 ozs. of the former to 10 ozs. of the latter. If the extract of arnica-root is

very tough it should be softened down with a small quantity of water before mixing it with the resin plaster, so as to insure a perfectly smooth mass.

Action and Uses.—Among the plasters which are more frequently procured without the prescription of a physician than with it, this is in popular use as a remedy for a variety of *local pains* which are generally muscular. It serves to protect, support, and mildly stimulate.

EMPLASTRUM BELLADONNÆ, *U. S., Br.*—Belladonna Plaster.

Emplâtre de belladone, Fr.; *Belladonna-Pflaster*, G.; *Emplasto de belladonna*, Sp.

Preparation.—Alcoholic Extract of Belladonna Leaves, 200 Gm.; Resin Plaster, 400 Gm.; Soap Plaster, 400 Gm.; to make 1000 Gm. Mix the plasters on a water-bath; then add the extract of belladonna, and continue the heat, stirring constantly, until a homogeneous mass results.—*U. S.*

Belladonna plaster may be conveniently prepared of official strength by incorporating 1 av. oz. of alcoholic extract of belladonna leaves with a previously-melted mixture of 2 av. ozs. each of resin plaster and soap plaster; to insure a perfectly smooth plaster it may be necessary to soften the extract with a small quantity of water if it appears to have become tough.

Take of alcoholic extract of belladonna-root 4 ounces (or 1 part); resin plaster, soap plaster, each 8 ounces (or 2 parts). Melt the plasters by the heat of a water-bath; then add the extract, and mix the whole thoroughly together.—*Br.*

The return of the Pharmacopœia to the use of an extract of belladonna-leaves seems to us eminently proper, as the advantage of the root extract was purely imaginary, and most excellent results have always followed the use of the extract made from the leaves. The addition of soap plaster is advantageous, and brings the formulas of the U. S. and Br. Ph. into close correspondence. The plaster is often used in the form of sparadrap.

Action and Uses.—Belladonna plaster diminishes the circulation of the blood in the part to which it is applied, and thereby, as well as by a direct action on the nerves, lessens pain. It is habitually employed to allay *neuralgic* and *rheumatic pains*, over *inflammatory swellings* in their congestive stage, and especially upon engorged *glands*, as the *mamma* and the *testicle*. Care must be taken that the skin is sound where it is applied, as the characteristic symptoms of belladonna-poisoning of a high grade have resulted from a neglect of this precaution. A very striking case of this kind is reported by Mather (*Med. Record*, xxiii. 82). The symptoms in a mild form, such as dilatation of the pupils, dryness of the throat, and a papular eruption on the skin, are common even when the plaster has been applied to the unbroken skin (*ibid.*, xxxiii. 244; *Jour. Amer. Med. Assoc.*, x. 686).

EMPLASTRUM CAPSICI, *U. S.*—Capsicum Plaster.

Sparadrapum capsici.—Sparadrap de capsique, Fr.; *Capsicumpflaster*, G.

Preparation.—Resin Plaster, Oleoresin of Capsicum, each a sufficient quantity. Melt the resin plaster at a gentle heat, spread a thin and even layer of it upon muslin, and allow it to cool. Then, having cut off a piece of the required size, apply a thin coating of oleoresin of capsicum by means of a brush, leaving a narrow blank margin along the edges. A space of 10 Cm. (4 inches) square should contain 0.25 Gm. (4 grains) oleoresin of capsicum.—*U. S.*

Allied Plasters.—Emplastrum Aromaticum, N. F. Aromatic Plaster, Spice Plaster.—Take of cloves, Saigon cinnamon, ginger, each 10 parts; capsicum, camphor, each 5 parts; cottonseed oil, 35 parts; lead plaster, 25 parts. Melt together the lead plaster and cottonseed oil with the aid of heat. Cool the mixture, and, while it is still soft, thoroughly incorporate with it the aromatic ingredients, previously reduced to a very fine powder.

Aromatic plaster, P. G. 1872, was composed of yellow wax 32 parts, suet 24 parts, common turpentine 8 parts, melted together and incorporated with expressed oil of nutmeg 6 parts, powdered olibanum 16 parts, powdered benzoin 8 parts, oil of peppermint and oil of cloves, each 1 part.

Action and Uses.—Capsicum plaster is mildly counter-irritant and decidedly stimulating. It is a convenient and efficient application to parts affected with *muscular rheumatism* or *neuralgia*, and to palliate some internal pains.

Spice plaster is popularly used in Germany to palliate *rheumatic* and other local pains, and deserves to be made officinal in this country.

EMPLASTRUM FERRI, *U. S., Br.*—Iron Plaster.

Emplastrum roborans; Emplastrum ferratum s. martiale.—Chalybeate plaster, Strengthening plaster, E.; *Emplâtre d'oxide rouge de fer, Emplâtre de Canet*, Fr.; *Eisenpflaster, Stärkendes Pflaster*, G.

Preparation.—Ferric Hydroxide, dried at a temperature not exceeding 80° C. (176° F.), 90 Gm.; Olive Oil 50 Gm.; Burgundy Pitch 140 Gm.; Lead Plaster 720 Gm.; to make 1000 Gm. Melt the lead plaster and Burgundy pitch by means of a water-bath and add the olive oil; then add the oxide of iron, and stir constantly until the mixture thickens on cooling.—*U. S.*

Iron plaster may also be made of official strength by melting together 9 av. ozs. of lead plaster and 1¾ av. ozs. of Burgundy pitch, then adding 273 grains of olive oil, and finally incorporating 492 grains of ferric hydroxide properly dried.

Peroxide of iron 1 ounce; Burgundy pitch 2 ounces; lead plaster 8 ounces.—*Br.*

Action and Uses.—There is no reason for believing that the iron in this plaster exerts any special therapeutic influence. Its protective, supporting, and stimulant action renders it a useful application to parts affected with chronic muscular and articular *rheumatism*, to the chest during the decline of acute *pleurisy*, to enlarged *glands*, etc.

EMPLASTRUM GALBANI, *Br.*—Galbanum Plaster.

Emplastrum galbani compositum, Emplastrum lithargyri (vel plumbi) compositum, P. G.; *Emplastrum diachylum gummatum*, F. Cod.; *Emplastrum diachylon compositum.—Compound galbanum plaster*, E.; *Emplâtre diachylon gommé*, Fr.; *Mutterhartz-Pflaster, Gummipflaster, Zugpflaster*, G.

Preparation.—Take of Galbanum, Ammoniacum, and Yellow Wax each 1 ounce; Lead Plaster 8 ounces. Melt the galbanum and ammoniacum together, and strain; then add the mixture to the lead plaster and wax, also previously melted together, and mix the whole thoroughly.—*Br.*

To a mixture of 3 parts of yellow wax and 24 parts of lead plaster, previously melted and partly cooled, add a mixture of 2 parts each of galbanum, ammoniac, and common turpentine, previously melted, with addition of a little water, and strained.—P. G.

Galbanum plaster is no longer recognized in the U. S. Pharmacopœia; the formula of 1880 directed that 6 parts of Burgundy pitch and 76 parts of lead plaster be added to a mixture of 16 parts of galbanum and 2 parts of Canada turpentine, previously melted and strained.

The corresponding plaster of the F. Cod. contains also elemi and sagapenum.

By rubbing 30 grains of powdered saffron with sufficient alcohol to produce a pulpy mass, and mixing this intimately with 4 troyounces of galbanum plaster (U. S. P. 1880), previously fused, a good substitute for *Emplastrum galbani crocatum*, used in Europe, is obtained.

Emplastrum oxycroceum, s. Empl. galbani rubrum. This compound galbanum plaster is frequently used by our German population; it is prepared as follows: Take of yellow wax, resin, Burgundy pitch, each 6 parts. Melt them together with a moderate heat, and to the strained mass add of ammoniac, powdered, and galbanum, each 2 parts, previously liquefied with turpentine 3 parts. Then add an intimate mixture consisting of mastic, myrrh, olibanum, each, in powder, 2 parts, and saffron, powdered, 1 part, and mix the whole together.—*P. G.* 1872. The plaster is reddish-brown and very tenacious.

Action and Uses.—As a more stimulant application than most of the other plasters used for the same purposes, it may be preferred before them in the treatment of various local affections named in the preceding articles.

EMPLASTRUM HYDRARGYRI, *U. S., Br., P. G.*—Mercurial Plaster.

Emplastrum mercuriale.—Emplâtre mercuriel, F.; *Quecksilber-Pflaster*, G.; *Empiastro mercuriale*, It.

Preparation.—Mercury, 300 Gm.; Oleate of Mercury, 12 Gm.; Lead Plaster, a sufficient quantity, to make 1000 Gm. Triturate the mercury with the oleate of mercury in a tared capsule until the globules of metal are no longer visible. Then place the capsule on a water-bath, add enough lead plaster, previously melted, to make the contents weigh 1000 Gm., and mix the whole thoroughly.

To make 4 av. ozs. of mercurial plaster, triturate 525 grains of mercury with 21 grains of mercuric oleate, and after the globules have all been extinguished, incorporate with 1204 grains of lead plaster previously melted.

The use of mercuric oleate in place of the resin and olive oil of the last Pharmacopœia appears to be an improvement.

Take of mercury 3 ounces; olive oil 56 grains; sublimed sulphur 8 grains; lead plaster 6 ounces. Heat the oil and add the sulphur to it gradually, stirring until they unite; with this mixture triturate the mercury until globules are no longer visible; then add the lead plaster, previously liquefied, and mix the whole thoroughly.—*Br.*

The P. G. directs that 2 parts of mercury shall be triturated with 1 part of common turpentine until uniformly mixed, and then added to 6 parts of lead plaster and 1 part of yellow wax previously melted together.

The French Codex gives a formula for EMPLASTRUM DE VIGO CUM MERCURIO (*Emplâtre mercuriel dit de Vigo*), which is occasionally used here. It is made by fusing together lead plaster 200 parts; yellow wax and resin, each 10 parts; add thereto the following powders: olibanum, ammoniac, bdellium, and myrrh, of each 3 parts, and saffron, 2 parts; also 60 parts of mercury extinguished by 10 parts of turpentine, and finally 30 parts of liquid storax and 1 part of oil of lavender.

Action and Uses.—The virtues of mercurial plaster depend upon its being not only a mechanical support to the affected parts and a mild counter-irritant, but also upon the specific operation of its mercury, whereby it tends to promote the absorption of exudation-matter, both by its direct local action and by its producing on the system a greater or less mercurial impression. Indeed, it not unfrequently occasions soreness of the gums and a degree of salivation. It is frequently employed for the removal of *syphilitic nodes* and *glandular engorgements* produced by the same cause, including those of the *liver*. It appears also to reduce that organ and the *spleen* when enlarged by malarial disease. The Vigo plaster of the French Codex, which is described above, has been applied as a mask to the face during the papular stage of *small-pox*, with the effect of preventing a full development of the pustules and the consequent pitting. The simpler mercurial plaster appears to have been used with equally good results. In both cases the influence of mechanical compression and of the exclusion of light should not be overlooked.

EMPLASTRUM ICHTHYOCOLLÆ, *U. S.*—ISINGLASS PLASTER.

Emplastrum adhæsivum anglicum, *Sparadrapum s Taffetas adhæsivum*, *Scricum anglicum.—Court plaster*, E.; *Sparadap de colle de poisson*, *Taffetas d'Angleterre*, Fr.; *Englisches Pflaster*, *Klebtaffet*, G.

Preparation.—Isinglass 10 Gm.; Alcohol 40 Gm.; Glycerin 1 Gm.; Water, Tincture of Benzoin, each a sufficient quantity. Dissolve the isinglass in a sufficient quantity of hot water to make the solution weigh 120 Gm. Spread one-half of this, in successive layers, upon taffeta (stretched on a level surface) by means of a brush, waiting after each application until the layer is dry. Mix the second half of the isinglass solution with the alcohol and glycerin, and apply it in the same manner. Then reverse the taffeta, coat it on the back with tincture of benzoin, and allow it to become perfectly dry. Cut the plaster in pieces of suitable length and preserve them in well-closed vessels. Substituting 15.5 gr. for 1 Gm., the above quantities are sufficient to cover a piece of taffeta 38 Cm. (15 inches) square.—*U. S.*

This formula has been taken from the German Pharmacopœia of 1872. The taffeta should be stretched upon a frame, so as to present a level surface. For the first two applications the isinglass solution should be warmed merely to above its congealing-point, so that when spread out it may rapidly solidify, and at the same time firmly adhere to, but not pass through, the fabric. The air having access to both sides of the taffeta, each coating will dry readily and uniformly in a dry and moderately warm atmosphere, and should be quite hard before a new application is made. The addition of glycerin to the last portion of the isinglass solution prevents the plaster from breaking and preserves its flexibility for a long time. The tincture of benzoin applied to the reverse side leaves a thin layer of resin, which, in a measure, renders this plaster waterproof; it is, however, advisable to repeat this application once or twice. The plaster should only be removed from the frame when thoroughly dry.

Action and Uses.—Isinglass plaster is in very common use to cover slight cuts and abrasions of the skin. It should never be moistened with saliva, but only with pure water, before application.

EMPLASTRUM MENTHOL, *Br. Add.*—Menthol Plaster.

Emplâtre de menthol, Fr.; *Mentholpflaster*, G.

Preparation.—Take of Menthol, 2 ounces; Yellow Wax, 1 ounce; Resin, 7 ounces. Melt the wax and resin together, and, as the mixture cools, stir in the menthol until dissolved.—*Br. Add.*

This is a new preparation introduced into the additions to the Br. P. in 1890.

Action and Uses.—Menthol plaster has been successfully employed to relieve *migraine* and general neuralgic pains.

EMPLASTRUM OPII, *U. S., Br.*—Opium Plaster.

Emplastrum opiatum s. cephalicum s. odontalgicum.—Emplâtre d'opium, Emplâtre céphalique (temporal, odontalgique, calmant. Fr.; *Opiumpflaster, Hauptpflaster*, G.

Preparation.—Extract of Opium 60 Gm.; Burgundy Pitch 180 Gm; Lead Plaster 760 Gm.; Water, 80 Cc.; to make 1000 Gm. Rub the extract of opium with the water until a uniformly smooth paste results, and add it to the Burgundy pitch and lead plaster, melted together by means of a water-bath; then continue the heat for a short time, stirring constantly, until the moisture is evaporated.—*U. S.*

To make 4 av. ozs. of official opium plaster, 105 grains of extract of opium may be rubbed into a smooth paste with $2\frac{1}{2}$ fluidrachms of water, and then added to 315 grains of Burgundy pitch and 1330 grains of lead plaster, melted together on a water-bath; the water is driven off as directed above.

Take of opium, in finest powder 1 ounce; resin plaster 9 ounces. Melt the resin plaster by means of a water-bath; then add the opium by degrees and mix thoroughly.—*Br.*

Both these formulas yield good and efficient plasters, the first being preferable on account of the absence of the insoluble and non-adhesive constituents of opium, and for being rather stronger as far as opium is concerned.

Action and Uses.—This plaster is a convenient form for the local application of opium to painful parts of limited extent—*e. g.* to the face in *toothache.*

EMPLASTRUM PICIS BURGUNDICÆ, *U. S.*—Burgundy Pitch Plaster.

Emplastrum picatum, F. Cod.—*Emplâtre de poix de Bourgogne*, Fr.; *Burgunder Pech-Pflaster*, G.

Preparation.—Burgundy Pitch 800 Gm.; Olive Oil 50 Gm.; Yellow Wax 150 Gm.; to make 1000 Gm. Melt together the Burgundy pitch and yellow wax, then incorporate the olive oil, and stir constantly, until the mass thickens on cooling.—*U. S.* If avoirdupois weight be preferred, 4 ozs. of Burgundy pitch may be mixed with $\frac{1}{4}$ oz. of olive oil and $\frac{3}{4}$ oz. of yellow wax, according to directions given above.

The present formula is an improvement on the former one, in that the proportion of wax has been increased, and olive oil added, thus diminishing the brittleness of the plaster. The French Codex directs 1 part of yellow wax to 3 parts of Burgundy pitch.

The formula of the British Pharmacopœia for *Emplastrum picis*, or *pitch plaster*, is as follows: Take of Burgundy pitch 26 ounces; common frankincense 13 ounces; resin and yellow wax, each $4\frac{1}{2}$ ounces; expressed oil of nutmeg 1 ounce; olive oil and water, each 2 fluidounces. Add the oils and water to the frankincense, Burgundy pitch, resin, and wax, previously melted together; then, constantly stirring, evaporate to a proper consistence.—*Br.*

Action and Uses.—Burgundy pitch plaster, besides giving mechanical support, is useful through its stimulant and mildly counter-irritant action. The British preparation is the more efficient of the two.

EMPLASTRUM PICIS CANTHARIDATUM, *U. S.*—Cantharidal Pitch Plaster.

Emplastrum calefaciens, Br.—*Warm or warming plaster*, E.; *Emplâtre de poix cantharidé*, Fr.; *Pechpflaster mit Canthariden*, G.

Preparation.—Cerate of Cantharides 80 Gm.; Burgundy Pitch, a sufficient quantity to make 1000 Gm. Melt the cerate of cantharides on a boiling water-bath, and continue the heat for fifteen minutes; then strain it through a piece of muslin of close

texture, so that the cantharides will be retained on the muslin. To the strained liquid add a sufficient quantity of Burgundy pitch to make the whole weigh 1000 Gm., render the mixture homogeneous by stirring, remove the heat, and stir the mass until it thickens on cooling.—*U. S.*

To make 4 av. ozs. of warming plaster use 140 grains of cerate of cantharides, treat as above directed, and add to sufficient Burgundy pitch to make the weight of the finished product 4 ounces.

As this plaster is apt to become very brittle when cold, we would suggest the addition of some hot water or olive oil, say 2 drachms, in place of a like quantity of the pitch.

Action and Uses.—This plaster maintains a mild counter-irritant action greater than that of the simple pitch plaster, but less than is caused by a blister. It is often of signal advantage in chronic affections of the *joints*, chronic muscular *rheumatism*, and chronic diseases of the *chest*. Of the last, chronic *bronchitis* is often greatly benefited by its use, and next to this is chronic *pleurisy*. It is of service in the treatment of chronic pulmonary engorgement due to the presence of *tubercle*, or in that of *broncho-pneumonia*, which so often tends to pulmonary phthisis.

EMPLASTRUM PLUMBI, *U. S., Br.*—Lead Plaster.

Emplastrum lithargyri (*simplex*), P. G.; *Emplastrum simplex*, F. Cod.; *Emplastrum diachylon simplex.—Diachylon plaster*, *Litharge plaster*, E.; *Emplâtre simple*, *Emplâtre de plomb* (*de litharge*), Fr.; *Bleipflaster*, *Diachylon-Pflaster*, G.; *Empiastro diachilon*, It.; *Emplasto de la Viréna*, Sp.

Preparation.—Lead Oxide 3200 Gm.; Olive Oil 6000 Gm; Water, a sufficient quantity. Mix the lead oxide, previously passed through a No. 80 sieve, intimately with about one-half of the olive oil, by trituration, and add the mixture to the remainder of the oil contained in a bright copper boiler of a capacity equal to at least four times the bulk of the ingredients. Then add 1000 Cc. of boiling water, and boil the whole together, over a fire, constantly stirring with a wooden spatula, until a homogeneous plaster is formed, adding from time to time a little water to replace that lost by evaporation. When the contents of the boiler have acquired a whitish color and are perfectly homogeneous, transfer them to a vessel containing warm water, and as soon as the mass has sufficiently cooled, knead it well with the water so as to remove from it the glycerin, renewing the water from time to time as long as it may be necessary. Finally, divide the mass into rolls of suitable size.—*U. S.*

If avoirdupois weight is preferred, the following quantities may be used, and in other respects the Pharmacopœia directions should be observed: lead oxide 16 ounces, olive oil 30 ounces, water 5 ounces.

The French and German Pharmacopœias used equal parts of olive oil and lard in place of olive oil alone, which is directed by the British and United States Pharmacopœias. A much greater discrepancy, however, exists in the proportion of the fat to the other ingredients. Calculated for 100 parts of fat, there are ordered of water 100 (*F. Cod.*), 50 (*Br.*), 16.7 (*U. S.*) parts, and sufficient (*P. G.*); of litharge 53.33 (*U. S.*), and 50 (*Br.*, *F. Cod.*, and *P. G.*) parts. A much smaller amount is decidedly insufficient, and yields a plaster which is and remains sticky. The litharge should be not less than half the weight of the fat used, and in view of its variable quality may very properly be increased somewhat beyond that proportion, as directed by the United States Pharmacopœia.

The U. S. and G. Pharmacopœias provide for the removal of all glycerin by subsequent kneading of the plaster with water; the Br. P. allows the glycerin to remain mixed with the plaster, and this accounts for the softer condition of the English article.

In view of the importance of this plaster as a basis for many others, it is usually prepared in larger quantities, and an expeditious and successful manipulation is therefore to be preferred to methods which may involve more labor and time. The lead oxide may be triturated in the kettle in which the plaster is to be made, with a portion of the oil gradually added until a thin, smooth, and uniform pasty mass is obtained, when the oil may be added more rapidly, the trituration being continued. But if the litharge is in very fine powder, as directed by the Pharmacopœia, there is no necessity for such trituration; the litharge, however, may be sifted directly into the mixture of oil and water, which may at the same time be heated. The whole is then boiled, and frequently stirred to prevent the litharge from settling to the bottom, and a little hot water is added from time to time to supply that which may have evaporated. The mixture has at first a

reddish color, which gradually changes until it finally becomes white. From the time it commences to boil the mixture foams, on account of the extrication of the watery vapors, and as the saponification proceeds the foaming increases. Now it requires additional attention to keep up the supply of water, the proportion ordered by the U. S. P. being ample for all purposes, and to prevent the mass from becoming overheated, which would interfere with the adhesive qualities of the plaster and more or less darken its color. The temperature may be allowed to rise to about 120° C. (248° F.), but it will be below that point if sufficient water be present. Instead of boiling the mixture, it may be digested in a water-bath, but the formation of the plaster will then require 2 or 3 days while by the pharmacopœial process it will be completed in little more than as many hours, depending upon the quantity worked. Without the addition of water, litharge will decompose fats, uniting with the fatty acids, but a much higher temperature will be required, and in the absence of water glycerin cannot be separated, but is decomposed. Plumbic hydroxide, the hydrated lead oxide, contains enough water for the separation of glycerin, and its combination with the acids of the oil is effected more readily and at a lower temperature. The relations are similar if the official directions are followed, but the saponification of the fat requires more time, as plumbic hydroxide is slowly formed; however, with sufficient attention no secondary decomposition-products are formed. To increase the saponifying action of the litharge a small quantity of lead acetate is sometimes added, by which the oxide is more readily dissolved, but the addition is not necessary. Since lead carbonate saponifies fat with greater difficulty than the oxide, the latter should be as free from the former as possible; the carbonic acid is gradually evolved as the saponification proceeds.

The chemical reactions involved in the manufacture of lead plaster are clearly the same as are noticed whenever a fat is saponified by means of alkali hydroxides or moist metallic oxides; the presence of water is essential for chemical action, although it also aids in keeping down the temperature, and thus prevents decomposition of the fat. In order to demonstrate the formation of lead plaster (lead oleate or lead soap), olive oil may be looked upon as olein or glyceryl trioleate, leaving out of consideration the presence of very small quantities of palmitin; the following equation then will show the reaction: $2\ C_3H_5(C_{18}H_{33}O_2)_3 + 3PbO + 3H_2O = 3Pb(C_{18}H_{33}O_2)_2 + 2C_3H_5(OH)_3$. The basylous radical C_3H_5 is trivalent, and is known as propenyl or glyceryl; being displaced from its combination with oleic acid by the lead, it readily unites with the oxygen and hydrogen present to form the alcohol glycerin or propenyltrihydroxide, $C_3H_5(OH)_3$.

Lead plaster may also be obtained by precipitating a solution of soap by sugar of lead, but the plaster thus obtained soon becomes hard and dark-colored. Similar objections exist against the substitution of many other fats for olive oil. As we have seen, the French and German Pharmacopœias sanction the use of equal weights of olive oil and lard.

The process is known to be finished when, after dropping a little of the plaster in cold water and kneading it between the fingers, it is found to be pliable, but not sticky. When this point has been reached the vessel is removed from the fire and allowed to cool somewhat. The temperature may then be reduced by the addition of cold water, and the mass kneaded and rolled out, as described above (see EMPLASTRA), into cylinders of any convenient size. The yield is but little more than the weight of the ingredients used.

Lead plaster is of a uniform grayish-white color, but not yellowish-white, as stated by the U. S. P. and P. G. At a low temperature the plaster breaks with a finely-granular fracture. On keeping, it becomes of a more dingy tint; and superficially changes to yellowish or pale-brownish. As stated above, it should, when warm, be pliable and not sticky, due to unsaponified fat, and it should be entirely free from uncombined litharge, the presence of which is easily recognized by its reddish color, or may be detected as follows: "On treating 5 Gm. of lead plaster with 25 Cc. of benzene, a somewhat viscid and slightly turbid solution will result, which will separate into a clear and a gelatinous layer after some time, but which should not deposit any sediment (absence of *uncombined lead oxide*)."—*U. S.* Chemically, lead plaster is a mixture of lead oleate and palmitate, containing also stearate if lard has been used in its preparation.

Zinc plaster, in which zinc oxide is substituted for litharge, has been occasionally recommended; it is most expeditiously prepared by mixing concentrated solution of 2 parts of white Castile soap and 1 part of zinc sulphate, digesting the mixture until the decomposition has been completed, and washing out the salt by kneading the mass under water.

Action and Uses.—The oxide of lead in this plaster is its only active ingredient, and hence it is used as a discutient as well as a protective. Owing to the possibility of absorption of the lead, it should not be applied to raw surfaces. It is frequently used to prevent *bed-sores* and the *abrasions* which many forms of surgical apparatus tend to produce. Zinc plaster may be used instead of lead plaster where a large surface is to be covered or the skin is delicate.

EMPLASTRUM PLUMBI IODIDI, *Br.*—Lead Iodide Plaster.

Emplâtre d'iodure de plomb, Fr.; *Jodblei-Pflaster*, G.

Preparation.—Take of lead Iodide 2 ounces (or 1 part): Lead Plaster 1 pound (or 8 parts); Resin 2 ounces (or 1 part). Add the lead iodide in fine powder to the plaster and resin, previously melted at as low a temperature as possible, and mix them intimately.—*Br.*

The present formula was proposed by A. W. Gerrard (1874), who showed that the plaster, as formerly prepared with soap plaster, contained very little lead iodide, which was nearly all decomposed by the soap.

Action and Uses.—This is perhaps the best form in which lead iodide can be employed topically for promoting the resolution of indurations resulting from inflammation, and especially from articular *rheumatism*.

EMPLASTRUM RESINÆ, *U. S. Br.*—Resin Plaster.

Emplastrum adhæsivum, P. G.—*Adhesive plaster*, E.; *Emplâtre résineux (adhésif)*, Fr.; *Heftpflaster*, G.; *Empiastro adesivo*, It.

Preparation.—Resin, in fine powder, 140 Gm.; Lead Plaster, 800 Gm.; Yellow Wax, 60 Gm.; to make 1000 Gm. To the lead plaster and wax, melted together over a gentle fire, add the resin, and mix them.—*U. S.*

To make 25 av. ozs. of resin plaster will require 1½ ozs. of yellow wax, 3½ ozs. of resin and 20 ozs of lead plaster.

Take of resin 4 ounces; lead plaster 2 pounds; curd soap 2 ounces. To the lead plaster, previously melted with a gentle heat, add the resin and soap; first liquefied, and stir them until they are thoroughly mixed.—*Br.*

This is the plaster which, spread upon muslin, forms the sparadrap commonly known as *adhesive plaster* or *sticking plaster*. About 2 per cent. more of resinous matter is contained in the plaster of the P. G., which is made by melting lead plaster 100 parts until all the water has evaporated; then adding yellow wax 10 parts and a previously melted mixture of dammar 10 parts, colophony 10 parts, and turpentine 1 part. This plaster is more pliable and adhesive at a low temperature, a quality possessed also by that of the Br. P. For the latter, A. W. Gerrard (1874) suggests that for use in summer one-fourth the quantities of soap and resin ordered should be used; in the spring one-half the quantity will answer, but in cold weather the official proportions are preferable. The *sparadrap commun* used in France is compound galbanum plaster.

Good adhesive plaster should not be sticky at the ordinary temperature; when spread upon muslin it should be pliable without cracking, and when applied to the skin should adhere firmly.

Action and Uses.—Adhesive plaster is chiefly employed for the support of mobile parts, for exerting pressure, for securing the coaptation of *wounds* and *fractures*, for supporting *surgical dressings*, etc. It is sometimes used for maintaining the immobility of parts, such as the chest, the abdomen, etc. It is apt to irritate delicate skins.

EMPLASTRUM SAPONIS, *U. S., Br.*—Soap Plaster.

Emplastrum saponatum, P. G.; *Emplastrum cum sapone*, F. Cod.—*Emplâtre de savon*, Fr.; *Seifenpflaster*, G.

Preparation.—Soap, dried and in coarse powder 100 Gm.; Lead Plaster 900 Gm.; Water a sufficient quantity. Rub the soap with water until brought to a semi-liquid state; then mix it with the lead plaster, previously melted, and evaporate to the proper consistence.—*U. S.*

To make 4 av. ozs. of soap plaster would require 175 grains of powdered soap and 1575 grains of lead plaster.

It is important that the soap be used in form of powder, so as to insure a smooth mix-

ture with water, and that subsequently the water be again expelled by evaporation, otherwise the plaster loses its adhesive properties.

Take of curd soap 6 ounces; lead plaster 2¼ pounds; resin 1 ounce. To the lead plaster, melted by a gentle heat, add the soap and the resin, first liquefied; then, constantly stirring, evaporate to a proper consistence.—*Br.*

The proportion of soap directed is 5.6 (*F. Cod.*), 5.8 (*P. G.*), 10 (*U. S.*), and 14 (*Br.*) per cent. The French Codex orders also 4.5 per cent. of white wax, while the German Pharmacopœia uses yellow wax 11.5 and camphor 1.15 per cent. The U. S. P. alone requires the soap to be rubbed up with water; the F. Cod. and P. G. order the soap to be powdered, when it may be uniformly incorporated with the melted plaster by sifting. Soap plaster has a whitish color, and should be nearly free from water, which renders the soap slippery.

Action and Uses.—Soap plaster is generally used to prevent *abrasions*, *bed-sores*, etc., and, like other plasters containing lead, it possesses some discutient powers. Owing to the thickness of the layer as it is usually spread, it is apt to be moved from its original position, and is therefore less efficient than adhesive plaster in preventing bed-sores. Soap cerate applied upon appropriate tissues affords mechanical support to joints, while it acts as a sedative of inflammation by promoting transpiration, and possibly by the direct operation of the lead in its composition. It is used to envelop *sprained*, *gouty*, *rheumatic*, and *scrofulous joints*, and as an application to *glandular swellings* and local hypertrophies.

EMPLASTRUM SAPONIS FUSCUM, *Br.*—Brown Soap Plaster.

Emplastrum Cerati Saponis, Br., 1867.—*Soap cerate plaster*, E.; *Emplâtre de savon saturné*, Fr.; *Seifencerat-Pflaster*, G.

Preparation.—Take of Curd Soap, in powder, 10 ounces; Yellow Wax, 12½ ounces; Olive Oil 1 pint; Lead Oxide 15 ounces; Vinegar 1 gallon. Boil the vinegar and lead oxide together by the heat of a steam-bath, constantly stirring them until the oxide has combined with the acid; then add the soap, and boil again until most of the moisture has evaporated; finally, add the wax and oil melted together, and stir the whole continuously, maintaining the heat until by the evaporation of the remaining moisture the product has acquired the proper consistence of a plaster.—*Br.*

A similar preparation was formerly (1850) official in the United States, but has been replaced by Empl. Saponis (which see). To avoid the prolonged unnecessary boiling, A. W. Gerrard (1874) proposed to substitute for the vinegar 18 ounces of acetic acid, which is sufficient to dissolve the lead oxide; the lead acetate formed reacts with the soap forming lead plaster.

Action and Uses.—Soap cerate plaster is used for the general purposes of adhesive plaster, and for supporting and protecting *enlarged joints* and other swollen parts.

NON-OFFICIAL PLASTERS.

Among the unofficial plasters, more or less employed in different sections, the following deserve to be mentioned in this place:

Emplastrum picis liquidæ compositum.—Compound Tar Plaster.—Take of Resin, 25 parts; Tar, 20 parts; Podophyllum, in No. 60 powder, 5 parts; Phytolacca root, in No. 60 powder, 5 parts; Sanguinaria, in No. 60 powder, 5 parts. Melt the resin and tar together, then stir in the mixed powders, and as the mass cools mould it into rolls or pour it into boxes.—*N. F.*

Emplastrum cerussæ, s. Empl. album coctum.—White lead plaster, *E.*; Emplâtre de céruse, Empl. blanc cuit, *Fr.*; Bleiweisspflaster, *G.*—Melt together lead plaster 60 parts and olive oil 10 parts; add finely-powdered lead carbonate 35 parts, and boil with the occasional addition of a little water until a plaster is formed.—*P. G.* The plaster may be obtained in one operation by using in place of the lead plaster the requisite quantities of fat and litharge. A similar composition, containing a little wax and powdered orris-root, is known as *Mahy's plaster*.

Emplastrum fuscum, s. Empl. matris fuscum, Empl. nigrum, s. noricum, s. minii adustum, s. universale. Finely-powdered red oxide of lead 2 parts and olive oil 4 parts are boiled, with constant stirring, until the mass assumes a dark-brown color, when 1 part of yellow wax is added. For some purposes 1 per cent. of camphor is added, when it

is known as *Emplastrum fuscum camphoratum*, *P. G.* The plaster is put up in square cakes and in boxes, and is also sold in some parts of the United States as *universal plaster* and *breast plaster*, and as a secret preparation under different names. It is extensively employed by the German population, and known to them as *Mutterpflaster*, *Universalpflaster*, etc. A very similar preparation, but boiled with litharge and twice the above amount of fat, is known in France as *Onguent de la mère Thècle* and *Emplâtre brun*.

Emplastrum matris album, s. Empl. lithargyri molle. Melt together lead plaster 3 parts, lard 2 parts, yellow wax and suet each 1 part.—*P. G.* 1872.

Emplastrum (ceratum) minii rubrum. Triturate 100 parts of powdered red oxide of lead and 3 parts of camphor with 60 parts of olive oil. Add the mixture to yellow wax and suet each 100 parts and olive oil 40 parts, previously heated together, and stir well until it has congealed.—*P. G.* 1872.

Logan's Plaster. Boil together over a slow fire olive oil 2½ pints, fresh butter 4 ounces, Castile soap 12 ounces, litharge 16 ounces avoirdupois, until the mass has a pale-brown color; then add lead carbonate 16 ounces, and continue the heat until the plaster is formed; lastly, add 2 drachms of powdered mastich.

The following preparations have been dropped from the U. S. P. 1890:

Emplastrum ammoniaci.—Ammoniac Plaster. Digest 100 parts of ammoniac with 150 parts of diluted acetic acid in a suitable vessel, avoiding contact with metals, until it is emulsionized; then strain and evaporate on a water-bath to the proper consistence.—*U. S.* 1880.

Emplastrum asafœtidæ.—Asafœtida Plaster. Digest 35 parts of asafœtida and 15 parts of galbanum with 120 parts of alcohol on a water-bath, so as to thoroughly disintegrate them, strain while hot, evaporate to the consistence of honey, and add 35 parts of lead plaster and 15 parts of yellow wax, previously melted together; stir the mixture well, and evaporate to the proper consistence.—*U. S.*, 1880.

Emplastrum picis canadensis.—Canada Pitch Plaster, Hemlock Plaster. Melt together 90 parts of Canada pitch and 10 parts of yellow wax; strain the mixture, and stir constantly until it thickens on cooling.—*U. S.* 1880.

EMULSA.—Emulsions.

Emulsiones, P. G.; *Emulsions*, Fr.; *Emulsionen*, G.; *Emulsiones*, It., Sp.; *Horchatas*, Sp,

The term "emulsions" is used to designate mixtures of liquids insoluble in one another, where one is suspended in the other in the form of minute globules, as fat in milk, and also mixtures in which solid particles of substances are suspended in liquids in which they are insoluble, as in the case of camphor or resin emulsions. Formerly emulsions were included under the general head of mixtures, "Misturæ," but a distinction is now very properly made, so as to restrict the term emulsion to such mixtures mentioned above as have a milk-like appearance, and in which the suspension of the insoluble liquid or solid is more or less permanent. Nature provides types of emulsions in the form of milk, the natural food of all young mammalia, and the milk-like juices of certain plants from which the official and other gum resins are obtained. Fixed and volatile oils, as well as ethereal liquids and resinous substances, are suitable for exhibition in the form of emulsion, and the suspension in water is accomplished by the use of appropriate excipients, such as acacia, tragacanth, yolk of egg, etc., etc.; many oil-yielding seeds, as well as the natural gum-resins, contain gummy and albuminous matter by means of which the oil and resin can be brought into perfect suspension in water. The theory of emulsification is as follows: The insoluble liquid or solid in a state of minute division is completely surrounded or enveloped by the vehicle consisting of water and excipient, and thus an opaque mixture is produced from which the particles cannot separate by mere force of cohesion; the stability of the emulsion depends to some extent upon the density of the vehicle, and it will be found that the presence of sugar or glycerin increases the suspending power of gum, whilst the addition of alcohol or glycerin will prevent fermentative changes likely to arise in vegetable solutions if kept on hand for some time. As a rule, emulsions should be prepared in unglazed wedgewood or porcelain mortars having a flat bottom, and in the case of seed or gum-resin emulsions mortars of deep shape and provided with hard wood pestles are preferable. When not otherwise specified, seed emulsions are made in the proportion of 1 part of seed to 10 parts of water, and the seed, as well as gum resins, should never be used in the shape of fine powder, but, after having been freed from dust and dirt, the material should be crushed into coarse powder, when a few drops of water should be added and the whole beaten into a smooth pasty mass,

after which the remainder of the water is gradually added with constant trituration and keeping the mass well scraped down from the sides and bottom of the mortar by means of a spatula. Finally, the emulsion is passed through a well-wetted strainer of flannel or cheesecloth to remove the inert woody fibre. In the case of emulsion of lycopodium the seed is first triturated with some pressure by itself in a mortar, so as to rupture the hard seed envelope; when the powder becomes adhesive, a little water is added, with which a smooth soft paste can be formed, and afterward the balance of the water is added under continuous stirring. This emulsion should never be strained. When fixed oils are to be emulsionized it is essential that definite proportions of gum, water, and oil be used to prepare the primary emulsion, which can then be further diluted as wanted. Now that acacia of choice quality and moderate price has again come into the market, it may be looked upon as the best emulsifying agent for fixed and volatile oils, and the simplest plan to follow for fixed oils is to place one-quarter as much finely powdered acacia into a dry mortar as will be used of oil; then add the oil and triturate well together into a smooth mixture. Now add, *all at once*, twice as much water as has been used of acacia, and triturate thoroughly until a perfect emulsion has been formed, which is evidenced by the appearance of a white pasty mass and a peculiar crackling noise as the pestle is drawn through the adhesive mixture. Having scraped the primary emulsion well down with a spatula, the diluent may be slowly added with constant stirring. *Not less than one-quarter nor more than one-half* as much acacia as oil should be used. The above plan will not answer if granulated acacia is used, as it dissolves in water more slowly than the fine powder: in the case of granulated acacia it will be found more advisable to take one-half as much acacia as oil; place the acacia in the mortar, add the oil and one-half as much water as has been taken of oil and acacia together (for instance, oil 1 fluidounce, acacia 4 drachms, water 6 fluidrachms); then triturate well until a perfect emulsion results, which dilute gradually as desired. Both of the preceding methods are equally well adapted for liquid oleoresins, such as copaiba. If Peru balsam is to be emulsionized, the addition of a little alcohol to the same will facilitate the process. Some prefer to emulsionize the oil by adding it to a previously prepared mucilage of acacia, but in our experience the two methods above stated, if strictly followed, will *invariably* result in success, and require less skill in manipulation than any other method. It is desirable to use separate graduates for oil and water, to avoid the possibility of carrying oil-globules with the water used for dilution, as these might fail to be fully incorporated, and afterward would rise to the surface. If yolk of egg is to be used as the excipient, an ounce of oil will require one yolk, and this should be triturated by itself first until it becomes adhesive, when a portion of oil may be added, then a part of the water, and after thorough trituration more oil and water alternately, until the emulsion has been completed; in place of yolk of egg the official glycerite of yolk of egg (glyconin) has been employed with decided advantage. When solid fats, camphors, some volatile oils, resinous extracts, and even oleoresins, are to be emulsified, it will be found advantageous to dissolve them in a small quantity of fixed oils (oil of almond or olive oil), and then treat as directed above for fixed oils: the emulsions thus prepared will be more desirable in every way and surely far more stable. Volatile liquids, such as ether, chloroform, and oil of turpentine, are best emulsionized by what is known as Forbes's plan: this consists of placing in a perfectly dry bottle the liquid to be emulsionized, then adding for each fluidounce of the liquid 20 grains of powdered acacia, mixing well by agitation, adding ½ fluidounce of water, and thoroughly incorporating by continued agitation until the emulsion is complete, and then diluting by adding the remaining water gradually. On standing, a dense cream-like layer is apt to separate, which can be readily reincorporated by simple agitation. Although this method will yield a perfect mixture, the stability of the emulsion will be improved by using at least 120 grains of acacia for each fluidounce of the oil or ether.

Mucilage of Irish moss, dextrin, and tincture of soap-bark, which have been suggested as substitutes for acacia, will be found inferior to it as emulsifying agents, and the tincture of soap-bark moreover possesses toxic properties.

The emulsio oleosa of continental Europe is composed of 2 parts of oil of sweet almond, 1 part acacia, and 17 parts of water, all by weight.

EMULSUM AMMONIACI, *U. S.*—Emulsion of Ammoniac.

Mistura ammoniaci, U. S. 1880, Br.; *Emulsio ammoniaci*, *Lac ammoniaci*.—*Ammoniacum mixture*, *Milk of ammoniac*, E.; *Emulsion (mixture) de gomme ammoniaque*, *Lait ammoniacal*, Fr.; *Ammoniak-Emulsion*, G.

Preparation.—Ammoniac 40 Gm.; Water, a sufficient quantity; to make 1000 Cc. Rub the ammoniac, in a warmed mortar, with 900 Cc. of water, at first very gradually added, until a uniform emulsion results. Then strain the mixture into a graduated vessel, and wash the mortar and strainer with enough water to make the product measure 1000 Cc.—*U. S.*

The foregoing formula corresponds to 18.24 grains of ammoniac for each fluidounce of water; the British preparation is slightly weaker, being nearly 13.7 grains for 1 fluidounce (Imperial measure).

Action and Uses.—Emulsion of ammoniac is employed chiefly in the treatment of *chronic bronchitis* and *bronchorrhœa*. The *dose* is Gm. 16–32 (fʒ–i).

EMULSUM AMYGDALÆ, *U. S.*—Emulsion of Almond.

Mistura amygdalæ, U. S. 1880, Br.; *Emulsio amygdalæ s. amygdalarum*, *Emulsio simplex.—Milk of almonds*, *Almond mixture*, E.; *Emulsion simple*, *Lait d'amandes*, Fr.; *Mandelemulsion*, *Mandelmilch*, G.

Preparation.—Sweet Almond, 60 Gm.; Acacia, in fine powder, 10 Gm.; Sugar, 30 Gm.; Water, a sufficient quantity; to make 1000 Cc. Having blanched the almond, add the acacia and sugar, and beat them in a mortar until they are thoroughly mixed. Then rub the mass with 900 Cc. of water, at first very gradually added, until a uniform mixture results. Strain this into a graduated vessel, and wash the mortar and strainer with enough water to make the product measure 1000 Cc. Mix the whole thoroughly.—*U. S.*

To make one pint of emulsion of almond will require 460 grains of sweet almond, 77 grains of acacia, and 230 grains of sugar.

Take of compound powder of almonds 2½ ounces; distilled water 20 fluidounces. Rub the powder with a little of the water into a thin paste, then add the remainder of the water, and strain through muslin.—Br.

The presence of acacia in both preparations is unnecessary, as it does not increase the stability of either or the amount of oil suspended.

Emulsio amygdalarum composita.—Take of sweet almonds 4 parts; hyoscyamus-seed 1 part; diluted bitter-almond water 64 parts. Make an emulsion, and add of white sugar 6 parts, calcined magnesia 1 part.—*P. G.* 1872.

Looch album.—White linctus, *E.;* Looch blanc, *Fr.*—30 parts of sweet and 2 parts of bitter almonds are blanched, triturated with 20 parts of sugar and 120 parts of water, and the emulsion strained and gradually added, with continued trituration, to a mixture of 10 parts of sugar and ½ part of powdered tragacanth. Finally, add 10 parts of orange-flower water. The finished preparation weighs 150 parts.—*F. Cod.*

Action and Uses.—Almond emulsion is an excellent demulcent in *acute laryngeal* and *bronchial* inflammations, *dysentery*, and irritations of the *urinary passages*. It should be administered freely. The white linctus of the French Codex is an excellent palliative of pharngeal, laryngeal, and bronchial irritation.

EMULSUM ASAFŒTIDÆ, *U. S.*—Emulsion of Asafœtida.

Mistura asafœtidæ, U. S. 1880; *Lac asafœtidæ.—Asafœtida mixture*, *Milk of asafœtida*, E.; *Mixture* (*Lait*) *d'asafœtida*, Fr.; *Asafœtida-Emulsion*, *Stinkasantmilch*, G.

Preparation.—Asafœtida, in selected tears, 40 Gm.; Water, a sufficient quantity; to make 1000 Cc. Rub the asafœtida, in a warmed mortar, with 900 Cc. of water, at first very gradually added, until a uniform emulsion results. Then strain the mixture into a graduated vessel, and wash the mortar and strainer with enough water to make the product measure 1000 Cc. Mix the whole thoroughly.—*U. S.*

This formula corresponds to 18.24 grains of asafœtida for each fluidounce of water.

A *syrup of asafœtida*, of the same strength as the emulsion, may be prepared by triturating 150 grains of selected tears with small quantities of water, decanting the concentrated emulsion until 4 fluidounces are obtained, in which 6 troyounces of sugar are dissolved by agitation. While at first milk-white, it acquires after exposure a pinkish color; the resin, which partially separates on standing, is easily incorporated by agitation. If desired, the asafœtida odor may be covered by the addition of a little oil of bitter almonds.

Action and Uses.—Asafœtida emulsion is the most prompt and decided in its action of all the forms of administering asafœtida by the mouth. It is frequently given

as an enema, but for the latter purpose a mixture of an ounce of tincture of asafœtida with half a pint of water is more convenient and efficient. The *dose* of emulsion of asafœtida is 1 or 2 tablespoonfuls—Gm. 16–32 (f℥ss–i).

EMULSUM CHLOROFORMI, *U. S.*—Emulsion of Chloroform.

Mistura chloroformi, U. S. 1880; *Emulsio chloroformi.—Emulsion de chloroforme*, Fr.; *Chloroform-Emulsion*, G.

Preparation.—Chloroform, 40 Cc.; Expressed Oil of Almond, 60 Cc.; Tragacanth, in very fine powder, 15 Gm.; Water, in sufficient quantity; to make 1000 Cc. Introduce the tragacanth into a perfectly dry bottle of sufficient capacity, add the chloroform, and shake the bottle thoroughly, so that every part of the surface may become wetted. Then add about 250 Cc. of water, and incorporate it by vigorous shaking. Next add the expressed oil of almond in several portions, shaking after each addition, and when the oil has been thoroughly emulsified, add enough water, in divided portions, shaking after each addition, until the product measures 1000 Cc.—*U. S.*

Since the Pharmacopœia directs 4 and 6 per cent. by volume of chloroform and oil of sweet almond respectively, ½ pint of the emulsion may be conveniently prepared by shaking 154 minims of chloroform with 55 grains of tragacanth, adding 2 ounces of water, then 230 minims of expressed oil of almond, and finally sufficient water to bring the volume of the finished product up to 8 fluidounces.

This formula differs radically from that of the Pharmacopœia of 1880, which directed 40 grains of chloroform and 10 grains of camphor in each fluidounce and yolk of egg to be used as the emulsifying agent.

Action and Uses.—This emulsion forms a stable preparation which may sometimes be convenient for the administration of chloroform in cases of *gastralgia*, *flatulent*, *biliary*, *renal*, and *uterine colic*, and in *nervous* or *hysterical* paroxysms. The *dose* is 1 or 2 tablespoonfuls (Gm. 16–32 (f℥ss–i).

EMULSUM GUAIACI.—Guaiacum Emulsion.

Mistura guaiaci, Br.—*Guaiacum mixture*, E.; *Emulsion de résine de gaïac, Lait de gaïac*, Fr.; *Guajak-Emulsion*, G.

Preparation.—Take of Guaiacum Resin, in powder, Refined Sugar, each ½ ounce; Acacia, powdered, ¼ ounce; Cinnamon-water, 1 pint (imperial). Triturate the guaiacum with the sugar and the gum, adding gradually the cinnamon-water.—*Br.*

This is a partial emulsion of guaiac resin, which, on exposure, changes in color. (See Resina Guaiaci.)

Action and Uses.—Although unpleasant to the taste, it is perhaps less repulsive than the tincture of guaiac. Very probably, also, the guaiacum in it, being thoroughly divided by sugar and gum, is more readily acted upon and absorbed by the stomach than the solid mass precipitated from the tincture would be. *Dose*, from 16–64 Cc. (f℥ss–ij) several times a day.

EMULSUM SCAMMONII.—Scammony Emulsion.

Mistura scammonii, Br.—*Emulsio purgans cum scammonio, Lac scammonii.—Scammony mixture, Milk of scammony*, E.; *Emulsion purgative avec la scammonée, Mixture de scammonée*, Fr.; *Scammonium-Emulsion*, G.

Preparation.—Take of Scammony, in powder, 6 grains; Milk, 2 fluidounces. Triturate the scammony with a little of the milk until a uniform emulsion is obtained.—*Br.*

Scammony is readily emulsionized with milk, the preparation being preferable to one made with water, as the acrid nauseous taste is better concealed by milk.

Action and Uses.—Scammony forms with unskimmed milk a fine uniform emulsion which perfectly suspends the drug and conceals its acrid and nauseous taste. The mixture is intended to be a *dose* for an adult; for a child of five years one-third of the quantity will suffice.

ENEMATA.—Clysters.

Clysmata, Clysteria.—Lavements, Clystères, Fr.; *Klystiere*, G.; *Lavativo*, It.; *Ayuda*, Sp.

Clysters are liquid medicines which are injected into the rectum by means of a syringe, and ordinarily consist of water or of infusions mixed with solutions of salts or holding insoluble substances in suspension. They are rarely if ever prepared by the apothecary, but are generally made at the bedside, and the introduction of formulas into the Pharmacopœia serves mainly the purpose of informing the physician of the mode of their preparation.

ENEMA ALOES, *Br.*—Enema of Aloes.

Lavement aloétique, Fr.; *Aloeklystier*, G.

Preparation.—Take of Aloes 40 grains; Potassium Carbonate 15 grains; Mucilage of Starch 10 fluidounces. Mix, and rub together.—*Br.*

Action and Uses.—It is far from certain that the enema of aloes exerts any special influence, or any that would not be secured equally well by a solution of common salt or of a magnesium salt. Aloetic enemata, when they are intended to purge, should be large, but when they are to be retained to destroy *ascarides* of the rectum or to stimulate the *uterus*, they should not exceed Gm. 60–90 (f℥ij–iij).

ENEMA ASAFŒTIDA, *Br.*—Enema of Asafœtida.

Enema fœtidum s. antihystericum, Clysma tonicum.—Lavement d'ase fétide, Fr.; *Asafötida-Klystier*, G.

Preparation.—Take of Asafœtida 30 grains; Distilled Water 4 fluidounces. Rub the asafœtida in a mortar, with the water added gradually, so as to form an emulsion.—*Br.*

This is identical with a mixture of equal parts of water and milk of asafœtida.

Action and Uses.—The use of asafetida by enema is often the most eligible mode of its administration, on account of the patient's inability to swallow, as in *hysteria*, or because it acts very promptly, as in cases of *intestinal flatus*. The association of aloes with the emulsion of asafetida forms a very useful enema in cases of *constipation* with flatulence. A mixture of the wine or tincture of aloes and tincture of asafetida, sufficiently diluted with water, is far better than the officinal enema made with water alone.

ENEMA MAGNESII SULPHATIS, *Br.*—Enema of Magnesium Sulphate.

Enema cathartieum.—Lavement de sulfate de magnésie, Fr.; *Bittersalz-Klystier*, G.

Preparation.—Take of Magnesium Sulphate 1 ounce; Olive Oil 1 fluidounce; Mucilage of Starch 15 fluidounces. Dissolve the magnesium sulphate in the mucilage of starch, add the oil, and mix.—*Br.*

Action and Uses.—The oil and mucilage in this enema are worse than useless. A simple solution of Epsom or of Glauber salt in water is preferable. It may be used as an evacuant of constipated bowels when a prompt operation is desired, as in cases of obstinate *constipation* or of *congestion of the brain*. For such purposes an enema should always be large.

ENEMA OPII, *Br.*—Enema of Opium.

Enema anodynum s. sedativum.—Lavement opiacé anodin, Fr.; *Opium-Klystier*, G.

Preparation.—Take of Tincture of Opium ½ fluidrachm; Mucilage of Starch 2 fluidounces. Mix.—*Br.*

Action and Uses.—The proportion of laudanum or of other liquid opiate in an enema must vary with the age and state of the patient, with the local or general narcotic effect that is sought, etc. As the enema ought to be retained, the quantity of liquid in it should not exceed Gm. 60 (f℥ij); and if designed to affect the system it should consist of water, which is promptly absorbed, and not of starch, which may not be absorbed at all.

ENEMA TABACI.—Enema of Tobacco.

Lavement de tabac, Fr.; *Tabak-Klystier*, G.

Preparation.—Take of Leaf Tobacco 20 grains; Boiling Water 8 fluidounces. Infuse in a covered vessel for half an hour, and strain.—*Br.* 1867.

Action and Uses.—The quantity stated in the formula is intended for one enema. The infusion of tobacco (*U. S. P.* 1870) was stronger than this preparation by one-half, but was prepared in the same way and used for the same internal purposes—that is to say, for producing nausea and muscular relaxation in cases of strangulated *hernia* and promoting alvine evacuations in *ileus*, as well as in the various cases indicated in the article on Tobacco. About Gm. 32 (f℥j) of the former American preparation was intended to be given at a time. Its use requires caution.

ENEMA TEREBINTHINÆ, *Br.*—Enema of Turpentine.

Lavement térébinthiné, Fr.; *Terpentinöl-Klystier*, G.

Preparation.—Take of Oil of Turpentine 1 fluidounce; Mucilage of Starch 15 fluidounces. Mix.—*Br.*

Action and Uses.—The proportion of oil of turpentine in an enema should vary with the case in which it is used. It is most frequently employed to lessen *tympanitic* distension of the bowels, but is of little use, comparatively, unless the flatus is confined in the colon. It sometimes affords great relief to suffering in *vesical calculus*. It has been used with alleged advantage in certain cases of *amenorrhœa* and to destroy *ascarides* of the rectum. It may be administered during a paroxysm of *hysteria*. When it is intended that a turpentine enema shall be retained, its bulk should be small, and it should also be made into an emulsion with yelk of egg.

EPIPHEGUS.—Beechdrop.

Cancer-root, E.; *Orobanche de Virginie*, Fr.; *Krebswurz*, G.

Epiphegus (Orobanche, *Linné*) virginiana, *Barton*, s. E. americanus, *Nuttall.* Meehan, *Native Flowers*, ii. p. 93.

Nat. Ord.—Orobanchaceæ.

Origin.—A perennial parasite growing upon the roots of beech trees in North America from New Brunswick to Florida and Missouri, and flowering from August to October. It is collected in autumn.

Description.—The subterraneous portion consists of a subglobular scaly tuber 12 Mm. ($\frac{1}{2}$ inch) and more in diameter. The stem is about 30 Cm. (12 inches) high, much branched, angular, with ovate scales at the base of the branches and flowers. The flowers are in long spicate racemes, the lower ones fertile and with a short corolla, the upper ones sterile, with a long tubular and two-lipped corolla, about 8 Mm. ($\frac{1}{3}$ inch) long. The stamens are didynamous, and the superior capsule is one-celled, two-valved, and contains numerous minute seeds. All parts of the plant have a pale purplish- or yellowish-brown color, and a disagreeable, bitter, and somewhat astringent taste.

The constituents of the plant have not been investigated.

Allied Plants, belonging to the same natural order, have been medicinally employed in Europe and America. They are all parasitic, destitute of green foliage, and have a more or less bitter, astringent, and nauseous taste. We mention the following North American species:

Conopholis (Orobanche, *Linné*) americana, *Wallroth.*—Cancer-root, Squaw-root, *E.*—It is from 10–15 Cm. (4–6 inches) high, 20 Mm. ($\frac{4}{5}$ inch) thick, fleshy, yellowish or brownish, covered with pale shining imbricated scales, resembling a pine-cone. The flowers have a curved two-lipped corolla and four exserted stamens. It grows in oak woods.

Aphyllon uniflorum, *Gray*, s. Orobanche uniflora, *Linné.*—Naked broom-rape, *E.*—It grows in woodlands, has a very short nearly subterraneous scaly stem bearing one or several peduncles about 10 Cm. (4 inches) long, each with a nodding flower having a curved tubular somewhat two-lipped corolla and included stamens. Its color is whitish or pale tawny.

Medical Action and Uses.—This plant appears to be astringent. Dried and powdered, it has been given internally to control *diarrhœa* and applied externally to fungous and unhealthy *ulcers*. *Conopholis*, as its popular name implies, has been used for similar purposes, and *aphyllon* is credited with analogous virtues.

EQUISETUM.—Horsetail.

Prêle, Fr.; *Schachtelhalm*, G.; *Coda di cavallo* It.: *Cola de caballo*, Sp.

Equisetum arvense, *Linné*, and Eq. hiemale, *Linné*.

Nat. Ord.—Equisetaceæ.

Description.—Both plants are leafless, and grow in damp soil in Europe and North America.

E. arvense, *common horsetail*, has a simple, smooth, fertile stem, appearing in March or April. The barren stems, which alone are used, are slender, about 60 Cm. (2 feet) long, green, jointed, about twelve-furrowed, with simple or compound quadrangular branches bearing at the joints four scales.

E. hiemale, *scouring rush* or *shave-grass*, has a simple stem about 60 Cm. (2 feet) or more long, round, grooved, the ridges rough, and at the joints with sheaths of about twenty narrow teeth, having a black girdle at the base and tip.

Constituents.—The scouring rush was analyzed by Diebold (1828), who found in it resin, wax, sugar, starch, and salts. John obtained 13 per cent. of ash, 63 per cent. of which (or 8 per cent. of the plant) was silica. The common horsetail gave to Willing (1856) 4.07 per cent. of ash, 41.4 per cent. of which was silica. Braconnot's *equisetic acid* (1828) is *aconitic acid*, according to Baup (1851).

Action and Uses.—The various species of Equisetum have had the reputation of being diuretic and astringent. It has been employed in *dropsy*, *calculous affections*, *hæmaturia*, *nocturnal incontinence of urine*, *diabetes insipidus*, *hæmoptysis*, *diarrhœa*, and *dysentery*, and also as an *emmenagogue*. If too freely used it is said to render the urine bloody, and therefore it should not be given when the urine is high-colored and the general condition feverish. A decoction may be prepared with Gm. 4–8 (ʒj–ij) of the dried plant to a pint of water, of which Gm. 64 (f℥ij) may be taken several times a day; or, the fresh expressed juice may be given in the dose of from Gm. 30–90 (ʒj–ij) daily, diluted with water or whey.

Arenaria rubra. It appears that this plant has long been used in Malta and in Algeria as a remedy for *dropsy*, *gravel*, and inflammations of the *urinary passages*, and that its use involves no risk. The large proportion of its alkaline and earthy salts appears to explain its diuretic virtues. It is best administered in decoction or infusion made with 3 per cent. of the dried plant (*Bull. de Thérap.*, xcvii. 69).

ERGOTA, *U. S., Br.*—Ergot.

Secale cornutum, P. G.; *Secale clavatum*, *Mater secalis*, *Clavus secalinus*.—*Spurred rye*, E.; *Ergot de seigle*, *Seigle ergoté* (*noir*), *Blé corne*, Fr.; *Mutterkorn*, *Kornmutter*, *Zapfenkorn*, *Hungerkorn*, G.; *Segata cornuta*, *Grano speronato*, It.; *Cuernecillo* (*Tizon*) *de centeno*, Sp.

The sclerotium (compact mycelium or spawn) of Claviceps purpurea (*Fries*), *Tulasne*, replacing the grain (produced within the paleæ, *Br.*) of rye, Secale cereale, *Linné*, Steph. and Church, *Med. Bot.*, plate 113; Bentley and Trimen, *Med. Plants*, 303.

Nat. Ord.—Fungi, Ascomycetes.

Origin.—The ergot fungus and similar but probably distinct organisms are met with upon many grasses and species of Carex and Cyperus. For medicinal purposes that of rye alone is collected. In its development three distinct stages are observed: At the flowering season one or more ovaries in an ear of rye appear covered by a sweet yellowish mucus, the so-called *honey-dew of rye*, which has a disagreeable odor and is avoided by bees, but attracts other insects, mainly ants and beetles, which were formerly considered to cause the disease of the grain. This honey-dew contains innumerable microscopic cells called *conidia*, and a sugar which reduces alkaline solutions of cupric oxide to cuprous oxide, a decomposition product of the constituents of the ovary caused by the developing fungus. The *mycelium* is formed of filamentous cells called *hyphæ*, with an outer layer forming a kind of membrane, the *hymenium*, composed of short linear cells, the *basidia*, by which the oblong or oval conidia are separated. In this stage of development it was formerly considered a distinct fungus, and received various names, the best known being Sphacelia segetum, *Léveillé;* this is often used as a descriptive term for the first stage, which is completed when the hyphæ have penetrated the lower part of the ovary and the separation of the conidia ceases; the relation of the sphacelia to ergot was first made known by Meyen (1841).

The hyphæ of the sphacelia now begins to unite at the base of the ovary into a com-

pact body, which is purplish-black externally, and rapidly grows in length, carrying upon its apex, in the form of a hood, the remains of the ovary and fragments of the sphacelia-tissue. Occasionally the formation of the honey-dew does not commence until some time after fructification has taken place and the fruit is partially developed; in such a case the ergot will be crowned by a stunted grain. When full grown the second stage of the fungus has been reached, which forms the officinal ergot, or *sclerotium*, and was formerly regarded as a distinct fungus, named Sclerotium (Spermœdia, *Fries*, Clavaria, *Schrunk*) Clavus, *De Candolle*.

In the succeeding spring small circular patches of the external layer are loosened and fold back, while at the same time small heads make their appearance, which, at first white, change to yellowish, reddish, and finally purple, and are upon slender, pale-purplish, curved stipes. On the surface of the head small wart-like excrescences are formed, containing the apertures of bottle-shaped cavities or conceptacles, the *perithecia*. Each one of these conceptacles contains a large number of somewhat fusiform cells or spore-sacs, the *asci*, each one of these containing eight filiform spores, which are discharged from the aperture of the conceptacle agglutinated in a bundle. The formation of the spores takes place about the time of the flowering of rye, and when brought in contact with its flowers the spores develop again the sphacelia. The spore-producing heads are nourished from the contents of tissues of the sclerotium, which at first becomes loose and spongy from the disappearance of the oil, and finally shrivels and is destroyed. This third and final stage was formerly likewise regarded as a distinct fungus, known, among other names, as Cordiceps purpurea, *Fries*, until Tulasne (1853)-proved it to be merely the final stage in the development of a fungus, as described above. The production of spores may be observed by leaving the ergot in the open air or by keeping it upon moist earth under a bell-glass; we have noticed it in a damp stoppered bottle containing some ergot.

Fig. 108.

Ergotized Rye.

Fig. 109.

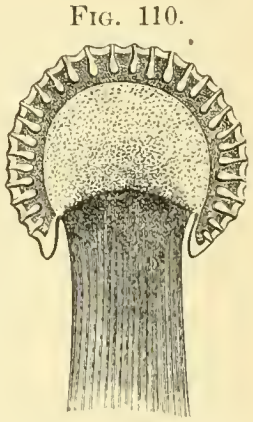
Ergot: fruiting-stage.

It will be seen that the officinal ergot is merely the intermediate or dormant state of a fungus named by the different pharmacopœias sclerotium, *U. S.*, compact mycelium or spawn, *Br.*, and stromata sterilla (sterile beds), *P. G.*, 1872.

The United States imported 7553 pounds of ergot during the fiscal year 1866–67, and during the years 1875–82 an average of 98,326 pounds annually.

Description.—Ergot forms a solid somewhat fusiform body, which is 2 to 3 Cm. ($\frac{3}{4}$ to $1\frac{1}{4}$ inches) long, 3 Mm. ($\frac{1}{8}$ inch) thick, subcylindrical or often obtusely triangular, tapering at both ends, usually somewhat curved, with three longitudinal furrows and an easily-detached yellowish, small appendage or hood at the apex. Externally of a purplish-black color, with the surface frequently fissured transversely, it is whitish, with some purplish striæ, internally of a uniform texture, and breaks readily with a smooth fracture. It has a peculiar heavy odor, particularly when moist or when treated with potassium or sodium hydroxide solution; its taste is oily and disagreeable. It is frequently attacked by a mite, from which it may be preserved by thoroughly drying it and keeping it in well-stoppered bottles or by putting a few drops of chloroform into the bottle containing it. Ergot appears to preserve its virtues not much over a year, and should therefore be annually renewed, the Pharmacopœia directing that old ergot, which breaks with a sharp snap, is almost or entirely devoid of a pinkish tinge upon the fracture, is hard and brittle between the teeth, and is comparatively odorless and tasteless, is to be rejected. Bernbeck (1881) ascertained that the

Fig. 110.



Longitudinal section of fruiting head, showing conceptacles.

fixed oil obtained with petroleum benzin from recent ergot has a neutral reaction, while that from old ergot shows a decided acid reaction to test-paper.

Powdered ergot spoils after a short time, the deterioration being induced by the fixed oil becoming rancid; it should therefore not be kept on hand in the powdered state except for a brief period. According to Mourrut (1877), the powder may be preserved unaltered for a long time by the addition to it of 5 per cent. of benzoin; but the evident change produced in the fixed oil, and probably other constituents, of the powder has caused a number of suggestions to be made looking toward the removal of the oil. For this purpose benzin or ether has been mostly recommended. Ferrot (1882) recommends bruising of the ergot, and drying it at 40° C. (104° F.), after which it should be powdered, again dried at 80° C. (176° F.), then exhausted with ether, and dried at 35° C. (95° F.), the heat being gradually raised to 100° C. (212° F.), when the powder is to be put into small vials. Benzin of a low boiling-point will likewise answer for this purpose. While there can be no doubt that powdered ergot deprived of fixed oil will not deteriorate readily, investigations are still needed as to the effect of the different solvents of the oil upon the other constituents, and to the length of time for which such ergot will retain its activity; Werner (1881) reported its virtues unimpaired after more than two years.

Constituents.—The separation of the constituents of ergot offers peculiar difficulties, which have been in part explained by the researches of Buchheim and of Dragendorff (1876); the former regards the active principle as a body somewhat resembling gelatin, and that it is formed from the gluten of rye-ovary, and readily changed by the influence of chemical agents. The latter, in connection with Podwissotzky, has isolated a number of uncrystallizable compounds possessing more or less activity, the most important being *sclerotic acid*, present to the amount of 4 or 4½ per cent., and *scleromucin*, of which 2 to 3 per cent. are obtained, and which is insoluble in alcohol of 40 per cent. by volume. The following principles are less active: *sclererythrin*, the red coloring matter, which was first noticed as peculiar by Winckler, is soluble in alkalies with a splendid murexid color, also in alcohol, ether, and chloroform; it is present in minute quantity ($\frac{1}{1000}$ per cent.); *scleroiodin* ($\frac{1}{10}$ per cent. of ergot) after drying is insoluble in water, alcohol, and ether, and dissolves with a violet color in potassa or strong sulphuric acid; *sclerocrystallin* and *scleroxanthin* are crystallizable, but without medicinal effect; their alcoholic solutions acquire with ferric chloride a violet and afterward blue-red color. Wenzell's pure alkaloids (see below) are likewise regarded as nearly inert.

Fig. 111.

Ergot.

This multiplicity of uncrystallizable principles seems to support the views of Buchheim, that the low organization of ergot prevents the formation of well-characterized principles, and that those which are formed are easily altered; it may also explain why preparations possessing some activity may be obtained by very different processes. Wiggers's *ergotin* (1830) was prepared from ergot deprived of fixed oil by ether, by extracting it with hot alcohol, evaporating, and washing the extract with water; the yield was about 1 per cent. It resembles cinchonic-red, is soluble in alcohol, but insoluble in water and ether, and is said to have poisonous properties. Bonjean's *ergotin* is soluble in water and in alcohol. (See Extract. Ergotæ.) More light was apparently thrown upon the active principles of ergot by the researches of Wenzell (1864), who proved the presence of two alkaloids—*ecboline* and *ergotine*, the former of which is precipitated by corrosive sublimate, and produces decided effects upon the brain and contractions of the muscles, while the less active *ergotine* reduces the pulse and is precipitated by phosphomolybdic acid, but not by corrosive sublimate. Both alkaloids are brownish, uncrystallizable, soluble in water, and have an alkaline reaction and bitterish taste. Ganser (1870) obtained from ergot 0.16 per cent. of ecboline and 0.04 of ergotine, the hydrochlorate of the latter crystallizing in needles. Manassewitz (1867) gives the composition of ergotine as $C_{50}H_{52}N_2O_3$. The alkaloids, according to Wenzell and Ganser, exist in combination with *ergotic acid*, which is volatile and yields crystallizable salts. Dragendorff (1876), however, regards the two alkaloids as identical; and this seems to have been proven by Blumberg (1878), who found that concentrated solution of ergotine is precipitated by corrosive sublimate in the same way as ecboline, and that this precipitate with the latter alkaloid is not entirely insoluble in water. Moreover Dragendorff denies that ecboline, which is entirely free from the compounds mentioned above, possesses any decided physiological action. Another alkaloid,

ergotinine, fluorescent in alcohol, ether, and chloroform solution was isolated by Tanret (1875) from the fixed oil of ergot prepared with ether by agitating it with acidulated water; Dragendorff could not obtain it. According to Villiers (1878), it has the formula $C_{35}H_{40}N_4O_6$. Blumberg obtained from fresh ergot .12 per cent. of ergotinine, which is crystalline, but soon becomes resinous; sulphuric acid colors it red, violet, and blue, and with Fröhde's reagent it becomes blue and blue-green; in its effects upon frogs it resembles *picrosclerotine* (producing decreased sensibility, paralysis of the extremities, and death without convulsions). The amorphous alkaloid was obtained together with *fusco-sclerotic-acid*, by Dragendorff and Podwissotzky in purifying sclererythrin. Kobert (1885) isolated another alkaloid, to which he applied the name of *cornutine*, which is claimed to be an active constituent of ergot, and is probably present to some extent in ecboline and ergotine. It is amorphous, reddish, by trituration flesh-colored, entirely insoluble in ether and water, but soluble in alcohol, and constitutes the chief active ingredient of various alcoholic extracts, which also contain *sphacelic acid*. This, also known as *sphacelotoxin*, is insoluble in water, but soluble in alcohol and alkalies. That water distilled from ergot particularly in presence of an alkali, possesses an alkaline reaction was observed by F. L. Winckler (1826); the alkaline principle was subsequently (1853) named *secaline*, but was found to be identical with *trimethylamine* (*methylamine*, according to Ludwig and Stahl). According to Ganser, it does not pre-exist in ergot, but appears to be formed through decomposition of choline, naturally present.

Ergot contains between 28 and 30 per cent. of bland yellowish, non-drying *fixed oil*, from which warm alcohol removes some acrid *resin* and *cholestrin*; the latter was obtained by L. Stahl (1866), and its character proven by Ludwig (1869). Schoonbrodt (1866) found in it *lactic acid*, which, according to Buchheim, often renders ergotine strongly acid. *Formic* and *acetic acid* appear to be sometimes present. Starch is entirely absent. The ash of ergot amounts to 3 or 4 per cent., and consists almost exclusively of phosphates.

Detection in Flour and Bread.—This depends upon dissolving the principles giving a color reaction. According to Hoffmann (1878), bread, 30 Gm., is grated, macerated in ether, 40 Gm., containing 12 drops of diluted sulphuric acid; after 24 hours the clear ethereal solution is agitated with a concentrated solution of sodium bicarbonate, the latter acquiring a reddish-violet color, due to sclererythrin. The percentage of ergot present according to Poehl (1862), may thus be determined by comparison with the results from mixtures of known composition.

Action and Uses.—In doses of a drachm or two the first action of ergot is to occasion more or less vomiting and purging, but its more characteristic effects are headache, fulness of the head, vertigo, drowsiness, and dilatation of the pupils. The pulse falls from 70 to 60, or even less, in a minute, and this reduction may continue for several days, as may also the dilatation of the pupils. The respiration also becomes slower. Examples have occurred of what may be regarded as acute poisoning by ergot. A woman of good constitution, suffering from menorrhagia, took from 5 to 6 grams (f℥1¼–1½) of fluid extract of ergot. Nine hours elapsed before the effects became noticeable. They comprised a sense of constriction in the pelvis, extreme dryness of the mouth and throat, præcordial anguish and gasping for breath, constrictive pain in the chest and loins, vertigo, confused senses, general formication, coldness and anæsthesia, epileptiform spasms, hurried and shallow breathing, a small pulse, beating 50, and a temperature of 96.8° F. These alarming symptoms yielded promptly to ether, hypodermically and by inhalation, chloral, and strong coffee; but not completely, for on the next day but one after the attack several convulsive paroxysms occurred, swallowing was difficult and painful, and the thoracic and abdominal pains persisted, although less severely. Even on the following day they still lingered (Debierre, *Bull. de Thérap.*, cvi. 52). An occasional and peculiar action of ergot consists in its producing swelling of the face and arms (*Times and Gaz.*, Oct. 1879, p. 397). After several drachm-doses of Squibb's fluid extract of ergot, taken by a woman for uterine hæmorrhage, the patient's "forearms and hands, legs and feet, became very red and swollen," and she suffered from a sense of coldness (*New York Med. Jour.*, June, 1884). In a more recent case "one small teaspoonful" of the same preparation occasioned similar but more alarming symptoms (*Med. News*, li. 538). The oil extracted from ergot by macerating it with ether displays even greater energy in producing the same symptoms, and, in addition, great languor and lassitude, lividity of the skin, painful rigidity of the muscles, and sometimes diuresis. These effects may continue for several days. The oil exerts no influence upon the gravid uterus, but the

residual ergot from which it had been extracted seems to possess the ecbolic power of the drug unimpaired.

Ergotism, as an epidemic disease, has been known from ancient times. It exhibits the poisonous effects of ergoted rye upon a large scale and in various phases, which probably depend upon the amount of the poison ingested. In one class of cases the cerebro-spinal nervous system is mainly involved, which is indicated by neuralgic pains, formication and numbness of the extremities, paroxysmal flexures and extensions of the limbs, opisthotonos, violent delirium, etc.—symptoms which are succeeded by exhaustion, and sometimes by strabismus and more or less impairment of vision. In fact, the symptoms are very analogous to those associated with lesions, and especially sclerosis. of the posterior columns of the spinal cord, and known as locomotor ataxia. Such an epidemic occurred in Germany in 1879 (*Archives gén.*, vii. sér. xx. 731). Death may occur in coma or in convulsions. In the other class of cases the nervous system is not conspicuously deranged, but the function of nutrition is impaired. A sense of muscular lassitude and a dull hue of the skin precede graver derangements, shown by the formation of gangrenous areas in various parts of the body. They begin most frequently in the thickness of a limb, and afterward form on the superficial parts, extending from the fingers or toes upward, causing these parts to blacken, shrivel, and harden—in a word, to become mummified or affected with dry gangrene. The dead parts may, as in gangrene from other causes, separate, so as to leave a clean wound behind. In a majority of cases, however, the attack is fatal. Gangrene has also been produced by the continued medicinal use of ergot. Debove reports the case of a woman with "chronic nephritis" who took about 4 grains a day of ergot for twenty days, and suffered gangrene of the hands; and Dujardin-Beaumetz relates that having, in a case of typhoid fever, prescribed a daily dose of 15 grains of ergot, the patient had sphacelus of the right hand, but recovered. A similar one is narrated by Boissaire (*Bull. de Thérap.*, xcviii. 229, 373). A case of constitutional poisoning produced by the administration of ergot to procure several successive abortions, and terminating fatally at last, is reported by Pouchet (*Annales d'Hyg. pub.*, 3^{me} sér., xvii. 253). In some cases of locomotor ataxia the symptoms have become distinctly aggravated under the use of ergot (*Centralbl. f. Therapie*, i. 227).

In comparing the different grades of the operation of ergot in animals and in man it is evident that the action in both cases is essentially the same, and that it is manifested mainly by the nervous and the circulatory functions. The former exhibits debility of the general and special senses—dilated pupils, spinal paralysis, and general convulsions, usually clonic in type; the gravid uterus is thrown into tonic contractions; the circulatory and nutritive functions are shown to be deranged by the slowness of the pulse, the fall of temperature, the cyanosis of vascular parts, the discharge of dark blood, the occurrence of cutaneous eruptions, the shedding of the hair, feathers, etc., and the gangrene of various parts, but in man of the feet and hands especially.

It may be hence inferred that the primary sensible action of ergot is upon the nervous system, since the lower degrees of its operation interest exclusively the functions of that system, while its more prolonged action gives rise to radical changes in tissue-nutrition. But all the evidence goes to show that the modifications of nervous action are consequent upon a diminished supply of arterial blood to the cerebro-spinal and the ganglionic nerve-centres. This diminished supply of blood is due partly to the sedative operation of the drug upon the heart, and partly to the contraction of the capillaries, which is demonstrable by the ophthalmoscope in the case of the human eye, and is also visible in the frog's foot and in the membranes of the brain and spinal membranes; it is inferred to exist in the spinal cord from the successive muscular spasm and paralysis which affect the voluntary and also the intestinal and uterine muscles, and the loss of vitality, with gangrene, which have been mentioned. It is, however, upon the non-striated muscular fibres, and especially upon those of the arteries and the uterus, that ergot displays its action first and most conspicuously.

Rules have long been in use for the administration of ergot during *labor*. It has been recommended—1, in lingering labors when the child's head is low, the parts relaxed, the pains absent or feeble, and there is danger in delay from hæmorrhage or other alarming symptoms; 2, when the pains are suspended and convulsions set in, venesection being premised; 3, in inevitable abortion; 4, when the placenta is retained by uterine inertia; 5, in post-partum hæmorrhage under like circumstances. Since about 1880 the use of ergot during labor has been restricted, and many obstetricians have ceased to employ it. It is claimed that in all cases the forceps are safer and more manageable. Some would limit its use to past-partum hæmorrhage, objecting to it as long as the placenta is

retained; others employ it to prevent, but not to remedy, this accident; some maintain that it is never needed during labor, and is more dangerous than useful, and that manual pressure, the hot douche, and the forceps render it superfluous. On the other hand, it is held to be indispensable in placenta prævia, and almost so in abortion; that it is the best safeguard against septicæmia and the hæmorrhage that follows the use of anæsthetics, and hence it is habitually employed by many after delivery of the placenta. In regard to the utility of the latter, differences of opinion exist even after a careful clinical study of the subject, some maintaining that ergot hastens, and others that it retards, involution (compare Blanc, *Bull. de Thérap.*, cxv. 563; *Lancet*, Feb. 11, 1888), but the weight of evidence appears to be upon the side of the former opinion. The influence of ergot upon the uterus in labor is unlike that of the natural forces: they are intermittent and rhythmical; it is constant and steady, and, as it were, tetanic, and therefore tends to destroy the child by interrupting the placental blood-supply and impeding the fœtal circulation. After labors with ergot the uterus is much larger and harder than natural, and remains so for several days. Ergot has been accused of causing rupture of the uterus, but the evidence is incomplete when the drug has been administered according to settled rules. Disease of the uterus, deformity of the pelvis or spine, and similar conditions forbid its use. No doubt laceration of the perineum and of the os uteri and hour-glass contraction may sometimes be attributed to its imprudent exhibition, as well as prolapse of the uterus or of the rectum. Retention of the placenta is even more apt to occur. In some cases also, perhaps from an overdose of ergot, it has appeared to cause delirium or coma, lividity of the face, muscular rigidity, etc. There is no doubt that ergot is dangerous to the child in proportion to the duration of its action, and that therefore it should not be administered until labor is near its termination. Fatal effects of the drug may occur even when it has not occasioned contraction of the uterus. Children are then born dead, with cyanosed skin and distorted limbs, and the discoloration has followed the use of the oil of ergot, which does not stimulate the uterine contractions. It follows from these facts that the rules above are justified, and that another might be added to them—viz. never to give ergot to expedite labor in larger doses than are necessary to produce that effect. In premature labor the drug appears to be more hostile to the child's life than at term, but is decidedly profitable to the mother. When the uterus is not in action, ergot does not readily excite its contraction; hence it seldom occasions abortion as a direct effect. Indeed, in certain cases when this occurrence is imminent from accidental uterine hæmorrhage, small and repeated doses of ergot have appeared to prevent it. It is stated that in the Dublin Lying-in Hospital it is a rule to administer the infusion of ergot immediately after delivery in all cases, and to multiparæ three times a day for two days. It is also given in all cases where there is any tendency to flowing, to a relaxed condition of the uterine walls, or to tenderness over the uterine region. The results, it is said, are the prevention of a tendency to subinvolution and the disappearance of threatening inflammatory symptoms.

Ergot has long been known as a remedy for *uterine hæmorrhage* after labor, as well as for *menorrhagia* and bleeding from *cancer* and other diseases of the uterus. In menorrhagia it seems to be most efficient when the uterus is in a flaccid condition, as shown, amongst other ways, by the persistence of uterine leucorrhœa between the menstrual periods. It doubtless in all these cases constringes the uterine tissue, but that it acts directly upon the blood-vessels is proved by its efficacy in other forms of hæmorrhage—*gastric*, *pulmonary*, *nasal*, *intestinal*, *hæmorrhoidal*, *urethral*, *vesical*, and *renal*—and also in *purpura hæmorrhagica*. In all of these cases it probably becomes efficient through its power of contracting the muscular coat of the small arteries of the bleeding part. It may be employed in substance or as a fluid extract by the mouth, or with more prompt effect by the hypodermic injection of ergotin. Full doses should be given. For hypodermic injection a solution may be prepared with Gm. 2 (30 grains) of ergotin, Gm. 50 (13 drachms) of water, and an equal proportion of glycerin. Gm. 4 (1 fluidrachm), containing about Gm. 0.06 (1 grain) of ergotin, may be used hypodermically. It does not cause local irritation, and its effect upon the hæmorrhage is very prompt. Yvon's preparation is said to be the best.

The power of ergot to contract the uterus may be used to expel retained *placentæ*, mural *fibroid tumors*, *polypi*, *hydatids*, etc. In regard to the advantages of ergot in the treatment of *uterine fibroids* the reports are very conflicting, but they are fairly represented in the conclusions arrived at by Herman (*Times and Gaz.*, Aug. 1879, p. 205): 1. "Ergot will often produce the diminution in size, and sometimes even complete absorption, of fibroid tumors of the uterus, and will, in the majority of cases, relieve their

symptoms. 2. These effects will often follow the administration of the drug by the mouth, but will more certainly be produced by its hypodermic injection in the neighborhood of the tumor." Even when the medicine has little or no appreciable effect upon the size of the uterus, it almost always checks the hæmorrhage which is a common and serious symptom of fibroid tumors of that organ. In *uterine hæmorrhage* due to other causes, such as chronic metritis, the menopause, cancer, subinvolution, parturition, abortion, etc., ergot, but more particularly ergotin hypodermically, has proved more completely and promptly successful than any other medicine. *Cornutin* is said to be efficient in such cases when administered hypodermically in doses of from $\frac{1}{4}$ to $\frac{1}{2}$ grain (*Med. News*, lv. 486). Ergot is also useful in treating chronic *endometritis*. This action, which under certain circumstances may be called tonic, has been found efficient in the treatment of uterine *leucorrhœa*, and even of *amenorrhœa* due to an enfeebled and anæmic state. It is stated that ergot moderates the excessive *secretion of milk*, and it has been used to prevent *mammary abscesses* and the engorgement of the breasts in weaning. It is one of the most efficient remedies in *diabetes insipidus*, in the treatment of which it was first used by Dr. J. M. DaCosta (*Phila. Med. Times*, July, 1875, p. 636), and afterward by Murrell, Rendu, and others in Europe (Garens, *Thèse*, 1879; *Lancet*, April, 1882; Bucquoy, *Société de Thérap.*, Avr. 1888); in 1882–83, DaCosta reported seven additional cases, in all of which, save one, a cure was wrought (*Med. News*, xl. 5; xlii. 72), since when he has cured many more (*ibid.*, lv. 347); and three other similar cases occurred to Lacy (*Med. News*, xlii. 9). The medicine sometimes fails entirely. (Compare *Practitioner*, xxix. 209; xxx. 136.) The more distinctly the affection is connected with nervous disorder, the greater is the benefit derived from ergot. In most cases the cure is complete and permanent. It is probably most efficient when associated with belladonna, and should be given in the form of the fluid extract in the dose of Gm. 4 (a fluidrachm) three times a day, gradually increased to double that quantity. It is remarkable that in several cases the diminution of the urine was attended with severe pains in the head. In one case (Garens) the polyuria was associated with "interstitial nephritis," and while using the medicine the patient ceased to urinate, and died of apoplexy. Ergot has long been used with advantage in the treatment of *paralysis of the bladder* and in *paraplegia*. Theoretically, it is most appropriate to cases in which hyperæmia of the spinal cord exists, but it would be very difficult, if not impossible, to account for its efficacy in all successful cases upon this ground, particularly since it appears to have been curative in reflex as well as in congestive paraplegia. It should be given in full doses to ensure its beneficial effects. *Incontinence of urine*, depending either upon paralysis or irritability of the bladder or upon enlarged prostate, is palliated or cured by it, according to the nature of the primary cause. It has been found efficient particularly in those cases of retention or incontinence of urine which are so apt to occur in the typhoid state of febrile diseases. Luton (*Bull. de l'Acad. de Méd.*, xxvi. 803) states that in *dysentery* he found that powdered ergot, or ergotin, in the dose of 8 grains arrested the course of the disease; but Dewar (*Practitioner*, xxviii. 361) states that the medicine always increased the *diarrhœa* for which it was given. Its power of contracting the blood-vessels has been exemplified in cases of *enlarged spleen* of malarial origin, and even when it occurred as a symptom of leucocythemia. In simple *goitre*, or vascular enlargement of the *thyroid* gland, the hypodermic injection of ergotin has been followed in many cases by a complete cure. Suppositories containing ergotin are reported to have cured four out of five cases of *hæmorrhoids*, although the first effect of the application was to cause pain for an hour or more (Lansing). Hypodermic injections of ergotin have been used by Vidal, Fernand, and others to prevent *prolapsus of the rectum*, both when attended with hæmorrhoids and when free from that complication. The injections were sometimes made into the hæmorrhoidal tumors, and sometimes into the skin around the anus. A solution of ergotin (1:5) was employed, of which from 15 to 20 drops were used for each injection (*Bull. et Mémoires de la Soc. de Thérap.*, 1881, p. 116). A convenient solution may be made with 1 part of ergotin to 3 parts each of water and glycerin. Suppositories containing ergotin have been used in the cases just referred to—with advantage, according to some, but others declare that they are tolerated with difficulty. They may contain 1 part of ergotin to 10 of cocoa-butter and a sufficient proportion of wax. It is alleged that *constipation* following an abuse of purgatives, and due to atony of the intestine, may be cured by ergot. The hypodermic method has been used with advantage in cases of ingravescent *apoplexy* and *mania a potu*, and might probably be applied in the same way in heat-apoplexy or *sunstroke*, for which it has been administered by the mouth in India. Several years ago numerous

cases of *cerebro-spinal meningitis* were published in which the treatment consisted mainly of a dose every three hours of 1 grain of ergotin and $\frac{1}{10}$ grain of extract of belladonna. The results were regarded by the reporter as exceptionably favorable (W. Read). We have not met with any reports which tend either to confirm or invalidate this conclusion. A case of supposed *tubercular meningitis* cured by ergot has been reported (Gibney). It is likewise credited with the cure of certain cases of *typhoid fever* in which active cerebral or cerebro-spinal symptoms existed (Dubonć), but the alleged results have not been confirmed; they are contrary to the history of the disease, and proof exists that the medicine has occasioned gangrene and death when used in typhoid fever. Chevallereau claims that the hypodermic injection of ergotin is capable of arresting the course of acute articular *rheumatism* (*Practitioner*, xxvi. 289). According to J. G. Rogers, it is remarkably potent in repressing the excitement of *insanity* depending upon "cerebral plethora, whether active or passive" (*Med. Record*, xx. 503), but, according to Nebel, Luton, Adam, and others, the medicine is most appropriate in *melancholia*. Its dangers, due to its interference with nutrition, should condemn it in such cases. There is no proof of its efficacy in *epilepsy*. In nervous *headache*, or migraine, there seems to be good reason for believing it to be useful when continued for some time in doses of 6 grains a day, gradually increased to 15 grains (Schumacher). It is claimed that *dilatation of the heart* from impaired nutrition and independent of valvular disease is greatly benefited by this medicine. Used hypodermically in the neighborhood of *aneurismal* tumors, ergotin is credited with having a share in their cure, along with digitalis, electro-puncture, etc. (*Bull. de Thérap*, cii. 505). It has also been used in *whooping cough* with apparent success. Dewar declares that in scores of cases he proved its power to cut short the disease (*Practitioner*, xxviii. 357), and Allan attributes to it a power of controlling other coughs, even that of phthisis (*ibid.*, xxvi. 291). It is said to relieve impaired vision arising from congestion of the *retina* and due to excessive strain of the eye in examining minute objects. A solution of 1 part of ergotin in 15 or 20 of glycerin and water has been used as a collyrium in numerous cases of *conjunctivitis*, *keratitis*, and *iritis*, and it is advised that it be applied every two or three hours, and that in severe cases a rag wetted with the solution should be kept almost constantly upon the affected eye (Planat; Dabney). The action of ergot upon the capillary blood-vessels has been tested in several chronic *diseases of the skin*, with alleged advantage, by Heitzmann and by D'Enslow (*Boston Med. and Surg. Jour.*, Sept. 1882, p. 253; *Phila. Med. Times*, xii. 873), and especially in acne rosacea, erythema, urticaria, and prurigo—which are notoriously rebellious to treatment. It seems useless in eczema and psoriasis, perhaps because in those affections an exudation exists. Its utility in *purpura hæmorrhagica* has already been noticed. According to Bulkley (*Trans. Med. Soc. of State of N. Y.*, 1876, p. 176), it causes "an almost, if not quite, immediate cessation of cutaneous and other hæmorrhages." He advises 1 or 2 grains of ergotin or 10 or 15 minims of the fluid extract hypodermically once or twice a day, but says that these doses may be more than doubled without harm. Colliquative *sweats* are effectually controlled in many instances by 15 or 20 grains of powdered ergot or by a proportionate dose of ergotin administered hypodermically (Huchard). It is alleged by Schilling that ergot prevents the tinnitus and deafness occasioned by quinine or by salicylic acid, and also the amblyopia which the former sometimes induces (*Med. News*, xliii. 123). It would be singular if ergot, which is believed to contract the capillaries, were to relieve a symptom supposed to be induced by that very mechanism.

Ergot is conveniently administered by making an infusion of Gm. 8 (℥ij) of the drug, coarsely powdered, in about half a pint of hot water, which should be given in tablespoonful doses every ten or fifteen minutes if contraction of the distended uterus is desired, or if hæmorrhage from any part is to be checked. The powder may be given in doses of from Gm. 0.30–1.30 (gr. v–xx) at similar intervals. Bonjean's or Yvon's ergotin may be prescribed in doses of from Gm. 0.06–0.20 (gr. j–iij) under like circumstances. Hypodermically, it may be administered in warm water, slightly salted, with the aid of glycerin, in doses of from $\frac{1}{10}$ to $\frac{1}{5}$ of those given by the mouth. Ergotin is usually taken in capsules. It may be used in suppositories containing from 6 to 15 grains. Tanret's *ergotinine* is said to be most suitable for hypodermic administration in doses of Gm. 0.001 (gr. $\frac{1}{64}$) or less.

ERIODICTYON. *U. S.*—Mountain-Balm.

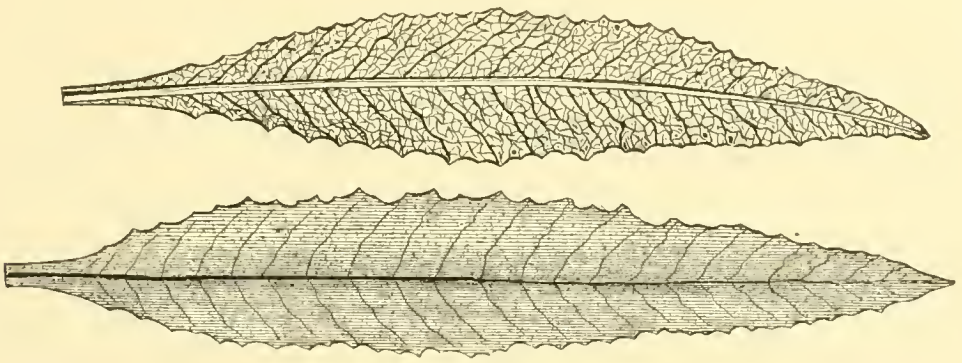
Consumptive's weed, Bear's weed, E.

The leaves of E. glutinosum, *Bentham*, s. Wigandia californica, *Hooker et Arnott.*

Nat. Ord.—Hydrophyllaceæ.

Origin.—An evergreen shrub 1 to 1.5 M. (3 to 5 feet) high, growing thriftily among the rocks on the mountain-ranges of Central California southward to Northern Mexico. It has axillary and terminal racemose clusters of showy purplish-blue flowers, with a

Fig. 112.



Eriodictyon-leaves, natural size: lower and upper surface.

funnel-shaped corolla and five stamens, and ovoid, semi-transparent capsules supported by the persistent five-lobed calyx and containing about twenty seeds. The leaves are employed.

Description.—The leaves are alternate, petiolate, 5 to 10 Cm. (2 or 4 inches) long oblong-lanceolate, sinuately toothed or nearly entire, with the upper surface smooth, green, and often varnished with a brownish resinous exudation, and the lower surface minutely white-tomentose, and delicately reticulated by a network of veins. After bruising the leaves their balsamic odor becomes more apparent; their taste is aromatic, balsamic, and free from bitterness.

Constituents.—The leaves evidently contain *volatile oil* and *resin*. According to H. S. Wellcome (1886), the latter is transparent, amber-colored, balsamic in odor and taste, amounts to from 20 to 30 per cent. of the leaves, and consists of several distinct resins. The same resin also covers the branches. Thal (1883) showed the presence of *ericolin*. (See Ledum.) Quirini (1888) isolated *eriodictyonic acid*, $C_{14}H_{18}O_5$, which is present to the amount of 2.4 per cent. It forms delicate yellow plates melting at 86–88° C., is very hygroscopic, neutral in reaction, and possesses a sweet-sour taste. Lead acetate, copper sulphate, mercuric chloride, gelatin, or tannin have no effect; ferric chloride, however, precipitates it reddish-black, the precipitate being soluble in ammonia.

Pharmaceutical Uses.—By triturating the resin with powdered French chalk, and following the official process for syrup of tolu, a *syrup* is obtained having a delicious fruity aroma and taste, closely resembling those of the pineapple, due, probably, to the presence of butyric ether in the resin.

Action and Uses.—Although supposed at first to possess medicinal value, it speedily ceased to attract attention. It is said that chewing the leaf masks the bitterness of quinine. It was stated to be very serviceable in atonic *bronchitis*, but worse than useless in the inflammatory form of the disease; but other accounts present the exact converse of this opinion, and a bold ignorance has pronounced it to be a "specific for chronic lung disease and a certain cure for consumption." Its real value as a medicine is not determined. A syrup and an elixir of it have been used to mask the bitterness of quinine.

ERYNGIUM.—Eryngo.

Button snakeroot, Corn snakeroot, Rattlesnake's-master, E.

The rhyzome of Eryngium yuccæfolium, *Michaux*, s. Er. aquaticum, *Linné.*

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—The plant grows in pine-barrens and prairies from New Jersey westward to Wisconsin and southward to South Carolina. It has grass-like, nerved and bristly-fringed leaves, the radical leaves being 30 to 45 Cm. (12 to 18 inches) long, those of the stem

much shorter; the white flowers are in dense ovate heads, which are larger than the nearly-entire leaflets of the involucre. It blooms in July and August.

Description.—Button snakeroot consists of a short root-stock 6 to 12 Mm. (¼ to ½ inch) long, with numerous short branches, terminating with a more or less deeply cup-shaped scar. A transverse section exhibits a large whitish central pith and several short wood-wedges, separated from the bark by a brown cambium-line. Below, the root-stalk is divided into a large number of thin nearly simple rootlets from 5 to 8 Cm. (2 to 3 inches) long, and containing a rather thick and soft whitish meditullium. Button snakeroot has a dark-brown color externally, a slight but rather heavy aromatic odor, and a sweetish and somewhat acrid and aromatic taste, recalling that of parsnip, which is probably due to a volatile oil.

Allied Plants.—Eryngium virginianum, *Lamarck*, has linear-lanceolate leaves and a spiny-toothed involucre longer than the heads of bluish flowers. It is biennial, and grows in swampy localities in the vicinity of the coast from New Jersey southward.

Er. campestre. *Linné.*—Eryngo, *E.*; Chardon-Roland, Penicaut, *Fr.*; Mannstreu, Brachdistel, *G.*—A European perennial. Its root is cylindrical, about 60 Cm. (2 feet) long and 25 Mm. (1 inch) thick, with several conical heads, brown externally, and with a thick internally white bark, covering the porous yellowish wood.

Action and Uses.—Button snakeroot has an acrid and aromatic taste, and is reputed to be diaphoretic and expectorant, and emetic in large doses. In Europe E. maritimum was once celebrated for its diuretic virtues, as was also E. campestre. Both species continue to be used in the treatment of *dropsy*, *gravel*, and *jaundice*. Eryngium may be given in a decoction made with Gm. 16 (℥ss) of the root to a pint of water, and reduced by boiling to half a pint, and given in 1-ounce doses.

ERYTHROPHLŒUM.—Sassy-Bark.

Mancona-bark, *Saucy-bark*, E.; *Ecorce de mançône*, Fr.; *Mancona-Rinde*, G.

The bark of Erythrophlœum guineense, *Don* (E. judiciale, *Procter*), s. Fillæa suaveolens, *Guillemin et Perrottet.*

Nat. Ord.—Leguminosæ, Mimoseæ.

Origin.—Sassy-bark comes from a large tree with bipinnate coriaceous leaves, terminal compound spicate racemes of decandrous flowers, and flat legumes with three or four lenticular seeds. The tree grows in Central and Western Africa, and the bark is used by the natives as an ordeal- and arrow-poison.

Description.—The bark is seen in flat or curved pieces, of irregular size, about 6 Mm. (¼ inch) thick, covered externally with an uneven warty and fissured corky layer, or deprived of the same, of a dull red-brown color. It is hard, brittle, of a fibrous texture, internally with pale yellowish-brown spots, inodorous, of an astringent, somewhat bitter and acrid taste, and when powdered excites violent sneezing.

Constituents.—Sassy-bark contains tannin and a red derivative of it, and yields its active principle to water and alcohol (Procter, 1852). Gallois and Hardy (1876) isolated the poisonous constituents by treating the aqueous extract of the alcoholic extract of the bark with an alkali, and exhausting the mixture with acetic ether. This alkaloid, *erythrophleïne*, is colorless, crystalline, soluble in water, alcohol, amylic alcohol, and acetic ether, but nearly or entirely insoluble in ether, chloroform, and benzene. With sulphuric acid and potassium permanganate a violet coloration is obtained, less intense than the one produced by strychnine, and soon changing to dirty brown. The solutions of its salts are precipitated by the usual reagents for alkaloids, including potassium dichromate which yields a yellowish precipitate. Harnack and Zabrocki (1882) ascertained that when boiled with acids or alkalies erythrophleïne yields *erythrophleïc acid*, which is free from nitrogen and *manconine*, which is a volatile base resembling pyridine and nicotine.

Erythrophlæum couminga or (*koumanga*) is also a large tree, all parts of which are poisonous, containing an alkaloid which is closely related to erythrophleïne, if not identical with it.

Action and Uses.—The accounts which were long received of the effects produced by the sassy ordeal agree in certain points, but not in others. In most of them the production of vomiting appears to be the capital phenomenon, for upon its occurrence or non-occurrence the person subjected to its ordeal was held to be innocent or guilty. According to Drs. Brunton and Pye, the vomiting produced by sassy occurs whether it be given internally or hypodermically, but purging only in the former case. The paralysis it causes they explain as being due not to a direct action upon the mus-

cles or the motor nerves, or the spinal cord itself, but to a contraction of the blood-vessels, which lessens the supply of blood to these parts.

When, in 1859, the essay of Mitchell and Hammond was published, it contained an appendix describing the medicinal applications of sassy. It was said to be astringent, narcotic, acrid, cholagogue, and diaphoretic, and to have been used successfully in the treatment of *periodical fevers*, *colic*, *diarrhœa*, and *dysentery*. A summary of cases of the last-named disease treated by the medicine appears to demonstrate its possession of marked curative virtues. It was given in tincture and also in extract. While these clinical reports point in one direction, physiological reasons are now given for using the medicine in *cardiac dropsy*, especially when it depends on mitral obstruction, and in cases of *hæmorrhage* due to flaccidity of the capillaries. Sée states that he used a tincture of erythrophlœum in *cardiac asthma* with the effect of rendering "the movements slower and fuller." But "the arhythmia did not disappear, the pulse was not slowed, the valvular murmurs were not modified, and there was no diuresis. As a cardiac remedy it presents no advantage." Hermann (*Centralbl. f. Ther.*, vi. 598) found that in various organic affections of the *heart* its power of slowing the pulse and increasing the urine was neither uniform nor lasting. Similar observations were made by Dujardin-Beaumetz (*Bull. de Thérap.*, cvii. 107), and by Hochhaus and others (*Therap. Gaz.*, xii. 207). As a substitute for cocaine in diseases of the *eye* it has proved inefficient as an anæsthetic, as well as painful and liable to cause inflammation of the conjunctiva and cloudiness, and even exfoliation, of the cornea (*Centralbl. f. Ther.*, vi. 235).

ESSENTIÆ.—Essences.

Alcoolés concentrés, Fr.; *Essenzen*, G.

Two preparations of this class have been admitted into the British Pharmacopœia. They are simply solutions of volatile oils in alcohol, and are therefore identical with, except that they contain a much larger amount of volatile oil than, the officinal spirits. The volatile oils are in France usually termed *essences*, while the spirits containing volatile oils, but prepared by distillation, are called *alcoolats*, and those made by simple solution of volatile and non-volatile substances are known as *alcoolés*. The *Essenzen*, popularly so called in Germany, are often strong tinctures or strong solutions of volatile oils, or mixtures of the two.

ESSENTIA ANISI, *Br.*—Essence of Anise.

Alcoolé d'anis concentré, Fr.; *Anisessenz*, G.

Preparation.—Take of Oil of Anise 1 fluidounce; Rectified Spirit 4 fluidounces. Mix.—*Br.*

Action and Uses.—(For medical uses see Spiritus Anisi.)

ESSENTIA MENTHÆ PIPERITÆ, *Br.*—Essence of Peppermint.

Alcoolé de menthe poivrée concentré, Fr.; *Pfefferminz-Essenz*, G.

Preparation.—Take of Oil of Peppermint 1 fluidounce; Rectified Spirit 4 fluidounces. Mix.—*Br.*

Action and Uses.—(For medical uses see Spiritus Menthæ Piperitæ.)

EUCALYPTOL, *U. S.*—Eucalyptol.

Cajuputol, *Cineol*, E., G., Fr.

Formula $C_{10}H_{18}O$. Molecular weight 153.66.

A neutral body obtained from the volatile oil of Eucalyptus globulus, *Labillardière*, and of some other species of Eucalyptus.

Nat. Ord.—Myrtaceæ.

Origin.—The Pharmacopœia directs the eucalyptol to be obtained from the oil of various species of Eucalyptus, and does not mention that it could be prepared from other oils, especially as one consists almost entirely of eucalyptol. This oil is that of

santonica, Artemisia pauciflora, *Weber;* it is also a constituent of the oils of rosemary and cajeput.

Preparation.—Eucalyptol is prepared from oil of eucalyptus by distillation and placing the portion going over between 150° and 175° C. (302° and 347° F.) in a freezing mixture, when it crystallizes in long, colorless needles. This is repeated a number of times, always draining the crystals to get rid of the adhering oil. From oil of santonica it may be obtained by the process of Wallach and Brass (1884). These authors took advantage of the property of eucalyptol to form a crystalline addition-product with gaseous hydrochloric acid. This latter is led into the oil, the crystals which separate collected, and the adhering oil removed by pressure. This hydrochloride is then treated with water, which liberates the eucalyptol, or, as it is called in this case, cineol. For purification it is then warmed with an alcoholic solution of potassium hydroxide and distilled with steam. Besides these two ways of preparing eucalyptol, there are others which are, however, not of much practical interest. As a case in point we might call attention to its formation in small quantities when terpin hydrate is acted on by mineral acids.

Properties and Tests.—It is a colorless liquid, having a characteristic aromatic and distinctly camphoraceous odor and a pungent, spicy, and cooling taste. At 15° C. (59° F.) it has the specific gravity 0.930 (*U. S.*), at 20° C. (68° F.) 0.927 (Wallach). When exposed to a temperature a few degrees below 0° C. (32° F.) it solidifies to a mass of needle-shaped crystals, which liquefy when the temperature rises to — 1° C. (30.2° F.), 1° C. (33.8° F.) (Voïry); it boils at 176° to 177° C. (348.8° to 350.6° F.). It is optically inactive, in which it differs from oil of eucalyptus and many other volatile oils. Alcohol, carbon disulphide, and glacial acetic acids dissolve it in all proportions. With hydrochloric acid it forms two addition-products containing 1 and 2 molecules respectively of eucalyptol to 1 of hydrochloric acid, and another with 1 of the latter to 1 of the former. If a solution of eucalyptol is shaken with iodo-potassium iodide, a magma of small green glossy crystals separates. "If a portion of eucalyptol be shaken with an equal volume of sodium hydroxide test-solution, it should not diminish in volume. Its alcoholic solution should be neutral to litmus-paper, and should not assume a brownish or violet color on the addition of a drop of ferric chloride test-solution (absence of phenols)."—*U. S.*

Action and Uses.—See Eucalyptus.

EUCALYPTUS, *U. S.*—Eucalyptus-leaves.

Feuilles d'eucalyptus, Fr.; *Eukalyptus-Blätter*, G.; *Eucalypto*, Sp.

The leaves of Eucalyptus globulus, *Labillardière*, collected from the older parts of the tree. Bentley and Trimen, *Med. Plants*, 109.

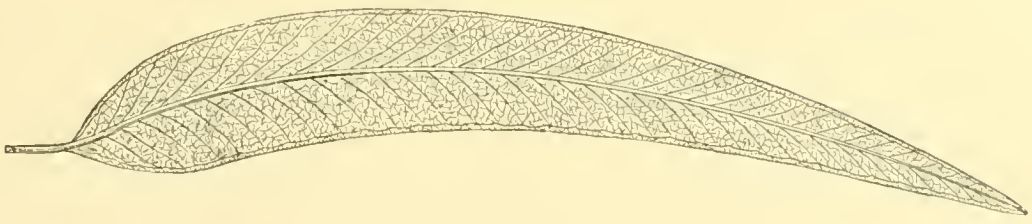
Nat. Ord.—Myrtaceæ, Leptospermeæ.

Origin.—This is the *blue-gum tree* of Tasmania, which was discovered by Labillardière in 1792. It grows on moist slopes of wooded hills in the southern half of that island, and in Victoria on the mainland of Australia; it was introduced into Europe in 1856, and has since then been very extensively planted in the southern part of Europe, in Northern Africa, in the Southern United States, and in California. It is a rapid grower, and attains a height of 60, and occasionally even of over 90, M. (200 and 300 feet). The flowers are upon short and broad axillary peduncles, either solitary or in clusters of two or three. The buds are covered with a whitish bloom, and consist of a top-shaped, ribbed, and warty calyx-tube covered by a so-called operculum, which is composed of the united petals, is hemispherical in shape and prolonged into a cone, and separates entire like a lid from the calyx-tube. The flowers are hermaphrodite, with numerous stamens inserted on a disk, a short style, and a four- or five-celled ovary united with the calyx-tube.

Description.—The leaves of young plants are opposite, shortly petiolate, broadly oval or oblong, rather obtuse, heart-shaped at base, and of a pale bluish-green color. Older trees have the leaves alternate, petiolate, falcate, lanceolate, or oval-lanceolate, rounded and oblique at the base, entire, and above gradually tapering to the acute apex. They have a length of 15 to 30 Cm. (6 to 12 inches), are thick, leathery, and of a pale yellowish-green or gray-green color, contain numerous pellucid oil-glands, are straight feather-veined, and have, besides the prominent midrib, two lateral veins near the margin. The leaves have a peculiar strong balsamic, camphoraceous odor, and an aromatic, bitterish, pungent taste, followed by a sensation of coolness.

Constituents.—Hartzer (1876) obtained from the leaves tannin, cerylic or an allied alcohol, a crystallizable fatty acid—the sodium salt of which is soluble in ether—and

Fig. 113.



Eucalyptus globulus, *Labillardière:* leaf, about half natural size.

three resins, one of which has acid properties, and yields with sulphuric acid a carmine-colored copulated acid, becoming violet with ether. E. S. Wayne (1876) likewise isolated an acid resin, which he found to be crystallizable and to give a brown-red reaction with ferric chloride. The most important constituent, however, is the volatile oil, of which the leaves yield about 6 per cent. (See Oleum Eucalypti.)

Action and Uses.—Applied to the skin, eucalyptus oil acts as an irritant, especially if its evaporation is prevented. On the raw skin it causes burning pain. Taken internally, it excites a sense of warmth in the fauces and stomach, with increased salivation and subsequent eructations of gas, but in doses of from 15 to 20 grains it is readily tolerated. It is apt to cause some fulness of the head and vascular excitement. It seems to be eliminated through the lungs. It does not impart to the urine a peculiar odor unless given in tincture and in large doses, and no resinous matter is detected in the urine by nitric acid, as when copaiva is taken. A child seven months old swallowed "a few drops" of eucalyptus oil. It became drowsy and lost the power of its limbs, its skin was pale, cold and insensible, the pupils contracted, the pulse imperceptible, and the breathing short, jerking, and interrupted. The patient gradually recovered (*Therap. Gaz.*, ix. 862). According to Gilbert, it eliminates an enormous proportion of urea. We are informed also by him that in doses of 20 drops the oil causes general stimulation, a feeling of lightness, and an irresistible desire to keep moving, together with a remarkable suppleness of the back and limbs. The spirits are raised and the mind is clear and active; the appetite is increased, and sometimes aphrodisiac effects are observed. To use this author's words, "there is a true medicinal intoxication," which is not followed by a corresponding depression. In doses relatively or absolutely excessive there is more or less general muscular paresis, without mental depression, and easily dissipated by coffee or alcohol. It is theoretically held to promote the capillary circulation by dilating the capillaries. and thereby rendering the pulse more frequent.

Eucalyptus has been very extensively used as a remedy for *intermittent fever*. As in all similar cases, the discovery of its virtues was accidental. It is alleged that more than forty years ago the crew of a French man-of-war, having lost a number of men with "pernicious fever," put into Botany Bay, where the remaining sick were treated with eucalyptus and rapidly recovered. It is also said that the virtues of the tree were well known to the aboriginal inhabitants. In 1867 some peasants of the Spanish province of Valencia were found to be using the leaves of the plant to cure fever and ague. In the following year Dr. Brunel of Montevideo was led by reports of this experience to employ it in hospital practice, and especially by such statements as the following of Dr. Ramel of Valencia: "I assure you that four leaves of this precious plant infused in water form an excellent febrifuge. The sick as soon as they find themselves attacked hasten to procure these leaves, and in no instance do they fail, contrasting strongly with cinchona, which not only is often unavailing, but often also does not prevent a relapse." The report of Dr. Brunel is scarcely less glowing and positive. In 1871, Dr. Keeler, an official physician of certain Austrian railways in malarious districts, affirmed that it was quite as efficient as cinchona. Others have attributed to it marvellous results in cases in which cinchona failed. Others, still, conclude that it is peculiarly curative in the inveterate forms of the disease. There were not wanting, however, physicians who doubted the published reports, some of them upon the ground of their own experience; and among them one, at least, accounts for their discrepancies by supposing that different species of Eucalyptus had been employed, and that E. latifolius is generally inefficient, while E. longifolius seldom fails (Oeffinger.) We regard the report of Burdel as

probably the most accurate and satisfactory. His field of observation was in one of the most marshy departments of France, La Sologne, where periodical fevers are exceptionally rife and grave. He put the alleged remedy to a prolonged and thorough test, and concluded that it possessed little or no curative power over intermittent fever. Out of 123 cases, only 11 were cured without relapse, and those were, moreover, treated in a hospital; and it is well known that intermittent-fever patients, on being removed from a malarial locality, are very apt to recover without any medicinal treatment at all. And, still further, it was observed that among those whose paroxysms ceased under the use of this medicine there was no diminution of the malarial cachexia, such as usually takes place after the treatment by quinine. In a report on its use in the British East Indian army it would seem to have failed in more than half the cases (Roberts). On the whole, there does not appear to be any substantial reason for believing that a substitute for cinchona has been found in eucalyptus.

It has been alleged that this tree has a special power of destroying malaria in the localities where it grows, but as the statement still lacks confirmation, it is unnecessary to refute the causes assigned for this effect—viz. "that its dead leaves, etc. raise the soil; that it energetically absorbs the soil-water in consequence of its very rapid growth and the multitude of stomata that stud its leaves; and, finally, that it protects the soil against the extreme solar heat so favorable to the generation of animalculæ" (Gubler). These reasons would be equally valid as proofs of its power to generate malaria. The improvement that has taken place in the sanitary state of certain malarial localities where the eucalyptus has been planted is real, but it should be remembered that all arboriculture has a similar effect. The extremely rapid growth of the eucalyptus may render it peculiarly efficient. In Italy, moreover, and elsewhere, localities at first supposed to be protected in this manner have sometimes relapsed into their original insalubrity. The use of eucalyptus oil in the treatment of *intermittent fever* was reported by Dr. J. H. Musser to be "of decided value in about one-third of all cases" (*Therap. Gaz.*, x. 369). This result was even less favorable than is usually attained by merely removing the patients from the malarial focus, as was subsequently recognized by Dr. M. (*Med. News*, lv. 632). The *a-priori* method of reasoning has led from the assumed germicidal properties of eucalyptus oil to its use in *typhoid fever*. In the dose of 10 minims every four hours it is claimed to have reduced the mortality of the disease to almost nothing during an epidemic in Queensland. But, along with the oil, an average quantity of 5 to 10 ounces, and sometimes 30 ounces, of whiskey was given in twenty-four hours; food was freely supplied; and "frequently cold packs from the head to the knees at any rise of temperature" were employed (*Practitioner*, xxxiv. 313; xxxviii. 255). It cannot be doubted that the influence of the oil, whatever it may have been, was completely overlaid by that of the alcohol within and the cold water without to which the patients were subjected. There is as little ground for admitting the value claimed for it in *scarlatina* (*Annuaire de Thérap.*, 1890, p. 117).

As a summary of the virtues claimed for this medicine the following may be cited: "Not being an irritant, it may be liberally used in all cases of hospital *gangrene* and other gangrenous affections, of fetid suppuration, such as occurs in glanders, syphilis, abscesses connected with dead bone, etc. It may be used with advantage to prevent animal and vegetable putrefaction, and hence as a *deodorizer* of hospital wards. Internally and by inhalation it may be given in all cases of *ulcer* of the *stomach or bowels*, in *septicæmia*, *typhoid fever*, *scarlatina*, *pulmonary gangrene*, *fetid bronchitis*, associated or not with *phthisis*, and in the absence of fever, etc." To this enumeration may be added cases of *fetid lochia*, *ozæna*, and *cancer of the tongue*. It would seem to be useful in *uterine* and *vesical catarrh*, and in *gonorrhœa* and *gleet*, and in some cases apparently of chronic *ulcer of the stomach* it has arrested the vomiting and enabled the patient to retain and digest food. According to Mosler, a solution of 1 part of eucalyptus oil in 5 of alcohol and 35 of water forms an efficient liquid, when atomized, for inhalation in *diphtheria* (*Times and Gazette*, Aug. 1879, p. 214; Gibbes, *Am. Jour. Med. Sci.*, July, 1883, p. 244). It seems quite possible that the 5 parts of alcohol would be more efficient than the 1 part of oil in this liquid when employed along with oil of turpentine in the disease, and it is certain that the vapor of warm water alone and of that from slaking lime is credited with many cures. The reports of Bonamy (*Bull. de Thér.*, cxii. 364) and of Murray-Gibbes (*Amer. Jour. Med. Sci.*, Jan. 1889, p. 68) must be thus qualified. Schultze used as a dressing for *wounds* a mixture of 1 part of this oil to 9 parts of olive oil (*Bull. de Thérap.*, xcix. 430). As a rationale of its mode of action we are told that if a person is kept under its influence the blood drawn from his veins will not undergo putrefaction. "At all

events, the hæmatoglobulin is expelled from the globules and becomes oxidized externally to them, and the anatomical element is, as it were, embalmed." It is somewhat difficult to conceive that the sick of any disease should profit by the mummification of their blood-corpuscles. Long ago the resemblance of eucalyptus oil to camphor was pointed out by Cloëz, and later by Gubler. Both substances are sedatives of the nervous and circulatory systems, but by relatively different doses. Like camphor, eucalyptus oil has been given for nervous *headache*, or migraine. Drs. Lewis and De Schweinitz (*Med. News*, lv. 62) used it with advantage in doses of 5 minims every four hours and in gelatin capsules.

Undoubtedly, eucalyptus, and especially its oil, tend to restrain putrefactive fermentation, as all aromatics have been known to do since the beginning of history; and possibly these new agents may excel the old in this respect. Certain it is that the oil is a most efficient deodorizer, and, having a very agreeable perfume of its own, is capable of substituting a pleasant for an offensive smell, while its stimulant operation upon diseased tissues assists them in recovering a natural mode of action. As an *antiseptic* dressing many surgeons have employed it as a substitute for carbolized oil, and it is stated to have been approved by Mr. Lister (*Lancet*, May 21, 1881). It has been used as a dressing for *cancerous* ulcers, and applied on tampons it corrects the *fetor* of *lochial* and other uterine discharges (Sloan, *Lancet*, Sept. 2, 1882). Similar applications of fluid extract of eucalyptus and glycerin are said to be very efficient in relieving *pain* in displacements and other painful disorders of the uterus (*Amer. Jour. Med. Sci.*, Oct. 1882, p. 397).

It has been claimed that tincture or the oil of eucalyptus will cure *whooping cough* (*Lancet*, No. 1889, p. 901), but there is no adequate proof of its efficacy beyond that which belongs to various astringent and stimulant applications made to the fauces in this disease. Its astringent and balsamic qualities naturally suggested its use in the topical treatment of various affections in which other medicines of like qualities had been found useful, especially in alcoholic tincture. But it cannot be doubted that the alcohol had a potent influence in the treatment by tincture of eucalyptus of slight *hæmorrhages*, *mucous profluvia*, *leucorrhœa*, *gonorrhœa*, indolent and irritable *ulcers*, *spongy gums*, etc. In certain of these affections, especially in *ulcers*, the fresh bruised leaves, deprived of their nerves, have been found to cause sufficient stimulation to promote a cure.

It is alleged that smoking the dried leaves of eucalyptus in a pipe or cigar is, with the exception of hypodermic injections of morphine, the most efficient means of calming irritation and procuring sleep in *cardiac* and *aneurismal asthma*, and particularly in cases of pressure on the vagus or its branches by thoracic aneurisms (Maclean). When the patient is too ill to inhale actively he may be kept in an atmosphere filled with the smoke of the burning leaves. The tincture of eucalyptus is said to remove the fishy flavor and smell from *cod-liver oil* when added in the proportion of 1 part to 100. The leaves are strewn among woollen clothing to protect it from *moths*.

The fresh leaves may be applied bruised or mixed with poultices. They may be given internally in doses of Gm. 0.30 (gr. v) or more, but efficient doses of them are too bulky for convenient use in this manner. The extract is very apt to derange digestion and occasion diarrhœa. The *dose* of the oil may be stated at from 2 to 5 drops. It should be given in an emulsion, or, still better, in gelatin capsules. The fluid extract is the most agreeable form of the medicine; it may be prescribed in doses of Gm. 1 (ℳ xv). The oil may be diluted with alcohol or oil for topical use, or incorporated in suppositories with the ordinary constituents of these preparations.

Eucalyptus honey is produced by bees feeding on eucalyptus flowers. From 150–175 grms. (say ℨ v–vj), mixed with milk and given to dogs, reduced the pulse from 121 to 70, and the temperature by 1° C. A tablespoonful of it occasioned in a man a diffused agreeable warmth and an increased freedom of breathing. Its continued use increased the urine and its uric acid, and gave it the peculiar smell of "new-mown hay." It has been recommended as a remedy for catarrhs, fevers, and putrid and parasitic conditions, also as a heart sedative and a remedy for gonorrhœa (*Centralbl. f. Ther.*, v. 474).

EUONYMUS, *U. S.*—Euonymus.

Cortex euonymi.—*Wahoo, Spindle tree, Burning bush*, E.; *Ecorce de fusain* (*de bonnet de prêtre*), Fr.; *Spillbaumrinde, Spindelbaum, Pfaffenhütchen*, G.

The bark of the root of Euonymus atropurpureus, *Jacquin.*

Nat. Ord.—Celastrineæ.

Origin.—The wahoo is a shrub 1.8 to 3 or even 4.2 M. (6 to 10, or 14, feet) high, and is found in shady woods of the northern and middle section of the United States east of the Mississippi. As an ornamental shrub it is of a strikingly handsome appearance in autumn from its copious crimson, smooth, four-lobed capsules, which are pendulous on long peduncles. Its branches are slightly quadrangular, the leaves opposite, petioled, elliptic-ovate, serrate, and pointed; the flowers are dark-purple, in loose cymes of three to six, and appear in June. The root-bark is preferred.

Description.—It comes in curved or quilled fragments varying in thickness between 2 and 5 Mm. ($\frac{1}{12}$ and $\frac{1}{5}$ inch). It is externally of a light ash-gray color, mottled with larger or smaller patches, or fine longitudinal scaly ridges and meshes, brown or blackish cork, detaching in very thin and small scales. The inner surface to which fragments of the white wood are often adhering, is slightly tawny and smooth. When dry the bark breaks, both transversely and longitudinally, with a nearly smooth fracture, exhibiting a whitish and pale brownish tissue, which in the inner layers has a distinct tangential arrangement. The bark attracts moisture in a damp atmosphere, thereby losing its brittleness, is nearly indorous, and has a sweetish afterward bitterish and somewhat acrid taste.

Constituents.—W. W. Clothier (1861) isolated bitter, yellow, acicular crystals from the tincture prepared with diluted alcohol by agitating it with chloroform. The same principle is probably contained in the so-called *euonymin* of the eclectics, which is obtained by precipitating a concentrated tincture of the bark with water. W. T. Wenzell (1862), however, obtained by treatment of the tincture with chloroform a dark-yellow substance from which ether dissolved a golden-yellow resin; the insoluble portion was dissolved by alcohol, a resin precipitated by lead acetate, and the lead removed from the filtrate; on evaporation, uncrystallizable *euonymin* was left, having an intensely bitter taste. It is a neutral principle soluble in ether (?), alcohol, and water, and precipitated by lead subacetate and phosphomolybdic acid. Wenzell obtained also *asparagin; euonic acid*, which crystallizes in needles and is precipitated by lead subacetate; tartaric, malic, and citric acids; several resins, starch, pectin, and other common vegetable principles. Naylor and Chaplin (1889) isolated what they thought was a glucoside, *atropurpurin*, as it reduced Fehling's Solution, but on preparing a larger quantity and purifying it, they found it not to reduce the Fehling's test and to be *dulcite* or an isomere of it.

Allied Drugs.—Euonymus americanus, *Linné*—Strawberry bush, E.—is a low, usually trailing shrub with crimson warty capsules and orange-red roots.

Euon. europæus, *Linné*, is 2.4 to 6 M. (8 to 20 feet) high, occasionally cultivated in gardens, has greenish-yellow flowers and pale-red capsules, the arillus being orange-red. All parts of it are emetic and purgative; the fruit, made into an ointment, has been used for the destruction of pediculi. Riederer (1833) believed the bitter taste to be due to an alkaloid, *euonymine*, which he did not succeed in obtaining pure. Grundner (1847) regarded it as a mixture of resin with bitter extractive. The arillus yields by pressure an orange-colored oil which has a bitter taste. The orange-red coloring matter, which is quite prevalent in this natural order, seems to deserve careful investigation.

Action and Uses.—Euonymus was formerly reported to be "tonic, a hydragogue cathartic, diuretic, and antiperiodic." This barbarous jumble of incongruous qualities is now replaced by one which belongs to euonymin, in common with many other purgatives which also increase the secretion of the bile, especially aloes, colocynth, and rhubarb, and many other medicines which are not purgatives, such as colchicum, ipecacuanha, nitro-muriatic acid, phosphate of ammonium, benzoate and salicylate of sodium, and phosphate of sodium, which last is only feebly laxative.

According to Rutherford (*Physiological Action of Drugs on the Secretion of Bile*, 1880, p. 45), "5 grains of euonymin, mixed with a small quantity of boiling water and placed in the duodenum of dogs, powerfully stimulated the liver." More recently (1888) Prevost and Binet reached similar conclusions. In dogs it only slightly increases the intestinal secretion, but is an active purgative in the human subject. Whether, therefore, it is a cholagogue in man is not yet demonstrated. We are indeed assured that one practitioner has prescribed it "in over fifty cases of *biliary derangement* and *sick headache*, and finds it of much value" (*Practitioner*, xxiii. 336); and another declares it to be "one of the best remedies in the materia medica, when used in small doses, for torpidity of the mucous membrane and liver, for hæmorrhoids with torpidity of the peristaltic action of the bowels, and in the 'erysipelatous diathesis'" (*Edinb. Med. Jour.*, xxvii. 175); but what is meant by "biliary derangement" or "torpidity," etc. it is impossible to define; and the impression remains that it signifies mainly *constipation*, which any familiar and

thorough purgative, such as the compound cathartic pill, would be adapted to remove, or podophyllin, whose action upon dogs seems to be almost identical with that of euonymin. On the whole, neither wahoo-bark nor its purgative principle can be said to possess any peculiar virtues. Either is an active and useful purgative, but nothing more. "Euonymin" has been tested by Conil and others with results like those just stated; but Paschkis maintains that E. atropurpureus has no medicinal qualities whatever, while Romm attributes to it a power over the heart like that of digitalis (*Ther. Gaz.*, ix. 143, 787).

A decoction or an infusion of euonymus may be prepared with Gm. 32 of the bark in Gm. 500 of water (℥j in Oj), and given in the *dose* of a wineglassful. The average dose of euonymin is Gm. 0.12 (gr. ij). It is usually taken at bed-time, and followed the next morning by a saline purge, which should be sulphate of sodium, according to Rutherford, a "hepatic stimulant," and not sulphate of magnesium, which the same authority assures us "has no cholagogue action."

Griffith states (*Med. Botany*) that E. americanus, E. europæus, and still other species, including E. atropurpureus, "have similar properties; the seeds are all nauseous, purgative, and emetic, and are used in some places to destroy vermin in the hair; the leaves are poisonous to sheep and other animals feeding on them."

EUPATORIUM, *U. S.*—Eupatorium.

Herba eupatorii perfoliati.—Thoroughwort, Boneset, Indian sage, E.; *Herbe d'eupatoire perfoliée, Herbe à fièvre, Herbe parfaite*, Fr.; *Durchwachsdost, Durchwachsener Wasserdost*, G.; *Eupatorio*, Sp.

The leaves and flowering tops of Eupatorium perfoliatum, *Linné*, s. E. connatum *Michaux*, gathered after flowering has commenced. Bentley and Trimen, *Med. Plants*, 147.

Nat. Ord.—Compositæ, Eupatorieæ.

Description.—Thoroughwort inhabits damp soil and low swampy grounds in Canada and the United States. It is a hairy perennial, with an erect stout stem 0.6 to 1.2 M. (2 to 4 feet) high and much branched at the summit; the leaves are opposite, tapering, lanceolate 10 to 15 Cm. (4 to 6 inches) long, united at the base, with the margin crenately serrate, rugosely veined, rough above and minutely resinous dotted beneath. The flowers are in dense level-topped corymbs; the heads have an oblong involucre consisting of lance-linear scales, and contain ten to fifteen tubular white florets with a bristly pappus in a single row. Its flowers appear in July, and it continues to bloom until September. The leaves and the flowering tops with the small branches are collected in July; on drying, they lose from 75 to 80 per cent. in weight. The drug has a rather weak aromatic odor and a somewhat astringent and persistently bitter taste.

Constituents.—Boneset contains a minute quantity of volatile oil, some tannin, and a bitter principle which has not been isolated. The analyses of W. Peterson (1851) and M. H. Bickley (1854) elicited, besides those mentioned, the usual common constituents of herbs. G. Latin (1880) isolated from the ethereal extract, by means of benzin, white needles of a tasteless wax, and ascertained the bitter principle *eupatorin* to be a glucoside soluble in alcohol, chloroform, ether, and boiling water; boiled with sulphuric acid and water, it gives off a raspberry-like odor. Shamel (1888) obtained eupatorin in a crystalline and amorphous state, and found it to be insoluble in water, concentrated sulphuric acid, and concentrated hydrochloric acid, but soluble even in dilute nitric acid, with a brown coloration. This solution gave with phosphomolybdic acid a green color; picric acid, a few needle-shaped crystals; and with auric chloride, a slight color. It is also soluble in alkalies. The formula of the crystalline nitrate was found to be $C_{20}H_{25}O_{36}HNO_3$. Parsons (1879) determined in the air-dry herb 13.5 albuminoids, 15.2 resin and chlorophyll, and 7.5 ash.

Pharmaceutical Uses.—Infusum eupatorii.—Infusion of thoroughwort, *E.*; Tisane d'herbe à fièvre, *Fr.*; Eupatorium-Aufguss, *G.*—Take of thoroughwort a troy-ounce; boiling water a pint. Macerate for two hours in a covered vessel, and strain.—*U. S. P.* 1870.

Action and Uses.—Eupatorium resembles chamomile in its effects. It is a stimulant tonic in small and a laxative in large doses, and an emetic or diaphoretic in warm infusion. Like all such plants, it is used to prevent or to break the chill in *intermittent fever* of a mild type. A hot infusion is a popular and efficient remedy in the forming stage of *muscular rheumatism*, *sore throat*, *bronchitis*, and even *influenza*. Its power of relieving pain in the limbs in the last-named disease entitled it to the popular name of "boneset." In atonic *dyspepsia* its effects resemble those of other bitter tonics. The

dose of the powder is stated to be Gm. 1.30–2.00 (gr. xx–xxx). The infusion, which is the most convenient form for administering the medicine, is made with Gm. 32 (1 ounce) of the herb to Gm. 500 (a pint) of boiling water, macerated for two hours in a covered vessel and strained. *Dose* as a tonic, Gm. 32–64 (1 or 2 fluidounces).

Mikania guaco was first known (1788) medicinally as an antidote to serpents' bites used in South America, and about 1831 it had a reputation in Europe for the cure of dyspepsia, debility, asthma, gout, rheumatism, and even cholera! It is therefore probably a stimulant tonic (Strumpf, *Handbuch*, ii. 14). More recently (1879) it was proposed as a cure for cancer. *Aristolochia cymbifera*, "the true guaco," is said by Butte to be a violent emeto-cathartic, but, when applied to the skin, to display analgesic properties, especially relieving the pruritus of several cutaneous diseases (*Therap. Gaz.*, xiii. 711).

Of the other allied species mentioned above, the greater number appear to possess essentially the same properties as the officinal plant, but E. purpureum and E. cannabinum are believed to be diuretic. The former has been used in *strangury*, *gravel*, and *gout*. The extract procured by evaporating the tincture has been sold as *eupurpurin*, of which it has been said that "three grains every three or four hours causes an enormous flow of urine" (*Lancet*, Jan. 1863, p. 127).

EUPHORBIA.—Spurge.

Wild ipecac, *Wild hipp*, E.; *Euphorbe*, Fr.; *Wolfsmilch*, G.; *Euforbia*, Sp.

The roots of two plants of this genus were recognized by the U. S. P. previous to 1880—namely, Euphorbia corollata, *Linné* (Meehan, *Native Flowers*, i. 109), and Euph. Ipecacuanha, *Linné*.

Nat. Ord.—Euphorbiaceæ.

Origin.—Euph. Corallata, the *blooming* or *large-flowering spurge*, also called *snake-milk* and *milk purslain*, is a smooth perennial herb which is met with in low, sandy, and dry soil from Canada to Florida and west to Mississippi, and is abundant in many localities, chiefly of the Southern and Western States. It produces a slender, nearly simple stem 60 to 90 Cm. (2 to 3 feet) high, which has the leaves, excepting the floral ones, alternate, linear-oblong, and obtuse. The flowers are in umbels of five to seven rays, each one being again two- or three-forked, and are conspicuous for the showy white appendages to the involucre, which have the appearance of petals and bear a greenish gland at the base. The smooth capsule separates at maturity into three carpels, each containing a single ash-colored seed. It flowers in the latter part of summer and in autumn, when the root should be collected. This, like the next, is rarely met with in the market; we have received instead of it the roots of Gillenia stipulacea, of Triosteum perfoliatum, and of other plants.

Euph. Ipecacuanha, called *ipecac spurge* and *American*, *Carolina*, or *white ipecac*, is a smooth perennial herb of a dark-green or dark-purplish color, growing in barren, sandy soil at a limited distance from the seashore from Connecticut southward to Georgia. It produces several ascending or often diffusely-spreading stems, which fork from near the base and have opposite, obovate or oblong, obtuse, and entire, nearly sessile leaves. The flowers are inconspicuous, long-peduncled, and appear singly from the forks or the axils of the upper leaves. The nearly smooth capsule contains in each of its three cells one white somewhat dotted seed. It flowers during the spring months.

Description.—The root of the *blooming spurge* is 45 to 60 Cm. (1½ to 2 feet) long, and, when full grown, about 25 Mm. (one inch) thick, cylindrical, and little branched; is externally of a dark-brown or, when old, of a blackish, color; has underneath the thin corky layer a thickish white bark, which encloses a spongy, porous, whitish wood, radially striate by many medullary rays. In the dry state it is longitudinally wrinkled and breaks with a short nearly smooth fracture. It is inodorous and has a sweetish afterward warm taste.

The root of the *ipecac spurge* resembles the preceding in general characters, but is thinner, from 0.9 to 1.8 M. (3 to 6 feet) long, has externally a gray or brownish-yellow corky layer, which is never blackish or dark colored, and shows internally a yellowish porous wood. Odor and taste are similar to the preceding. Barton believed it to be equally efficacious throughout the year.

Constituents.—The latest analyses of the last-named root, by Petzelt (1873) and Dilg (1875), agree with the older one of Bigelow in proving the presence of resinous, gummy, and other common constituents of plants; they also showed abundant presence of starch. Petzelt regards the resinous portions as containing the emetic principle. The

root may possibly contain a glucoside, since Dilg did not get a reaction for glucose until the decoction had been boiled with an acid. *Euphorbon* was found among the products extracted by petroleum benzin. The constituents of blooming spurge-root are probably similar.

Allied Plants.—The genus Euphorbia comprises a large number of shrubby and herbaceous species, all of which are laticiferous and possess more or less acrid properties. Of the thirty or more species growing in the United States, we give brief descriptions of a few which are low or prostrate:

Euphorbia prostrata, *Aiton.* It is villous-pulverulent, with roundish, very obtuse, and above serrulate leaves, and produces a woolly fruit with quadrangular, rugose, and brown seeds. It grows in moist localities in the Southern States.

Euph. maculata, *Linné.* It is a common weed, growing on roadsides, with oblong or nearly linear leaves, having usually a brownish spot upon the upper surface, and being very oblique at the base and serrulate above. Like the following species, it is known in some places as *spotted eyebright:*

Euph. humistrata, *Engelmann.* It inhabits rich soil in the Mississippi Valley, and resembles the two preceding, but has elliptical or obovate leaves and obtusely-angled seeds.

Euph. hypericifolia, *Linné.* It is found in the West Indies, and is common in the United States and Canada, grows to the height of 38 to 50 Cm. (15 or 20 inches), resembles in foliage the preceding, and has smooth capsules and obtusely-angled seeds.

These and allied species probably contain the same principles found by Zollikofer (1842) in E. maculata—namely, caoutchouc, resin, tannin, gallic acid (?), etc. Similar constituents have been found by John, Stickel, and others in E. Cyparissias, *Linné*, E. Esula, *Linné*, E. Peplus, *Linné*, E. helioscopia, *Linné*, and others which are natives of Europe, but occasionally met with in cultivation or spontaneous in North America. Their acrid principle has not been fully isolated. Numerous other species of Euphorbia are medicinally employed in those countries where they are indigenous. Recently, Euph. pilulifera, *Linné*, an herbaceous plant of India and Australia, has been recommended in bronchial and asthmatic affections.

Action and Uses.—Large-flowering spurge is reputed to possess emeto-cathartic properties, and its bruised root will vesicate the skin. Hence it cannot be a safe agent in cases of gastro-intestinal irritation. *Dose* as an emetic, Gm. 1.30 (gr. xx); as a cathartic, Gm. 60 (gr. x); as a diaphoretic, Gm. 0.30 (gr. v).

Ipecacuanha spurge does not differ essentially from the other officinal species of Euphorbium. It may be used under the same conditions and in similar doses.

A case of poisoning by the seeds of *Euphorbia lata*, found in the neighborhood of Philadelphia, is related by Harlan (*Med. and Physical Researches*, p. 603). The symptoms included violent retching and vomiting, with excessive purging, followed by stupor and dilated pupils. The patient recovered after cold affusions. A similar case of poisoning by the seeds of E. lathyris is reported in a French journal for 1881 (*Bull. de Thérap.*, ci. 541). The reporter recommends opiates as the most appropriate antidote.

Euphorbia prostrata was in 1861 reported by Dr. Irwin, Asst. Surgeon U. S. A., to be esteemed by the Indians and settlers in Arizona as an infallible remedy for the bite of the *rattlesnake* and for the bites and stings of almost all *venomous* animals and *insects*. In several experiments performed by him on dogs allowed to be bitten by rattlesnakes, and after the characteristic effects of the venom had been fully developed, the fresh juice of this plant was applied to the wounds, and at the same time administered internally in doses of from 4 to 6 ounces, with the effect of immediately abating the symptoms and afterward curing the animals.

Euphorbia heterodoxa, a Brazilian plant, furnishes an acrid juice which is escharotic and softens tissues to which it is applied, and especially *cancroids*, *epitheliomas*, and *syphilitic vegetations*. It is this plant which has been spoken of as "lcite d'Alveloz" (*Bull. de Thérap.*, cx. 513; cxi. 130; *Therap. Gaz.*, xi. 755).

EUPHORBIUM, *P. G.*—Euphorbium.

Euphorbe, Gomme-résine d'euphorbe, Fr.; *Euphorbium*, G.; *Euforbio*, Sp.

The gum-resin obtained from Euphorbia resinifera, *Berg.* Bentley and Trimen, *Med. Plants*, 240.

Nat. Ord.—Euphorbiaceæ.

Origin.—The plant is indigenous to the lower slopes of the Atlas Mountains of Morocco. It has an ascending, cactus-like, fleshy, quadrangular stem with spreading branches, and, instead of leaves, is furnished with divergent, spinescent stipules, situated in pairs on the angles; the flowers are in pedunculate cymes of three or rarely more. On wounding the branches a milk-juice exudes, which hardens upon the plant, usually

encrusting the spines. While it is being collected the mouth and nostrils are protected by a cloth from the irritating effects of the dust.

Description.—Euphorbium is seen in roundish or somewhat three-cornered, conical-cylindrical, or irregular pieces varying considerably in size, the largest measuring nearly an inch (25 Mm.). The shape is influenced by the portion of the plant around which the exudation is hardened, and most pieces are observed with one or more holes and enclosing fragments of the spines, flowers, or fruit. Euphorbium is light brownish-yellow, scarcely glossy, somewhat translucent, brittle, nearly inodorous, but the dust excites violent sneezing, and, if inhaled, acts as an acrid poison. The taste is at first slight, afterward burning and acrid. When heated it gives off a faint odor, suggesting that of benzoin, and afterward fuses and burns with a bright, sooty flame. Euphorbium is not entirely soluble in any of the simple solvents, and when triturated with water yields a turbid mixture, but not an emulsion.

Constituents.—The older analyses by Braconnot, Brandes, and others seem to indicate that the composition of euphorbium varies to some extent; the *resin*, readily soluble in cold alcohol and possessing an extremely burning taste, varied between 37 and 44 per cent.; Flückiger (1868) obtained 38 per cent. of it, and Hlasiwetz (1867) ascertained its composition to be $C_{10}H_{16}O_2$. This resin is amorphous, imparts to boiling water its acrid and bitter taste, and, according to Sommer (1859), does not yield umbelliferon. The sparingly soluble, crystallizable resin of Bonastre and others was named *euphorbon* by Flückiger, who obtained 22 per cent. and gave it the formula $C_{13}H_{22}O$. It is soluble in ether, benzene, benzin, amylic alcohol, chloroform, acetone, glacial acetic acid, and hot alcohol, but requires about 60 parts of alcohol for solution at the ordinary temperature. When the last traces of the acrid resin have been destroyed by boiling in a weak solution of potassium permanganate it is entirely tasteless. If its alcoholic solution is allowed to evaporate until it forms a thin film, and this is moistened with sulphuric acid, the slow addition of a little strong nitric acid produces a fine violet color—a reaction which is also observed with lactucerin. Braconnot (1808) observed the presence of malic acid in euphorbium. Flückiger obtained 12 per cent. of *malates*, chiefly of calcium and sodium, 10 per cent. of *mineral compounds*, and 18 per cent. of *gum*, which is precipitated by lead acetate, also by sodium silicate and borax.

Pharmaceutical Uses.—Euphorbium is an ingredient in a few plasters. TINCTURA EUPHORBII is made with 1 part of euphorbium and 10 parts of alcohol.

Action and Uses.—The juice of the fresh and the powder of the dried plant act upon the skin and mucous membranes as acrid irritants, and internally cause persistent vomiting and purging and even gangrene of the bowels. Although euphorbium was anciently and even in comparatively modern times used as a drastic purgative in *dropsy*, yet the extreme harshness of its operation led to its being associated with milder drugs for the same purpose, and at the present day it is never given internally. It was also at one time applied as a local stimulant in certain cases of *paralysis*, and more recently as a *sternutatory* when mitigated with inert or mild powders. As a local irritant it has been used in the same cases for which mezereon is appropriate, and particularly in plasters intended to prolong *suppuration*, as in cases of obstinate *sciatica*. In ointments it was applied to *ulcers* maintained by necrosed bone. Plasters containing it have also been employed in the treatment of chronic swellings of the *joints* induced by scrofula, gout, or rheumatism.

Euphorbia pilulifera was brought into notice first in Australia, and then in the United States, about 1883. In 1884, Baker lauded it in *bronchitis* and *asthma;* Matheson stated that its popular name was "asthma herb," and that it was tonic and antispasmodic; and Wragge testified that in asthma "its effects are almost magical." In 1885, Tison employed tincture of this euphorbia in eleven cases of dyspnœa with or without emphysema or bronchitis, and all were benefited by its use. He regarded the nervous element of the disease as the one principally affected by it. (See also *Therap. Gaz.*, xi. 171.) In the same year Marsset used it in experiments upon animals, from which he inferred that it first quickens and then retards the respiration and the pulse; he also concluded, after clinical experience, that it affords marked relief in asthma. He observed that it is apt to occasion nausea and pain in the stomach, probably through its acrid qualities. It has been used in a decoction made with two quarts of water and half an ounce of the dried plant, simmered to one quart, of which the dose was a wineglassful three or four times a day. The watery (or the hydro-alcoholic) extract has been given in 2-grain doses. A tincture, one part of which represents five parts of the dried plant, has been recom-

mended in doses of 10–20 drops. *E. helioscopia* furnishes a juice which is used to remove *warts*.

Euphorbium Drummondii, an Australian plant which destroys many cattle, is said to furnish an anæsthetic alkaloid to which the name drumine has been applied, but its action and its very existence have been questioned (*Therap. Gaz.*, xi. 107; *ib.*, 463).

EUPHRASIA.—Eyebright.

Euphraise, Fr.; *Augentrost*, G.; *Eufrasia*, Sp.

Euphrasia officinalis, *Linné*.

Nat. Ord.—Scrophulariaceæ.

Description.—An annual plant about 15 Cm. (6 inches) high, indigenous in the greater part of Europe, and in North America to the White Mountains and from the Great Lakes northward. It has opposite, shortly petiolate or sessile, ovate or lanceolate leaves, which are about 8 Mm. (⅓ inch) long, and have four or five teeth on each side; the upper (floral) leaves are alternate, nearly rhomboid, and bristly-toothed. The axillary flowers have a four-cleft calyx and a white or lilac two-lipped corolla with a yellow throat, four ascending stamens, and an oblong, many-ovuled ovary. When fresh, the plant has a faint balsamic odor which is almost completely lost on drying; the taste is somewhat saline, bitter, and scarcely astringent.

Constituents.—Examined by J. B. Enz (1859), the fresh plant was found to contain 62 per cent. of moisture and 10.8 per cent. of cellulose, the remainder being tannin, a little volatile oil, an acrid and bitter principle, several organic acids, mannit, glucose, and other common principles. The tannin precipitates ferric salts dark-green, and lead salts of a bright-green color.

Action and Uses.—The name "euphrasia," signifying cheerfulness, was anciently as well as in more recent times given to this plant, which was supposed to render the vision clearer and to cure various inflammatory affections of the eyes. Its English name, *eyebright*, may be due to this circumstance, but some maintain that its use in such disorders was prompted by the doctrine of signatures, for a yellow spot upon its flower suggests the pupil of the eye. Its utility, when applied as a fomentation or decoction in *ophthalmia*, was probably due to its astringency. E. odontites in vinous infusion is mentioned by Pliny as a remedy for the toothache (*Hist. Nat.*, xxvii. 84). Strumpf (*Arzneimittellehre*, 1848, i. 487) says of E. officinalis "that at one time it was held to have a specific action upon the brain and eyes and the abdominal viscera, especially the liver; . . . . that it cured syncope, strengthened the understanding, cleared the complexion, etc.;" and at another to cure all catarrhal affections of the eyes, ears, lungs, etc. It was employed internally and externally. Still earlier, in 1826, Richter (*Arzneimittel.*, i. 417) gave a similar account of it, adding that a metallic salt was sometimes added to the infusion of the herb. In 1847, Griffith (*Med. Botany*, p. 517) related the same facts in part, and adds that the medicine is no longer employed; and Cazin (*Plantes Médicinales indigènes*, 1858, p. 401) after a similar review blames a belief in its virtues as being derived chiefly from a faith in the dead doctrine of signatures. Recently it has been alleged that a few drops of tincture of euphrasia at the beginning of an acute *coryza*, and repeated at intervals of two or three hours, will abort the attack (Garland, *Boston Med. and Surg. Jour.*, Nov. 1889, p. 453). The fact that a forming coryza may be aborted by numerous agents (*e. g.* alcohol, ammonia, camphor, tannin, etc.) should prevent one's having much faith in the alleged special virtues of euphrasia.

EXTRACTA ET EXTRACTA FLUIDA.—Extracts and Fluid or Liquid Extracts.

Extraits et Extraits liquides, Fr.; *Extrakte und Flüssige Extrakte*, G.; *Estratto, Estratto liquido*, It.; *Extractos*, Sp.

Extracts are preparations which are obtained by evaporating a solution of the medicinal principles of drugs to the consistence of a soft solid or to dryness. The solution of the medicinal principles either exists as such in crude drugs while yet in a fresh and juicy state, and may then be obtained by expression, or it may be prepared by treating the dried and powdered drugs with suitable menstrua, such as water, water and alcohol, alcohol, or ether until deprived of all active constituents. These two methods give rise to different classes of extracts, which are distinguished by specific names, such as *inspissated juices, aqueous, alcoholic, hydro-alcoholic, and ethereal extracts;* the last named

class contains all the fixed and volatile oils, together with resin which may have been present in the drug, and with few exceptions remain liquid after complete evaporation of the solvent: they possess the property of self-preservation, and are known in the Pharmacopœia as *Oleoresinæ* (which see).

Inspissated Juices.—The United States Pharmacopœia recognizes only one inspissated juice (Ext. taraxaci), while those of the narcotic herbs which are not indigenous or grow spontaneously only in a few localities have very properly not been admitted. The expressed juices of herbs contain, besides the medical principles, chlorophyll in suspension and albuminous and mucilaginous matters in solution. Of these the chlorophyll separates on heating the liquid to about 55° C. (130° F.) and the albuminoids are coagulated between this temperature and about 94° C. (200° F.); The solubility of the gum and mucilage is not affected by the heat but these principles may be removed by alcohol, in which they are insoluble. The different pharmacopœias have adopted different processes for the purification of the expressed juices: that of Germany endeavors to obtain the extracts as free as possible from inert principles, and purifies by heat and by alcohol, as recommended by C. F. Mohr (*Pharmacopœia Universalis*, 1845); the French Codex, like the 1870 U. S. P., directs the juice to be coagulated by heat, but the gum is not precipitated; and that of Great Britain aims only at the separation of the albumen, and reincorporates with the extract the previously-removed chlorophyll. The inspissated juices of the latter are of a green color and of a firm pilular consistence; those of the other pharmacopœias are brown in color, and cannot be made into pills without the addition of some vegetable powder. Provided the material has been of the same quality, an inspissated juice made according to the German Pharmacopœia ought to be stronger, and if made by the British Pharmacopœia weaker, than is obtainable by the French (and former United States) process.

To obtain the juice, the vegetable should have been recently collected, well washed with water to free it from extraneous matter, and the superfluous water drained off. It is then cut into pieces of convenient size and bruised in a stone mortar, by means of a pestle made of hard wood, until reduced to a smooth pulpy mass. If not succulent enough, a little water may be sprinkled over it during this operation. The mass is then enclosed in canvas bags, strongly expressed, again mixed with water, and expressed a second time, whereby that portion of the juice remaining in the pulp is obtained. The mixed liquids are then heated to 80° C. (176° F.) to coagulate the albumen, which encloses also the chlorophyll, and is removed by straining, after which the clear liquid is evaporated to the proper consistence (*F. Cod.*). The German Pharmacopœia directs the strained liquor to be evaporated until reduced in weight to 10 per cent. of the weight of the plant, when an equal weight of alcohol is added to precipitate gummy matter; the mixture is set aside until the insoluble matter has subsided; it is then decanted and filtered, and the retained liquid obtained by the addition of a little diluted alcohol; the alcohol is partly distilled off and the remaining liquor evaporated as before, The British Pharmacopœia directs the heating of the expressed juice to 130° F., whereby the chlorophyll separates from the liquid and is collected upon a calico strainer. The strained liquor is now heated to 200° F. to coagulate the albumen, again strained, and evaporated to the consistence of a thin syrup, to which the chlorophyll, previously separated, is added and well mixed by assiduous stirring, Evaporation to the proper consistence will complete the extract. If the part of the plant employed does not contain chlorophyll, its removal and subsequent readmixture are obviously omitted from the process, and if starch is present some of it will pass through the press-cloth, and the expressed juice must be allowed to subside and then be decanted from the deposited fecula. The U. S. process for extract of taraxacum is faulty in not removing the albumen.

Aqueous Extracts were formerly usually made by boiling the drug with water, expressing the watery solution, and evaporating. The pharmacopœias have very properly discontinued this process almost altogether, and have in nearly all cases substituted infusion or percolation with water. Prolonged boiling with water will often render inert constituents (starch, etc.) soluble in water, and thus increase the amount of extract, to the injury of its quality. In other cases, however, it may not only injure the quality, but also decrease the yield of the extract, as in the case of krameria, the tannin of which is either partly destroyed or becomes insoluble through combination with other constituents. Some pharmacopœias exhaust the comminuted drugs by hot infusion or digestion, but cold infusion or percolation appears to produce not only unobjectionable aqueous extracts, but they are in some cases at least superior in appearance to those made by hot infusion or digestion. When infusion is directed, the properly-comminuted drug is mixed with

sufficient water to cover it, and in case the material be light, it is submerged by putting a perforated cover with sufficient weights upon it to keep it covered by the water. After due maceration or digestion a concentrated solution of the principles is at once obtained by expression, and a second maceration with a small amount of water and expression will practically exhaust the drug. If a large quantity of water be used in the beginning, a second maceration may be avoided or becomes unprofitable, but a longer-continued evaporation is necessary.

Only two extracts are prepared with water containing acetic acid or ammonia, which chemicals are ordered in a fixed proportion to the drug, the extraction being finished with water, used merely for the purpose of recovering a percolate equal to the amount of menstruum first employed. (For the proper treatment of the material by displacing with an aqueous menstruum we refer to the remarks on PERCOLATION.) The menstruum used is—

Water for Aloe, Gentiana, Hæmatoxylon, Krameria, Opium, Quassia;

Water and acetic acid for Colchici radix; and

Water and ammonia for Glycyrrhiza.

ALCOHOLIC EXTRACTS.—Whether made with strong or diluted alcohol, the powdered material is most conveniently exhausted by percolation. In all cases where alcohol or diluted alcohol is directed in the beginning, the same menstruum is now ordered until exhaustion is accomplished. But for some extracts a stronger and a diluted alcohol are directed; in such cases the former is always used first, and by the addition of the latter an amount of percolate obtained equal in volume to that of the stronger alcohol employed, and usually more than sufficient to practically exhaust the drug. It is obvious that the tinctures obtained in this manner must be of uniform alcoholic strength from beginning to end, which fact renders a separate treatment of different fractions unnecessary; the alcohol is distilled off from the whole of the tincture, and the residue left is then evaporated to the proper consistence. Yet for several extracts it has been deemed proper to distil or evaporate only the weak tincture, and after mixing the residue with the percolate first obtained—rather less than one-third of the whole amount—to evaporate to the proper consistence. Such a precaution is particularly commendable for physostigma, belladonna, and hyoscyamus. Spontaneous evaporation of the most concentrated portion of the percolate has been retained only for rhubarb. Only one extract, ergot, is directed to be made from the fluid extract, yet when the processes for several other extracts and the corresponding fluid extracts are examined, there would appear to be as little objection to prepare the former from the latter as with the important preparation mentioned.

The menstruum used for this class of extracts, as a rule, has been judiciously selected, and leaves but little occasion for criticism:

Alcohol for Aconitum, Cannabis Indica, Cimicifuga, Iris, Jalap, Physostigma.

Alcohol 4 *volumes*, *water* 1 *volume*, for Podophyllum, Rheum.

Alcohol 3 *volumes*, *water* 1 *volume*, for Cinchona, Leptandra, Nux Vomica (with acetic acid).

Alcohol 2 *volumes*, *water* 1 *volume*, for Belladonnæ foliæ, Digitalis, Euonymus, Hyoscyamus.

Diluted Alcohol, for Arnicæ radix, Colocynthis, Conium (with acetic acid), Ergot (with acetic acid), Stramonii semen, Juglans.

Alcohol 1 *volume*, *water* 2½ *volumes*, for Uva Ursi.

ETHEREAL EXTRACTS.—All the ethereal extracts of the United States Pharmacopœia will be found under OLEORESINÆ, where also the necessary apparatuses and operations are described. Ext. mezerei æthereum, *Br. P.*, is the ethereal extract of an alcoholic extract, the latter being prepared from the drug and afterward exhausted by ether.

Fluid or Liquid Extracts, in the meaning of the United States, British, and German Pharmacopœias, are permanent concentrated solutions of vegetable drugs, made of such a strength that, in the United States, 1 Cc. contains the medicinal principles and represents the virtues of 1 Gm. of the drug. Prior to 1880 the pharmacopœial strength was 1 troyounce of drug to 1 fluidounce of the fluid extract. The present Pharmacopœia strength is based upon the relation of the metric measures of weight and capacity, so that any weight of a given drug is to be converted into a fluid extract having the bulk of the same weight of water at its maximum density; or, in other words, a Gm. of the drug is to be represented by 1 Cc. of the fluid extract. The Pharmacopœia omits to state the temperature at which the finished preparation is to be measured; it is obvious, however, that the fluid extract should in all cases be cooled and measured at or near 15° C. (59° F.), which is the standard temperature adopted for taking specific gravity. The relation of the present and former fluid extracts is shown at a glance by the following table:

100 troyounces of drug yield	3110.3	Cc.	=	105.25	fℨ	U. S. 1890;	2952.4	Cc. or	100	fℨ	U. S. 1870.
100 ounces av.	"	"		2834.9	"	= 95.94	"	"	2691.1	"	91.15	"	"
100 Gm.	"	"		100.0	"	= 3.38	"	"	95.15	"	3.22	"	"

It will be observed that 100 ounces avoirdupois of a drug will practically make 6 pints or 96 fluidounces of fluid extract, the actual difference as compared with the pharmacopœial requirements being about half a fluidrachm; or for 20 fluidounces of the present fluid extracts only 19 troyounces, not 20 of drug will be required.

The liquid extracts of former pharmacopœias of Continental Europe, which are still occasionally described under their older official title, *Mellago*, were solutions of extracts in water, made in proportions of 3, or sometimes 2, parts of the former to 1 of the latter; they can be kept unaltered for a short time only, and are best prepared extemporaneously. The liquid extracts of the British Pharmacopœia are of the same strength as those of the U. S. P. (1 oz. avoir. to 1 fl. oz. Imperial), except that of male fern, which is an oleoresin, and those of cinchona, glycyrrhiza, opium, and pareira.

For the first time in the history of German pharmacy fluid extracts have been granted official recognition; the Germ. Pharm. of 1890 gives directions for preparing 4 fluid extracts (condurango, frangula, ergota, hydrastis) by a plan almost identical with the general directions laid down in the U. S. Ph. The strength of the G. Ph. fluid extracts is weight for weight, or 100 Gm. of drug must yield 100 Gm. of finished product.

All the pharmacopœial fluid extracts are directed to be prepared by percolation, and, as with the extracts, a menstruum uniform in alcoholic strength is employed during the process of exhaustion. This statement requires to be qualified in this, that when glycerin is used with the first portion of the menstruum percolation is continued and finished with the same alcoholic liquid, but not mixed with glycerin. As has been customary for these preparations, a portion of the strongest percolate is reserved and the weaker percolate is directed to be evaporated to a soft extract, which is dissolved in the reserved portion, the requisite measure being made up with the initial menstruum containing no glycerin. By evaporating the weak tincture to a soft extract most of the water is also expelled, and the comparatively small portion remaining with the extract will occasion but a slight change in the menstruum of the reserved portion, this menstruum being at the same time the most suitable for dissolving the extractive matter, and its alcoholic strength being not changed by the subsequent addition of some of the original menstruum. Special authority is given by the Pharmacopœia to employ, where it may be applicable, the process of re-percolation, described below, without change of the initial menstruum.

For the pharmacopœial extract and fluid extract of the same drug the menstruum is usually alike. The exceptions are aconite, arnica root, colchicum root, cinchona, gentian, krameria, and quassia; in the first named alcohol and water are used in place of alcohol, in arnica root a mixture of 3 volumes alcohol and 1 volume water in place of diluted alcohol; in colchicum root alcohol and water take the place of water and acetic acid; in cinchona glycerin is used in place of water to insure stability of the fluid preparation, and in the three last named a hydro-alcoholic menstruum is necessary to prevent fermentation.

The menstruum for exhausting the drugs is as follows:

Alcohol for Pulvis aromaticus, Buchu, Calamus, Cannabis indica, Capsicum, Cimicifuga, Cubeba, Cusso, Gelsemium, Grindelia, Iris, Lupulinum, Mezereum, Sabina, Veratrum viride, Xanthoxylum, Zingiber.

Alcohol 4 *volumes*, *water* 1 *volume*, for Belladonnæ radix, Eriodictyon, Podophyllum, Rheum, Serpentaria.

Alcohol 3 *volumes*, *water* 1 *volume*, for Aconitum, Arnicæ radix, Calumba, Eucalyptus, Guarana, Ipecacuanha, Leptandra, Matico, Nux vomica (with acetic acid), Sanguinaria (with acetic acid), Scilla, Stramonii semen, Valeriana, Viburnum opulus, Viburnum prunifolium.

Alcohol 2 *volumes*, *water* 1 *volume*, for Aurantii Amari cortex, Chirata, Colchici radix, Colchici semen, Digitalis, Hyoscyamus, Menispermum, Phytolaccæ radix.

Diluted Alcohol, for Asclepias, Chimaphila, Coca, Conium (with acetic acid), Convallaria, Cypripedium, Dulcamara, Ergota (with acetic acid), Eupatorium, Gentiana, Lappa, Lobelia, Pilocarpus, Rhamnus Purshiana, Rumex, Scoparius, Scutellaria, Senna, Spigelia, Stillingia, Taraxacum.

Alcohol 5 *volumes*, *water* 8 *volumes*, for Frangula.

Alcohol 1 *volume*, *water* 2 *volumes*, for Quassia, Sarsaparilla.

Alcohol 4 *volumes*, *glycerin* 1 *volume*, *followed by alcohol* 4 *volumes*, *water* 1 *volume*, for Cinchona Calisaya.

Alcohol 3 *volumes*, *glycerin* 1 *volume*, *followed by alcohol*, for Gossypium.

Alcohol 72 *volumes*, *water* 18 *volumes*, *glycerin* 10 *volumes*, for Pareira.

Alcohol 65 *volumes*, *water* 25 *volumes*, *glycerin* 10 *volumes*, for Apocynum.

Alcohol 6 *volumes*, *water* 3 *volumes*, *glycerin* 1 *volume*, for Aspidosperma, Hydrastis, Rubus.

Diluted Alcohol 9 *volumes*, *glycerin* 1 *volume*, for Geranium, Krameria, Rhus glabra, Rosa gallica.

Alcohol 5 *volumes*, *water* 8 *volumes*, *glycerin* 1 *volume*, for Hamamelis.

Alcohol 3 *volumes*, *water* 6 *volumes*, *glycerin* 1 *volume*, for Sarsaparilla (compound fld. ext.).

Alcohol 2 *volumes*, *water* 5 *volumes*, *glycerin* 3 *volumes*, for Uva Ursi.

Alcohol 75 *volumes*, *water* 20 *volumes*, *ammonia-water* 5 *volumes*, for Senega.

Alcohol 30 *volumes*, *water* 65 *volumes*, *ammonia-water* 5 *volumes*, for Glycyrrhiza.

Water 2 *volumes*, *glycerin* 1 *volume*, *followed by alcohol* 85 *volumes*, *water* 15 *volumes*, for Prunus Virginiana.

Boiling water for Triticum. Finished product contains about 25 per cent. by volume of alcohol.

Boiling water followed by cold water, for Castanea. Finished product contains 10 per cent. by volume of glycerin and about 20 per cent. by volume of alcohol.

For some time past experiments have been going on in the hands of manufacturers and others with a view of introducing acetic acid, in place of alcoholic and hydro-alcoholic menstrua, in the preparation of fluid and solid extracts. Results thus far published indicate that 60 per cent. acetic acid is admirably suited for the exhaustion of certain drugs, particularly those owing their virtue to alkaloidal, aromatic, and even resinous principles, less menstruum, as a rule, also being required for complete exhaustion. The fact, however, that acetic-acid menstruum has been found to cause an increase in the percentage of extractive rather shows that, in some instances at least, an increased amount of inert matter is dissolved by the more aqueous menstruum, since practically no increase in percentage of alkaloid or active resinous matter has been observed: this would appear to be a drawback to the use of the acid aqueous menstruum; besides which, the presence of a considerable quantity of acetic acid in the finished fluid extracts might be objected to by physicians from a therapeutical standpoint. In a few cases, notably of alkaloidal and oleoresinous as well as the purely aromatic drugs, superior preparations have been obtained with acetic-acid menstruum, and the finished fluid extracts possessed a finer aroma than those made with the official menstruum. The U. S. Pharmacopœia has recognized the value of acetic acid as a solvent in the manufacture of fluid extracts by directing its use, at least in part, in the case of nux vomica and sanguinaria; no doubt continued favorable results will cause the displacement of alcohol by acetic acid for a larger number of drugs.

Preparation.—Fineness of Powder. (For remarks on powdering consult the article Pulveres.) "The fineness of powder is expressed in the Pharmacopœia either by descriptive words (generally so in the case of brittle or easily pulverizable substances) or in terms expressing the number of meshes to a linear inch in the sieve through which the powder will pass. These different forms of expression correspond to each other as follows:

A *very fine* powder	should pass through a sieve having 80 or more meshes to the linear inch.	= No. 80 powder.
A *fine* powder	should pass through a sieve having 60 meshes to the linear inch.	= No. 60 powder.
A *moderately fine* powder	should pass through a sieve having 50 meshes to the linear inch.	= No. 50 powder.
A *moderately coarse* powder	should pass through a sieve having 40 meshes to the linear inch.	= No. 40 powder.
A *coarse* powder	should pass through a sieve having 20 meshes to the linear inch.	= No. 20 powder

"In certain cases powders of a different degree of fineness (*e. g.* No. 30, No. 12) are directed to be taken. When a substance is directed to be in a limited degree of fineness, as specified by the number of meshes to the linear inch in the sieve, not more than one-fourth of the powder should be able to pass through a sieve having ten meshes more to the linear inch."—*U. S.*

Percolation.—"The process of percolation, or displacement, directed in the Phar-

macopœia, consists in subjecting a substance or a mixture of substances, in powder, contained in a vessel called a percolator, to the solvent action of successive portions of a certain menstruum in such a manner that the liquid, as it traverses the powder in its descent to the recipient, shall be charged with the soluble portion of it, and pass from the percolator free from insoluble matter.

"When the process is successfully conducted, the first portion of the liquid or percolate passing through the percolator will be nearly saturated with the soluble constituents of the substance treated; and if the quantity of menstruum be sufficient for its exhaustion, the last portion of the percolate will be destitute of color, odor, and taste other than that possessed by the menstruum itself.

"The percolator most suitable for the quantities contemplated by the Pharmacopœia should be nearly cylindrical or slightly conical, with a funnel-shaped termination at the smaller end. The neck of this funnel end should be rather short, and should gradually and regularly become narrower toward the orifice, so that a perforated cork, bearing a short glass tube, may be tightly wedged into it from within until the end of the cork is flush with its outer edge. The glass tube, which must not protrude above the inner surface of the cork, should extend from 3 to 4 Cm. beyond the outer surface of the cork, and should be provided with a closely-fitting rubber tube at least one-fourth longer than the percolator itself, and ending in another short glass tube, whereby the rubber tube may be so suspended that its orifice shall be above the surface of the menstruum in the percolator, a rubber band holding it in position.

"The dimensions of such a percolator, conveniently holding 500 Gm. of powdered material, are preferably the following: Length of body, 36 Cm.; length of neck, 5 Cm.; internal diameter at top, 10 Cm.; internal diameter at beginning of funnel-shaped end, 6.5 Cm.; internal diameter of neck, 12 Mm., gradually reduced at the end to 10 Mm. It is best constructed of glass, but, unless so directed, may be made of a different material.

"The percolator is prepared for percolation by gently pressing a small tuft of cotton into the space of the neck above the cork, and a small layer of clean and dry sand is then poured upon the surface of the cotton to hold it in place.

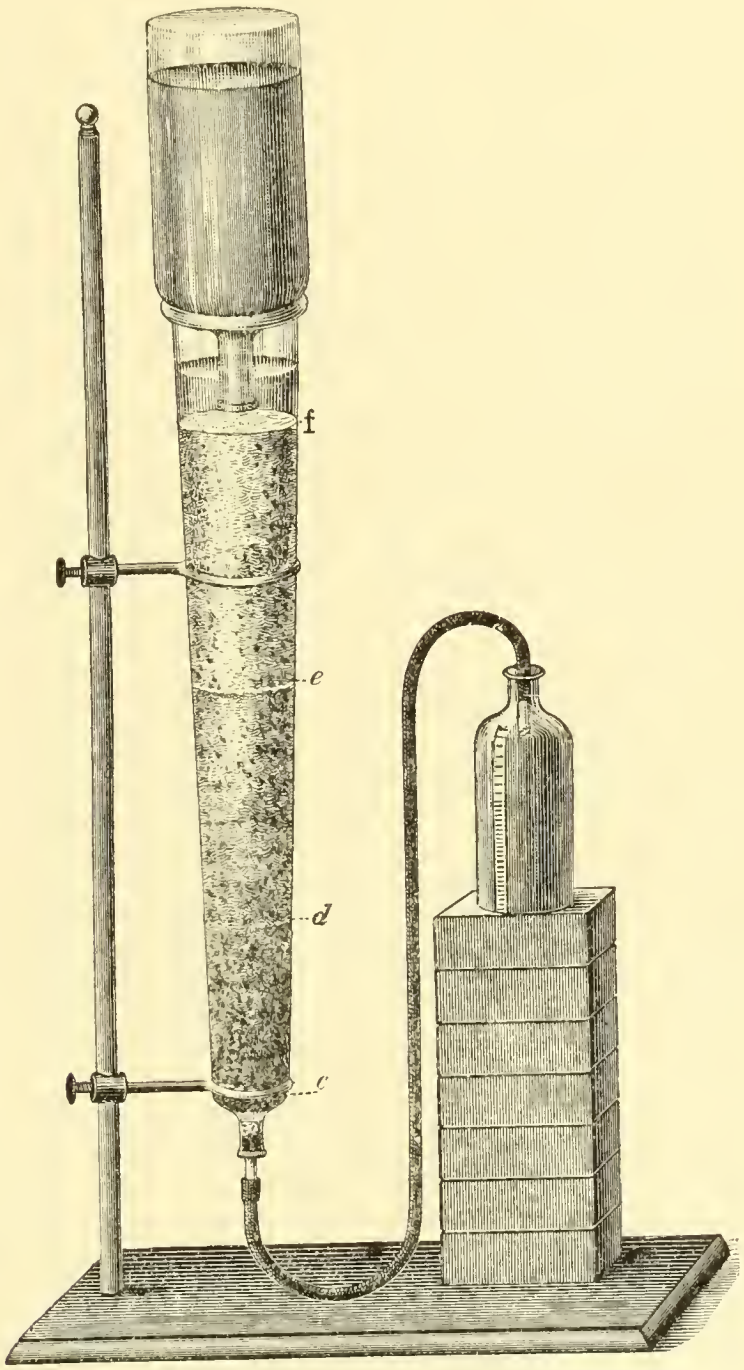
"The powdered substance to be percolated (which must be uniformly of the fineness directed in the formula, and should be perfectly air-dry before it is weighed) is put into a basin, the specified quantity of menstruum is poured on, and it is thoroughly stirred with a spatula or other suitable instrument until it appears uniformly moistened. The moist powder is then passed through a coarse sieve—No. 40 powders and those which are finer requiring a No. 20 sieve, whilst No. 30 powders require a No. 15 sieve for this purpose. Powders of a less degree of fineness usually do not require this additional treatment after the moistening. The moist powder is now transferred to a sheet of thick paper, and the whole quantity poured from it into the percolator. It is then shaken down lightly, and allowed to remain in that condition for a period varying from fifteen minutes to several hours, unless otherwise directed; after which the powder is pressed, by the aid of a plunger of suitable dimensions, more or less firmly in proportion to the character of the powdered substance and the alcoholic strength of the menstruum; strongly alcoholic menstrua, as a rule, permitting firmer packing of the powder than the weaker. The percolator is now placed in position for percolation, and, the rubber tube having been fastened at a suitable height, the surface of the powder is covered by an accurately fitting disk of filtering-paper or other suitable material, and a sufficient quantity of the menstruum poured on through a funnel reaching nearly to the surface of the paper. If these conditions are accurately observed, the menstruum will penetrate the powder equally until it has passed into the rubber tube, and has reached in this a height corresponding to its level in the percolator, which is now closely covered to prevent evaporation. The apparatus is then allowed to stand at rest for the time specified in the formula.

"To begin percolation, the rubber tube is lowered and its glass end introduced into the neck of the bottle previously marked for the quantity of liquid to be percolated if the percolate is to be measured, or of a tared bottle if the percolate is to be weighed; and by raising or lowering this recipient the rapidity of percolation may be increased or lessened as may be desirable, observing, however, that the rate of percolation, unless the quantity of material taken in operation is largely in excess of the pharmacopœial quantities, shall not exceed the limit of ten to thirty drops in a minute. A layer of menstruum must constantly be maintained above the powder, so as to prevent the access of air to its interstices, until all has been added or the requisite quantity of percolate has been obtained. This is conveniently accomplished, if the space above the powder will admit of it, by

inverting a bottle containing the entire quantity of menstruum over the percolator in such a manner that its mouth may dip beneath the surface of the liquid, the bottle being of such a shape that its shoulder will serve as a cover for the percolator.

"When the dregs of a tincture or of a similar preparation are to be subjected to percolation, after maceration, with all or with the greater portion of the menstruum the liquid portion should be drained off as completely as possible, the solid portion packed in a percolator, as before described, and the liquid poured on until all has passed from the surface, when immediately a sufficient quantity of the original menstruum should be poured on to displace the absorbed liquid, until the prescribed quantity has been obtained." —*U. S.*

Fig. 114.

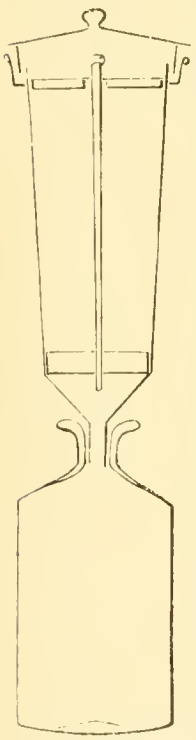


Percolation as recommended by the U. S. Pharmacopœia.

Fig. 114 shows a style of percolator admirably adapted for the manufacture of fluid and solid extracts; it illustrates the process of percolation as recommended by the U. S. Pharmacopœia. The principle involved is almost identical with that of the well-tube or syphon percolators introduced some years ago. The liquid is made to traverse a long column of moistened drug, thus insuring more thorough exhaustion of the soluble matter with less menstruum; every particle of the mass can be kept at uniform pressure during maceration by reason of the column of fluid in the tube on the outside of the percolator and the rate of flow is completely under control of the operator.

Although, with proper management, good results may be obtained in the preparation of extracts and fluid extracts by using a funnel-shaped (usually termed *a conical*) percolator for exhausting the powder, experience has demonstrated that the so-called *cylindrical* percolator is to be preferred, having the shape described above, which represents the section of a long cone, and this is terminated below either by a funnel or by a shorter cone. The relative proportion of *diameter to height* of powder is of importance, since it is evident that with an increase of the latter the same fraction of menstruum must come into contact with a larger number of particles of the powder. Its height should be four or five times greater than its mean diameter. The *cover* of the percolator should not fit air-tight, or, if from the volatility of the menstruum, this should be desirable, a communication should be established by means of a glass tube between the receiving vessel and the top of the percolator for the equalization of pressure. Gum-cloth furnishes a convenient material for an ordinary cover.

Fig. 115.



Tin Percolator, arranged for volatile liquids.

In conducting a series of experiments on percolation Dr. Squibb (1866) proved, first, that there is a sufficient degree of uniformity of results to admit of the adoption of a model plan of proceeding applicable to drugs in general; second, that the extract or soluble matter yielded to the menstruum is not uniform in its chemical and therapeutical value as obtained during the different stages of the percolation, but diminishes in effective value far more rapidly than the extract does in weight; and third, that this decrease in value depends upon the difference in solubility between the active and inactive portions of the extract, and that the ratio of this decrease is about the same for drugs in general, provided the proper menstruum be used. Critical experiments made with seven different drugs proved that the first 12 fluidounces of the percolate contained from 61 to 78 per cent. of the total extract obtainable from 16 troyounces of a drug with 3 or 4 pints of percolate, as directed by the Pharmacopœia of 1860, and that the first 16 fluidounces contained from 71 to 84 per cent. of the total amount of extract. Subsequently (1869), Samuel Campbell showed that some drugs may be practically exhausted by careful management on obtaining 1 fluidounce for every troyounce of the drug used. This principle, however, is applicable to those drugs only which are rather heavy, and at the same time are readily permeated by a menstruum in which the active principles are easily and freely soluble, so that complete exhaustion is attained without difficulty. The U. S. P. 1870 directed in most cases 24 fluidounces of percolate for 16 troyounces of drug, and regarded the latter then as practically exhausted. The present Pharmacopœia directs displacement to be continued until the drug is exhausted—a point which may be reached by careful manipulation without requiring finally long-continued evaporation. But while for fluid extracts the *exhaustion* of the material is mostly left to the good judgment of the pharmacist, definite quantities of percolate are usually directed for the extracts—sufficient to exhaust the material completely. In the light of the experience cited above it would seem that this might likewise have been left to the judgment of the experienced operator.

When the active principles possess a decided taste their gradual diminution in the percolate is easily ascertained; in other cases recourse may be had to chemical tests, especially in the presence of alkaloids. The color of the percolate alone is no reliable criterion for its medicinal strength, some drugs continuing to yield colored percolates after the active principles have been exhausted, while others still yield appreciable quantities of the latter after most of the coloring matter has been taken up. The strength of extracts and fluid extracts depends solely on the amount of the active principles, and not on the total amount of extractive matter, obtained.

For *moistening* the powder a definite quantity of menstruum is now directed which experience has shown to be most suitable; generally, this quantity is greater than was formerly thought desirable. The manner of *packing* described is the most convenient, the pressing of the whole amount of the powder in one operation giving better and more uniform results in the hands of most operators than if done in fractions. Ligneous material requires to be very firmly packed, and when of more loose cellular structure the packing should be less firm, but in all cases it should be uniform. Again, when an alcoholic menstruum is used the packing must be correspondingly firmer as the menstruum is stronger in alcohol. When well packed, a disk of paper or muslin is spread upon the surface and the requisite menstruum poured upon it. Thus arranged, the material is

permitted to macerate for 2 days, both orifices of the percolator being securely closed to prevent evaporation. The time directed for maceration is ample, but may be prolonged to 3 or 4 days without disadvantage, or for easily-exhausted drugs even shortened. It is to be observed that the powder is to remain constantly covered by a stratum of the menstruum; this precaution is of imperative necessity until the powder has been deprived of the greater proportion of its active principles, and the liquid in the percolator may be more than sufficient to displace the solution of the remainder.

After the exhaustion of the powder has been accomplished the absorbed alcohol may be recovered by distillation with steam, or, when this is impracticable, it may be obtained by percolation with a weaker alcohol, the alcoholic strength being gradually reduced until finally water is used for pushing the last portions of the percolate through. The more mucilaginous the material is, the greater the caution which should be exercised in this decrease of the alcoholic strength. The alcohol thus obtained requires to be rectified, and may usually be deprived of its foreign odor by distillation with a small quantity of potassium permanganate.

Re-percolation—or, as it has been called by Prof. Diehl, *fractional percolation*—is a process recommended by Dr. Squibb in 1866, and was more recently somewhat modified with the view of obtaining more uniform results, the object being preparation of fluid extracts without the use of heat. The process may be briefly described as follows: 32 parts of powder are divided into four equal portions, one of which is moistened, packed, macerated, and then slowly displaced until exhausted. The percolate is collected in fractions, the first 6 parts being reserved, and the next fraction used for moistening the second portion of 8 parts of the powder, which is afterward macerated and displaced with the remaining fractions, the weakest being used last. Of this portion 8 parts of percolate are reserved. The third and fourth portion of 8 parts each of the powder are percolated in the same manner as the second portion, and, finally, the 4 reserved percolates are mixed to obtain 30 parts of fluid extract. The weaker percolates from the fourth portion are preserved for a subsequent operation, when from each portion of 8 parts of powder 8 parts of percolate are reserved. (See paper on "Fluid Extracts by Re-percolation" by Dr. Squibb, and "Report on Fluid Extracts" by Prof. Diehl, in *Proc. Am. Phar. Assoc.*, 1878.)

While the process of *fractional percolation* possesses the advantage of yielding a perfect fluid extract without the use of heat, and consequently avoids any possible injury from this source, it also carries with it the disadvantage of necessitating the keeping of a series of weak percolates, properly numbered and labelled, to be used for the same drug at a subsequent operation, in the order in which they have been collected. The process can be made practically continuous, each fraction of reserve tincture being in itself a finished fluid extract.

Sectional percolation is a modification of this process proposed by William M. Thomson (1883). The percolator is an elongated cone, which may be taken apart in sections, each section forming a percolator, ending below with a perforated diaphragm of the same diameter as that of the top portion of the next section; the powder to be exhausted is packed in the different sections, and the liquid, percolating through from above, as it leaves one section is again uniformly distributed over the powder contained in the next.

Another process for the preparation of fluid extracts without the use of heat deserves a passing notice, since from the employment of a very powerful press it is perhaps better adapted for the manufacturer than for the pharmacist. It was devised by N. S. Thomas (1865), and consists in moistening the ground drug with a portion of the menstruum, and after sufficient maceration expressing the liquid. The operation of maceration and expressing is repeated several times until the proper quantity of fluid extract is obtained. A very efficient press, serviceable for this purpose and for other pharmaceutical preparations, has been constructed by Mr. Charles T. George (*Proc. Penna. Phar. Assoc.*, 1878).

Fig. 116.

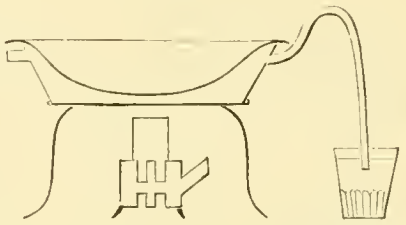
Réal's Filter-press.

Percolation under Pressure.—The first notice of percolation under pressure was given by Count Réal (*Jour. de Phar.*, 1816, April), who constructed an apparatus known as *Réal's solution-press or filter-press*, and which consisted in a tin percolator surmounted by a tube which could be made 15 M. (50 feet) or more in length; after the fine, previously-moistened powder has absorbed all the menstruum provided for its exhaustion, the tube was filled with water, and the menstruum absorbed by the powder was thus forced out by hydrostatic pressure. The incon-

venience of the long water-tube suggested its replacement by a column of mercury, which, communicating with a reservoir, forced the water through the powder. Semmelbauer (*Buchner's Reportorium*, 1817, iii.) already conceived the idea of using compressed air for the same purpose, and a suitable apparatus for this purpose was constructed by Dr. Romershausen, and is described in *Buchn. Repert.*, 1819, vi. p. 316. The process was subsequently applied by Boullay (*Jour. de Phar.*, 1833, June) to displacement under the pressure of a low column of liquid, as in the percolators at present in use. The necessity of saturating the powder with the menstruum without rendering it adhesive, and of firmly compressing the moistened powder, was early recognized as essential conditions for success. The same principle of percolating under pressure applies to the apparatuses more recently constructed by Duffield, Stearns, and others, in which the air in the receiver may be rarified and that contained in the percolator above the powder may be compressed. The pressure percolators introduced by Rosenwasser, Berry, Anderson, and Suit during the past twelve years closely resemble Réal's press, with this addition, that the powder by a screw arrangement may be confined between perforated disks in any desired space, without the possibility of expansion on coming in contact with the bulk of the menstruum percolating; the percolators are made of tin or heavily-tinned copper and glass. One of the chief claims for pressure percolation is the complete exhaustion of the drug with less menstruum than by ordinary methods.

Evaporation.—Spontaneous evaporation at ordinary temperatures of the atmosphere is easily accomplished with ethereal and similar volatile liquids, but alcoholic tinctures, in order to avoid a too-prolonged contact with air, require a somewhat elevated temperature, that directed by the Pharmacopœia being usually about 50° C. (122° F.). Where a higher temperature exerts no injurious influence upon the important constituents, a *water-bath* is most convenient for the purpose; and since the evaporating liquid will always remain several degrees below the boiling-point of water, even though the water in the bath may be actively boiling, empyreuma is effectually prevented. *Steam-baths* will likewise be useful, provided the arrangements are such that the pressure of steam cannot, or only slightly, exceed that of the atmosphere. *Sand-baths* and other contrivances by which the temper-

Fig. 117.



Water-baths.

Fig. 118.

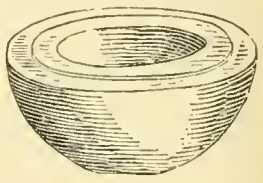
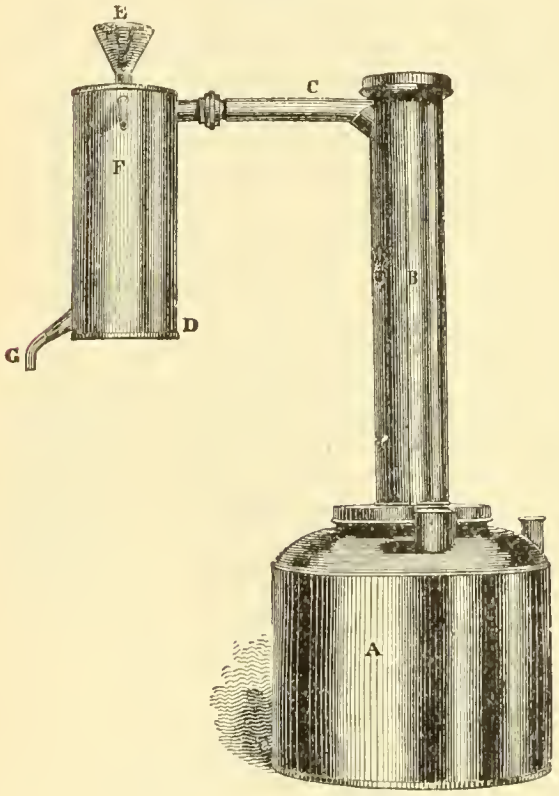
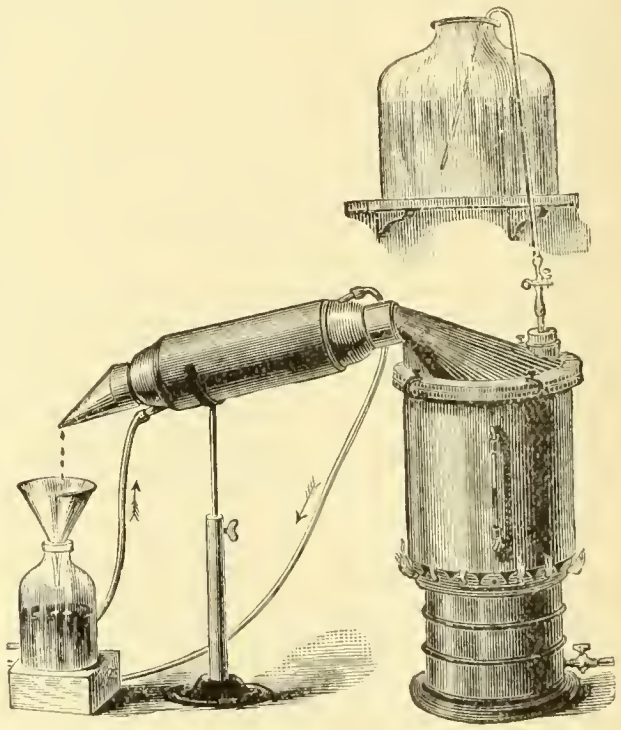


Fig. 119.



The Prentiss Alcohol Reclaimer.

Fig. 120.



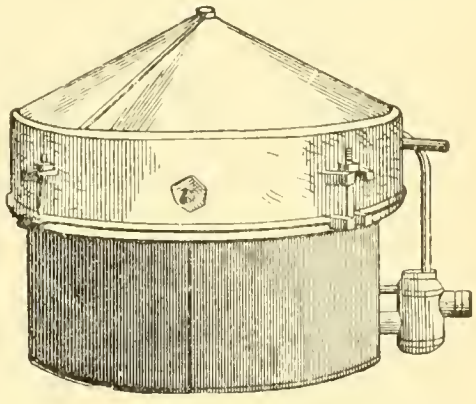
The Remington Still.

ature is likely to rise above 100° C. (212° F.) should be used only with due precautions. Evaporation is most successful if conducted from a shallow dish, with a current of dry air passing over the surface of the liquid, which may at the same time be agitated; but the use of metallic spatulas for stirring during evaporation is generally inadmissible: the proper material is porcelain or wood. Various mechanical contrivances have been constructed with the view of saving the manual labor and constant attendance in stirring, and they serve a good purpose.

In evaporating a tincture the alcohol will be lost unless provision is made for recondensing the vapor by means of a distillatory apparatus.

For the recovery of alcohol in the concentration of weak percolates or from the dregs remaining in the percolator a variety of pharmaceutical stills have been designed. Figs. 119, 120, and 121 represent the more popular styles; all three can be heated by means of a gas- or oil-stove, and in all three the liquid to be concentrated as well as the alcoholic vapor is not allowed to come in contact with any metal but tin. The "Prentiss Alcohol Reclaimer," Fig. 119, is easily operated, condensation of the alcoholic vapor is well-nigh complete, and the still is specially adapted for smaller operations. The "Remmington Still," Fig. 120, combines the united condensing power of a series of tubes within one refrigerator, and by the peculiar shape of the head or dome recondensation of the vapor in the body of the still is reduced to a minimum. The main features of the "Anderson Still," Fig. 121, are the use of a broad, shallow dish from which the alcoholic vapors will rise speedily, owing to the large extent of surface exposed, and, furthermore, the automatic supply of partially warmed water from the condensing surface to the water-bath, thus obviating the necessity of replenishing the boiler from time to time with cold water in larger operations whereby loss of time would be incurred.

Fig. 121.



The Anderson Automatic Still.

In 1889 the plan of concentrating large volumes of aqueous solutions of extracts by means of cold was formulated by M. Adrian, and put into practice on a large scale. Following up the suggestions of Herrera (1877), M. Adrian subjects the filtered aqueous solutions to a temperature of —20° C. (—4° F.) in an ammonia-ice apparatus, and thus obtains large blocks of ice, in which the extractive solution is enveloped, the pure water alone freezing; these blocks of ice are rapidly converted into snow by means of large shaving machines. Another French pharmacist, M. Vée, prefers to convert the aqueous solution into a crystalline magma instead of solid blocks of ice, and accomplishes this by keeping the liquid in constant agitation during the freezing process. The snow-like mass is placed in centrifugal extractors, where about 75 per cent. of water is removed. The remaining solution is again subjected to cold (even a lower temperature than at first), when a syrupy liquid is obtained which can readily be evaporated to a solid extract in a vacuum apparatus at a temperature not exceeding 30° C. (86° F.). Extracts thus prepared are lighter in color than those obtained by ordinary vacuum or open-air evaporation, form almost clear solutions with water, and possess the odor and taste of the drug in a marked degree. It has been found that all vegetable matter in solution is retained in its original condition, even the albumen, water alone being removed.

There can be no doubt that this plan of concentration by freezing will yet meet with more extended application in pharmacy, as it has already done in the arts.

In many processes carried on in the arts *vacuum-stills* are used for the evaporation of liquids, the boiling-point of which is lowered in proportion as the pressure within the apparatus is reduced to below that of the surrounding atmosphere. For operations on a small scale, and quite suitable for the requirements of the pharmacist, the *water-air-pump* described by Dr. Sprengel in 1865, and known also as Bunsen's water-air-pump, may be used with advantage. It is simply water descending in a perpendicular tube which laterally communicates with the interior of the otherwise hermetically-closed vessel containing the liquid to be evaporated; the descending column of water creates suction, the air in the apparatus being carried down with the water, and thus causes a partial vacuum, in which the liquid evaporates at a low temperature. The apparatus is well adapted for rapid filtration, washing of precipitates, evaporation, etc., but provision may also be made for condensing the vapors and recovering the menstruum.

Changes by Evaporation.—All plants contain one or more principles, which, though originally colorless, are very easily altered under the influence of air and heat, acquiring a yellow or brown color. It is not known whether the so-called *colorless extractive* is alike in all plants, nor is its composition known or the nature of changes produced under the conditions mentioned, except that the heat of boiling water and the prolonged action of oxygen will convert it ultimately into a blackish insoluble substance, to which the name *apotheme* has been given, and which appears to be allied to *humin*. Extractive is almost insoluble in in absolute alcohol and ether, but dissolves freely in weaker alcohol and water, and is removed from its solution by animal charcoal and aluminum hydroxide, the more readily after it has become colored by oxidation. It is with difficulty freed from all admixtures, and the terms sweet, bitter, acrid, etc. extractives refer to the same body in a more or less altered condition, combined or intimately mixed with other principles to which the peculiar taste is due. The injurious influence of air and heat upon the vegetable juices is mainly confined to the alterations of this extractive, and extends in a limited degree only to the majority of the well-defined principles. Its effects have often been much overrated, except as regards the appearance of the extracts. The color of the different extracts and fluid extracts varies with the nature of the drug from which they have been made, but should never be black. Fluid extracts should preserve the taste and also the odor of the drug, except in so far as both may be modified by the menstruum. The characteristic taste, and to some extent also the odor, of the drug should be perceived in the extracts, and these should yield a nearly clear or moderately turbid solution with the menstruum used in their preparation. Not to come up to these requirements is indicative of carelessness, and the presence of empyreumatic products proves the operation to have been slovenly.

Consistence of Extracts.—The Pharmacopœia recognizes two degrees of consistence—namely, 1, pilular consistence (25 extracts); 2, dry (7 extracts). These degrees are practically the same as those adopted by the German Pharmacopœia, but designated as—1, thin extracts, of the thickness of fresh honey (mostly oleoresins); 2, thick extracts, which when cold cannot be poured from a vessel; and 3, dry extracts, which may be rubbed to powder. A pilular consistence is practically unattainable for most extracts unless some dry substance is added, like the chlorophyll to the inspissated juices of the British Pharmacopœia. The nearest degree of consistence attainable with some extracts is such that they may be formed into pills, which, however, do not retain their globular shape. Others, like Extr. gentianæ, taraxaci, etc., are even too soft for that purpose, while some, like Extr. rhei, etc., gradually become quite tough or hard. The addition of 10 per cent. of glycerin to some extracts is intended to preserve the proper consistence. Extracts which do not contain any fixed oil or hygroscopic constituents may usually be reduced to powder when sufficiently evaporated and cooled. On being warmed all extracts become softer, and, if pulverulent at the ordinary temperature, acquire sufficient pliability to be rolled into pills.

Of late years powdered extracts have come very much into demand, and are supplied by nearly all manufacturers: while their convenience in dispensing pharmacy cannot be denied, it is questionable whether damage is not done in many cases by the prolonged and high heat necessary to bring the pilular extract to the proper condition for powdering, even with the addition of diluents. Some extracts, such as colocynth, krameria, nux vomica, and opium, are readily brought to the state of powder as directed by the Pharmacopœia, whilst in other cases it is difficult to see how drug-millers can succeed in producing such fine powders, apparently not very hygroscopic (if at all), unless high heat and large proportions of diluent powder be employed.

According to P. W. Squire and M. Conroy, calcined magnesia is the most desirable absorbent to use in making powdered extracts: it should be mixed with the soft extract, which is then evaporated to dryness and powdered. About 10 per cent. of magnesia will be found sufficient in most cases.

The *abstracts* of the Pharmacopœia of 1880, which have been dropped from the present edition, were powdered extracts, but bore no simple relation to the extracts proper; they were intended to replace the more bulky powder of the crude drug from which they were made, and in strength corresponded to twice their weight of the drug. Eleven abstracts were recognized in the last Pharmacopœia: Aconite, belladonna, conium, digitalis, hyoscyamus, ignatia, jalap, nux vomica, podophyllum, senega, and valerian. The general plan for preparing them was to make a fluid extract of the drug with alcohol, mix this with some sugar of milk, dry by spontaneous evaporation in a warm place, then

add sufficient sugar of milk to bring the product up to one-half the weight of the powdered drug used, and finally reduce to a fine powder.

The *powdered* or *dry narcotic extracts*, P. G., are identical with those of the Prussian Pharmacopœia of 1862, and are prepared by mixing 4 parts of the extract with 3 parts of finely-powdered liquorice-root, drying the mixture between 40° and 50° C. (104° and 122° F.), rubbing the residue to powder while warm, and adding sufficient powdered liquorice-root to make 8 parts. These are made for convenience in dispensing only, but, while they are well adapted for being added to powders, they cannot be used in mixtures, owing to their partial insolubility. The use of dextrin in place of liquorice-root, prescribed by the P. G. 1872, has been abandoned, most of the powders thus prepared being too hygroscopic.

Preservation.—The consistence of *extracts* nearly neutralizes any injurious effect which contact with the atmosphere might otherwise exert, and the most ordinary care will therefore suffice to keep them unaltered for a considerable time. The sprinkling upon the softer extracts of a small quantity of alcohol has been recommended, but this is entirely unnecessary for those which are to some degree hygroscopic, and of little permanent utility for those which have a tendency to become tough. The difficulty may generally be avoided by spreading a few drops of glycerin over the surface, or, as has been proposed, by working into the warm extract half its weight of glycerin and dispensing 50 per cent. more than prescribed. The plan adopted by the U. S. P. is that of W. J. M. Gordon (1864), 10 per cent. of glycerin being added to extracts to keep them soft and prevent mouldiness.

FIG. 122.

Jar in tin box.

The ordinary extracts are kept in jars of queensware, or, preferably, of porcelain or glass, with a cover of the same material. Small quantities may be kept in wide-mouthed vials with a very narrow shoulder, or in an ordinary tie-over jar enclosed in a tin-box just large enough to receive it and provided with a well-fitting cover to prevent absorption of moisture from the atmosphere or evaporation of the water contained in the extract. Extracts are rarely liable to mould unless they contain a considerable proportion of mucilaginous principles, and such are nearly always adapted to be brought to a dry condition. Dry extracts are in most cases preferably reduced to a granular or rather coarse powder. Extracts which have become too soft should be evaporated to the proper consistence by means of a water-bath, and those having become hard and unmanageable should be softened by the heat of a water-bath, when the requisite quantity of distilled water may be incorporated to bring them to the proper consistence.

For the preservation of *fluid extracts* the same precautions are required as for the preservation of most other liquid medicines. The bottles in which they are kept should be provided with a well-ground glass stopper or with a sound cork to prevent the slow evaporation of alcohol, which would occasion a change in the solvent power of the menstruum; and they should be placed in a position where they are exposed neither to the direct sunlight nor to any great or sudden changes in temperature. It should be remembered that perhaps all fluid extracts are saturated solutions of some of the principles naturally contained in the drug, and that their re-solution in the fluid extract from which they may have deposited in the cold can be effected only very gradually at the same temperature at which they previously existed in perfect solution.

Variation.—By Mohr's process (see p. 636) for inspissated narcotic juices a number of inert principles are excluded from the extracts; the use of one menstruum in the preparation of extracts from dry drugs excludes many inert constituents. While it is known that drugs may vary in their medicinal activity within rather considerable limits, few or no analytical researches have been made as to the variation of the extracts prepared from such varying material by a uniform process. In the near future the progress of science will most likely require a standardizing of these preparations, as it has been already deemed necessary for two of the more important ones.

25 av. ounces of drug will yield 24 fluidounces of fluid extract, practically corresponding to the official strength, as stated before.

Fluid extracts, if properly made, will fairly represent the drugs, and necessarily must vary to some extent in their efficacy; but the variation should be only within the limits of the variation which is unavoidable in the crude material.

EXTRACTUM ACONITI, *U. S.*—Extract of Aconite.

Extractum aconiti radicis.—Extract of aconite-root, E.; *Extrait de racine d'aconit*, Fr.; *Akonitknollen-Extrakt*, G.; *Estratto di aconito*, Sp., It.

Preparation.—Aconite, in No. 60 powder, 1000 Gm.; Alcohol, a sufficient quantity. Moisten the powder with 400 Cc. of alcohol, and pack it firmly in a cylindrical glass percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until 3000 Cc. of tincture are obtained, or the aconite is exhausted. Reserve the first 900 Cc. of the percolate, evaporate the remainder in a porcelain capsule at a temperature not exceeding 50° C. (122° F.), to 100 Cc., add the reserved portion, and evaporate at or below the above-mentioned temperature until an extract of a pilular consistence remains.

When operating upon 1 pound of aconite, the same should be moistened with 6 fluidounces of alcohol, and of the 3 pints of percolate to be obtained the first 15 fluidounces should be set aside as the reserve tincture, which is to be added to the remainder after the latter has been evaporated to about 1½ fluidounces.

Alcohol appears to be the most appropriate menstruum. The yield is about 20 per cent.; the color yellowish-brown. It should be remembered that this extract is from six to nine times stronger than that of aconite-leaves, still prescribed by some under *the same name;* it is therefore advisable to designate in prescriptions the pharmacopœial extract as *Extract. aconiti radicis.*

Extractum aconiti, *Br.*, is the inspissated juice of the fresh herb, and is appropriately prescribed as *Extract. aconiti herbæ.* The process, which will serve as an example of the one adopted by that authority for inspissated narcotic juices, is as follows:

Take of the fresh leaves and flowering tops of aconite 112 pounds. Bruise in a stone mortar and press out the juice; heat it gradually to 130° F., and separate the green coloring matter by a calico filter. Heat the strained liquor to 200° F. to coagulate the albumen, and again filter. Evaporate the filtrate by a water-bath to the consistence of a thin syrup; then add to it the green coloring matter previously separated, and, stirring the whole together assiduously, continue the evaporation at a temperature not exceeding 140° F. until the extract is of a suitable consistence for forming pills.—*Br.* The color is brown-green, and the extract contains the chlorophyll and mucilaginous constituents.

Uses.—This extract of aconite-root is represented to be about nine times as strong as the preparation of the leaves, which were unofficial in the Pharmacopœia of 1870. Its *dose* may be stated as Gm. 0.01–0.02 (gr. $\frac{1}{6}$–$\frac{1}{3}$). The dose of the British extract is Gm. 0.06–0.12 (gr i–ij).

EXTRACTUM ACONITI FLUIDUM, *U. S.*—Fluid Extract of Aconite.

Extractum aconiti radicis fluidum.—Fluid extract of aconite-root, E.; *Extrait liquide de racine d'aconit*, Fr.; *Flüssiges Akonitknollen Extrakt*, G.

Preparation.—Aconite, in No. 60 powder, 1000 Gm.; Alcohol, Water, each, *a sufficient quantity*, to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water, and having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical glass percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the aconite is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder, in a porcelain capsule, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of aconite should be moistened with about 10 fluidounces of the menstruum (alcohol 3 volumes, water 1 volume), and the first 22 fluidounces of the percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

The new menstruum ordered by the Pharmacopœia appears equally as well suited for the complete exhaustion of the drug as pure alcohol, directed in 1880, and tartaric acid has been entirely omitted as superfluous.

Uses.—Each minim of this preparation represents about 1 grain of aconite-root. Its commencing *dose* should not exceed Gm. 0.06 (℥j), and it is more prudent to use only half that quantity. This extract is a convenient addition to liniments intended to relieve neuralgic and rheumatic pains, which should then be applied with a brush or mop.

EXTRACTUM ALOES, *U. S., P. G.*—Extract of Aloes.

Extractum aloes socotrinæ, Extractum aloes barbadensis, Br.; *Extrait d'aloès*, Fr.; *Aloe-Extrakt*, G.; *Estratto di aloe acquosa*, It.

Preparation.—Aloes 100 Gm.; Boiling Distilled Water 1000 Cc. Mix the aloes with the water in a suitable vessel, stirring constantly, until the particles of aloes are thoroughly disintegrated, and let the mixture stand for twelve hours; then pour off the clear liquor, strain the residue, mix the liquids, and evaporate to dryness by means of a water- or steam-bath.—*U. S.*

The Br. P. process is identical with the foregoing, as also the P. G. process, except that in the latter only half as much water is used. The U. S. P. allows the extract to be made from either official variety, whereas the Br. P. specifies both, and the P. G. recognizing only *Cape aloes*, the extract is of course to be made from it. *Extractum aloes acido-sulphurico correctum* was obtained by diffusing 8 parts of the extract in 32 parts of distilled water, adding gradually 1 part of sulphuric acid and evaporating to dryness.

The object of using so large a proportion of water is to avoid the admixture of resin, for a concentrated aqueous solution of aloes retains in solution the resin present, whereas a dilute solution again deposits it on cooling. Complete separation of resinous matter is impossible, and hence the extract does not yield a perfectly clear solution with water.

The yield of dry extract varies from 20–50 per cent. according to the variety of aloes and care used in manufacture. When powdered the extract is of a yellowish-brown color. According to Tilden (1870), an efficient extract of aloes is obtained by evaporating the mother-liquor from which aloin has been deposited, but this should never be substituted for the official product.

Uses.—It may be given for the same purposes as the extract of Barbadoes or Socotrine aloes or as aloes itself, and in the same *dose*—from Gm. 0.06–0.40 (gr. j–vj).

EXTRACTUM ANTHEMIDIS, *Br.*—Extract of Chamomile.

Extractum chamomillæ Romanæ.—Extrait de camomille romaine, Fr.; *Römisch-Kamillen-Extrakt*, G.

Preparation.—Take of Chamomile-Flowers 1 pound; Oil of Chamomile 15 minims; Distilled Water 1 gallon. Boil the chamomile with the water until the volume is reduced to one-half, then strain, press, and filter. Evaporate the liquor by a water-bath until the extract is of a suitable consistence for forming pills, adding the oil of chamomile at the end of the process.—*Br.*

It is a dark-brown extract having the odor and bitter taste of chamomile. It would seem not to be very difficult to work out a better process, in which the long boiling should be avoided.

Extractum anthemidis fluidum.—Fluid extract of chamomile, *E.*—This is sometimes called for. Prof. Procter (1857) suggested exhaustion with alcohol and diluted alcohol, and after evaporation preservation by sugar. Mr. Samuel Campbell (1870) suggested a menstruum composed of 2 measures of alcohol and 1 measure each of glycerin and water.

Uses.—Like extract of gentian, it is a convenient excipient for tonic medicines given in the pilular form, especially quinia and the salts of iron. It is by itself a mild stomachic tonic. *Dose*, Gm. 0.10–0.60 (gr. ij–x).

EXTRACTUM APOCYNI FLUIDUM, *U. S.*—Fluid Extract of Apocynum.

Fluid Extract of Canadian Hemp, E.; *Extrait liquide de chanvre du Canada*, Fr.; *Flüssiges Canadisches Hanfwurzel-Extrakt*, G.

Preparation.—Apocynum, in No. 60 powder, 1000 Gm.; Glycerin 100 Cc.; Alcohol, Water, each a sufficient quantity to make 1000 Cc. Mix the glycerin with 650 Cc. of alcohol and 250 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward a mixture of alcohol and water, made in the

proportion of 650 Cc. of alcohol to 350 Cc. of water, until the apocynum is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with 10 fluidounces of the menstruum (alcohol 65 volumes, water 25 volumes, glycerin 10 volumes), and the first 22 fluidounces of the percolate set aside as reserve. The final volume of the finished product is made up to 24 fluidounces by addition of a mixture of alcohol 65 volumes and water 35 volumes.

This is one of the new pharmacopœial preparations, which has been on the market for some years. Experience has shown that the above menstruum thoroughly exhausts the drug and yields a stable fluid extract.

Uses.—This preparation represents fully the virtues of the plant from which it is derived. *Dose*, Gm. 0.3 to 1 or 2 (♏iv–xv–℥ss).

EXTRACTUM ARNICÆ RADICIS, *U. S.*—Extract of Arnica-root.

Extrait de racine d'arnique, Fr.; *Arnika Extrakt, Wohlverleih-Extrakt*, G.

Preparation.—Arnica-root, in No. 60 powder, 1000 Gm.; Diluted Alcohol, a sufficient quantity. Moisten the powder with 400 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the arnica-root is exhausted. Reserve the first 900 Cc. of the percolate; evaporate the remainder to 100 Cc. at a temperature not exceeding 50° C. (122° F.), mix the residue with the reserved portion, and evaporate at or below the above-mentioned temperature to a pilular consistence.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of diluted alcohol, and the first 22 fluidounces of the percolate set aside as reserve; the balance of the percolate should be evaporated to 2½ fluidounces before it is incorporated with the reserve portion for final evaporation to a pilular consistence.

The yield is about 25 or 30 per cent. The extract is brown, of a slight odor, and has the bitter and acrid taste of the root. Formerly extract of arnica was prepared from the flowers. A mixture of 2 parts of alcohol and 1 of water yields a better extract, although arnica-root is completely exhausted by diluted alcohol.

Dose, from Gm. 0·20–0.30 (gr. iij–v).

EXTRACTUM ARNICÆ RADICIS FLUIDUM, *U. S.*—Fluid Extract of Arnica-root.

Extrait liquide de racine d'arnique, Fr.; *Flüssiges Arnika-Extrakt*, G.

Preparation.—Arnica-root, in No. 60 powder, 1000 Gm.; Alcohol, Water, each a sufficient quantity to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the arnica-root is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of the menstruum (alcohol 3 volumes, water 1 volume), and the first 22 fluidounces of the percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

The proportion of alcohol appears unnecessarily large, as arnica-root can be thoroughly exhausted with a mixture of alcohol 2 volumes, water 1 volume, the fluid extract keeping well.

The fluid extract is of a reddish-brown color, and has the bitter and acrid taste of arnica-root.

Dose, Gm. 0.60–2 (♏x–xxx).

EXTRACTUM AROMATICUM FLUIDUM, *U. S.*—Aromatic Fluid Extract.

Extrait liquide des aromates, Fr.; *Flüssiges Gewürzextrakt*, G.

Preparation.—Aromatic Powder, 1000 Gm.; Alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 350 Cc. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until the aromatic powder is exhausted. Reserve the first 850 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the powder should be moistened with about 9 fluidounces of alcohol, and the first 21 fluidounces of the percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

This preparation is of a rich red-brown color, and has the warm aromatic taste of the powder.

Uses.—This tincture of several aromatics is convenient as a flavoring ingredient of mixtures, and may be used alone to relieve flatulent colic in the *dose* of half a teaspoonful or more (Gm. 2).

EXTRACTUM ASCLEPIADIS FLUIDUM, *U. S.*—Fluid Extract of Asclepias.

Fluid extract of pleurisy root, E.; *Extrait liquide de racine d' asclépiade tubereuse*, Fr.; *Flüssiges Knollige Schwalbenwurzel-Extrakt*, G.

Preparation.—Asclepias, in No. 60 powder, 1000 Gm.; Diluted Alcohol, a sufficient quantity, to make 1000 Cc. Moisten the powder with 400 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the asclepias is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of diluted alcohol, and the first 22 fluidounces of the percolate set aside as a reserve; the final volume of the finished product should be made up to 24 fluidounces.

Diluted alcohol seems to exhaust pleurisy-root thoroughly, and yields a stable preparation.

Uses.—This preparation is a convenient substitute for the decoction of A. tuberosa. It may be prescribed in *doses* of Gm. 1 to 4 (℥xv–℥j).

EXTRACTUM ASPIDOSPERMATIS FLUIDUM, *U. S.*—Fluid Extract of Aspidosperma.

Fluid extract of quebracho, E.; *Extrait liquide de quebracho*, Fr.; *Flüssiges Quebracho-Extrakt*, G.

Preparation.—Aspidosperma, in No. 60 powder, 1000 Gm.; Glycerin, 100 Cc.; Alcohol, Water, each, a sufficient quantity, to make 1000 Cc. Mix the glycerin with 600 Cc. of alcohol, and 300 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder, and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first the remainder of the menstruum, and then a mixture of alcohol and water, made in the proportion of 200 Cc. of alcohol to 100 Cc. of water, until the aspidosperma is exhausted. Reserve the first 800 Cc. of the percolate, and evaporate the remainder, in a porcelain capsule, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of the menstruum (alcohol 6 volumes, water 3 volumes, glycerin 1 volume, and the first 19½ fluidounces of the percolate set aside as reserve; when 24 fluidounces of menstruum have been used, percolation is to be continued with a mixture of alcohol 2 volumes, water 1 volume, and the final volume of the finished product should be made up to 24 fluidounces.

Uses.—This extract fully represents quebracho, and is more convenient than the bulkier preparations of the drug. *Dose*, Gm. 1 to 4 (♏xv to ʒj).

EXTRACTUM AURANTII AMARI FLUIDUM, *U. S.*—Fluid Extract of Bitter Orange-peel.

Extrait liquide d'écorce d'orange amère, Fr.; *Flüssiges Pomeranzenschalen-Extrakt*, G.

Preparation.—Bitter Orange-peel, in No. 40 powder, 1000 Gm.; Alcohol, Water, each a sufficient quantity, to make 1000 Cc. Mix 600 Cc. of alcohol with 300 Cc. of water, and, having moistened the powder with 350 Cc. of the mixture, pack it moderately in a conical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the orange-peel is exhausted. Reserve the first 800 Cc. of the percolate, and evaporate the remainder at a temperature not exceeding 50° C. (122° F.) to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 9 fluidounces of the menstruum (alcohol 2 volumes, water 1 volume), and the first 19½ fluidounces of the percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

In preparing this fluid extract it should be remembered that the orange-peel should consist almost exclusively of the glandular epidermal layer, known in commerce as Curaçoa orange-peel. Prepared of good material, the preparation will be of a yellowish-brown color and have the agreeable odor and pleasantly bitter taste of the peel.

Uses.—A flavoring agent especially suitable for bitter mixtures, and also as a mild stimulant tonic in the *dose* of Gm. 4 (fʒi).

EXTRACTUM BELÆ LIQUIDUM, *Br.*—Liquid Extract of Bael.

Extrait liquide de bael, Fr.; *Flüssiges Belaextrakt*, G.

Preparation.—Take of Bael-fruit 1 pound; Distilled Water 12 pints; Rectified Spirit 3 fluidounces. Macerate the bael for twelve hours in one-third of the water; pour off the clear liquor; repeat the maceration a second and third time for 1 hour in the remaining two-thirds of the water; press the marc and filter the mixed liquors through flannel. Evaporate to 13 fluidounces, and when cold add the rectified spirit.—*Br.*

This fluid extract represents 1 avoirdupois ounce of bael in each fluidounce, Imperial measure. The amount of spirit seems very small for such a concentrated liquid.

Uses.—In the *dose* of Gm. 4–8 (fʒj–ii) it may be given in chronic diarrhœa and dysentery.

EXTRACTUM BELLADONNÆ FOLIORUM ALCOHOLICUM, *U. S.*—Alcoholic Extract of Belladonna Leaves.

Extractum belladonnæ alcoholicum, U. S. 1880.—*Extrait de belladone alcoholique*, Fr.; *Spirituöses Tollkirschen-Extrakt*, G.; *Estratto di belladonna*, It.

Preparation.—Belladonna-leaves, in No. 60 powder, 1000 Gm.; Alcohol, Water, each a sufficient quantity. Mix 2000 Cc. of alcohol with 1000 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder, and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until 3000 Cc. of tincture are obtained or the belladonna-leaves are exhausted. Reserve the first 900 Cc. of the percolate, evaporate the remainder to 100 Cc. at a temperature not exceeding 50° C. (122° F.), mix the

residue with the reserved portion, and evaporate at or below the above-mentioned temperature to a pilular consistence.—*U. S.*

25 av. ozs. of the powdered leaves should be moistened with about 10 fluidounces of the menstruum, and the first 22 fluidounces of the percolate set aside as a reserve; the balance of the percolate is to be evaporated to 2½ fluidounces before it is incorporated with the reserve portion for final evaporation to a pilular consistence.

The yield is about 22 per cent. The color is greenish-brown or brown-green, and the extract has the characteristic odor and bitter taste of belladonna. EXTRACTUM BELLADONNÆ ALCOHOLICUM, *Br.*, is made from the *root*.

EXTRACTUM BELLADONNÆ, *Br.*, *P. G.*, is the inspissated juice of fresh belladonna-herb, prepared in accordance with the formulas outlined on page 636. The extract of Br. P. is brown-green, of P. G. brown; the yield of the latter is 3 to 3½ per cent. On keeping, crystals are formed in the extract, which were found by Attfield (1862) to be potassium chloride and nitrate; according to Biltz, crystals of asparagin are sometimes observed.

Uses.—The local applications of this, as of all other narcotic extracts, are numerous. Softened with water or mixed with oil, it enters into many magistral formulas for the relief of local pains, especially those of a *neuralgic* sort. A more elegant form for this purpose is belladonna plaster. The relaxing and anodyne operation of the extract is used to allay spasm of the muscles surrounding canals, as the *ureter*, *bladder*, *urethra*, *os uteri*, *vagina*, and *rectum*, when irritation causes their contraction. In these several cases the softened extract may be rubbed in as near as possible to the seat of pain, or it may be introduced in a suppository into the vagina or rectum. When applied to the prepuce in *phimosis* and in *paraphimosis* it sometimes reduces the engorgement and stricture. Rubbed on the forehead or eyelids, it was formerly much used to *dilate the pupil*, but the more cleanly solution of atropia is to be preferred. It may be given internally for all the purposes to which belladonna is appropriate. Extract of belladonna is of uncertain strength, and its *dose* is therefore variable. A quarter of a grain (Gm. 0.01) may be given three times a day, and the quantity gradually increased until the state of the pupil denotes the degree of its action.

The *dose* of the British preparation is stated to be Gm. 0.016–0.03 (gr. ¼–½), and of the German extract Gm. 0.06 (gr. i).

Belladonna suppositories (U. S. P. 1870, and containing each half a grain of the alcoholic extract) are efficient in allaying or removing pain in the pelvic viscera, and have the advantage over opium suppositories that they do not tend to constipate. They are especially adapted to relieve *irritation* in the *bladder*, *urethra*, *ovaries*, *uterus*, *vagina*, or *rectum*, and *neuralgia* of these parts, and even of the sciatic nerve.

EXTRACTUM BELLADONNÆ RADICIS FLUIDUM, *U. S.*—FLUID EXTRACT OF BELLADONNA-ROOT.

Extractum belladonnæ fluidum, U. S. 1880.—*Extrait liquide de racine de belladone*, Fr.; *Flüssiges Tollkirschenwurzel-Extrakt*, G.

Preparation.—Belladonna-Root, in No. 60 powder, 1000 Gm.; Alcohol, Water, a sufficient quantity, to make 1000 Cc. Mix 800 Cc. of alcohol with 200 Cc. of water, and, having moistened the powder with 350 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the belladonna-root is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder at a temperature not exceeding 50° C. (122° F.) to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

Since a fluid extract of belladonna-leaves is occasionally employed, the above preparation should always be designated by the title of the U. S. P., given above. Care should be taken in the selection of belladonna-root, which should not be woody. This fluid extract has a reddish-brown color.

25 av. ozs. of the powdered root should be moistened with about 9 fluidounces of the menstruum (alcohol 4 volumes, water 1 volume), and the first 22 fluidounces of the percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

The alcoholic strength of the menstruum is weaker than that of 1880, but it exhausts

the drug perfectly and yields a stable preparation, hence the addition of water is fully justified.

Uses.—The *dose* of this preparation is Gm. 0.06–0.12 (♏j–ij). It is one of the most efficient representatives of belladonna.

EXTRACTUM BUCHU FLUIDUM, *U. S.*—Fluid Extract of Buchu.

Extrait liquide de bucco, Fr.; *Flüssiges Buccoextrakt*, G.

Preparation.—Buchu, in No. 60 powder, 1000 Gm.; Alcohol, a sufficient quantity; to make 1000 Cc. Moisten the powder with 400 Cc. of alcohol, pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until the buchu is exhausted. Reserve the first 850 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of alcohol, and the first 21 fluidounces of the percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

We cannot see the necessity for again introducing strong alcohol as a menstruum for this preparation; experience has shown that all the active principles of buchu are extracted by a mixture of alcohol 2 volumes and water 1 volume, and that the fluid extract keeps well. The color of the preparation made by the present formula is a deep green, and the odor and taste of the drug well marked.

Uses.—This fluid extract is inferior to the infusion of buchu for diseases of the urinary organs, but in default of that preparation may be prescribed in *doses* of Gm. 1.20–2.00 (♏xx–xxx), very largely diluted with water.

EXTRACTUM CALAMI FLUIDUM, *U. S.*—Fluid Extract of Calamus.

Extrait liquide d'acore vrai, Fr.; *Flüssiges Kalmusextrakt*, G.

Preparation.—Calamus, in No. 60 powder, 1000 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 350 Cc. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until the calamus is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of powdered calamus should be moistened with about 9 fluidounces of alcohol, and the first 22 fluidounces of the percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces. Alcohol is decidedly the best menstruum.

Made from peeled calamus, this fluid extract is of a brownish-yellow color, but if prepared from the unpeeled rhizome, which is now to be used, it is of a considerably darker tint, the characteristic odor and taste being likewise more prominent. For preparing the powder the air-dry calamus should be dried over unslaked lime, but not by heat, which would expel much of the volatile oil. In view of the large intercellular passages contained in the tissue of calamus a powder passing through a No. 40 or No. 30 sieve would seem to be sufficiently fine for ready extraction.

(For Extractum calami, *P. G.*, see page 368.)

Uses.—It may be used in all the cases for which calamus is appropriate. It is a convenient form of that drug. *Dose*, Gm. 0.60–1.30 (♏x–xx).

EXTRACTUM CALUMBÆ, *Br.*—Extract of Calumba.

Extractum columbo.—Extrait de colombo, Fr.; *Kolombo-Extrakt*, G.; *Estratto di colombo*, It.

Preparation.—Take of Calumba-root, cut small, 1 pound; Proof Spirit 4 pints. Macerate the calumba with 2 pints of proof spirit for twelve hours, strain and press.

Macerate again with the remainder of proof spirit; strain and press as before. Mix and filter the liquors, and evaporate them by the heat of a water-bath until the extract is of a suitable consistence for forming pills.—*Br.*

The present formula is an improvement compared with that of the Br. P. 1867, which directed water for exhausting the root, and yielded a very mucilaginous extract liable to become mouldy. The French Codex uses alcohol of 60 per cent. volume for preparing this extract, the yield being 14 to 16 per cent.

Uses.—This preparation, which in its action differs but little from the extracts of quassia and gentian, may be prescribed in the *dose* of from Gm. 0.10–0.60 (gr. ij–x).

EXTRACTUM CALUMBÆ FLUIDUM, *U. S.*—Fluid Extract of Calumba.

Extrait liquide de colombo, Fr.; *Flüssiges Kolomboextrakt*, G.

Preparation.—Calumba, in No. 20 powder, 1000 Gm.; Alcohol, Water, each, a sufficient quantity: to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water, and, having moistened the powder with 300 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the calumba is exhausted. Reserve the first 700 Cc. of the percolate; by means of a water-bath, distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 7½ fluidounces of the menstruum (alcohol 3 volumes, water 1 volume) and the first 17½ fluidounces of the percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

The present menstruum is preferable to that of 1880, yielding a fluid extract less liable to precipitate, but as the Pharmacopœia directs for tincture of calumba a mixture of alcohol 6 volumes and water 4 volumes, we think a menstruum of alcohol 2 volumes, water 1 volume, would answer equally well for the fluid extract.

The fluid extract is of a rich orange-brown color, and possesses a strongly bitter taste.

Uses.—It is a convenient substitute for the infusion, and may be prescribed in *doses* of a fluidrachm in Gm. 4 in Gm. 64 (f℥i in f℥ij) of water.

EXTRACTUM CANNABIS INDICÆ, *U. S., Br.*—Extract of Indian Cannabis.

Extract of Indian hemp, E.; *Extrait de chanvre indien*, Fr.; *Indisch-Hanfextrakt*, G.

Preparation.—Indian Cannabis, in No. 20 powder, 1000 Gm.; Alcohol a sufficient quantity. Moisten the powder with 300 Cc. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol until the cannabis is exhausted. By means of a water-bath distil off the alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it on a water-bath to a pilular consistence.—*U. S.*

25 av. ozs. of the drug should be moistened with about 7½ fluidounces of alcohol.

The process of the Br. P. is practically identical with the foregoing, except that the drug is exhausted by maceration. The yield is from 12 to 14 per cent. The extract is of a blackish-green color, and has a slight but heavy narcotic odor and a bitter taste. It should be completely insoluble in water, and dissolve in alcohol, ether, chloroform, and oil of turpentine; its alcoholic solution should be precipitated by aqueous solution of potassa or soda, the resin being insoluble in alkalies. Nitric acid converts the extract into an orange-red resin, which after washing with water has the color of gamboge (Procter, 1864).

Uses.—This extract varies so greatly in activity that its dose cannot be definitely fixed. Gm. 0.013–0.017 ($\frac{1}{5}$–$\frac{1}{4}$ of a grain) of a specimen not before tested should be given at first, and the *dose* gradually increased until its sensible effects are produced. For children the dose should be at least one-half less.

EXTRACTUM CANNABIS INDICÆ FLUIDUM, *U. S.*—Fluid Extract of Indian Cannabis.

Extrait liquide de chanvre indien, F.; *Flüssiges Indisch-Hanfextrakt*, G.

Preparation.—Indian Cannabis, in No. 20 powder, 1000 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 300 Cc. of alcohol and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until the Indian cannabis is exhausted. Reserve the first 900 Cc. of the percolate; by means of a water-bath distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 7½ fluidounces of alcohol, and the first 22 fluidounces of percolate set aside as reserve.

There is scarcely any necessity for this preparation, since the extract of Indian cannabis is readily soluble in alcohol. The fluid extract is of a dark-green color. If properly prepared it may be used for the extemporaneous preparation of the extract, and this extract should have the characteristics mentioned under the preceding article.

Uses.—As each minim represents a grain of Indian cannabis, the fluid extract may be given in commencing *doses* of from Gm. 0.03–0.06 (♏ ½–j).

EXTRACTUM CAPSICI FLUIDUM, *U. S.*—Fluid Extract of Capsicum.

Fluid extract of red pepper, E.; *Extrait liquide de capsique, de piment des jardins*, Fr.; *Flüssiges Spanisch-Pfefferextrakt*, G.

Preparation.—Capsicum, in No. 60 powder, 1000 Gm.; Alcohol, a sufficient quantity; to make 1000 Cc. Moisten the powder with 500 Cc. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until the capsicum is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of capsicum should be moistened with 12 fluidounces of alcohol and the first 22 fluidounces of percolate set aside as reserve.

There is likewise little need for this preparation, the drug being already represented by the oleoresin and the tincture. The fluid extract is of a rich brown-red color, yields a turbid mixture with water, and has the hot taste of the drug.

Dose, Gm. 0.6–0.12 (♏ i–ij).

EXTRACTUM CARNIS.—Extract of Meat.

Extractum carnis Liebig.—Extract of beef, E.; *Extrait de viande de Liebig*, Fr.; *Liebig's Fleischextrakt*, G.

Preparation.—Extracts of meat have been prepared for many years. Thouvenel exhausted fresh meat with alcohol, and Van Mons used the same menstruum for dry meat. Cadet de Gassicourt recommended the meat to be minced, mixed with cold water, the liquid expressed, boiled, skimmed, and evaporated. In 1854, Liebig published a formula for preparing a *broth for invalids* as follows: ½ pound of fresh meat is finely chopped and macerated for one hour with 1 pound of cold distilled water, to which 4 drops of hydrochloric acid and from 30 to 60 grains of table-salt are added. The mass is then displaced on a colander, a little water being added, until 1 pound of percolate has been obtained. The clear liquid has a red color and contains the albuminoids of the meat in solution. In 1859 the Bavarian Pharmacopœia adopted a process for extract of meat in which chopped meat was exhausted with hot water, and the expressed liquid, carefully freed from fat and albumen, was evaporated.

Since then factories have been established in different parts of South America, Australia, and the United States, where cattle were abundant and cheap. In the majority of

these establishments Liebig's process appears to be followed, perhaps with some slight modification. At Fray-Bentos, on the river Uruguay, where a factory was conducted under the direction of Liebig, the extract, according to F. Müller (1868), is prepared as follows: The freshly-slaughtered meat is allowed to cool for twenty-four hours, and then ground into a pulpy mass by passing it between iron rollers furnished with small projections. The pulp is stirred with water for about an hour, strained through sieves, the fat carefully removed, and the liquid evaporated in steam-pans, a current of air being continuously passed over the surface. At a certain state of concentration the liquid is filtered and the evaporation continued until the extract is transferred to well-glazed stoneware jars, which are carefully covered.

Properties.—Thus prepared, extract of meat is of a brown color, usually somewhat granular, and has a pleasant odor suggestive of roasted meat, and a characteristic, distinctly saline, and faintly acidulous taste. It is completely soluble in water, yielding a clear solution, which on the addition of a little table-salt has the flavor of beef-broth. When dried at the temperature of 110° C. (230° F.) 100 parts of the extract should lose not over 22 parts of moisture, and after incineration not less than 18 parts of ashes should be left, containing only a small quantity of sodium chloride. If 100 parts of the extract are digested with alcohol, and the liquid filtered and evaporated, not less than 56 parts of extract should be obtained (*P. G.* 1872). The figures given by Liebig himself as indicating the limits of variation in extract of meat prepared by his process are for *moisture* 16 to 22 per cent.; *ash* 18 to 22 per cent.; *extractive*, soluble in 80 per cent. alcohol, 56 to 66 per cent. Niederstadt (1881) gives the actual variation of the commercial Fray-Bentos extract as follows: moisture 13.2–29.2; nitrogen 2.6–9.04; organic matter, 49.5–68.7; ash 10.5–21.4 per cent.; the ash contains potassa 30.1–32.5 and phosphoric acid 36.5–38.0 per cent. The absence of sodium chloride in meat juice is proven by precipitating first the salts of inosic acid by an equal bulk of alcohol, and then adding 5 volumes of alcohol, when the mixture will separate into two layers, the lower of which, about one-twentieth of the whole, on evaporation at a low temperature will yield prisms of the potassium chloride containing not a trace of sodium salt.

The amount of nitrogen in extract of meat is sometimes as low as 2.6 per cent., but if made of good beef usually between 9 and 10 per cent., and depends chiefly on the presence of *creatin*, *creatinin*, *globulin*, and *urea*. The solution in water of the extract usually yields a slight precipitate with tannin, which, according to Eichhorn (1867), is due to the presence of a nitrogenated body which somewhat resembles gelatin, but is not identical with it. Werner (1868), however, states that, if in preparing the extract the temperature of 60° C. (140° F.) be not exceeded, the aqueous solution will give no reaction for gelatin. It would seem, therefore, best to evaporate the liquid under reduced pressure. It is well known, however, that some extracts of meat which have appeared in our market have contained large quantities of gelatin. (See paper by A. E. Ebert in *Proc. Amer. Phar. Assoc.*, 1871, p. 512.)

Other extracts of meat, liquid as well as solid, have from time to time claimed attention, some of the former containing the soluble albuminous compounds or the ground flesh-fibres. In 1873, Prof Leube recommended an extract in which the meat-fibrin was emulsionized by heating meat, free from fat and bones and chopped fine, in very diluted hydrochloric acid until almost completely disintegrated. At the present time peptones are used in preference to this preparation. (See PEPSINUM.)

Action and Uses.—It appears to be too often overlooked that Liebig, to whom is due the vogue of beef-tea during the last quarter of a century, expressly declared it to be incapable of promoting nutrition, and that it is to be classed as nervous food, along with tea, coffee, and alcohol, and even as inferior to the last—a judgment which has been expressed in almost identical words by Virchow, and emphasized by Sibson, Brunton, Loffen, and many others. The small proportion of creatin beef-tea may contain does not materially affect this estimate. Its 2½ per cent. of albumen, according to some modes of preparation, is altogether eliminated in Liebig's extract, and the gelatin almost completely, leaving the organic alkaloids and acids and the salts. That these act as temporary nervous stimulants there can be no doubt; but the popular impression is that beef-tea is a substitute for food, and hence it often happens that the patient is plied with it inordinately, with the result of provoking vomiting or diarrhœa. That it often occasions the latter when habitually used as a substitute for food, to repair fatigue, or to fortify the body or mind for an unusual exertion, is probably within the experience of many physicians. Sibson, alluding to its use in diarrhœa, and especially in that of typhoid fever, declares that he looks "upon this fluid in the light of a poison in such

cases," and strongly condemns its use in Bright's disease as burdening the already overtaxed kidneys with the duty of eliminating this non-assimilable matter. It is, however, rather indirectly than directly injurious by being used as a nutrient—a function which it has no claim to perform. On the other hand, it has not that poisonous operation which science, "falsely so called," attributed to it through Kemmerich in 1868. He arrived at the singular conclusion that concentrated cold extract of horse-flesh injected into the stomach of dogs in small doses increases the number and strength of the heart's pulsations, but that in large doses it kills, with all the appearances of cardiac paralysis. This remarkable result he attributed to the potash salts of the meat! In 1880, Mr. Masterman (*Lancet*, Oct. 1880, p. 562) showed that beef-tea is analogous to urine, except that it contains less urea and uric acid, and that it is merely a stimulant; and Dr. Neale (*Practitioner*, xxvii. 343) calls attention to the fact that in several countries, including South America and Eastern Asia, the urine of young persons is used as a medicinal stimulant. Some investigators of the action of beef-tea (*e. g.* Mays, *Trans. Coll. Phys., Philad.*, 3d Ser., viii. 259) have claimed more positive nutritive qualities for this preparation; but while they have illustrated anew its stimulant action, they do not appear to have proved its nutritive power.

The stimulant and non-nutritious qualities of beef-tea render it peculiarly fitted for the treatment of the greater number of acute *febrile diseases*. Nature protests against the use of food in them by the repugnance of the patients to taking it and by the aggravation of the fever which it induces. During the augment and acme of these affections food in a literal sense heaps fuel on the fire, but in many of them the animal mechanism must be kept in such active movement as to enable it to resist the disintegrating tendencies of the disease, and afterward to throw off the effete accumulations. This beef-tea aids in accomplishing, and in the same manner as alcohol. When that end is attained, and when the fever has declined, the preparation holds only a secondary place in the treatment, the first being occupied by true nutrients, which are better prepared by culinary skill than by chemical science. No more serious mistake can be made in the treatment of acute diseases, when the febrile stage has passed by, than to continue to administer beef-tea, soups and jellies. By such agents the patient may literally die of inanition while being gorged with what erroneously passes for food. Feeding by the rectum with beef-tea is, if possible, of even more temporary utility than when this preparation is given by the stomach. The following receipt for preparing beef-tea differs somewhat from that of Liebig given above: To a pound of lean beef scraped to shreds, add as much cold water as will barely cover it; let it stand for an hour, occasionally stirring it. Put it on the fire and heat it gently until it begins to give off vapor, or for about twenty minutes. Strain off the liquor and press the beef. A more nutritious preparation, which is really a broth, may be prepared as follows: Cut a pound of lean beef into small pieces and place them with a pint of cold water in a bowl. When it has stood for at least an hour transfer the contents to a pitcher, covering it securely. Set the pitcher in a sauce-pan of water and let it boil for three or four hours, and until the beef is reduced to a pulp. When cold remove the fat from the surface of the liquid, and strain off the latter, pressing the beef. Beef tea should be avoided in *albuminuria*, it increases the albuminous contents of the urine. *Pancreatic emulsion* is more efficient. It is highly recommended in various affections of the stomach when the mucous coating require to be protected from irritation, in convalescence from typhus, etc., and may be combined with broth or with Liebig's extract of meat, or milk and powdered cracker (hard biscuit) may be used alternately with it. It has been employed with marked advantage in cases of fatty *diarrhœa* due to obstruction of the pancreatic secretion and in the *wasting diseases* of children induced by artificial feeding. It also promotes the digestion and assimilation of *cod-liver oil*.

EXTRACTUM CASTANEÆ FLUIDUM, *U. S.*—Fluid Extract of Castanea.

Fluid extract of chestnut-leaves, E.; *Extrait liquide de feuilles de châtaignier*, Fr.; *Flüssiges Kastanienblätter-Extrakt*, G.

Preparation.—Castanea, in No. 30 powder, 1000 Gm.; Glycerin, 100 Cc.; Alcohol, Water, each a sufficient quantity to make 1000 Cc.

Pour 5000 Cc. of boiling water upon the powder, allow it to macerate for two hours, then express the liquid, transfer the residue to a percolator, and pour water upon it until the powder is exhausted. Evaporate the united liquids, on a water-bath, to 2000 Cc., allow this to cool, and add 600 Cc. of alcohol. When the insoluble matter has subsided, separate the clear liquid, filter the remainder, evaporate the united liquids to 700 Cc.,

allow to cool, and add the glycerin, and enough alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of powdered chestnut-leaves should be macerated with 8 pints of boiling water for two hours, and after expression the residue is exhausted with cold water by percolation. The united liquids should be evaporated to 3 pints, and when cool mixed with 14½ fluidounces of alcohol; after filtration the clear liquid should be evaporated to 17 fluidounces, to which are added 2½ fluidounces of glycerin and 4½ fluidounces of alcohol.

It is well known that hot water extracts the virtues of chestnut-leaves. The toughness of the fibro-vascular tissue (veins) of the latter render their reduction to a powder of the required fineness a matter of difficulty. This is practically recognized by the Pharmacopœia in ordering the partial extraction of the leaves by hot maceration and expression; a repetition of this manipulation with one-half the amount of hot water would have virtually exhausted the drug, provided a sufficiently powerful press be used. By clarification with $\frac{3}{10}$ volume of alcohol albuminous and mucilaginous matters are removed. The finished fluid extract is preserved by alcohol equal to nearly one-fourth its measure; formerly, it was customary to use sugar for this purpose. The fluid extract is reddish-brown, and of a slight odor and of a strongly but pleasantly astringent taste. Mr. A Robbins states that there is no special difficulty in exhausting chestnut-leaves by percolation if a weak alcoholic menstruum be used, the most suitable being composed of alcohol 1 part and water 2 parts, the first 800 Cc. of this mixture being used with 200 Cc. of glycerin.

Dose, Gm. 4–8 (f℥j–ij).

EXTRACTUM CHIMAPHILÆ FLUIDUM, *U. S.*—Fluid Extract of Chimaphila.

Extrait liquide de pyrole ombellée, Fr.; *Flüssiges Doldenmangold-Extrakt*, G.

Preparation.—Chimaphila, in No. 30 powder, 1000 Gm.; Diluted Alcohol a sufficient quantity, to make 1000 Cc. Moisten the powder with 400 Cc. of diluted alcohol and pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the chimaphila is exhausted. Reserve the first 700 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion and add enough diluted alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of the menstruum, and the first 17½ fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

Experience has shown that the addition of about 10 per cent. of glycerin improves the stability of the fluid extract; the same result might be obtained by using a mixture of alcohol 2 volumes and water 1 volume.

Uses.—This preparation is less eligible than the decoction. *Dose*, Gm. 4 (f℥j.) largely diluted, three or four times a day.

EXTRACTUM CHIRATÆ FLUIDUM, *U. S.*—Fluid Extract of Chirata.

Extrait liquide de chirette, Fr.; *Flüssiges Chirettaextrakt*, G.

Preparation.—Chirata, in No. 30 powder, 1000 Gm.; Alcohol, Water, each a sufficient quantity, to make 1000 Cc. Mix 600 Cc. of alcohol with 300 Cc. of water, and, having moistened the powder with 350 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the chirata is exhausted. Reserve the first 850 Cc. of the percolate; by means of a water-bath, distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 9 fluidounces of menstruum

(alcohol 2 volumes, water 1 volume), and the first 21 fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

The fluid extract is reddish-brown, and has the intensely bitter taste of the drug. The bitter principles of chirata being soluble in water, a more aqueous menstruum is indicated for this drug. Although precipitation takes place after some time, the active principles are probably not affected thereby.

Dose, about Gm. 1.30 (ɱxx).

EXTRACTUM CIMICIFUGÆ, *U. S.*—Extract of Cimicifuga.

Extract of black cohosh, E.; *Extrait d'actée à grappes*, Fr.; *Cimicifuga-Extrakt*, G.

Preparation.—Cimicifuga, in No. 60 powder, 1000 Gm.; Alcohol, a sufficient quantity. Moisten the powder with 250 Cc. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until the cimicifuga is exhausted. By means of a water-bath, distil off the alcohol from the tincture, and evaporate the residue in a porcelain capsule, on a water-bath, to a pilular consistence.—*U. S.*

25 av. ozs. of cimicifuga should be moistened with about 6 fluidounces of alcohol.

Although alcohol is directed by the pharmacopœia, we think that a mixture of alcohol 4 volumes and water 1 volume will exhaust the drug equally well. The extract is almost black in color, and contains all the resinous constituents of the root. The yield is about 15 per cent.

Uses.—The advantages of this preparation over the fluid extract of cimicifuga are not apparent. *Dose*, Gm. 0.1 to 0.50 (gr. iss to vij).

EXTRACTUM CIMICIFUGÆ FLUIDUM, *U. S.*—Fluid Extract of Cimicifuga.

Extractum cimicifugæ liquidum, Br.—*Fluid extract of black cohosh*, E.; *Extrait liquide à grappes*, Fr.; *Flüssiges Cimicifuga-Extrakt*, G.

Preparation.—Cimicifuga, in No. 60 powder, 1000 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 250 Cc. of alcohol, and pack it in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until the cimicifuga is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of cimicifuga should be moistened with 6 fluidounces of alcohol, and the first 22 fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

As in the case of the solid extract of cimicifuga, we think a somewhat weaker alcoholic menstruum will yield an equally efficient preparation.

This has all the sensible properties of the drug from which it was made, and is a permanent preparation. That of the Br. P. is nearly identical with the foregoing, the menstruum being alcohol sp. gr. 0.838.

Uses.—This preparation is greatly preferable to the decoction, which was formerly used. *Dose*, Gm. 2–4 (f3ss–j).

EXTRACTUM CINCHONÆ, *U. S.*—Extract of Cinchona.

Extractum chinæ spirituosum, P. G.—*Extract of calisaya-bark*, E.; *Extrait de quinquina jaune*, Fr.; *Weingeistiges China-Extrakt*, G.: *Estratto di china*, It.

Preparation.—Yellow Cinchona, in No. 60 powder, 1000 Gm.; Alcohol 3000 Cc.; Water 1000 Cc.; Diluted Alcohol, a sufficient quantity. Mix the alcohol and water, and, having moistened the powder with 350 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and

then diluted alcohol, until 4000 Cc. of tincture are obtained or the cinchona is exhausted. By means of a water-bath distil off the alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it on a water-bath to a pilular consistence. —*U. S.*

25 av. ozs. of the drug should be moistened with about 9 fluidounces of the menstruum (alcohol 3 volumes, water 1 volume).

As the finished extract has a tendency to become tough by age, the addition of 10 per cent. by weight of glycerin is advisable; it should be thoroughly incorporated while the extract is still warm.

The yield varies between about 15 and 20 per cent. The extract is of a reddish-brown color, is only partly soluble in water, and has the persistently bitter taste of cinchona. The German Pharmacopœia directs its spirituous extract of cinchona to be made with alcohol spec. grav. 0.894, and to be evaporated to dryness; it recognizes also an *Extractum chinæ aquosum*, s. *Extractum chinæ frigide paratum*, which is obtained by evaporating the cold aqueous infusion of cinchona-bark. The cinchona extracts of the French Codex are prepared with boiling water.

Uses.—Extract of cinchona, since it possesses all the virtues of Peruvian bark, would for many purposes be preferable to quinine were it less bulky. The *dose* is from Gm. 0.60–2.00 (gr. x–xxx).

EXTRACTUM CINCHONÆ FLUIDUM, *U. S.*—Fluid Extract of Cinchona.

Extractum cinchonæ liquidum, Br.; *Extractum chinæ calisayæ fluidum.—Liquid extract of yellow cinchona- or calisaya-bark*, E.; *Extrait liquide de quinquina jaune*, Fr.; *Flüssiges Chinaextrakt, Kalisayarinden-Extrakt*, G.

Preparation.—Yellow Cinchona, in No. 60 powder, 1000 Gm.; Glycerin 200 Cc.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix the glycerin with 800 Cc. of alcohol. Moisten the powder with 350 Cc. of the mixture, pack it firmly in a cylindrical percolator, and pour on the remainder of the menstruum. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, and when the liquid in the percolator has disappeared from the surface gradually pour on a mixture of alcohol and water, made in the proportion of 800 Cc. of alcohol to 200 Cc. of water, and continue the percolation until the cinchona is exhausted. Reserve the first 750 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough of a mixture of alcohol and water, using the same proportions as before, to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 9 fluidounces of menstruum (alcohol 4 volumes, glycerin 1 volume), and the first 18½ fluidounces of percolate set aside as reserve; when 24 fluidounces of menstruum have been used, percolation is to be continued with a mixture of alcohol 4 volumes and water 1 volume. The final volume of the finished product should be made up to 24 fluidounces.

Macerate for two days red cinchona in No. 60 powder 20 oz., with water 100 oz., glycerin 2½ fluidounces, and hydrochloric acid 5 fluidrachms; percolate, exhaust with water, evaporate below 82.2° C. (180° F.) to 20 fluidounces. Agitate 50 fluidgrains of this liquid with benzolated amyl alcohol 1 fluidounce (benzene 3 vol., amyl alcohol 1 vol.), and soda solution ½ fluidounce; separate the alkaline watery liquid, wash the remainder with water, then evaporate to dryness and weigh. By evaporation, or if necessary by dilution with water, adjust the concentrated percolate to 85 fluidgrains for every 5 grains of total alkaloids; add 12.5 fluidgrains of alcohol and enough distilled water to make 100 fluidgrains.—*Br.*

The first formula is decidedly the better, and, though the addition of a small quantity of water to the mixture of alcohol and glycerin would yield an equally good preparation, the fluid extract remains practically unaltered. It is of a rich, red-brown color, and if made of good bark contains all the alkaloids in their natural combination. Water alone will but partially exhaust cinchona-bark, and during the long-continued evaporation a portion of the alkaloids will become insoluble through the alteration of the tannin. On the other hand, a stronger alcohol will dissolve more cinchonic red, but secure the more thorough exhaustion of the alkaloids. The product of the second formula contains 5 grains of the alkaloids of red cinchona in every 100 fluidgrains.

Uses.—An advantage of this preparation is, that it contains in solution all the active

principles of cinchona, and not merely one or the other of the alkaloids. As a tonic it may be given in the *dose* of Gm. 2 (ʒss). For securing the antiperiodic effects of cinchona it is eligible only in mild cases of periodical fever; in severer cases efficient doses of it would be too bulky.

EXTRACTUM COCÆ FLUIDUM, *U. S.*—Fluid Extract of Coca.

Extractum erythroxyli fluidum, U. S., 1880; *Fluid extract of erythroxylon*, E.; *Extrait liquide de coca*, Fr.; *Flüssiges Coca-Extrakt*, G.

Preparation.—Coca, in No. 40 powder, 1000 Gm.; Diluted Alcohol, a sufficient quantity; to make 1000 Cc. Moisten the powder with 450 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the coca is exhausted. Reserve the first 800 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 1000 Cc.

25 av. ozs. of the drug should be moistened with about 10¼ fluidounces of menstruum, and the first 19½ fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

Fluid extract of coca is of a deep-brown or olive-brown color, and has the astringent bitter and slightly aromatic taste of the leaves.

Uses.—This preparation may be used to secure the milder effects of cocaine. *Dose*, Gm. 1 to 4 (ɱxv–fʒi).

EXTRACTUM COLCHICI RADICIS, *U. S.*—Extract of Colchicum-root.

Extractum colchici aceticum, U. S., 1870, Br.; *Acetic extract of colchicum*, E.; *Extrait de colchique acétique*, Fr.; *Zeitlosen-Essigextrakt*, G.

Preparation.—Colchicum-root, in No. 60 powder, 1000 Gm.; Acetic Acid 350 Cc.; Water a sufficient quantity. Mix the acetic acid with 1500 Cc. of water, and, having moistened the powder with 500 Cc. of the mixture, pack it moderately in a cylindrical glass percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then water, until the colchicum-root is exhausted. Evaporate the percolate in a porcelain vessel by means of a water-bath, at a temperature not exceeding 80° C. (176° F.), to a pilular consistence.—*U. S.*

25 av. ozs. of the drug should be moistened with about 12 fluidounces of the menstruum (acetic acid 3½ volumes, water 15 volumes.)

The corresponding preparation of the Br. P. is made like the extract, the formula of which is given below, the only difference consisting in the addition of 6 fluidounces of acetic acid to the bruised colchicum-tubers before the juice is expressed. The extract is of a brown color and bitter taste, and yields with water a rather turbid solution. The U. S. P. errs in directing it to be of pilular consistence, while the Br. P. is correct in stating it to be a soft extract; it is certainly softer than the next:

Extractum colchici, *Br.*—Extract of colchicum, *E.*; Extrait de bulbe de colchique, *Fr.*; Zeitlosen-Extrakt, *G.*—Take of fresh colchicum-corms, deprived of their coats, 7 pounds. Crush the corms, press out the juice, allow the feculence to subside, and heat the clear liquor to 212° F.; then strain through flannel, and evaporate by a water-bath, at a temperature not exceeding 160° F., until the extract is of a suitable consistence for forming pills.—*Br.*

The extract of colchicum of the French Codex is prepared from the seeds with alcohol of 60 per cent.

Uses.—These two extracts are convenient forms of colchicum for prescription in pills, and especially in those purgative pills which gouty patients commonly require. The *dose* of either is from Gm. 0.03–0.12 (gr. ss–ij), according to the British Pharmacopœia, but some German authorities state the dose at Gm. 0.01–0.03 (gr. ⅙–½).

EXTRACTUM COLCHICI RADICIS FLUIDUM, *U. S.*—Fluid Extract of Colchicum-Root.

Extrait liquide de bulbe de colchique, Fr.; *Flüssiges Zeitlosenknollen-Extrakt*, G.

Preparation.—Colchicum-Root, in No. 60 powder, 1000 Gm.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix 600 Cc. of alcohol with 300 Cc. of water, and, having moistened the powder with 350 Cc. of the mixture, pack it moderately in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the colchicum-root is exhausted. Reserve the first 850 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 9 fluidounces of the menstruum (alcohol 2 volumes, water 1 volume), and the first 21 fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

Diluted alcohol will extract all the virtues of colchicum-root, and experience has shown that the fluid extract made therewith remains clear for years, hence there appears no reason for continuing the stronger alcoholic menstruum of 1880.

This fluid extract is of a deep brown-red color, keeps well, and fully represents the drug from which it is prepared.

Uses.—This preparation contains all the virtues of colchicum. *Dose*, Gm. 0.10–0.50 (♏ii–viii).

EXTRACTUM COLCHICI SEMINIS FLUIDUM, *U. S.*—Fluid Extract of Colchicum-Seed.

Extrait liquide de semence de colchique, Fr.; *Flüssiges Zeitlosensamen-Extrakt*, G.

Preparation.—Colchicum-Seed, in No. 30 powder, 1000 Gm.; Alcohol, Water, each a sufficient quantity, to make 1000 Cc. Mix 600 Cc. of alcohol with 300 Cc. of water, and, having moistened the powder with 300 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the colchicum-seed is exhausted. Reserve the first 850 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the powdered seed should be moistened with about 7½ fluidounces of menstruum (alcohol 2 volumes, water 1 volume), and the first 21 fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

As in the case of colchicum-root, diluted alcohol has been found to completely exhaust the seed likewise, and a more satisfactory preparation is obtained, as the separation of oily globules is entirely obviated by the use of the weaker menstruum.

Uses.—Like the preceding, this extract is a full representative of colchicum. *Dose*, from Gm. 0.10–0.50 (♏ij–viij).

EXTRACTUM COLOCYNTHIDIS, *U. S., P. G.*—Extract of Colocynth.

Extractum colocynthidis alcoholicum.—Extrait de coloquinte, Fr.; *Koloquinten-Extrakt*, G.; *Estratto di coloquintide*, It.

Preparation.—Colocynth, dried and freed from the seeds, 1000 Gm.; Diluted Alcohol a sufficient quantity. Reduce the colocynth to a coarse powder by grinding or bruising, and macerate it in 3500 Cc. of diluted alcohol for four days, with occasional stirring; then express strongly and strain through flannel. Pack the residue, previously broken up with the hands, firmly in a cylindrical percolator, cover it with the strainer,

and gradually pour diluted alcohol upon it until the tincture and expressed liquid, mixed together, measure 5000 Cc. Having recovered from the mixture 3000 Cc. of alcohol by distillation, evaporate the residue to dryness by means of a water-bath. Lastly, reduce the dry mass to powder. Extract of colocynth should be kept in well-stopped bottles.—*U. S.*

25 av. ozs. of the coarsely-powdered colocynth pulp should be macerated with 5½ pints of diluted alcohol for four days, and after expression percolated with diluted alcohol until the volume of tincture and expressed liquid, mixed together, measures 8 pints. 4½ pints of alcohol should be recovered from the mixture by distillation, and the residue evaporated to dryness and powdered.

The proportion of diluted alcohol directed by the Pharmacopœia for maceration might be increased to 4500 Cc. (for 25 av. ozs. to 7 pints) with advantage, as the experiments of Klie and others have shown; subsequent percolation should be extended correspondingly until the drug is exhausted.

Maceration and expression being considered necessary in the beginning, it would seem that the extract remaining in the press-cake could be more expeditiously obtained, and with a smaller amount of menstruum, by repeating the operation once or twice. This is the process of the German Pharmacopœia, which directs for 2 parts of colocynth, with the seeds, for the first maceration, 15 parts of alcohol spec. grav. .894, and for the second maceration 5 parts each of the same alcohol and of water. With some care colocynth may be treated at once by percolation, but owing to the spongy character of its tissues it is advisable to express the absorbed liquid with a good press as soon as the greater portion of the active matter is exhausted. When the extract is made on a large scale the removal of the seeds is a tedious operation, if not impossible. For this reason the colocynth is ground, care being taken not to crush the seeds, which would load the extract with much oily matter. Dr. Squibb (1867) obtained from very dry colocynth 20.6 per cent. of extract; the general yield from the commercial article is about 14 to 14.5 per cent. After completely removing the seeds, Procter (1867) had left, from 49 troyounces of colocynth, only 12 troyounces of pulp, which yielded 3¾ troyounces of extract, equal to 6.8 per cent., while G. H. C. Klie (1878) obtained 16 troyounces of pulp, and not over 6 troyounces, or 12.5 per cent., of extract. The pulp alone yields usually from 30 to 40 per cent., the seeds about 5 per cent., of extract, the latter being far less bitter than the former.

Action and Uses.—It is seldom used alone, but is an ingredient of the compound extract of colocynth. In Germany this extract is prescribed as a mild laxative in the *dose* of from Gm. 0.03 to 0.06 (gr. ½–1), and as a drastic purgative in the *dose* Gm. 0.1 to 0.3 (gr. 1½–2).

EXTRACTUM COLOCYNTHIDIS COMPOSITUM, *U. S., Br.*— Compound Extract of Colocynth.

Extrait de coloquinte composé, Fr.; *Zusammengesetztes Koloquinten-Extrakt*, G.

Preparation.—Extract of Colocynth 160 Gm.; Purified Aloes 500 Gm.; Cardamom, in No. 60 powder, 60 Gm.; Resin of Scammony, in fine powder, 140 Gm.; Soap, dried and in coarse powder, 140 Gm.; Alcohol 100 Cc. Heat the aloes on a water-bath until it is completely melted; then add the alcohol, soap, extract of colocynth, and resin of scammony, and heat the mixture, at a temperature not exceeding 120° C. (248° F.), until it is perfectly homogeneous and a thread taken from the mass appears brittle when cool. Then withdraw the heat, thoroughly incorporate the cardamom with the mixture, and cover the vessel until the contents are cold. Finally, reduce the product to a fine powder. Compound extract of colocynth should be kept in well-stopped bottles.—*U. S.*

To make 4 av. ozs. of compound extract of colocynth the following formula may be used, yielding a preparation of official strength: Warm 875 grains of purified aloes in a covered vessel on a water-bath, with 2½ fluidrachms of alcohol; add 280 grains of extract of colocynth, 245 grains each of powdered soap and resin of scammony, and heat the mixture (not above 248° F.) until it is perfectly homogeneous and brittle. Withdraw the heat, incorporate 105 grains of powdered cardamom, and cover the vessel until the contents are cold. Finally reduce to fine powder.

Take of colocynth-pulp 6 ounces; extract of Socotrine aloes 12 ounces; resin of scammony 4 ounces; curd soap, in powder, 3 ounces; cardamom-seeds in fine powder, 1 ounce; proof spirit 1 gallon. Macerate the colocynth in the spirit for four days; press out the

tincture and distil off the spirit; then add the aloes, scammony, and soap, and evaporate by a water-bath until the extract is of a suitable consistence for forming pills, adding the cardamoms toward the end of the process.—*Br.*

The first formula is preferable for directing a definite amount of the extract of colocynth, instead of the extract obtained from a definite weight of colocynth-pulp, which may vary considerably (see above). By mixing the ingredients in the state of fine powder a preparation uniform in appearance cannot be obtained. But by melting them together with the assistance of a little alcohol, and by subsequently drying and powdering, an unobjectionable compound extract is produced.

Action and Uses.—As an efficient and safe purgative this compound, when well prepared, is not excelled by any other in cases of habitual *constipation* produced by torpor of the bowels. Calomel or rhubarb can be added to it to meet special indications, or, if it is disposed to gripe, extract of hyoscyamus will help to correct the tendency. The *dose* is Gm. 0.30–1.30 (gr. v–xx). This extract, as found in the shops, is often inert.

EXTRACTUM CONDURANGO FLUIDUM, *P. G.*—Fluid Extract of Condurango.

Extrait liquide de condurango, Fr.; *Flüssiges Condurango-Extrakt*, G.

Preparation.—Condurango-bark, in No. 25 powder, 100 parts; Glycerin, 6⅔ parts; Alcohol, Water, each a sufficient quantity; to make 100 parts. Mix the glycerin with 66⅔ parts of alcohol and 26⅔ parts of water, and, having moistened the powder thoroughly with sufficient of the menstruum, set the mixture aside in a closed vessel for two or three hours. Transfer to a percolator, pack firmly, and pour on the balance of the menstruum, and when the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours at a temperature of 15°–20° C. (59°–68° F.). Allow percolation to proceed at the rate of 15–20 drops per minute, pouring on menstruum composed of alcohol 1 part, water 3 parts, until the drug is exhausted. Reserve the first 85 parts; evaporate the remainder of the percolate to a syrupy consistence, and add sufficient menstruum to make 15 parts. Mix the two liquids and set aside for two or three days, then filter.—*P. G.*

Fluid extract of condurango is of brown color and has the specific gravity 1.038–1.040, yielding from 16–20 per cent. of extractive.

It should be borne in mind that all liquid preparations of the German Pharmacopœia are made by weight.

Dose, Gm. 2 (ℳxxx).

EXTRACTUM CONII, *U. S.*—Extract of Conium.

Extractum Conii alcoholicum, U. S. 1880.—*Alcoholic extract of hemlock-fruit*, E.; *Extrait alcoolique de semence (fruit) de ciguë*, Fr.; *Spirituöses Schierlingsfrucht-Extrakt*, G.

Preparation.—Conium, in No. 40 powder, 1000 Gm.; Acetic Acid 20 Cc.; Diluted Alcohol, a sufficient quantity. Moisten the powder with 300 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until 3000 Cc. of tincture are obtained or until the conium is exhausted. Reserve the first 900 Cc. of the percolate, add the acetic acid to the remainder, and evaporate it, at a temperature not exceeding 50° C. (122° F.) to a soft extract; mix this with the reserved portion in a porcelain capsule, and evaporate at or below the before-mentioned temperature to a pilular consistence.—*U. S.*

25 av. ozs. of the drug should be moistened with about 7½ fluidounces of the menstruum, diluted alcohol, and the first 22 fluidounces of percolate set aside as reserve. The balance of the percolate after addition of 4 fluidrachms of acetic acid should be evaporated to a soft extract at a temperature not above 122° F., the reserve tincture added, and the whole then evaporated to a pilular consistence.

The extract formerly (prior to 1880) recognized under the above title was made from the leaves, and was of slight efficacy and variable strength. By using the green fruit a more reliable preparation is obtained, of which, however, the limits of variation of strength have not been ascertained. The addition of acetic acid is intended to prevent the volatilization of the coniine. The yield is between 15 and 20 per cent.

Extractum conii, *Br.*, is the inspissated juice of the fresh herb, prepared in precisely the same manner as the corresponding inspissated juices of aconite and belladonna. The yield is 3 or 4 per cent.

Uses.—The primary *dose*, of about Gm. 0.10 (gr. ij), may be gradually increased until its operation becomes manifest.

EXTRACTUM CONII FLUIDUM, *U. S.*—Fluid Extract of Conium.

Extractum conii fructus fluidum, U. S. 1870.—*Fluid extract of hemlock-fruit, of conium-seed*, E.; *Extrait liquide de semence (fruit) de ciguë*, Fr.; *Flüssiges Schierlingsfrucht-Extrakt*, G.

Preparation.—Conium in No. 40 powder, 1000 Gm.; Acetic Acid, 20 Cc. Diluted Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 300 Cc.; of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the conium is exhausted. Reserve the first 900 Cc. of the percolate, and, having added the acetic acid to the remainder, evaporate it, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 7½ fluidounces of the menstruum, and the first 22 fluidounces of percolate set aside as reserve; to the balance of the percolate 4 fluidrachms of acetic acid are added before evaporation. The final volume of the finished product should be made up to 24 fluidounces.

A fluid extract, prepared from the fully-developed green fruit of conium, is preferable to that from the leaves. The acetic acid is added to the portion to be evaporated for the purpose of preventing the evaporation of the readily volatile coniine. The fluid extract keeps well, is of a brown-green color, and has the peculiar odor of conium, and this is considerably increased on the addition of potassa.

Uses.—It is a convenient form, and, next to the juice, the most reliable, for the administration of conium. *Dose*, Gm. 0.10–0.40 (♏ij–vj).

EXTRACTUM CONVALLARIÆ FLUIDUM, *U. S.*—Fluid Extract of Convallaria.

Fluid extract of lily-of-the-valley, E.; *Extrait liquide de muguet*, Fr.; *Flüssiges Maiblumenwurzel-Extrakt*, G.

Preparation.—Convallaria, in No. 60 powder, 1000 Gm.; Diluted Alcohol, a sufficient quantity; to make 1000 Cc. Moisten the powder with 400 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the convallaria is exhausted. Reserve the first 800 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs of the drug should be moistened with about 10 fluidounces of the menstruum, and the first 19½ fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

This is one of the new fluid extracts of the Pharmacopœia; experience has shown that diluted alcohol thoroughly exhausts the drug and yields a stable preparation.

Uses.—An efficient preparation of convallaria. *Dose*, Gm. 0.18–0.60 (♏iij–x).

EXTRACTUM CUBEBÆ FLUIDUM, *U. S.*—Fluid Extract of Cubeb.

Extrait liquide de cubèbe, Fr.; *Flüssiges Kubeben-Extrakt*, G.

Preparation.—Cubeb, in No. 60 powder, 1000 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 250 Cc. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until the cubeb is exhausted.

Reserve the first 900 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of powdered cubeb should be moistened with about 6 fluidounces of the menstruum, and the first 22 fluidounces of the percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

This fluid extract should not be confounded with the oleoresin of the same drug, which was formerly recognized as fluid extract; it contains the medicinally active resin, together with most of the volatile oil, is of a dark-green color, and has the odor and taste of cubeb.

Uses.—As a substitute for cubeb this preparation is of doubtful utility, except, perhaps, in chronic affections of the genito-urinary passages. *Dose*, Gm. 0.60–2.00 (♏ x–xxx).

EXTRACTUM CUSSO FLUIDUM, *U. S.*—Fluid Extract of Cusso.

Extractum brayeræ fluidum, U. S. 1880.—*Extractum koso fluidum.*—*Fluid extract of brayera*, E.; *Extrait liquide de cousso*, Fr.; *Flüssiges Koso Extrakt*, G.

Preparation.—Cusso, in No. 40 powder, 1000 Gm.; Alcohol, a sufficient quantity, to make 1000 Cc. Moisten the powder with 400 Cc. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol until the cusso is exhausted. Reserve the first 900 Cc. of the percolate; by means of a water-bath, distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 1000 Cc. —*U. S.*

25 av. ozs. of cusso should be moistened with about 10 fluidounces of menstruum, and the first 22 fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

Alcohol is a good solvent for the active principles of cusso. The fluid extract has a brownish-green color, possesses the unpleasantly bitter and acrid taste of the drug, and if properly made produces only a slight deposit.

Uses.—This preparation is intended to supplant the infusion and decoction of cusso, but its efficacy has not yet been demonstrated. The *dose* may be stated at Gm. 8–12 (ʒij–ʒiij).

EXTRACTUM CYPRIPEDII FLUIDUM, *U. S.*—Fluid Extract of Cypripedium.

Extrait liquide de cypripède de jaune, Fr.; *Flüssiges Gelbfrauenschuh-Extrakt*, G.

Preparation.—Cypripedium, in No. 60 powder, 1000 Gm.; Diluted Alcohol, a sufficient quantity; to make 1000 Cc. Moisten the powder with 350 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until the cypripedium is exhausted. Reserve the first 850 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 9 fluidounces of menstruum, and the first 21 fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

Although the present menstruum is an improvement upon that directed in 1880, yet experience has taught that a mixture of alcohol 2 volumes, water 1 volume will yield better results than either alcohol or diluted alcohol.

It is of a reddish-brown color, with the taste of the drug well marked.

Dose, Gm. 0.60–1.30 (♏ x–xx).

EXTRACTUM DIGITALIS, *U. S.*—Extract of Digitalis.

Extractum digitalis alcoholicum.—*Extrait alcoolique de digitale*, Fr.; *Fingerhut-Extrakt*, G.; *Estratto di digitale*, It.; *Extracto di digitale*, Sp.

Preparation.—Digitalis, recently dried and in No. 60 powder, 1000 Gm.; Alcohol, Water, each, a sufficient quantity. Mix 600 Cc. of alcohol with 300 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until 3000 Cc. of tincture are obtained or the digitalis is exhausted. By means of a water-bath distil off the alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it on a water-bath to a pilular consistence.

25 av. ozs. of digitalis should be moistened with about 10 fluidounces of the menstruum (alcohol 2 volumes, water 1 volume), and percolation continued with the same menstruum until about 75 fluidounces of percolate have been obtained.

The French Codex directs a weaker alcoholic solvent of 60 per cent. by volume. The yield is usually from 22 to 25 per cent. The extract is of a green-brown color, and with ordinary care retains a good consistence without having glycerin incorporated with it. Extractum digitalis, *P. G.*, is the inspissated juice, prepared like Extractum belladonnæ. It is brown, and its weight is equal to that of 3 or 4, or sometimes 5, per cent. of the fresh leaves and branches employed.

Uses.—This extract is rarely used, and probably is less reliable than any other preparation of digitalis. *Dose*, Gm. 0.01 (gr. ¼), and gradually increased.

EXTRACTUM DIGITALIS FLUIDUM, *U. S.*—Fluid Extract of Digitalis.

Extrait liquide de digitale, Fr.; *Flüssiges Fingerhut-Extrakt*, G.

Preparation.—Digitalis, recently dried, in No. 60 powder, 1000 Gm.; Alcohol, Water, each, a sufficient quantity, to make 1000 Cc. Mix 600 Cc. of alcohol with 300 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the digitalis is exhausted. Reserve the first 850 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of digitalis should be moistened with about 10 fluidounces of menstruum, and the first 21 fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

Digitalis not being indigenous to North America, and the leaves varying in activity according to the locality of their growth, the directions of this and the preceding formula to employ recently-dried leaves cannot well be carried out. The fluid extract is of a green-brown color, and a fair representative of digitalis; the precipitate which is formed on standing probably retains little or none of the active principles of the leaves.

Uses.—Its advantages over the tincture, and especially over the infusion, are not very apparent. The *dose* is Gm. 0.06–0.12 (gtt. j–ij).

EXTRACTUM DULCAMARÆ FLUIDUM, *U. S.*—Fluid Extract of Dulcamara.

Fluid extract of bittersweet, E.; *Extrait liquide de douce-amère*, Fr.; *Flüssiges Bittersüss-Extrakt*, G.

Preparation.—Dulcamara, in No. 60 powder, 1000 Gm.; Diluted Alcohol, a sufficient quantity, to make 1000 Cc. Moisten the powder with 400 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the dulcamara is exhausted. Reserve the first 800 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of menstruum, and the first 19½ fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

The fluid extract is of a deep-brown color, and on standing deposits a precipitate which probably contains none of the active principle.

EXTRACTUM DULCAMARÆ, *U. S.* 1870, which has been dismissed from the Pharmacopœia, was made with diluted alcohol, and may be prepared extemporaneously by evaporating the fluid extract; the twigs yield from 20 to 25 per cent. of extract.

Uses.—This fluid extract probably contains all the active elements of dulcamara, and may be prescribed in the *dose* of Gm. 4 (f℥j), largely diluted and gradually increased.

EXTRACTUM ERGOTÆ, *U. S.*—EXTRACT OF ERGOT.

Extractum secalis cornuti, P. G.; *Extractum hæmostaticum.—Extrait d'ergot de seigle*, Fr.; *Mutterkornextrakt*, G.

Preparation.—Fluid Extract of Ergot 150 Cc. Evaporate the fluid extract of ergot in a porcelain capsule by means of a water-bath, at a temperature not exceeding 50° C. (122° F.), constantly stirring, until it is reduced to a pilular consistence.—*U. S.*

Exhaust ergot 10 parts twice by maceration with 8 parts of cold water; evaporate the mixed infusions to 5 parts, add alcohol spec. grav. 0.894, 5 parts, shake well; after three days filter, and evaporate to the consistence of an extract; treat this extract twice with its weight of alcohol, decant the liquid, and evaporate the residue to a thick extract. —*P. G.*

The first formula is based upon observations made by Dr. Squibb (*Proc. Amer. Phar. Assoc.*, 1873, p. 644) with fluid extract of ergot, *U. S. P.*, 1860; this was prepared with diluted alcohol containing some acetic acid, and represented 5 per cent. more of ergot than the present fluid extract. 6 parts of the former yielded 1 part of extract, which was insoluble in cold alcohol, perfectly soluble in diluted alcohol, and easily soluble in water, with the exception of an insignificant residue which could easily be filtered out, the filtrate being of a garnet-red color. Considering the variation of soluble matter in ergot (see below), the yield of extract, strictly prepared in accordance with the above directions, may vary greatly; 16 per cent. is a fair average. It is of a light-brown or reddish-brown color, having the behavior to solvents stated above; on being treated with an alkali the peculiar odor of ergot is strongly increased.

The extract resulting from the second formula is evidently intended to contain the active sclerotic acid in a more concentrated state. The concentrated infusion on being mixed with the quantity of alcohol stated yields a precipitate consisting mainly of inert salts and scleromucin; on treating the extract subsequently with alcohol coloring matters and alkaloidal salts are removed and the sclerotates left in the extract. The yield is about 14 per cent. By treating the concentrated infusion with alcohol, Hirsch (*Vergleichende Übersicht*, 1883, p. 119) obtained from 8.66 to 20, and on an average 15, per cent. of extract.

ERGOTINUM, *Br.*; Ergotin, *E., G.*; Ergotine, *Fr.*—Evaporate 4 fluidounces of liquid extract of ergot to a syrupy consistence; add 4 fluidounces of rectified spirit, filter, and evaporate to a soft extract.—*Br.* To the aqueous infusion of ergot, concentrated to a syrupy liquid, add alcohol until the liquid begins to lose its transparency; agitate, decant, and evaporate.—*F. Cod.* The first is Bonjean's process; the second is very similar to that of the *P. G.* above, the precipitation of the active sclerotates being avoided by lessening the alcohol. (See paper by Prof. Diehl in *Proc. Amer. Phar. Assoc.*, 1881, p. 69).

Uses.—*Ergotin* may be given internally in the dose of Gm. 0.20–0.80 (gr. iij–xij), equivalent to from 30 to 120 grains of ergot. It is also administered hypodermically—5 parts of it being dissolved in 7 parts each of glycerin and water, and filtered. It should be injected deeply into a muscular part after its acidity has been partially neutralized by sodium bicarbonate. In this manner it has been injected into *goitres* with reported success.

EXTRACTUM ERGOTÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF ERGOT.

Extractum ergotæ liquidum, Br.; *Extractum secalis cornuti fluidum*, P. G.; *Extrait liquide d'ergot de seigle*, Fr.; *Flüssiges Mutterkornextrakt*, G.

Preparation.—Ergot, recently ground and in No. 60 powder, 1000 Gm.; Acetic

Acid 20 Cc.; Diluted Alcohol a sufficient quantity, to make 1000 Cc. Moisten the powder with 300 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the ergot is exhausted. Reserve the first 850 Cc. of the percolate, and, having added the acetic acid to the remainder, evaporate to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 7½ fluidounces of diluted alcohol and the first 21 fluidounces of percolate set aside as reserve; to the balance of the percolate 4 fluidrachms of acetic acid are added before evaporation. The final volume of the finished product should be made up to 24 fluidounces.

We fail to see any good reason for increasing the alcoholic strength of the menstruum over that ordered in 1880, it is conceded now that water alone is capable of extracting the valuable constituents of ergot, and hence nothing can be gained by a stronger alcoholic liquid. The advantage of adding an acid to the weak percolate before evaporation is doubtful, and by many is positively denied; acetic acid is, however, less objectionable than hydrochloric acid, formerly employed.

The corresponding preparation of the Br. P. is equally efficient. The following is the formula: Take of ergot, crushed, 1 pound; distilled water 6 pints (Imperial); rectified spirit 6 fluidounces. Digest the ergot in 4 pints of the water for twelve hours; draw off the infusion and repeat the digestion with the remainder of the water; press out, strain, and evaporate the liquors by the heat of a water-bath to 11 fluidounces; when cold add the spirit, allow to stand for an hour to coagulate, then filter. The product should measure 16 fluidounces.—*Br.*

The Germ. Pharm. directs that 100 parts of ergot shall be exhausted with a menstruum composed of 1 part of alcohol and 4 parts of water (both by weight); the first 85 parts of percolate are set aside as reserve and the weak percolate, after addition of 2.4 parts of 25 per cent. hydrochloric acid, is evaporated to a syrup, mixed with enough menstruum to make 15 parts and then added to the reserve tincture.

The large quantity of fixed oil present in ergot is liable to be displaced by percolation with an alcoholic menstruum, but not with water. None of the pharmacopœias direct the removal of the oil; this may be accomplished by exhausting the ergot with ether or petroleum benzin. By evaporating the liquid extract of the Br. P. to the consistence of a soft extract, a preparation agreeing with the ergotin of the French Codex is obtained.

Uses.—This preparation represents the totality of the active elements of ergot. In cases of *uterine inertia* it may be prescribed in the *dose* of Gm. 2–4 (ʒss–ʒj) repeated every fifteen or twenty minutes. To counteract the effects of *spinal hyperæmia* the commencing dose should not be less than Gm. 8 (ʒij) three times a day, and it may be increased to three, or even four, times that quantity.

EXTRACTUM ERIODICTYI FLUIDUM, *U. S.*—Fluid Extract of Eriodictyon.

Fluid extract of yerba santa, E.; *Extrait liquide d'eriodictyon*, Fr.; *Flüssiges Eriodictyon-Extrakt*, G.

Preparation.—Eriodictyon, in No. 60 powder, 1000 Gm.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix 800 Cc. of alcohol with 200 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the eriodictyon is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of the menstruum (alcohol 4 volumes, water 1 volume), and the first 22 fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

This is another of the new official fluid extracts,—it is of a deep brownish-green color, pleasantly aromatic odor and a slightly astringent not disagreeable taste; the menstruum perfectly exhausts the drug and yields a stable preparation.

Uses.—The medicinal virtues of mountain balm remain undiscovered. The fluid extract may be more convenient than chewing the fresh leaf for concealing the bitterness of quinine.

EXTRACTUM EUCALYPTI FLUIDUM, *U. S.*—Fluid Extract of Eucalyptus.

Extrait liquide d'eucalyptus, Fr.; *Flüssiges Eukalyptus-Extrakt*, G.

Preparation.—Eucalyptus, in No. 40 powder, 1000 Gm.; Alcohol, Water each a sufficient quantity, to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the eucalyptus is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc. —*U. S.*

25 av. ozs. of eucalyptus should be moistened with about 10 fluidounces of the menstruum (alcohol 3 volumes, water 1 volume), and the first 22 fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

The new official menstruum yields a more permanent preparation than alcohol alone, as already pointed out by A. Robbins in 1883.

Uses.—This is probably the best form in which eucalyptus can be administered. *Dose* Gm. 0.60–1.20 (♏ x–xx).

EXTRACTUM EUONYMI, *U. S.*—Extract of Euonymus.

Extract of wahoo, E.; *Extrait d'écorce de fusain*, Fr.; *Spillbaumrinden-Extrakt*, G.

Preparation.—Euonymus, in No. 30 powder, 1000 Gm.; Alcohol, Water, each a sufficient quantity. Mix 600 Cc. of alcohol with 300 Cc. of water, and, having moistened the powder with 400 Cc. of the menstruum, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until 3000 Cc. of tincture are obtained or the euonymus is exhausted. By means of a water-bath distil off the alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it, on a water-bath, to a pilular consistence.—*U. S.*

25 av. ozs. of wahoo-bark should be moistened with about 10 fluidounces of menstruum (alcohol 2 volumes, water 1 volume), and percolation with the same menstruum continued until 75 fluidounces of percolate have been obtained.

The new official menstruum is better than diluted alcohol and will thoroughly exhaust the drug, the yield being about 25 per cent. of extract of a brown or yellowish-brown color.

Extractum euonymi siccum, *Br. Add.*: Dry extract of euonymus. 1 pound of euonymus-bark is exhausted with a mixture of equal volumes of rectified spirit and water: the percolate is evaporated to a soft extract, and while still fluid so much sugar of milk is incorporated with it—the amount having been ascertained experimentally—that the final product shall contain 80 per cent. of the dry extractive. Evaporate the mixture until it becomes brittle when cold, and finally reduce the mass to powder.

Uses.—Probably this preparation contains whatever virtues belong to euonymus. *Dose*, about Gm. 0.30 (gr. v).

EXTRACTUM EUPATORII FLUIDUM, *U. S.*—Fluid Extract of Eupatorium.

Fluid extract of boneset, E.; *Extrait liquide d'eupatoire perfoliée*, Fr.; *Flüssiges Durchwachsdosten-Extrakt*, G.

Preparation.—Eupatorium, in No. 40 powder, 1000 Gm.; Diluted Alcohol a sufficient quantity, to make 1000 Cc. Moisten the powder with 400 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the eupatorium is exhausted. Reserve the first 800 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of diluted alcohol, and the first 19½ fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

This fluid extract is of a dark-greenish or brown-red color, and represents the virtues of the drug.

Uses.—This preparation may be used to obtain the tonic effects of eupatorium in the *dose* of Gm. 4 (ʒj).

EXTRACTUM FRANGULÆ FLUIDUM, *U. S.*, *P. G.*—Fluid Extract of Frangula.

Extractum Rhamni Frangulæ liquidum, Br.—*Extrait liquide d'écorce de bourdaine*, Fr.; *Flüssiges Faulbaumrinden-Extrakt*, G.

Preparation.—Frangula, in No. 40 powder, 1000 Gm.; Alcohol, Water, each a sufficient quantity, to make 1000 Cc. Mix 500 Cc. of alcohol with 800 Cc. of water, and, having moistened the powder with 350 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the frangula is exhausted. Reserve the first 800 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 9 fluidounces of menstruum (alcohol 5 volumes, water 8 volumes), and the first 19½ fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

The Pharmacopœia has slightly increased the alcoholic strength of the menstruum over that ordered in 1880; experience has shown that the new menstruum yields a more stable preparation. The fluid extract has a dark brown-red color and sweetish bitter taste.

The Germ. Ph. directs a menstruum of 3 parts of alcohol and 7 parts of water, both by weight.

Extractum rhamni frangulæ, *Br.*—Macerate for two days frangula, in No. 40 powder, 1 pound, with proof spirit 40 fluidounces; percolate with water to obtain 60 fluidounces, and evaporate. *Dose*, Gm. 1–4 (15 to 60 grains).—*Br.*

Extractum rhamni frangulæ liquidum, *Br.*—Boil frangula in coarse powder, 1 pound with three or four quantities of water, until exhausted; evaporate to 12 fluidounces, cool, add rectified spirit 4 fluidounces, and filter. *Dose*, Gm. 4–16 (1 to 4 fluidrachms).

Uses.—The action of this laxative appears to be very uncertain. The *dose* of it is variously stated at Gm. 1–2 (♏ xv–xxx).

EXTRACTUM GELSEMII FLUIDUM, *U. S.*—Fluid Extract of Gelsemium.

Extrait liquide de gelsemium, Fr.; *Flüssiges Gelsemien-Extrakt*, G.

Preparation.—Gelsemium, in No. 60 powder, 1000 Gm.; Alcohol a sufficient quantity to make 1000 Cc. Moisten the powder with 300 Cc. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until the gelsemium is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder to a

soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 7½ fluidounces of alcohol, and the first 22 fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

Alcohol is well adapted for exhausting gelsemium. The fluid extract has a deep red-brown color and the strong odor and bitter taste of the drug.

EXTRACTUM GELSEMII ALCOHOLICUM, *Br.*, is made with rectified spirit. *Dose*, Gm. 0.03–0.12 (½ to 2 grains).

Uses.—If used at all, for which there seems to be no necessity, great caution should be observed, on account of the profound and even fatal depression it has occasioned. The *dose* is from Gm. 0.30–0.60 (♏ v–x), beginning always with the smaller quantity.

EXTRACTUM GENTIANÆ, *U. S., Br., P. G.*—EXTRACT OF GENTIAN.

Extrait de gentiane, Fr.; *Enzian-Extrakt*, G.; *Estratto di genziana*, It.; *Extracto di genciana*, Sp.

Preparation.—Gentian, in No. 20 powder, 1000 Gm; Water, a sufficient quantity. Moisten the powder with 400 Cc. of water, and let it macerate for forty-eight hours; then pack it in a conical percolator, and gradually pour water upon it until the infusion passes but slightly imbued with the properties of the gentian. Reduce the liquid to three-fourths of its weight by boiling, and strain; then by means of a water-bath evaporate to a pilular consistence.—*U. S.*

25 av. ozs. of gentian should be macerated with 10 fluidounces of cold water for forty-eight hours before being packed for percolation.

The British Pharmacopœia alone directs boiling with water for exhausting gentian-root, while the United States, French, and German Pharmacopœias exhaust with cold water, the albumen being removed from the infusion by boiling. The long-continued boiling directed by the U. S. P. until one-fourth of the solution has evaporated is not necessary. Cold water is preferable for exhausting gentian, since it dissolves all of the bitter principle without taking up the whole of the pectin compounds, which enter into solution in hot water. An extract prepared with the latter has a gelatinous appearance, though not in the same degree as if made by prolonged boiling with water. The yield by cold water approaches, or sometimes exceeds, 30 per cent. of the weight of the dry root, and the yellowish-brown extract yields with water a nearly clear solution.

Uses.—This extract contains all the virtues of gentian in a form convenient for administration. It is, however, most generally used as an excipient for other tonics, and especially for iron and quinia. The *dose* is from Gm. 0.16–0.60 (gr. iij–x).

EXTRACTUM GENTIANÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF GENTIAN.

Extrait liquide de gentiane, Fr.; *Flüssiges Enzian-Extrakt*, G.

Preparation.—Gentian, in No. 30 powder, 1000 Gm.; Diluted Alcohol a sufficient quantity, to make 1000 Cc. Moisten the powder with 350 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the gentian is exhausted. Reserve the first 800 Cc. of the percolate. By means of a water-bath distil off the alcohol from the remainder and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of gentian should be moistened with about 9 fluidounces of menstruum, and the first 19½ fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces The bitter principle of gentian is perfectly soluble in water, but a certain amount of alcohol is necessary for preventing fermentation.

Uses.—It may be employed for all the purposes of the bitter tonics, but it is seldom prescribed alone. It may also be used to reinforce the tonic properties of the compound tincture of gentian and other liquid tonic preparations. *Dose*, Gm. 2 (ʒss.)

EXTRACTUM GERANII FLUIDUM, *U. S.*—Fluid Extract of Geranium.

Extrait liquide de géranium maculé, Fr.; *Flüssiges Fleckstorchschnabel-Extrakt*, G.

Preparation.—Geranium, in No. 30 powder, 1000 Gm.; Glycerin 100 Cc.; Diluted Alcohol a sufficient quantity, to make 1000 Cc. Mix the glycerin with 900 Cc. of diluted alcohol, and, having moistened the powder with 350 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and, afterward diluted alcohol, until the geranium is exhausted. Reserve the first 700 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 9 fluidounces of the menstruum (diluted alcohol 21½ fluidounces, glycerin 2½ fluidounces), and the first 17½ fluidounces of percolate set aside as reserve; after the 24 fluidounces of menstruum have been used, percolation is to be continued with diluted alcohol. The final volume of the finished product is to be made up to 24 fluidounces.

It is a dark reddish-brown fluid extract of a strongly astringent taste.

The menstruum of 1880 has been retained, although A. Robbins in 1883 pointed out that an increase in the alcoholic strength would no doubt overcome the tendency to partial gelatinization, and even suggested the entire omission of water.

Uses.—Fluid extract of geranium is an excellent substitute for the liquid preparations of catechu and other simple astringents. *Dose*, from Gm. 2–8 (ʒss–ij).

EXTRACTUM GLYCYRRHIZÆ, *U. S., Br.*—Extract of Glycyrrhiza.

Succus liquoritiæ, P. G.; *Extractum liquiritiæ.—Liquorice*, *Extract of liquorice*, E.; *Suc* (*jus*) *de réglisse*, *Sucre noir*, Fr.; *Lakriz*, *Lakrizensaft*, G.; *Estratto di liquirizia*, It.

The commercial extract of the root of Glycyrrhiza glabra, *Linné*.

Preparation.—Liquorice is prepared for commercial purposes in the southern portion of Europe and in this country. The fresh root is mostly employed, but the dried root will likewise answer the purpose. The root is crushed to a pulpy mass or broken into a coarse powder, and then boiled with water over a naked fire or by steam. The liquor is expressed, allowed to settle, and decanted, or, for the common qualities, together with the fine pulpy matter evaporated by boiling and continued stirring until the mass has attained the proper consistence to be rolled out into sticks of a certain weight, a portion of olive oil being used to prevent it from adhering to the hands and the table. The sticks are made of an adopted length and thickness, stamped with the initials or name of the manufacturer or of the town where the factory is located, and finally dried. Russian liquorice-root is likewise used in the manufacture of liquorice.

On exhausting the root with hot or cold water hygroscopic extracts are obtained, but on treating the root now with steam Delondre (1856) observed that a considerable amount of matter was dissolved, which, on evaporating the solution, was friable, without attracting moisture, and had a sweet taste without acridity. It is this substance, consisting of altered glycyrrhizin, together with the starch contained in the root, which gives firmness to the commercial extract. Previous to 1878 over 1,000,000 pounds of liquorice were annually imported into the United States. Since 1878 the quantity imported has varied between 692,919 and 874,044 pounds in 1881, and a considerable quantity is manufactured here.

Description.—Liquorice appears in commerce packed in boxes between layers of laurel-leaves (Laurus nobilis, *Linné*,) to prevent the sticks from adhering; in Southern Russia oak-leaves are used for the same purpose. Besides the liquorice of American manufacture, two principal varieties are distinguished in our commerce, the *Sicilian* and *Calabrian* or *Spanish*. The former is in thin sticks 6 to 9 Mm. (¼ to ⅜ inch) in diameter, of a dull-black color, frequently of an empyreumatic taste, and generally very impure. The latter is in larger sticks, 15 to 25 Mm. (⅝ to 1 inch) in diameter, 15 to 17 Cm. (6 to 6¾ inches) long, black and somewhat glossy externally, slightly flexible except at a low temperature, and breaking with a sharp conchoidal and shining fracture;

some small cavities may usually be found in the interior. The products of the different manufacturers of this liquorice differ from one another not only in the size of the sticks, but often by marked differences in their odor and taste; while some specimens are almost purely sweet, others are persistently acrid and empyreumatic. For medicinal purposes liquorice should be almost devoid of acridity.

Placed in cold water, a portion of the liquorice is dissolved, but the residue retains the shape of the sticks; after the addition of a little ammonia to the water, Rump (1855) observed the liquid to become again colored, and again to acquire a sweet taste from dissolving fresh portions of glycyrrhizin. The amount soluble in cold water varies considerably, and reaches in the best brands about 70 to 75 per cent. of the dried liquorice, but the percentage is usually a little less than this. "Not less than 60 per cent. of the extract should be soluble in cold water."—*U. S.* "After drying 100 parts of liquorice at 100° C. (212° F.) it should weigh at least 83 parts. On exhausting air-dry liquorice with water of not over 50° C. (122° F.), the residue dried in a water-bath should not exceed 25 per cent., and when examined under the microscope should not show any starch-granules."—*P. G.*

Under the name of *Italian liquorice* an impure article in thin sticks is met with, and the so-called *refined liquorice* of the shops is in still thinner cylindrical and glossy pieces, likewise impure and readily attacked by insects. *Pontefract cakes* are small liquorice lozenges which are much used in England. *Corigliano* and *Barracco* are the foreign brands most esteemed in the United States; *Solazzi* juice is highly valued in England.

Constituents.—Liquorice contains glycyrrhizin, free (soluble in ammonia) and in combination with ammonia (soluble in cold water); also starch, modified by long boiling, sugar, a little acrid resinous matter, from 8.4 to 17 per cent. of moisture, and from 6 to 9 per cent. of ash. Madsen (1881) treated the concentrated aqueous solution of liquorice with cold alkaline solution of copper, ignited the precipitate, and calculated the sugar from the cupric oxide obtained; the amount varied between 11 and 15 per cent., which is probably too high. For estimating the gum, the infusion was precipitated by alcohol, the well-washed precipitate dissolved in water, this solution precipitated by cupric sulphate and soda, the precipitate washed with dilute soda, dissolved in hydrochloric acid, and this solution precipitated by alcohol; good liquorice yielded from 1.5 to 4.4 per cent. of arabin.

Impurities and Adulterations.—Fragments of vegetable tissue are generally present to some extent; shreds of copper are sometimes also met with, and result from careless scraping of the evaporating-pans. The fraudulent additions usually consist of farinaceous matters, gum, glucose, and mineral compounds; the latter are estimated in the ash. Starch may sometimes be seen in little lumps in the interior of the sticks, and if not altered by heat may be recognized by the microscope. Gum added fraudulently is detected in the precipitate which takes place on the addition of an equal bulk of alcohol to the cold aqueous solution (see above). Grape-sugar will cause the solution of liquorice in cold water to be of a lighter color; it may be estimated after removing gum by alcohol and glycyrrhizin by sulphuric acid.

EXTRACTUM GLYCYRRHIZÆ PURUM, *U. S.*—Pure Extract of Glycyrrhiza.

Extrait de réglisse, Fr.; *Süssholz-Extrakt*, G.

Preparation.—Glycyrrhiza, in No. 20 powder, 1000 Gm.; Ammonia-water, 150 Cc.; Distilled Water a sufficient quantity. Mix the ammonia-water with 1000 Cc. of distilled water, and having moistened the powder with 1000 Cc. of the menstruum, let it macerate for twenty-four hours. Then pack it moderately in a cylindrical glass percolator, and gradually pour upon it, first, the remainder of the menstruum, and then distilled water, until the glycyrrhiza is exhausted. Lastly, by means of a water-bath, evaporate the infusion to a pilular consistence.—*U. S.*

The ammonia is intended to dissolve any glycyrrhizin which may be present in the powdered root in the insoluble condition, and to prevent its becoming insoluble from the loss of ammonia during evaporation. The yield is from 16 to 20, or even 25, per cent. The extract is of a brown color and of a sweet taste; it is used for preparing Mistura glycyrrhizæ composita, *U. S.* It yields a clear solution with water, as does also the following:

Other Extracts of Liquorice.—Extractum glycyrrhizæ, *Br.*; Extractum liquiritiæ radicis, *P. G.* 1872. This extract is practically identical with that of the French Codex, except that

the latter exhausts the root by displacement with distilled water at a temperature of 15° to 20° C. (59° to 68° F.); the following is the formula: Take of liquorice-root, in No. 20 powder, 1 pound; distilled water, 4 pints. Macerate the liquorice-root with 2 pints of the water for 12 hours, strain, and press; again macerate the pressed marc with the remainder of the water for 6 hours, strain, and press. Mix the strained liquors, heat them to 100° C. (212° F.), and strain through flannel; then evaporate by a water-bath until the extract is of a suitable consistence for forming pills.—*Br.*

Succus liquiritiæ depuratus, *P. G.*, s. Extractum glycyrrhizæ depuratum.—Purified liquorice, *E.*: Extrait de suc de réglisse, *Fr.*; Gereinigter Lakriz, *G.*—It is recognized by several European pharmacopœias, and is made by alternately placing layers of washed straw and broken liquorice in a cylindrical vessel and covering the material with cold water. As the water becomes saturated it is withdrawn through a faucet below, and replaced by fresh water until but little color and taste are imparted to it. The perfectly clear liquids are then evaporated to the consistence of an extract, which should yield a clear solution with water. The yield is 50 to 60 per cent. For convenience in dispensing, a concentrated solution of definite strength is often kept on hand. To remove the resinous matter, which imparts a disagreeable acrid taste, Ungewitter (1875) suggests the digesting of the stick liquorice in strong alcohol and afterward exhausting it with cold water.

Elixir e succo liquiritiæ, *P. G.* Purified liquorice 10 parts is dissolved in 30 parts of fennel-water; the solution is mixed with anisated spirit of ammonia 10 parts.

Uses.—Extract of liquorice is protective, lenitive, and demulcent; it also excites the secretions of the fauces, and perhaps of the larynx. It is chiefly employed in irritable conditions of these parts, in *sore throat*, *laryngitis*, and *bronchitis*. It may be conveniently used by allowing small fragments of it to dissolve in the mouth, or by adding it to the various syrups, lozenges, and mixtures appropriate to these objects. It sometimes appears to prevent *flatulence* depending upon fermentation of the food, for which purpose a piece as large as a grain of wheat may be taken after meals. "Pure extract of liquorice" (*U. S. P.* 1890) is still more appropriate to the purposes designated than the ordinary extract.

EXTRACTUM GLYCYRRHIZÆ FLUIDUM, *U. S.*—Fluid Extract of Glycyrrhiza.

Extractum glycyrrhizæ liquidum, Br.—*Liquid extract of liquorice-root*, E.; *Extrait liquide de réglisse*, Fr.; *Flüssiges Süssholz-Extrakt*, G.

Preparation.—Glycyrrhiza, in No. 40 powder, 1000 Gm.; Ammonia-water, 50 Cc.; Alcohol, Water, each, a sufficient quantity, to make 1000 Cc. Mix the ammonia-water with 300 Cc. of alcohol and 650 Cc. of water, and, having moistened the powder with 350 Cc. of the mixture, pack it firmly in a cylindrical glass percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then a mixture of alcohol and water made in the proportion of 300 Cc. of alcohol and 650 Cc. of water, until the glycyrrhiza is exhausted. Reserve the first 750 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough of the mixture of alcohol and water to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of liquorice-root should be moistened with about 9 fluidounces of the menstruum composed of alcohol 7⅛ fluidounces, water 15¾ fluidounces, and ammonia-water 1⅛ fluidounces; when this quantity of menstruum has been used, percolation is continued with a mixture of 3 volumes of alcohol and 6½ volumes of water. The first 18½ fluidounces of percolate should be set aside as reserve, and the final volume of finished product made up to 24 fluidounces.

The present official menstruum is decidedly preferable to that of 1880 in containing less alcohol.

Take of liquorice-root, in No. 20 powder, 1 pound; distilled water 4 pints. Macerate the liquorice-root with 2 pints of the water for twelve hours, strain, and press; again macerate the pressed marc with the remainder of the water for six hours, strain, and press. Mix the strained liquors, heat them to 212° F., and strain through flannel; then evaporate by a water-bath until it has acquired, when cold, a specific gravity of 1.160; add to this one-sixth of its volume of rectified spirit; let the mixture stand for twelve hours, and filter.—*Br.*

Uses.—The fluid extract of liquorice-root is a very agreeable substitute for the simple extract of liquorice in flavoring cough medicines and concealing acrid tastes.

Elixir of liquorice is too stimulating to be used in the former, but may be used advantageously in the latter, manner.

EXTRACTUM GOSSYPII RADICIS FLUIDUM, *U. S.*—Fluid Extract of Cotton-root Bark.

Extrait liquide d'écorce de cotonnier, Fr.; *Flüssiges Baumwollwurzel-Extrakt*, G.

Preparation.—Cotton-root Bark in No. 30 powder, 1000 Gm.; Glycerin 250 Cc.; Alcohol a sufficient quantity; to make 1000 Cc. Mix the glycerin with 750 Cc. of alcohol, and, having moistened the powder with 500 Cc. of the mixture, pack it firmly in a cylindrical percolator and pour on the remainder of the menstruum. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, and when the liquid in the percolator has disappeared from the surface gradually pour on alcohol, and continue the percolation until the cotton-root bark is exhausted. Reserve the first 700 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of cotton-root bark should be moistened with about 12 fluidounces of menstruum, composed of alcohol 18 fluidounces and glycerin 6 fluidounces, and when this menstruum has all been used, percolation is to be continued with alcohol. The first 17½ fluidounces of percolate should be set aside as reserve, and the final volume of finished product made up to 24 fluidounces.

The present official menstruum is better than that of 1880 in containing less glycerin, but experience has shown that a most satisfactory fluid extract will be obtained if a menstruum be employed composed of alcohol 6 volumes, water 3 volumes, and glycerin 1 volume.

Fresh or recently-dried bark appears to yield a more effectual preparation than old bark. The fluid extract has a bright brownish-red color.

Uses.—It is used chiefly as a substitute for ergot, as an oxytocic and emmenagogue, and may be given in the *dose* of Gm. 2 (fʒsss) or more.

EXTRACTUM GRINDELIÆ FLUIDUM, *U. S.*—Fluid Extract of Grindelia.

Extrait liquide de grindélia, Fr.; *Flüssiges Grindelienextrakt*, G.

Preparation.—Grindelia, in No. 30 powder, 1000 Gm.; Alcohol, a sufficient quantity, to make 1000 Cc. Moisten the powder with 300 Cc. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until the grindelia is exhausted. Reserve the first 850 Cc. of the percolate, evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 7½ fluidounces of alcohol, and the first 21 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

The official menstruum has been changed to pure alcohol in conformity with the suggestions of A. Robbins and others, who found the fluid extract to keep better when made with alcohol alone; some authorities still claim, however, that a mixture of alcohol 3 volumes and water 1 volume is a better menstruum.

This fluid extract is of a brown-green color. The active principles are, most likely, volatile oil and resin, and these require alcohol for solution.

Uses.—This preparation contains all the virtues of grindelia. *Dose*, Gm. 0.60–1.20 (♏ x–xx).

EXTRACTUM GUARANÆ FLUIDUM, *U. S.*—Fluid Extract of Guarana.

Extrait liquide de guarana, Fr.; *Flüssiges Guarana-Extrakt*, G.

Preparation.—Guarana, in No. 60 powder, 1000 Gm.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water, and,

having moistened the powder with 200 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the guarana is exhausted. Reserve the first 800 Cc. of the percolate. By means of a water-bath distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of guarana should be moistened with about 5 fluidounces of menstruum (alcohol 3 volumes, water 1 volume), and the first 19½ fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

Fluid extract of guarana has been in use for a number of years, but in the endeavor to obtain it as little alcoholic as possible many of the preparations formerly used gradually formed heavy deposits. Experience has shown that the present official menstruum yields very satisfactory results; the alcoholic strength very closely approaches that suggested by A. Robbins in 1883, which was 2 parts of alcohol and 1 of water, by weight.

The fluid extract is of a deep red-brown color and has an astringent and bitter taste.

Uses.—It represents guarana efficiently. *Dose*, Gm. 0.60–1.20 (♏ x–xx) and upward.

EXTRACTUM HÆMATOXYLI, *U. S.*, *Br.*—Extract of Hæmatoxylon.

Extractum ligni campechiani.—Extract of logwood, E.; *Extrait de bois de Campéche*, Fr.; *Campecheholz-Extrakt*, G.

Preparation.—Hæmatoxylon, rasped, 1000 Gm.; Water, 1000 Cc. Macerate the hæmatoxylon with the water for forty-eight hours. Then boil, avoiding the use of metallic vessels, until one-half of the water has evaporated; strain the decoction while hot, and evaporate to dryness.—*U. S.*

25 av. ozs. of rasped logwood should be macerated with 2 gallons of water for forty-eight hours, and then boiled, as directed above.

This process somewhat corresponds with that of the British Pharmacopœia, which orders infusion with boiling distilled water for twenty-four hours, boiling to one-half, and finally evaporating by a water-bath, stirring with a wooden spatula. The yield is about 12 per cent., occasionally as low as 6 per cent. The extract is not hygroscopic; it is of a red-brown color and a sweet afterward astringent taste. It yields with water a red and almost clear solution. It is prepared on a large scale for uses in the arts. (For composition compare Hæmatoxylon.)

Uses.—The extract has the medicinal qualities of the wood, and does not lose them by keeping. It may be administered in *doses* of Gm. 0.60 (gr. x) or more, and in solution rather than in pills, which in time grow very hard.

EXTRACTUM HAMAMELIDIS FLUIDUM, *U. S.*—Fluid Extract of Hamamelis.

Extractum Hamamelidis liquidum, Br. Add.—*Liquid extract of hamamelis*, E.; *Extrait liquide de hamamélis*, Fr.; *Flüssiges Hamamelis-Extrakt*, G.

Preparation.—Hamamelis, in No. 40 powder, 1000 Gm.; Glycerin, 100 Cc.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix the glycerin with 500 Cc. of alcohol and 800 Cc. of water, and, having moistened the powder with 350 Cc. of the mixture, pack it firmly in a percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then a mixture of alcohol and water, made in the proportion of 500 Cc. of alcohol to 800 Cc. of water, until the hamamelis is exhausted. Reserve the first 850 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with abont 9 fluidounces of menstruum, composed of alcohol 8¼ fluidounces, water 13¼ fluidounces, glycerin 2½ fluidounces, and

the first 21 fluidounces of percolate set aside as reserve. Subsequent percolation is to be continued with a mixture of alcohol 5 volumes and water 8 volumes, and the final volume of finished product should be made up to 24 fluidounces.

The Br. Ph. directs a menstruum composed of 1 volume alcohol, sp. gr. 0.838 (rectified spirit) and 2 volumes of water, to be used for exhausting the leaves.

This fluid extract is of a brown color, and has the astringent and bitter taste of the leaves. The substitution of glycerin for a portion of the water will probably give a better menstruum and yield a more permanent preparation.

Uses.—This preparation contains all the virtues of hamamelis, which is elsewhere described. *Dose*, Gm. 0.60–1.20 (♏ x–xx).

EXTRACTUM HYDRASTIS FLUIDUM, *U. S., P. G.*—Fluid Extract of Hydrastis.

Extractum Hydrastis liquidum, Br. Add.—*Extrait liquide de hydrastis*, Fr.; *Flüssiges Hydrastis-Extrakt*, G.; *Estratto di idraste liquido*, It.

Preparation.—Hydrastis, in No. 60 powder, 1000 Gm.; Glycerin, 100 Cc.; Alcohol, Water, each a sufficient quantity, to make 1000 Cc. Mix the glycerin with 600 Cc. of alcohol and 300 Cc. of water, and, having moistened the powder with 300 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then a mixture of alcohol and water, made in the proportion of 600 Cc. of alcohol to 300 Cc. of water, until the hydrastis is exhausted. Reserve the first 850 Cc. of the percolate. By means of a water-bath, distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 7½ fluidounces of menstruum, composed of alcohol 14¼ fluidounces, water 7¼ fluidounces, glycerin 2½ fluidounces, and the first 21 fluidounces of percolate set aside as reserve. Subsequent percolation is to be continued with a mixture of alcohol 2 volumes, water 1 volume, and the final volume of finished product should be made up to 24 fluidounces.

The introduction of glycerin into the official menstruum will prove of decided advantage and add to the permanency of the preparation.

The fluid extract of the Br. Pharm. is prepared with diluted alcohol.

The Germ. Pharm. directs the extraction of hydrastis with a mixture of 7 parts of alcohol and 3 parts of water, both by weight.

The fluid extract has a deep brown-yellow color and the strongly bitter taste of the root.

Uses.—This is a convenient and efficient form of the medicine. *Dose*, Gm. 4 (f℥j) two or three times a day.

EXTRACTUM HYOSCYAMI ALCOHOLICUM, *U. S., Br.*—Extract of Hyoscyamus.

Extract of henbane, E.; *Extrait alcoolique de feuilles de jusquiame*, Fr.; *Spirituöses Bilsenkraut-Extrakt*, G.; *Estratto di giusquiamo*, It.

Preparation.—Hyoscyamus, recently dried, in No. 60 powder, 1000 Gm.; Alcohol, 2000 Cc.; Water, 1000 Cc.; Diluted Alcohol, a sufficient quantity. Mix the alcohol and water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then diluted alcohol, until 3000 Cc. of tincture are obtained or the hyoscyamus is exhausted. Reserve the first 900 Cc. of the percolate, evaporate the remainder, at a temperature not exceeding 50 C. (122° F.), to a soft extract; mix this with the reserved portion, and evaporate, at or below the before-mentioned temperature, to a pilular consistence.—*U. S.*

25 av. ozs. of the drug should be moistened with about 16 fluidounces of the menstruum composed of alcohol 3 pints, water 1½ pints, and, after 4½ pints of menstruum

have been used, percolation is to be continued with diluted alcohol; about 72 fluidounces of percolate will be necessary.

Since diluted alcohol will completely exhaust hyoscyamus-leaves, we see no reason why the menstruum for this and the next following preparation should not have been reduced to alcohol 3 volumes, water 2 volumes; moreover, experience has shown this weaker menstruum to yield very satisfactory results.

The extract has a green-brown color and the heavy odor of hyoscyamus. The leaves yield from 20 to 26 per cent. of extract, the seed about 16 per cent.; the latter extract is used to some extent in Europe.

EXTRACTUM HYOSCYAMI, *Br.*, *P. G.*, is the inspissated juice of the fresh leaves and branches prepared like the inspissated juices of other narcotic herbs. The yield varies from 2.5 to 3.5 or 4 per cent. The color of the extract is brown-green (*Br.*) or greenish-brown (*P. G.*).

The crystals observed in old extracts, according to Attfield (1862), are potassium nitrate.

Uses.—This preparation, like the former simple extract, is one of the most variable in strength of all narcotic extracts. Its minimum *dose*, Gm. 0.10 (gr. ij), should be rapidly increased until the characteristic effects of the medicine are produced.

EXTRACTUM HYOSCYAMI FLUIDUM, *U. S.*—FLUID EXTRACT OF HYOSCYAMUS.

Extrait liquide de jusquiame, Fr.; *Flüssiges Bilsenkraut-Extrakt*, G.

Preparation.—Hyoscyamus, in No. 60 powder, 1000 Gm.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix 2000 Cc. alcohol with 1000 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the hyoscyamus is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of menstruum (alcohol 2 volumes, water 1 volume), and the first 22 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

(For remarks concerning the menstruum see preceding article.)

The fluid extract is of a deep green-brown color, has the heavy odor of the drug, and keeps well.

Uses.—The fluid extract is a good representative of hyoscyamus, and may be prescribed in *doses* of from Gm. 0.30–0.60 (℥ v–x), and increased if necessary.

EXTRACTUM IPECACUANHÆ FLUIDUM, *U. S.*—FLUID EXTRACT OF IPECAC.

Extrait liquide d'ipécacuanha, Fr.; *Flüssiges Ipecacuanha-Extrakt*, G.

Preparation.—Ipecac, in No. 80 powder, 1000 Gm.; Alcohol, Water, each, a sufficient quantity; to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water, and, having moistened the powder with 350 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the ipecac is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of ipecac should be moistened with about 9 fluidounces of menstruum (alcohol 3 volumes, water 1 volume), and the first 22 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

The present official formula yields a fluid extract more truly representative of the drug

than the last: fluid extract of ipecac is chiefly used by the pharmacist for preparing the syrup and wine, and as the present fluid extract will not mix clear with syrup or weak alcoholic liquids, the Pharmacopœia has modified the formulas for all preparations containing fluid extract of ipecac, so that clear liquids may be obtained.

The difficulty was at one time supposed to arise from a so-called resin in ipecac, but the opinion now prevails that it is due to a decomposition-product of a peculiar pectin compound, and that heat is one of the chief causes of the changes produced in this inert principle. A mixture of alcohol 3 volumes and water 1 volume has been found to exhaust ipecac-root very much better than alcohol alone, and as now made only a very small portion of the extractive will be subjected to heat.

Uses.—Fluid extract of ipecacuanha is a convenient addition to expectorant mixtures, but hardly as much so as the syrup, to the preparation of which, indeed, it is essential. The *dose*, as an emetic for children, is about Gm. 1.20–2.00 (♏xx–xxx); as an expectorant Gm. 0.30 (♏v).

EXTRACTUM IRIDIS, *U. S.*—Extract of Iris.

Extract of blue flag, E.; *Extrait d'iris varié*, Fr.; *Schwertel-Extrakt*, G.

Preparation.—Iris, in No. 60 powder, 1000 Gm.; Alcohol, a sufficient quantity. Having moistened the powder with 400 Cc. of alcohol, pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until 3000 Cc. of tincture are obtained or the iris is exhausted. By means of a water-bath distil off the alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it, on a water-bath, to a pilular consistence.—*U. S.*

25 av. oz. of the drug should be moistened with about 10 fluidounces of alcohol and percolation continued to exhaustion. About 75 fluidounces of percolate will be necessary.

From what is known of the constituents of the drug, the menstruum should be efficient for extracting the active constituents. The extract is of a dark-brown color.

Uses.—It is laxative in the *dose* of Gm. 0.12–0.20 (gr. ij–iij).

EXTRACTUM IRIDIS FLUIDUM, *U. S.*—Fluid Extract of Iris.

Fluid extract of blue flag, E.; *Extrait liquide d'iris varié*, Fr.; *Flüssiges Schwertelextrakt*, G.

Preparation.—Iris, in No. 60 powder, 1000 Gm.; Alcohol, a sufficient quantity, to make 1000 Cc. Having moistened the powder with 400 Cc. of alcohol, pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the iris is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder, on a water-bath, to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of alcohol, and the first 22 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

The menstruum used is the same as for the preceding preparation. The fluid extract is of a deep red-brown color. Using alcohol for exhausting the drug, W. E. Jenks (1881) obtained a dark reddish-brown *oleoresin* of a thick viscid consistence and of a peculiar odor; by dissolving this in ether, filtering, and evaporating, it became comparatively free from astringency.

Uses.—It may be employed as a laxative in the *dose* of Gm. 0.60–1.20 (♏x–xx).

EXTRACTUM JALAPÆ, *U. S., Br.*—Extract of Jalap.

Extrait de jalap, Fr.; *Jalapen-Extrakt*, G.

Preparation.—Jalap, in No. 60 powder, 1000 Gm.; Alcohol a sufficient quantity. Moisten the powder with 350 Cc. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having

closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until the jalap is exhausted. Reserve the first 900 Cc. of the percolate, evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to 100 Cc., add the reserved portion, and evaporate, at or below the above-mentioned temperature, until an extract of a pilular consistence remains.—*U. S.*

25 av. ozs. of jalap should be moistened with about 9 fluidounces of alcohol, and the first 22 fluidounces of percolate set aside as reserve; the balance of the percolate is to be evaporated to 2½ fluidounces before mixing it with the reserve portion for final evaporation to a pilular consistence.

Jalap, in coarse powder, 1 pound; Rectified Spirit 4 pints; Distilled Water 1 gallon. Macerate the jalap in the spirit for seven days, press out the tincture, then filter, and distil off the spirit, leaving a soft extract. Again macerate the residual jalap in the water for four hours, express, strain through flannel, and evaporate by a water-bath to a soft extract. Mix the two extracts, and evaporate at a temperature not exceeding 140° F. until it has acquired a suitable consistence for forming pills.—*Br.*

No advantage whatever results from treating jalap with water after it has been exhausted by alcohol. 240 grains of such an aqueous extract were taken by A. B. Taylor (1864) in the course of eight hours without producing any noticeable effect. Alcohol alone will yield between 12 and 18 or 22 per cent. of active extract, and cold water will subsequently extract 30 to 35 per cent. of inert matter. The supposed advantage is due to an erroneous conception of the statement that the aqueous extract was possessed of mild purgative and diuretic properties: this statement is correct as far as it applies to that portion of the aqueous extract soluble in alcohol, or, what is the same thing, to the aqueous extract of the alcoholic extract. The watery washing obtained in the preparation of resin of jalap when evaporated to the consistence of an extract would serve a useful purpose in the treatment of children and weak adults.

Uses.—This preparation contains all the virtues of jalap in about half the bulk, and may be substituted for it in all prescriptions. The *dose* is Gm. 0.30–1.00 (gr. v–xv).

EXTRACTUM JUGLANDIS, *U. S.*—Extract of Juglans.

Extract of butternut, E.; *Extrait d'écorce de noyer gris*, Fr.; *Butternussrinden-Extrakt*, G.

Preparation.—Juglans, in No. 30 powder, 1000 Gm.; Diluted Alcohol a sufficient quantity. Moisten the powder with 400 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding diluted alcohol until 3000 Cc. of tincture are obtained or the juglans is exhausted. By means of a water-bath distil off the alcohol from the tincture, and having placed the residue in a porcelain capsule, evaporate it on a water-bath to a pilular consistence.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of menstruum (diluted alcohol), and about 75 fluidounces of percolate obtained.

The Pharmacopœia has changed the menstruum for this extract; already, in 1881, B. F. Moise, Jr. (*Proc. A. P. A.*, 1881, p. 71), called attention to the fact that diluted alcohol yields a more efficient preparation, and that the large amount of fixed oil extracted by pure alcohol caused the extract to remain plastic and prevented its adherence to the spatula. Manufacturers have long since employed diluted alcohol as the solvent, which menstruum also increases the yield about 30 per cent.

The yield is from 12 to 15 per cent.; the extract is of a blackish-brown color and bitter taste.

Uses.—It is a mild cathartic in the dose of Gm. 1.30–2 (gr. xx–xxx), and is said to be peculiarly appropriate for relieving habitual costiveness.

EXTRACTUM KRAMERIÆ, *U. S., Br.*—Extract of Krameria.

Extractum ratanhiæ.—Extract of rhatany, E.; *Extrait de ratanhia*, Fr.; *Ratanha-Extrakt*, G.

Preparation.—Krameria, in No. 40 powder, 1000 Gm.; Water, a sufficient quantity. Moisten the powder with 300 Cc. of water, pack it in a conical glass percolator, and gradually pour water upon it until the infusion passes but slightly imbued with the astringency of the krameria. Heat the liquid to the boiling-point, strain, and by means

of a water-bath, at a temperature not exceeding 70° C. (158° F.), evaporate to dryness.—*U. S.*

25 av. ozs. of krameria should be moistened with about 7½ fluidounces of water before being packed in a percolator.

The processes of the other pharmacopœias are practically identical with this, but the Br. P. and Fr. Cod. order distilled in place of common water.

It is important that the root be exhausted with *cold* water. Hot water will yield about 5 or 6 per cent. more extract, which, however, is but incompletely soluble in water, while the official extract yields a somewhat turbid solution with warm water, but a clear solution in the presence of sugar. The amount of extract obtainable depends on the size and the variety of rhatany-root used, the woody part of which contains but little soluble matter. The smaller branches of Peruvian rhatany yield about 12 per cent. of *dry* extract, but the thick main root yields only 5 or 6 per cent.; Savanilla and Para rhatany give a larger yield, about 12 to 15 per cent. The extract is of a red-brown color, glossy, resembling kino in appearance, and is not hygroscopic. Iron utensils must not be used in its preparation.

Uses.—This extract is a convenient form of krameria in nearly all of the cases for which that medicine is appropriate. The *dose* is from Gm. 0.30–1.30 (gr. v–xx), the smaller dose being frequently repeated.

EXTRACTUM KRAMERIÆ FLUIDUM, *U. S.*—Fluid Extract of Krameria.

Fluid extract of rhatany, E.; *Extrait liquide de ratanhia*, Fr.; *Flüssiges Ratanha-Extrakt*, G.

Preparation.—Krameria, in No. 30 powder, 1000 Gm.; Glycerin, 100 Cc.; Diluted Alcohol, a sufficient quantity, to make 1000 Cc. Mix the glycerin with 900 Cc. of diluted alcohol, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical glass percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward diluted alcohol, until the krameria is exhausted Reserve the first 700 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of krameria should be moistened with about 10 fluidounces of menstruum (diluted alcohol 21½ fluidounces, glycerin 2½ fluidounces), and when the original menstruum has all been used, percolation is to be continued with diluted alcohol; the first 17½ fluidounces of percolate should be set aside as reserve, and the final volume of finished product made up to 24 fluidounces.

The reduction of glycerin in the menstruum to nearly one-half the quantity ordered in 1880 is in accordance with the suggestions of A. Robbins in 1883, and has been found advantageous.

It is of a deep brownish-red color and strongly astringent taste.

Uses.—It has the advantage over the tincture of being more astringent and less stimulant. *Dose*, Gm. 2 (f℥ss).

EXTRACTUM LACTUCÆ, *Br.*—Extract of Lettuce.

Extractum lactucæ virosæ; Thridacium.—Extrait des feuilles de laitue vireuse, Fr.; *Gift-lattich-Extrakt*, G.; *Estratto di lattuca vérosa*, It.

Preparation.—The formula of the British Pharmacopœia is identical with that for the inspissated juices of the other narcotic herbs (see page 648). The extract contains the chlorophyll and is completely soluble in water. The French Codex directs the removal of the chlorophyll and albumen, and obtains an extract of a dark-brown color which yields with water a somewhat turbid solution. The yield is about 3 or 4 per cent.

Extrait de laitue, Thridace, *F. Cod.*, is made in the same manner from the cortical portion of the stem of cultivated lettuce, and is sometimes called *French lactucarium;* the yield is about 1½ per cent.

Uses.—Like all the medicinal preparations of lettuce, it is an extremely feeble hypnotic. *Dose*, Gm. 0.30 (gr. v).

EXTRACTUM LAPPÆ FLUIDUM, *U. S.*—Fluid Extract of Lappa.

Fluid extract of burdock, E.; *Extrait liquide de bardane*, Fr.; *Flüssiges Klettenwurzel-Extrakt*, G.

Preparation.—Lappa, in No. 60 powder, 1000 Gm.; Diluted Alcohol, a sufficient quantity; to make 1000 Cc. Moisten the powder with 400 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow percolation to proceed, gradually adding diluted alcohol, until the lappa is exhausted. Reserve the first 800 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of menstruum, and the first 19½ fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

Experience has shown that diluted alcohol perfectly exhausts burdock-root, yielding a very satisfactory preparation.

Dose, Gm. 2 to 8 (f℥ss–℥ij).

EXTRACTUM LEPTANDRÆ, *U. S.*—Extract of Leptandra.

Extrait de leptandra, Fr.; *Leptandra-Extrakt*, G.

Preparation.—Leptandra, in No. 40 powder, 1000 Gm.; Alcohol, Water, each a sufficient quantity. Mix 750 Cc. of alcohol with 250 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the leptandra is exhausted. By means of a water-bath distil off the alcohol from the tincture, and, having placed the residue in a porcelain capsule, evaporate it on a water-bath to a pilular consistence.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of menstruum composed of alcohol 3 volumes and water 1 volume, and percolation continued to exhaustion with the same mixture.

This extract is evidently intended to take the place of the so-called leptandrin of commerce, which is of variable composition. By simply evaporating a tincture of leptandra it is extremely difficult to obtain a pulverizable extract, as pointed out by Dr. Greve and by Prof. Lloyd (1880), owing to the large amount of glucose present. The yield is about 10 per cent. The extract is of a blackish-brown color, and is partly soluble in water, yielding a dark-brown, very bitter solution.

Uses.—This extract represents very well the virtues of leptandra. *Dose*, Gm. 0.12–0.24 (gr. ij–iv).

EXTRACTUM LEPTANDRÆ FLUIDUM, *U. S.*—Fluid Extract of Leptandra.

Extrait liquide de leptandra, Fr.; *Flüssiges Leptandraextrakt*, G.

Preparation.—Leptandra, in No. 60 powder, 1000 Gm.; Alcohol, Water, each, a sufficient quantity, to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it moderately in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the leptandra is exhausted. Reserve the first 800 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of menstruum (alcohol 3 volumes, water 1 volume), and the first 19½ fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

A weaker alcoholic menstruum we think would be equally serviceable; a mixture of alcohol 2 volumes and water 1 volume has been found to yield a very satisfactory preparation (A. Robbins, 1883); and even diluted alcohol has been used with good results both for the fluid and solid extract.

It is of a dark red-brown color and has a very bitter taste.

Uses.—This preparation is less suitable for a purgative than the solid extract. *Dose*, Gm. 2–4 (ɱ xxx–lx).

EXTRACTUM LOBELIÆ FLUIDUM, *U. S.*—Fluid Extract of Lobelia.

Extrait liquide de lobélie enflée, Fr.; *Flüssiges Lobelien-Extrakt*, G.

Preparation.—Lobelia, in No. 60 powder, 1000 Gm.; Diluted Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 350 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the lobelia is exhausted. Reserve the first 850 Cc. of the percolate, and evaporate the remainder at a temperature not exceeding 50° C. (122° F.) to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 9 fluidounces of menstruum (diluted alcohol) and the first 21 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

This fluid extract is of a deep green-brown color, has the unpleasant acrid taste of the drug, and if properly made and kept remains in good condition.

Dose, as an emetic, Gm. 0.60–1.30 (ɱ x–xx); as an expectorant, Gm. 0.06–0.30 (ɱ j–v).

EXTRACTUM LUPULI, *Br.*—Extract of Hop.

Extractum humuli.—Extrait de houblon, Fr.; *Hopfenextrakt*, G.

Preparation.—Take of Hop 1 pound; Rectified Spirit 1½ pints; Distilled Water 1 gallon. Macerate the hop in the spirit for 7 days, press out the tincture; filter, and distil off the spirit, leaving a soft extract. Boil the residual hop with the water for 1 hour, press out the liquor, strain, and evaporate by a water-bath to the consistence of a soft extract. Mix the two extracts, and evaporate at a temperature not exceeding 140° F., until it has acquired a suitable consistence for forming pills.—*Br.*

Alcohol is required for exhausting the lupulin of hops, and would also exhaust hops if used in sufficient quantity; the subsequent use of water is a saving of alcohol. The extract of the French Codex, which is made with alcohol of 60 per cent. by volume, is preferable. The yield is about 20 per cent.

Uses.—This preparation represents pretty well the virtues of hop. *Dose*, Gm. 0.30 (gr. v) or more.

EXTRACTUM LUPULINI FLUIDUM, *U. S.*—Fluid Extract of Lupulin.

Extrait liquide de lupuline, Fr.; *Flüssiges Lupulin-Extrakt*, G.

Preparation.—Lupulin 1000 Gm.; Alcohol a sufficient quantity to make 1000 Cc. Moisten the lupulin with 200 Cc. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the lupulin and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until the lupulin is exhausted. Reserve the first 700 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

From the percolation of 25 av. ozs. of lupulin with alcohol the first 17½ fluidounces obtained should be set aside as reserve, and the final volume of finished product made up to 24 fluidounces.

The use of alcohol is necessary to keep the volatile oil and resinous matter in solution, and the preparation fairly represents the drug. Mr. Alonzo Robbins suggests that lupulin be packed without previously moistening it, as then the percolation proceeds evenly and

without any difficulty, while the moistened powder is apt to form a tough mass difficult to percolate. The fluid extract is of a deep red-brown color and of the odor and taste of the drug.

Uses.—It affords a convenient mode of administering lupulin. The *dose* is Gm. 1.00–1.30 (ɱxv–xx), which should be mixed with syrup or brandy and afterward diluted with water.

EXTRACTUM MALTI.—Extract of Malt.

Essence (*Extrait*) *de malt*, Fr.; *Malzextrakt*, G.

Preparation.—Malt, in coarse powder, not finer than No. 12, 100 parts (100 oz. av.); Water a sufficient quantity. Upon the powder, contained in a suitable vessel, pour 100 parts of water, and macerate for six hours. Then add 400 parts (400 oz. av. or 24 pints) of water heated to about 30° C. (86° F.), and digest for an hour at a temperature not exceeding 55° C. (131° F.). Strain the mixture with strong expression. Finally, by means of a water-bath or vacuum-apparatus, at a temperature not exceeding 55° C. (131° F.), evaporate the strained liquid rapidly to the consistence of thick honey. Keep the product in well-closed vessels in a cool place.—*U. S.* 1880.

In making this extract it is of the utmost importance that the temperature should never exceed 65° C. (149° F.), and it is safer, for the preservation of the diastase, to keep it at or below 55° C. (131° F.) until the starch of the malt has been converted into glucose and dextrin. According to Payen and Persoz, good malt contains 2 per cent. of diastase, and since 1 part of this compound is estimated to convert 2000 parts of starch, it is obvious that properly-prepared malt extract should contain nearly the entire amount of diastase which was originally present in the malt. This is only accomplished by the rapid evaporation of the infusion at a temperature which does not act injuriously upon diastase, as is directed in the above process. The yield is from 65 to 75 per cent.

Properties.—Extract of malt is a brown-yellow or light amber-colored, thick liquid or semi-fluid mass, having a slight peculiar odor, a sweet mucilaginous taste, and a distinct acid reaction to litmus-paper. It dissolves in water in all proportions, yielding a nearly transparent solution, in which alcohol produces a milky turbidity, after a short time becoming clear, with the separation of a flocculent precipitate. The aqueous solution also yields precipitates with picric acid, tannin, most alkaloidal reagents, and mercuric chloride and other metallic salts. When the extract is added to starch-paste, this is gradually liquefied, and will finally not acquire a blue color on the addition of iodine solution. On heating the extract it is decomposed, giving off the odor of burning sugar, and finally leaving a small amount of ash.

Constituents.—Good extract of malt contains about 30 per cent. of water, 60 of maltose and dextrin, 8 of nitrogenated principles, and 1½ of ash. Maltose and dextrin are usually present in nearly equal proportion, the former somewhat predominating. A minute amount of free lactic and perhaps of other acids is likewise present.

Valuation.—(For valuable papers on the analysis of malt-extract consult W. H. Dunstan and A. F. Dimmock in *Phar. Jour. and Transactions*, March, 1879, p. 734, and J. F. C. Jungk in *Amer. Jour. Phar.*, June, 1883, p. 289.) The amount of solid matter may be determined from the specific gravity, which is not identical with that of a solution containing the same percentage of cane-sugar. Hager has constructed the annexed table, which gives the density at 17.5° C. (63.5° F.) and the amount of solids dried at 110° C. (230° F.):

Table of Specific Gravity at 17.5° C. and Percentage of Solids, Dried at 110° C., of Extract of Malt.

Solids.	Specific gravity.	Solids.	Specific gravity.	Solids.	Specific gravity.	Solids.	Specific gravity.	Solids.	Specific gravity.
1	1.0035	11	1.0448	21	1.0866	31	1.1305	41	1.1792
2	1.0072	12	1.0490	22	1.0908	32	1.1353	42	1.1844
3	1.0112	13	1.0532	23	1.0950	33	1.1401	43	1.1897
4	1.0154	14	1.0574	24	1.0991	34	1.1449	44	1.1952
5	1.0197	15	1.0616	25	1.1033	35	1.1497	45	1.2007
6	1.0238	16	1.0658	26	1.1075	36	1.1545	46	1.2062
7	1.0279	17	1.0700	27	1.1117	37	1.1594	47	1.2119
8	1.0321	18	1.0741	28	1.1159	38	1.1643	48	1.2178
9	1.0363	19	1.0782	29	1.1202	39	1.1692	49	1.2239
10	1.0406	20	1.0824	30	1.1258	40	1.1741	50	1.2303

Should the extract be too thick, it is to be dissolved in an equal weight of distilled water. According to Jungk, 5 Gm. of the extract are mixed with 20 Gm. of well-washed and dried sand, and the mixture is dried at 100° C.; the loss in weight indicates the water. The dry powder is, exhausted with ether, in a small percolator, the loss being resin of hops if present. A mixture of 2 volumes of strong alcohol and 1 volume of ether will next take up glycerin; then the maltose is dissolved by alcohol, and afterward the dextrin by boiling water. On heating the sand to redness, the albuminates are burned, and estimated by loss of weight. The diastatic strength of extract of malt is determined by forming starch into paste with about 20 parts of boiling water, and digesting it with the extract. According to Jungk, properly-prepared extract of malt should convert its own weight of starch at 16.6° C. (62° F.) in 40 minutes, or at 37.8° C. (100° F.) in 10 minutes, or at 65.5° C. (150° F.) in 3 minutes. The proteids may be estimated, according to Hager, by digesting for 30 minutes 10 Gm. of extract of malt with 100 Gm. of aqueous solution of picric acid saturated in the cold, washing the precipitate, and drying; one-half the weight is about equal to the albuminoids, of which from 3 to 3.25 per cent. should be present (Jungk).

Some commercial malt extracts are scarcely superior to glucose; others consist of a stronger or weaker beer.

Pharmaceutical Uses.—Extract of malt is serviceable in emulsionizing fixed oil and as a vehicle for various medicaments.

EXTRACTUM MALTI FERRATUM (*P. G.* 1872) is made by dissolving 2 parts of pyrophosphate of iron in 3 parts of water, and incorporating the solution with 95 parts of extract of malt. Hager (1876) recommends instead the use of 3 parts of saccharated iron rubbed up with 7 of glycerin and 90 of extract of malt.

If quinine is combined with malt, the neutral tannate of quinine is best employed. Hops may be used with it in the form of fluid extract of lupulin. A combination with pepsin should be made extemporaneously, since the taste is gradually modified.

EXTRACTUM MALTI FLUIDUM, suggested by Prof. Lloyd, may be made by macerating and percolating 4 parts of ground malt with a mixture of 1 part of alcohol and 4 parts of water until 3 parts of percolate are obtained. It is a thin yellow or brownish liquid, containing the malt-sugar and diastase, the latter being destroyed on the application of heat.

Uses.—(See MALTUM.) It is a condiment and digestive whose *dose* must vary with individual cases.

EXTRACTUM MATICO FLUIDUM, *U. S.*—FLUID EXTRACT OF MATICO.

Extrait liquide de matico, Fr.; *Flüssiges Matico-Extrakt*, G.

Preparation.—Matico, in No. 40 powder, 1000 Gm.; Alcohol, Water, each a sufficient quantity to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water, and, having moistened the powder with 300 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the matico is exhausted. Reserve the first 850 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 7½ fluidounces of menstruum (alcohol 3 volumes, water 1 volume), and the first 21 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

The omission of glycerin in the official menstruum for this fluid extract seems justifiable, as the preparation has been found to keep as well without it.

Uses.—The utility of this preparation consists in the facility with which it is absorbed. It may be given in *dose* of Gm. 2–8 (fʒss–ij).

EXTRACTUM MENISPERMI FLUIDUM, *U. S.*—FLUID EXTRACT OF MENISPERMUM.

Fluid extract of yellow parilla or Canadian moonseed, E.; *Extrait liquide de ménisperme du Canada*, Fr.; *Flüssiges Canadisches Mondkorn-Extrakt*, G.

Preparation.—Menispermum, in No. 60 powder, 1000 Gm.; Alcohol, Water, each

a sufficient quantity to make 1000 Cc. Mix 600 Cc. of alcohol with 300 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the menispermum is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of menstruum (alcohol 2 volumes, water 1 volume), and the first 22 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

Fluid extract of yellow parilla has a dark reddish-brown color and a disagreeable bitter taste.

Uses.—The virtues of this preparation, as of the plant from which it is derived, remain problematical. *Dose*, Gm. 1–4 (ɱxv–ʒj).

EXTRACTUM MEZEREI FLUIDUM, *U. S.*—Fluid Extract of Mezereum.

Extrait liquide de mézéréon (de garou), Fr.; *Flüssiges Seidelbast-Extrakt*, G.

Preparation.—Mezereum, in No. 30 powder, 1000 Gm.; Alcohol, a sufficient quantity; to make 1000 Cc. Moisten the powder with 400 Cc. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until the mezereum is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of mezereum should be moistened with about 10 fluidounces of alcohol, and the first 22 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

This fluid extract, which is of a green color and very acrid, is used in the preparation of linimentum sinapis compositum, for which purpose it is very convenient. The alcohol may be recovered by distillation without detriment to the preparation.

Extractum mezerei, *U. S.* 1880. Extract of mezereum, *E.;* Extrait de garou, *Fr.;* Seidelbast-Extrakt, *G.*—Mezereum in No. 30 powder is moistened with two-fifths of its weight of alcohol, packed firmly in a percolator, and exhausted with alcohol; about three times the weight of the drug will be found sufficient to collect of percolate, from which the alcohol may be recovered by distillation, and the residue evaporated to the consistence of a soft extract, a pilular consistence being impossible. The extract is of a green color and the yield from 10 to 12 per cent.

Extractum mezerei æthereum. *Br., Fr. Cod.*—Ethereal extract of mezereum, *E.;* Extrait étheré de garou (de mézéréon), *Fr.;* Ätherisches Seidelbast-Extrakt, *G.;* Estratto di mezereo etereo, *It.*—An alcoholic tincture of mezereum is distilled until a soft extract remains; this is agitated with ether, the ethereal solution decanted, the ether recovered by distillation, and the residue converted into a soft extract. The yield is 6 or 7 per cent. This extract retains the consistence of honey, and is an ingredient of the compound liniment of mustard, Br. P.

Uses.—Diluted, this extract may take the place of decoction of mezereon. But as an overdose of it, undiluted, may give rise to violent and even fatal effects, this mode of administration is ineligible. The *dose* is nominally Gm. 0.06–0.60 (ɱj–v–x). Its chief use is its external application to maintain a discharge from blistered surfaces.

EXTRACTUM NUCIS VOMICÆ, *U. S., Br.*—Extract of Nux Vomica.

Extractum strychni, P. G.; *Extractum nucum vomicarum spirituosum (vel alcoholicum). Extrait de noix vomique*, Fr.; *Brechnuss-Extrakt, Strychnossamen-Extrakt, Krähenaugen-Extrakt, G.*; *Estratto di noce vomica*, It.

Preparation.—Nux Vomica, in No. 60 powder, 1000 Gm.; Acetic Acid, 50 Cc.; Alcohol, Water, Ether, Sugar of Milk, recently dried and in fine powder, each a sufficient quantity. Mix alcohol and water in the proportion of 750 Cc. of alcohol to 250 Cc. of

water. Mix the powder with 1000 Cc. of the mixture, to which the acetic acid had previously been added, and let it macerate, in a well-covered vessel in a warm place, during forty-eight hours. Then pack it tightly in a cylindrical glass percolator, gradually pour menstruum upon it, and continue the percolation until the nux vomica is practically exhausted. Distil off the alcohol by means of a water-bath, transfer the remainder to a tared capsule, and evaporate it until it weighs about 150 Gm. Transfer it to a bottle of the capacity of about 500 Cc., and wash the capsule with about 50 Cc. of warm water, adding the washings to the bottle and mixing the contents thoroughly. When the liquid extract is cold, add to it one-fourth of its volume of ether, stopper the bottle, and bring the extract and ether into intimate contact by gently agitating and frequently inverting the bottle, avoiding violent shaking so as to prevent the formation of an emulsion. Pour off the ethereal layer as closely as possible, and repeat this treatment with ether several times, until a few drops of the ethereal layer no longer impart a permanent greasy stain to filtering-paper. Then transfer the contents of the bottle back to the tared capsule, using a sufficient quantity of warm water for washing. Recover the ether from the united ethereal washings, add to the oily residue about 15 Cc. of boiling water, and then acetic acid, in drops, until the mixture has a permanent acid reaction. Then filter it through a moistened filter, and wash the filter with a little water. Add the filtrate to the extract in the capsule, evaporate until the residue weighs about 200 Gm., and allow it to become cold. Then determine its weight exactly, remove 4 Gm. of the mass, and assay this by the process given below, using the amounts of liquids there directed for 2 Gm. of dry extract. In another portion of 5 Gm. determine the amount of water by drying it, in a flat-bottomed capsule, at 100° C. (212° F.), until it ceases to lose weight. From the results thus obtained ascertain, by calculation, the amount of total alkaloids and of water contained in the remainder of the mass, add to this enough well-dried sugar of milk to bring the quantity of alkaloids in the final dry extract to 15 per cent.; then evaporate the mass to complete dryness, reduce it to powder, and transfer it to small, well-stoppered vials.

Extract of nux vomica, when assayed by the following process, should be found to contain 15 per cent. of total alkaloids:

Assay of Extract of Nux Vomica.—Extract of Nux Vomica, dried at 100° C. (212° F.), Alcohol, Ammonia-water, Water, Chloroform, Decinormal Sulphuric Acid Solution, Centinormal Potassium Hydroxide Solution, each a sufficient quantity. Put 2 Gm. of the dried extract of nux vomica into a glass separator (separatory funnel), add to it 20 Cc. of a previously prepared mixture of 2 volumes of alcohol, 1 volume of ammonia-water (specific gravity 0.960), and 1 volume of water, and shake the well-stoppered separator until the extract is dissolved. Then add 20 Cc. of chloroform and shake well during five minutes. Allow the chloroform to separate, remove it as far as possible, pour into the separator a few Cc. of chloroform, and, without shaking, draw this off through the stopcock to wash the outlet-tube. Repeat the extraction with two further portions of chloroform of 15 Cc. each, and wash the outlet-tube each time as just directed. Collect all the chloroformic solutions in a wide beaker, expose the latter to a gentle heat, on a water-bath, until the chloroform and ammonia are completely dissipated, add to the residue 10 Cc. of decinormal sulphuric acid measured with great care from a burette, stir gently, and then add 20 Cc. of hot water. When solution has taken place, add 2 Cc. of brazil-wood test-solution, and then carefully run in centinormal potassium hydroxide solution, until a permanent pinkish color is produced by the action of a slight excess of alkali upon the brazil-wood indicator. Divide the number of Cc. of centinormal potassa solution used by 10, subtract the number found from 10 (the 10 Cc. of decinormal acid used), multiply the remainder by 0.0364, and that product by 50 (or multiply at once by 1.82), which will give the percentage of *total alkaloids* in the extract of nux vomica, it being assumed that strychnine and brucine are present in equal proportion, and the above factor being found by taking the mean of their respective molecular weights [(324 + 394) ÷ 2 = 364].—*U. S.*

25 av. ozs. of the powdered seed should be digested in a covered vessel with a mixture of alcohol 18 fluidounces, water 6 fluidounces, acetic acid 9½ fluidrachms, and percolation continued to exhaustion with a menstruum of alcohol 3 volumes, water 1 volume. The treatment with ether is sufficiently described above, as also the subsequent washing and evaporation. The moist extract before it is assayed should weigh about 5 av. ozs.

Prepare a tincture from nux vomica 1 pound, and alcohol (sp. gr. .875) 80 fluidounces; evaporate 1 fluidounce almost to dryness; dissolve in chloroform ¼ fluidounce and dilute sulphuric acid ½ fluidounce, agitate and warm gently; draw off the chloroform; add to the acid liquid ammonia in excess and chloroform ½ fluidounce; agitate, gently warm, evaporate the chloroform in a weighed dish, dry at 100° C., and weigh the cooled alkaloids. Take of the tincture as much as contains 131¼ gr. of total alkaloid; distil, and evaporate to 2 ounces.—*Br.*

The French Codex directs maceration with alcohol of 80 per cent. by volume, sp. gr. 0.864; the German Pharmacopœia, digestion with alcohol sp. grav. 0.894.

In this and the next following preparation a radical change has been made by the Pharmacopœia, not only in the menstruum and manipulation, but chiefly in the fact that a process has been prescribed for determining the quantity of alkaloid present in the extract, which shall be 15 per cent. in the official article. The mixture of 3 volumes of alcohol and 1 volume of water will exhaust the active principles of nux vomica equally as well as the menstruum of 1880, and at the same time take up less fixed oil; moreover, the solution of the alkaloids is facilitated by the addition of acetic acid. The washing with ether is intended to remove any fatty matter which may have been extracted, and to recover any alkaloid possibly associated with the fat, the latter is again treated with acid and hot water. As the extract is directed to be reduced to powder, the removal of the fatty matter becomes a necessity.

The following example will serve to demonstrate how the necessary quantity of sugar of milk can be readily calculated. Suppose the residue obtained by evaporation of the final filtrate, when tested by the methods above described, is found to contain 17½ per cent. of alkaloid and 18 per cent. of moisture,—this would be equivalent to 21.34 per cent. of alkaloid if all moisture were evaporated, for 100 — 18=82 and 82 : 100 : : 17.5 : x (21.34); since the Pharmacopœia demands but 15 per cent. of alkaloid in the dried and powdered extract, every 100 Gm. (or grains) of the residue require the addition of 34.67 Gm. (or grains) of sugar of milk before it is finally evaporated to dryness and powdered, for x : 82 : : 21.34 : 15, x = 116.67, and 116.67 — 82 = 34.67 — proof: 100 parts of moist residue + 34.67 parts sugar of milk = 134.67, which upon drying are reduced to (134.67 — 18) = 116.67 parts; the dry residue will contain 17.5 parts of alkaloid, which is equal to 15 per cent., for 116.67 : 17.5 : : 100 : x (15).

Nux vomica is exceedingly difficult to powder; the object is best accomplished on a small scale by somewhat crushing the seeds and drying them well by heat, or by heating them with a little water until they become soft enough to be bruised, while still warm, into a pulpy mass, with which a little alcohol is incorporated, when they should be thoroughly dried and powdered for displacement. Where steam is available for the softening of the seeds we would recommend that they be crushed or bruised while hot. In this way the rapid drying will be facilitated. The official extract is of a yellowish-brown color and of an intensely bitter taste. The yield is variable; with alcohol sp. gr. 0.835 we have obtained from 8 to 11.3 per cent. of the weight of the seeds; with weaker alcohol the yield is increased. It contains about 6 per cent. of strychnine, but this percentage must necessarily vary. The Br. P. extract contains 15 per cent. of total alkaloid.

Extractum strychni (nucis vomicæ) aquosum is prepared from coarsely-powdered nux vomica by digesting it with hot water and evaporating the infusion to dryness. The yield is about 16 per cent., and the extract contains about 2 or 3 per cent. of strychnine.

Some persons will no doubt object to the official volumetric determination of the total alkaloids in extract of nux vomica on account of the uncertain knowledge regarding the proportions in which the alkaloids exist in the seed; by many authorities it is stated that brucine, which is said to be far less active than strychnine, always predominates, but chemists in Europe as well as here still assume the equal distribution of the two alkaloids in case of volumetric determinations. Schweissinger (1885) has recommended to take advantage of the difference in saturating power of brucine and strychnine, and thus obtain more accurate results. According to his method, it becomes necessary first to ascertain the weight of the alkaloidal residue by evaporating the united chloroform solutions of the above process to dryness in a tared beaker; then ascertain the exact amount of decinormal acid neutralized by the mixture according to the official directions, divide the weight of alkaloids in milligrammes by the number of cubic centimeters of acid neutralized; subtract the quotient from 3.94; divide the remainder by 6, and move the decimal point three places to the right to obtain the percentage of strychnine. Example: Weight of total alkaloids 75 Mgm.; volume of decinormal acid neutralized 20.25 Cc., 75 ÷ 20.25 = 3.704; 3.94 — 3.704 = 0.236; 0.236 ÷ 6 = 0.0393, giving 39.3 per cent. of strychnine = 29.5 Mgm.; 75 — 29.5 = 45.5 Mgm. of brucine.

Uses.—It is chiefly used as an ingredient of pills intended to overcome habitual atonic constipation. The primary *dose* is about Gm. 0.03 (gr. ½); it may gradually be increased to Gm. 0.10–0.20 (gr. ij–iij) when the specific action of the drug is sought.

EXTRACTUM NUCIS VOMICÆ FLUIDUM, *U. S.*—Fluid Extract of Nux Vomica.

Extrait liquide de noix vomique, Fr.; *Flüssiges Strychnossamen-Extrakt*, G.

Preparation.—Nux vomica, in No. 60 powder, 1000 Gm.; Acetic Acid 50 Cc.; Alcohol, Water, each a sufficient quantity. Mix alcohol and water in the proportion of 750 Cc. of alcohol and 250 Cc. of water. Moisten the powder with 1000 Cc. of the mixture, to which the acetic acid had previously been added, and let it digest, in a well-covered vessel, in a warm place, during forty-eight hours. Then pack it in a cylindrical glass percolator, and gradually pour menstruum upon it until the nux vomica is practically exhausted. Distil off the alcohol by means of a water-bath, transfer the remainder to a tared capsule, evaporate it until it weighs about 200 Gm., and allow it to become cold. Then determine the weight exactly, remove 4 Gm. of the mass, and assay this by the process given under Extract of Nux Vomica (see Extractum Nucis Vomicæ), using the amount of liquids there directed for 2 Gm. of dry extract. From the results thus obtained ascertain, by calculation, the amount of total alkaloids in the remainder of the mass, and then add to the latter, first, 300 Cc. of alcohol, and afterward a sufficient quantity of a mixture of 3 volumes of alcohol and 1 volume of water, so that each 100 Cc. of the finished fluid extract shall contain 1.5 Gm. of total alkaloids.—*U. S.*

If, when assayed, the moist extract should be found to contain 17.5 per cent. of alkaloid, each gramme of the extract will make 11.66 Cc. of fluid extract; the Pharmacopœia requiring 100 Cc. to contain 1.5 Gm. of alkaloid, each Cc. represents 0.015 Gm., and if 1 Gm. of the moist extract contains 0.175 Gm. of alkaloid, 11.66 Cc. of fluid extract made therefrom will be of official strength for $0.015 : 1 :: 0.175 : x$, $x = 11.66$.

(For remarks on the manipulation we refer to the preceding article.)

Fluid extract of nux vomica, being practically of one-tenth the strength of the solid extract, it can be conveniently made by dissolving the latter in a mixture of alcohol 3 volumes and water 1 volume; 366 grains of the official extract should be dissolved in a sufficient quantity of menstruum to make the solution measure 8 fluidounces.

Uses.—On account of its intense bitterness this is an ineligible preparation. It should be largely diluted with water. *Dose*, from 1 minim to 5 or more, cautiously increased.

EXTRACTUM OPII, *U. S., Br., P. G.*—Extract of Opium.

Extractum thebaicum.—Extrait d'opium, *Extrait thebaïque*, Fr.; *Opium-Extrakt*, G.; *Estretto di oppio acquosa*, It.

Preparation.—Powdered Opium 100 Gm.; Sugar of Milk, recently dried and in fine powder, Water, each a sufficient quantity. Triturate the powdered opium in a mortar thoroughly with 1000 Cc. of water, repeat the trituration occasionally, in the course of twelve hours, then filter through a rapidly-acting, double filter, and wash the filter and residue with water, until the filtrate is nearly colorless. Concentrate the filtrate and washings in a tared capsule, on a water-bath, until the residue weighs about 200 Gm., and allow it to become cold. Then determine the weight exactly; transfer 12 Gm. of it to an Erlenmeyer flask having a capacity of about 100 Cc., and determine in this portion the amount of morphine by the process of assay given below, using the quantities of liquids there directed for 4 Gm. of the dry extract. In another portion of 5 Gm. determine the amount of water by drying it in a flat-bottomed capsule, at 100° C. (212° F.), until it ceases to lose weight. From the results thus obtained ascertain, by calculation, the amount of morphine and of water contained in the remainder of the extract, add to this enough well-dried sugar of milk to bring the quantity of morphine in the final dry extract to 18 per cent., then evaporate the whole to dryness, reduce it to powder, and transfer it to small, well-stoppered vials.

Assay of Extract of Opium.—Extract of Opium, dried at 100° C. (212° F.) 4 Gm.; Ammonia-water 2.2 Cc.; Alcohol, Ether, Water, each a sufficient quantity. Dissolve the extract of opium in 30 Cc. of water, filter the solution through a small filter, and wash the filter and residue with water (collecting the washings separately) until no more soluble matter is extracted. Evaporate, first, the washings in a tared capsule to a small volume, then add the first filtrate, and reduce the whole by evaporation to a weight of 10 Gm. Rotate the concentrated solution about in the capsule until the rings of extract are redissolved, pour the liquid into a tared Erlenmeyer flask having the capacity of about 100 Cc., and rinse the capsule with a few drops of water at a time, until the entire solution weighs 15 Gm. Then add 7 Gm. (or 8.5 Cc.) of alcohol, shake well, add 20 Cc. of ether, and shake again. Now add the ammonia-water from a graduated pipette or

burette, stopper the flask well with a sound cork, shake it thoroughly during ten minutes, and then set it aside, in a moderately cool place, for at least six hours or over night. Remove the stopper carefully, and, should any crystals adhere to it, wash them into the flask with a little ether. Place two rapidly-acting filters, of a diameter of 7 Cm., plainly folded, one within the other (the triple fold of the inner filter being laid against the single side of the outer filter); in a small funnel, wet them well with ether, and decant the ethereal solution as completely as possible upon the inner filter. Add 10 Cc. of ether to the contents of the flask, and rotate it; again decant the ethereal layer upon the inner filter, and repeat this operation with another portion of 10 Cc. of ether. Then pour into the filter the liquid in the flask, in portions, in such a way as to transfer the greater portion of the crystals to the filter, and when this has passed through, transfer the remaining crystals to the filter by washing the flask with several portions of water, using not more than about 10 Cc. in all. Allow the double filter to drain, then apply water to the crystals, drop by drop, until they are practically free from mother-water, and afterwards wash them, drop by drop, from a pipette, with alcohol previously saturated with powdered morphine. When this has passed through, displace the remaining alcohol by ether, using about 10 Cc. or more if necessary. Allow the double filter to dry in a moderately warm place, at a temperature not exceeding 60° C. (140° F.), until its weight remains constant; then carefully transfer the crystals to a tared watchglass and weigh them. The weight found, multiplied by 25, represents the percentage of crystallized morphine in the extract.—*U. S.*

The pharmacopœias agree in ordering cold water for the extraction of crude opium; only the U. S. P. and the German Pharmacopœia direct the use of powdered opium and common water, the other authorities directing distilled water. The manipulation does not differ materially except in the number of macerations and the proportion of water used. For 1 part of opium two macerations are directed with 8 and 4 parts, *F. Cod.* (with 5 and 2½ parts, *P. G.*), of water; three macerations each with 2½ parts of water, *Br.*, and one maceration with 10 parts of water, *U. S.* The macerations should be effected at a low temperature, say about 60° F. At a higher temperature a larger amount of extract is obtained, more largely contaminated with narcotine and other principles, and of an inferior quality.

4 av. ozs. of opium should be macerated with 2½ pints of cold water during twelve hours with frequent trituration, and then exhausted on a filter as directed; the filtrate should be concentrated to 8 av. ozs., allowed to become cold, and then assayed. The necessary amount of sugar of milk to be added to bring the final product up to the official standard (18 per cent. of crystallized morphine) is readily ascertained: suppose the residue is found to contain 72 per cent. of moisture and 7 per cent. of morphine, then every 100 Gm. (or grains) of residue require the addition of 11 (10.88 +) Gm. (or grains) of sugar of milk before final evaporation to dryness, for 100 + 11 = 111, which upon drying will be reduced to (111 − 72) 39 Gm. (or grains). No morphine having been lost, the 7 parts originally present in the 100 parts of residue will now be contained in the 39 parts of powder, and this is equal to 18 per cent., for 39 : 7 : : 100 : x (18).

Although the Pharmacopœia has fixed the morphine strength of extract of opium only a few per cent. above that for powdered opium, yet it is a source of gratification that a fixed standard has at last been adopted. Powdered opium yields variable quantities of extractive matter to water (40–60 per cent.), and hence the uncertainty of a non-standardized extract. We think 20 per cent. of crystallized morphine would have been a more desirable strength for the powdered extract.

Denarcotized extract of opium is still occasionally employed. It may be obtained by agitating the concentrated infusion with 2 portions of ether, each time allowing the mixture to settle, and decanting the ether, which dissolves the narcotine, but not the morphine; the aqueous liquid is then evaporated as before. This extract is probably in no way superior to the official preparation.

Pharmaceutical Uses.—UNGUENTUM OPIATUM. Unguentum opii, opium ointment, is made by triturating 1 part of extract of opium with 1 part of water and adding 18 parts of simple ointment.—*P. G.* 1872.

Uses.—This preparation is essentially opium purified from its inert constituents. Its average *dose* is about Gm. 0.03 (gr. ½).

EXTRACTUM OPII LIQUIDUM, *Br.*—LIQUID EXTRACT OF OPIUM.

Extrait liquide d'opium, Fr.; *Flüssiges Opium-Extrakt*, G.

Preparation.—Extract of Opium 1 ounce; Distilled Water 16 fluidounces; Rectified Spirit 4 fluidounces. Macerate the extract of opium in the water for an hour, stirring frequently; then add the spirit and filter. The product should measure 1 pint (Imperial). It contains 22 grains of extract of opium (nearly) in 1 fluidounce.—*Br.*

This is somewhat stronger in opium than the tincture of opium, *Br.*, and scarcely deserves to be classed with the fluid extracts; it is analogous to the Tinctura opii deodorata, *U. S.* The specific gravity varies between 0.985 and 0.995.

Uses.—Essentially a solution of the watery extract of opium, this preparation is probably less apt to nauseate and constipate than laudanum. *Dose*, Gm. 0.60–2 (♏x–xxx).

EXTRACTUM PAPAVERIS, *Br.*—Extract of Poppies.

Extrait de pavot (capsules), Fr.; *Mohn-Extrakt*, G.

Preparation.—Poppy-capsules, dried, freed from the seeds, and coarsely powdered, 1 pound; Rectified Spirit 2 ounces; Boiling Distilled Water a sufficiency. Mix the poppy-capsules with 2 pints of the water and infuse for twenty-four hours, stirring them frequently; then pack them in a percolator, and, adding more of the water, allow the liquor slowly to pass until about a gallon has been collected or the poppies are exhausted. Evaporate the liquor by a water-bath until it is reduced to a pint, and when cold add the spirit. Let the mixture stand for twenty-four hours, then separate the clear liquor by filtration, and evaporate this by a water-bath until the extract has acquired a suitable consistence for forming pills.—*Br.*

Warm water extracts, with the medicinal principles, also the mucilaginous matters, which are but imperfectly precipitated by the small quantity of alcohol added. The yield is about 30 per cent. The French Codex directs extraction with 60 per cent. alcohol, which yields about 15 per cent. of extract.

Uses.—This extract appears to be unnecessary. It has no virtues that are not more decided in the various preparations of opium. *Dose*, Gm. 0.10–0.30 (gr. ij–v).

EXTRACTUM PAREIRÆ, *Br.*—Extract of Pareira.

Extrait de pareira brava, Fr.; *Pareira-Extrakt*, G.

Preparation.—Pareira-root, in coarse powder, 1 pound; Boiling Distilled Water 1 gallon or a sufficiency. Digest the pareira with a pint of the water for twenty-four hours, then pack in a percolator, and, adding more of the water, allow the liquor slowly to pass until a gallon has been collected or the pareira is exhausted. Evaporate the liquor by a water-bath until the extract has acquired a suitable consistence for forming pills. —*Br.*

The use of boiling water, followed by prolonged digestion, must result in the solution of the starch, which is but imperfectly removed by the subsequent percolation. A diluted alcohol would seem to be a very appropriate menstruum for exhausting pareira.

Uses.—The solid form of a medicine intended to act upon the mucous membrane of the urinary passages cannot be an eligible one. The fluid extract and the decoction are greatly preferable. *Dose*, Gm. 0.60–1.20 (gr. x–xx).

EXTRACTUM PAREIRÆ FLUIDUM, *U. S.*—Fluid Extract of Pareira.

Extractum pareiræ liquidum, Br.—*Liquid extract of pareira*, E.; *Extrait liquide de pareira brava*, Fr.; *Flüssiges Pareira-Extrakt*, G.

Preparation.—Pareira, in No. 40 powder, 1000 Gm.; Glycerin, 100 Cc.; Alcohol, water, each, a sufficient quantity to make 1000 Cc. Mix the glycerin with 720 Cc. of alcohol and 180 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward, a mixture of alcohol and water, made in the proportion of 400 Cc. of alcohol to 100 Cc. of water until the pareira is exhausted. Reserve the first 850 Cc. of the percolate. By means of a water-bath distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of menstruum composed of alcohol 17 fluidounces, water 4½ fluidounces, glycerin 2½ fluidounces, and

the first 21 fluidounces of percolate set aside as reserve. Subsequent percolation should be continued with a mixture of alcohol 4 volumes, water 1 volume, and the final volume of finished product made up to 24 fluidounces.

Take of Extract of Pareira, Distilled Water, Rectified Spirit, of each a sufficiency. Dissolve 4 parts of the extract in a sufficient quantity of a mixture of 1 fluid part of rectified spirit and 3 parts of water to form 16 fluid parts of liquid extract. Filter if necessary.—*Br.*

The second preparation is really a concentrated infusion preserved by one-third its volume of alcohol.

The fluid extract is of a brown color, and possesses the peculiar bitter taste of the root in a marked degree.

The proportion of alcohol in the official menstruum seems to us to be unnecessarily large, being even greater than that suggested by A. Robbins in 1883. Experience has shown that a very satisfactory fluid extract of pareira can be made with a menstruum composed of alcohol 5 volumes, water 4 volumes, and glycerin 1 volume.

Uses.—This preparation probably contains all the medicinal qualities of pareira brava. It may be given in doses of Gm. 4 (fʒj) three times a day, largely diluted.

EXTRACTUM PHYSOSTIGMATIS, *U. S., Br.*—Extract of Physostigma.

Extractum fabæ Calabaricæ.—Extrait alcoolique de fève de Calabar, Fr.; *Kalabarbohnen-Extrakt, Physostigma-Extrakt*, G.

Preparation.—Physostigma, in No. 80 powder, 1000 Gm.; Alcohol a sufficient quantity. Moisten the powder with 400 Cc. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until 3000 Cc. of tincture are obtained or the physostigma is exhausted. Reserve the first 900 Cc. of the percolate; evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to 100 Cc.; mix this with the reserved portion, and evaporate in a porcelain capsule on a water-bath to a pilular consistence.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of alcohol, and percolation continued until about 75 fluidounces of percolate have been obtained. The first 22 fluidounces should be set aside as reserve, and the balance evaporated to 2½ fluidounces before adding the reserve portion for final evaporation to a pilular consistence.

The British Pharmacopœia directs maceration and percolation with alcohol spec. grav. 0.838; the French Codex orders digestion for two hours, followed by percolation with hot alcohol spec. grav. 0.864; the former German Pharmacopœia employed alcohol, spec. grav. 0.893, and exhausted by maceration. Strong alcohol yields only 5 or 6 per cent. of extract, which, owing to the resinous and oily constituents, is obtainable of a homogeneous condition only by constant stirring during the latter part of the process. By the use of weaker alcohol a more uniform and less oily extract is obtained, and the yield is increased to 10 or 12 per cent. It is evident from this that the strict adherence to the menstruum directed by the pharmacopœias is of primary importance. The extract is of a greenish-brown color. Kennedy (1875) suggested the addition of glycerin to keep it soft and to render it more convenient for dispensing.

Uses.—The extract represents all the active constituents of Calabar bean. Its average *dose* may be stated at Gm. 0.006 (gr. $\frac{1}{10}$). Hiller used, to overcome constipation with flatulent distension of the bowel, the following: Ext. Calabar bean Gm. 0.10; Glycerin 30 Gm.—M. S. 10 drops, equal to about $\frac{1}{50}$ grain, three or four times a day. In this dose it may also be used to counteract colliquative sweats.

EXTRACTUM PHYTOLACCÆ RADICIS FLUIDUM, *U. S.*—Fluid Extract of Phytolacca-root.

Fluid extract of poke-root, E.; *Extrait liquide du racine de phytolaque*, Fr.; *Flüssiges Kermesbeerenwurzel-Extrakt*, G.

Preparation.—Phytolacca-root, in No. 60 powder, 1000 Gm.; Alcohol, Water, each, a sufficient quantity, to make 1000 Cc. Mix 600 Cc. of alcohol with 300 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylin-

drical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the phytolacca-root is exhausted. Reserve the first 800 Cc. of the percolate, and evaporate the remainder in a porcelain capsule at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of the menstruum (alcohol 2 volumes, water 1 volume), and the first 19½ fluidounces of percolate set aside as reserve. The final volume of finished product should be made up to 24 fluidounces.

Dose, Gm. 0.3 to 2 (♏v–xxx).

EXTRACTUM PILOCARPI FLUIDUM, *U. S.*—Fluid Extract of Pilocarpus.

Fluid extract of jaborandi, E.; *Extrait liquide de jaborandi*, Fr.; *Flüssiges Jaborandi-Extrakt*, G.

Preparation.—Pilocarpus, in No. 40 powder, 1000 Gm.; Diluted Alcohol a sufficient quantity, to make 1000 Cc. Moisten the powder with 350 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the pilocarpus is exhausted. Reserve the first 850 Cc. of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 9 fluidounces of menstruum, and the first 21 fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

This is essentially the process recommended by Dr. F. V. Greene (1877), who also called attention to the difficulty of packing powdered pilocarpus-leaves properly for percolation, owing to the strong fibres of the veins and the tough epidermal tissue, for which reason he suggested placing a rather thick layer of sand upon the powder. The fluid extract is of a greenish-red-brown color. A somewhat more aqueous menstruum has been suggested by A. Robbins as preserving the properties equally well.

Extractum jaborandi, *Br.*, is made with proof spirit. *Dose*, Gm. 0.12–0.66 (2 to 10 grains).

Uses.—This preparation is far inferior in promptness and efficiency of action to pilocarpine administered hypodermically, but is preferable to the other liquid preparations of jaborandi. *Dose*, Gm. 0.60–1 (♏x–xv), gradually increased, at short intervals, until its specific operation is manifested.

EXTRACTUM PODOPHYLLI, *U. S.*—Extract of Podophyllum.

Extract of May-apple or of mandrake, E.; *Extrait de podophylle*, Fr.; *Podophyllum-Extrakt*, G.

Preparation.—Podophyllum, in No. 60 powder, 1000 Gm.; Alcohol, Water, each a sufficient quantity. Mix alcohol and water in the proportion of 800 Cc. of alcohol with 200 Cc. of water, and, having moistened the powder with 300 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the podophyllum is exhausted. By means of a water-bath distil off the alcohol from the tincture, and evaporate the residue to a pilular consistence.—*U. S.*

25 av. ozs. of the drug should be moistened with about 7½ fluidounces of menstruum (alcohol 4 volumes, water 1 volume), and percolation continued to exhaustion.

The menstruum is admirably adapted for the complete extraction of the active principles of podophyllum. The color of the extract is a deep brown, and the yield about 20 to 22 per cent.

Uses.—The operation of this medicine closely resembles that of extract of jalap; it may be used for the same purpose in the *dose* of Gm. 0.30–1.20 (gr. v–xx).

EXTRACTUM PODOPHYLLI FLUIDUM.—Fluid Extract of Podophyllum.

Fluid extract of May-apple or of mandrake, E.; *Extrait liquide de podophylle*, Fr.; *Flüssiges Podophyllum-Extrakt*, G.

Preparation.—Podophyllum, in No. 60 powder, 1000 Gm.; Alcohol, Water, each a sufficient quantity, to make 1000 Cc. Mix 800 Cc. of alcohol with 200 Cc. of water, and, having moistened the powder with 300 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the podophyllum is exhausted. Reserve the first 850 Cc. of the percolate; by means of a water-bath distil off the alcohol from the remainder; dissolve the residue in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 7½ fluidounces of menstruum (alcohol 4 volumes, water 1 volume), and the first 21 fluidounces of percolate set aside as reserve; the final volumes of finished product should be made up to 24 fluidounces.

The fluid extract is of a dark brown-red color. Being prepared with the same menstruum, it may be used for the extemporaneous preparation of the preceding extract.

Uses.—It is inferior to the solid extract for most of the purposes for which podophyllum is used. *Dose*, Gm. 0.60–1.20 (♏ x–xx).

EXTRACTUM PRUNI VIRGINIANÆ FLUIDUM.—Fluid. Extract of Wild Cherry.

Extrait liquide d'écorce de cerisier de Virginie, Fr.; *Flüssiges Wildkirschenrinden-Extrakt*, G.

Preparation.—Wild Cherry, in No. 20 powder, 1000 Gm.; Glycerin, 100 Cc.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix the glycerin with 200 Cc. of water, and, having moistened the powder with the mixture, pack it firmly in a cylindrical glass percolator, and, having closely covered the percolator, macerate for forty-eight hours; then gradually add menstruum, made in the proportion of 850 Cc. of alcohol, to 150 Cc. of water, and allow the percolation to proceed until the wild cherry is exhausted. Reserve the first 800 Cc. of the percolate, and evaporate the remainder to a soft extract. Dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with a mixture of glycerin 2½ fluidounces and water 5 fluidounces and after macerating for forty-eight hours percolation is to be continued with a menstruum composed of alcohol 8½ volumes, water 1½ volumes. The first 19½ fluidounces of percolate should be set aside as reserve, and the final volume of finished product made up to 24 fluidounces.

This is one of those troublesome fluid extracts the formula of which has been changed since its introduction in each subsequent edition of the Pharmacopœia. The one suggested by Prof. Proctor in 1859, in which the bark was exhausted by alcohol, and after the evaporation of the menstruum the decompositum of amygdalin was effected by emulsion of almonds, was an efficient and elegant preparation, but objected to on account of troublesome manipulation. We think that a No. 30 powder would be preferable to No. 20, as it would admit of firmer packing and more thorough exhaustion with less menstruum, and we cannot see the advantage of so large a proportion of alcohol as is directed in the official menstruum; in our experience, a mixture of alcohol 2 volumes, water 6 volumes, and glycerin 2 volumes, has been found to yield a preparation satisfactory in every way. A. Robbins (1883) suggested a formula containing 20 per cent. of sugar, 10 per cent. of glycerin, and a weak alcohol (about 20 per cent.). (See *Am. Jour. Phar.* 1883.)

The fluid extract is of a deep brownish-red color, and when recently made has the bitter-almond odor in a marked degree, and possesses also the astringent and pleasantly bitter taste of the bark; the odor diminishes in the course of time, and finally disappears.

Uses.—If well prepared, this extract represents more fully and in a more convenient form than any other preparation the virtues of wild-cherry-bark. It is an excellent adjuvant to cough mixtures in chronic *pulmonary* affections, and a palliative of *nervous* disorder of the heart's action. The *dose* is from Gm. 2–4 (gr. xxx–lx), and should be gradually increased.

EXTRACTUM QUASSIÆ, *U. S.*, *Br.*—Extract of Quassia.

Extrait de quassie (bois amer) Fr.; *Quassien-Extrakt*, G.; *Estratto di quassia acquosa*, It.

Preparation.—Quassia, in No. 20 powder, 1000 Gm.; Water, a sufficient quantity. Moisten the powder with 400 Cc. of water, pack it firmly in a conical percolator, and gradually pour water upon it until the infusion passes but slightly imbued with bitterness. Reduce the liquid to three-fourths of its weight by boiling and strain; then by means of a water-bath evaporate to a pilular consistence.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of water before it is packed in the percolator.

The British and French Pharmacopœias unite in ordering distilled water. With cold water the yield varies between 2½ and 5 per cent. J. S. Whall (1874) observed that 1 part of quassia is practically exhausted by obtaining from it 4 parts of percolate, and will yield rather less than 3½ per cent. of extract if water, or a little more if diluted alcohol, is used; the latter is considered preferable. The yield is increased to about 6 or 7 per cent. if boiling water is used, but the extract has a jelly-like appearance, probably from pectin compounds, and after some time contains a considerable quantity of crystals. The concentrated infusion should be filtered before final evaporation, as directed by the British Pharmacopœia.

Uses.—This preparation possesses the virtues of quassia in a concentrated state. *Dose*, Gm. 0.06–0.12 (gr. j–ij). It is usually associated with tonics of another order—*e. g.* quinine, iron, etc.

EXTRACTUM QUASSIÆ FLUIDUM.—Fluid Extract of Quassia.

Extrait liquide de quassie, Fr.; *Flüssiges Quassien-Extrakt*, G.

Preparation.—Quassia, in No. 60 powder, 1000 Gm.; Alcohol, Water, each, a sufficient quantity, to make 1000 Cc. Mix 300 Cc. of alcohol with 600 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the quassia is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of menstruum, alcohol 1 volume, water 2 volumes, and the first 22 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

The bitter principle of quassia is perfectly soluble in water, and the fluid extract made with the official menstruum will probably keep as well as that made with diluted alcohol, as directed in 1880. We have had no experience with the present menstruum. The fluid extract has a brown-yellow color and a persistently bitter taste.

Uses.—The intense bitterness of this preparation renders it ineligible as an internal medicine unless it is largely diluted. It may be used as an addition to various bitter tonic mixtures. *Dose*, Gm. 0.30–1.30 (♏ v–xx.)

EXTRACTUM RHAMNI PURSHIANÆ FLUIDUM, *U. S.*—Fluid Extract of Rhamnus Purshiana.

Extractum cascaræ sagradæ liquidum, Br.; *Liquid extract of cascara sagrada*, E.; *Extrait liquide de cascara sagrada*, Fr.; *Flüssiges Cascara Sagrada-Extrakt*, G.

Preparation.—Rhamnus Purshiana, in No. 60 powder, 1000 Gm.; Diluted Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 400 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop

from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the rhamnus purshiana is exhausted. Reserve the first 800 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25. av. ozs. of the drug should be moistened with about 10 fluidounces of menstruum, and the first 19½ fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

The Br. Ph. directs that the bark shall be exhausted by boiling with 3 or 4 successive quantities of water; the strained liquors are to be evaporated on a water-bath to three-fourths of the weight of the drug used, and when cold mixed with rectified spirit (one-fourth the intended volume of the finished product).

According to J. Moss (1892) cold water extracts all the virtues of cascara sagrada bark, and yields an extract which does not deposit on keeping and which mixes clear with water; he recommends to macerate the bark, in No. 20 powder, for a few hours with cold water, then to pack loosely and exhaust with water. The percolate is to be evaporated to a dry extract, mixed with cold water, strained, and evaporated to a definite volume, which is then mixed with one-third of its volume of alcohol.

The so-called tasteless fluid extract of cascara sagrada may be prepared by mixing 25 av. ozs. of the drug with 1½ ozs. of calcined magnesia, and then treating with diluted alcohol as directed above.

Extractum cascaræ sagradæ, *Br.*, is prepared by percolating the bark first with proof spirit (diluted alcohol sp. gr. 0.920), and finally with water, and evaporating the mixed percolate to a pilular consistence.

Dose, Gm. 0.60–4 (ɱ x–lx).

EXTRACTUM RHEI, *U. S., Br., P. G.*—Extract of Rhubarb.

Extractum rhei alcoholicum.—Extrait de rhubarbe, Fr.; *Rhabarber-Extrakt*, G.; *Estratto di rabarbaro*, It.

Preparation.—Rhubarb, in No. 30 powder, 1000 Gm.; Alcohol, Water, each a sufficient quantity. Mix alcohol and water in the proportion of 800 Cc. of alcohol and 200 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a conical percolator; then gradually pour the menstruum upon it until the tincture passes nearly tasteless. Reserve the first 1000 Cc. of the percolate, and set it aside in a warm place until it is reduced by spontaneous evaporation to 500 Cc. Evaporate the remainder of the percolate in a porcelain vessel by means of a water-bath, at a temperature not exceeding 70° C. (158° F.), to the consistence of syrup; mix this with the reserved portion, and continue the evaporation until the mixture is reduced to a pilular consistence.—*U. S.*

25 av. ozs. of rhubarb should be moistened with about 10 fluidounces of menstruum, and the first 25 fluidounces of percolate evaporated spontaneously in a warm place until reduced to 12½ fluidounces; the balance of the percolate should be evaporated on a water-bath to the consistence of syrup, mixed with the reserved portion, and finally evaporated to a pilular consistence.

The other pharmacopœias prepare this extract by maceration, and employ a menstruum composed of 2 parts of alcohol sp. gr. 0.832 and 3 parts of water, *P. G.*; proof spirit, 4 fluid parts, followed by distilled water, *Br.*; cold distilled water, *F. Cod.* Each of these liquids gives an efficient extract, the yield of which necessarily varies with the quality of the root, it being from 35 to 40 per cent. when made with cold water, and from 40 to 50 per cent. if prepared with an alcoholic liquid. The extract is yellowish-brown, bitter, has the odor of rhubarb, and yields with water a turbid solution.

Extractum rhei compositum, *P. G.* Extract of rhubarb 30 parts, extract of aloes 10 parts, resin of jalap 5 parts, and soap 20 parts; triturate together, moisten with diluted alcohol, mix well, and dry. It is of a blackish-brown color, and is also known as *Extractum catholicum* s. *panchymagogum.*

Uses.—Owing to the difficulty of obtaining this preparation of proper quality, it is scarcely to be preferred to good rhubarb-root. Its *dose*, as a purgative, is Gm. 0.60–1 (gr. x–xv).

EXTRACTUM RHEI FLUIDUM, *U. S.*—Fluid Extract of Rhubarb.

Extrait liquide de rhubarbe, Fr.; *Flüssiges Rhabarber-Extrakt*, G.

Preparation.—Rhubarb, in No. 30 powder, 1000 Gm.; Alcohol, water, each a sufficient quantity; to make 1000 Cc. Mix 800 Cc. of alcohol with 200 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the rhubarb is exhausted. Reserve the first 750 Cc. of the percolate, and evaporate the remainder at a temperature not exceeding 70° C. (156° F.) to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of menstruum (alcohol 4 volumes, water 1 volume), and the first 18½ fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

This fluid extract has undergone considerable modifications. The root, exhausted by an alcoholic menstruum, and the liquid, after the evaporation of the alcohol, preserved by sugar, resulted in a fluid extract which was very thick and deposited considerably. A fluid extract prepared with cold water and preserved by sugar, as recommended by Geo. Bille (1872), is free from the last-named objection, but, it was claimed, though fairly active, not to contain *all* the purgative principles of rhubarb. The use of glycerin with an alcoholic menstruum proved a failure with the fluid extract, as it did with the tincture, the liquids, although clear for a time, precipitating more copiously afterward. The present menstruum yields a fluid extract which precipitates only very slightly, and is almost identical with that proposed by A. Robbins in 1883; a fluid extract thus prepared retained its fluidity for nearly four years. None of these different fluid extracts will yield clear mixtures with aqueous liquids unless an alkali be added. Fluid extract of rhubarb is of a blackish red-brown color, and has the odor and taste of the drug.

Uses.—This fluid extract is not often used as a purgative, but its *dose* may be stated at from Gm. 0.60–2.00 (♏x–xxx).

EXTRACTUM RHOIS GLABRÆ FLUIDUM, *U. S.*—Fluid Extract of Rhus Glabra.

Fluid extract of sumach-berries, E.; *Extrait liquide de fruit de sumac*, Fr.; *Flüssiges Sumachbeeren-Extrakt*, G.

Preparation.—Rhus Glabra, in No. 40 powder, 1000 Gm.; Glycerin, 100 Cc.; Diluted Alcohol a sufficient quantity; to make 1000 Cc. Mix the glycerin with 900 Cc. of diluted alcohol, and, having moistened the powder with 350 Cc. of the mixture, pack it firmly in a cylindrical percolator: then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward diluted alcohol, until the rhus glabra is exhausted. Reserve the first 800 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs of the drug should be moistened with about 9 fluidounces of a menstruum composed of diluted alcohol 21½ fluidounces and glycerin 2½ fluidounces; subsequent percolation is to be continued with diluted alcohol. The first 19½ fluidounces of percolate should be set aside as a reserve, and the final volume of finished product made up to 24 fluidounces.

As originally suggested by Prof. Remington (1874), this fluid extract contained about 25 per cent. of glycerin and a slightly weaker alcohol than the above, and kept well for a long time. Mr. A. Robbins suggests a still weaker alcohol, by using 1 part of alcohol to 2 parts of water (or 25 to 41 measures), 80 parts of which menstruum are to be mixed with 20 parts of glycerin. The fluid extract is of a deep-red color, and has a pleasant acidulous and astringent taste.

Uses.—The fluid extract may sometimes be more convenient than the infusion of sumach-berries treated of elsewhere. (See Rhus Glabrum.) Diluted with water, it forms an excellent detergent and stimulating gargle and mouth-wash.

EXTRACTUM ROSÆ FLUIDUM, *U. S.*—Fluid Extract of Rose.

Fluid extract of red rose, E.; *Extrait liquide de rose rouge*, Fr.; *Flüssiges Essigrosen-Extrakt*, G.

Preparation.—Red Rose, in No. 30 powder, 1000 Gm.; Glycerin 100 Cc.; Diluted Alcohol a sufficient quantity; to make 1000 Cc. Mix the glycerin with 900 Cc. of diluted alcohol, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical glass percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward diluted alcohol, until the red rose is exhausted. Reserve the first 750 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of a menstruum composed of dilute alcohol 21½ fluidounces and glycerin 2½ fluidounces; subsequent percolation is to be continued with diluted alcohol. The first 18½ fluidounces of percolate should be set aside as reserve, and the final volume of finished product made up to 24 fluidounces.

This fluid extract is of a deep-red color, of an agreeable odor of rose, and of a pleasant mildly-astringent taste.

Uses.—An agreeable ingredient of gargles and mouth-washes. It may take the place of rose-leaves in the compound infusion of rose; it masks the taste of solutions of Epsom and Glauber salts, and imparts a pleasing odor to many magistral mixtures.

EXTRACTUM RUBI FLUIDUM, *U. S.*—Fluid Extract of Rubus.

Fluid extract of blackberry-bark, E.; *Extrait liquide d'écorce de ronce*, Fr.; *Flüssiges Brombeerrinden-Extrakt*, G.

Preparation.—Rubus, in No. 60 powder, 1000 Gm.; Glycerin 100 Cc.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix the glycerin with 600 Cc. of alcohol and 300 Cc. of water, and, having moistened the powder with 350 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward a mixture of alcohol and water made in the proportion of 600 Cc. of alcohol to 300 Cc. of water until the rubus is exhausted. Reserve the first 700 Cc. of the percolate; by means of a water-bath distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough of a mixture of alcohol and water, using the last-named proportions, to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 9 fluidounces of a menstruum composed of alcohol 14½ fluidounces, water 7 fluidounces, and glycerin 2½ fluidounces; subsequent percolation is to be continued with a mixture of alcohol 2 volumes, water 1 volume. The first 19½ fluidounces of percolate should be set aside as a reserve, and the final volume of finished product made up to 24 fluidounces.

Experience has shown that the reduction in the quantity of glycerin and increase in the alcoholic strength, as now directed in the official menstruum, and first suggested by A. Robbins in 1883, is of decided advantage in securing a more permanent fluid extract.

The deep-brown liquid has a decidedly astringent taste.

Uses.—It is a good astringent, and well suited for the treatment of mild cases of *diarrhœa* in children, after a sufficient evacuation of the bowels. The *dose* is Gm. 2–8 (fʒss–ij). It may, like other vegetable astringents, be added to the chalk mixture.

EXTRACTUM RUMICIS FLUIDUM, *U. S.*—Fluid Extract of Rumex.

Fluid extract of yellow dock, E.; *Extrait liquide de patience frisée*, Fr.; *Flüssiges Grindwurz-Extrakt*, G.

Preparation.—Rumex, in No. 40 powder, 1000 Gm.; Diluted Alcohol a sufficient

quantity, to make 1000 Cc. Moisten the powder with 350 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the rumex is exhausted. Reserve the first 800 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 9 fluidounces of menstruum and the first 19½ fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

This fluid extract has a deep red-brown color and the bitter and astringent taste of the root, which is thoroughly exhausted by the menstruum.

Dose, about Gm. 4 (1 fluidrachm.)

EXTRACTUM SABINÆ FLUIDUM, *U. S.*—Fluid Extract of Savine.

Extrait liquide de sabine, Fr.; *Flüssiges Sadebaum-Extrakt*, G.

Preparation.—Savine, in No. 40 powder, 1000 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 250 Cc. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until the savine is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 6 fluidounces of menstruum, and the first 22 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

The process does not differ from that of 1880. The brown-green liquid contains the volatile oil, resin, and tannin of the drug, and is not only well adapted for making Ceratum sabinæ, but it offers likewise a convenient way for administering savine.

Extractum sabinæ is made with 60 per cent. alcohol (*F. P.*), the tincture being evaporated to the proper consistence; it has a greenish-brown color. The yield is 19 or 20 per cent.

Uses.—The fluid extract appears to contain all the virtues of savine. *Dose*, Gm. 0.30–1.00 (♏v–xv.)

EXTRACTUM SANGUINARIÆ FLUIDUM, *U. S.*—Fluid Extract of Sanguinaria.

Fluid extract of blood-root, E.; *Extrait liquide de sanguinaire*, Fr.; *Flüssiges Blutwurz-Extrakt*, G.

Preparation.—Sanguinaria, in No. 60 powder, 1000 Gm.; Acetic Acid, 50 Cc.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix alcohol and water in the proportion of 750 Cc. of alcohol and 250 Cc. of water. Moisten the powder with 300 Cc. of the mixture, to which the acetic acid had previously been added, and let it macerate, in a well-covered vessel, in a warm place, during forty-eight hours. Then pack it firmly in a cylindrical percolator, and gradually pour menstruum upon it, until the sanguinaria is exhausted. Reserve the first 850 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with a mixture of 45 fluidrachms of alcohol, 15 fluidrachms of water, and 9½ fluidrachms of acetic acid, and macerate for forty-eight hours before it is packed in a percolator. The menstruum for percolation consists of alcohol 3 volumes, water 1 volume, and the first 21 fluidounces of percolate should be set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

The menstruum for this fluid extract has been greatly changed from that of 1880, and it is thought that a more satisfactory preparation will now result; the addition of an acid was suggested as early as 1880, and has since been tried with good effect. It

is doubtful, however, whether the preparation can be kept entirely free from precipitation for any great length of time.

Uses.—*Dose*, as an emetic, Gm. 0.60–4 (ɱx–lx); as a nauseant, Gm. 0.20–0.30 (ɱiij–v). In this concentrated form sanguinaria should be cautiously used.

EXTRACTUM SARSAPARILLÆ FLUIDUM, *U. S.*—Fluid Extract of Sarsaparilla.

Extractum sarsæ liquidum, Br.—*Liquid extract of sarsaparilla*, E.; *Extrait liquide de salsepareille*, Fr.; *Flüssiges Sarsaparilla-Extrakt*, G.

Preparation.—Sarsaparilla, in No. 30 powder, 1000 Gm.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix 300 Cc. of alcohol with 600 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the sarsaparilla is exhausted. Reserve the first 800 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of menstruum (alcohol 1 volume, water 2 volumes), and the first 19½ fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

The omission of glycerin from the menstruum of 1880 is no doubt justified, but we think a slight increase in the alcoholic strength (say, alcohol 2 volumes, water 3 volumes) would be of advantage.

Mix Jamaica sarsaparilla, in No. 40 powder, 40 ounces, with proof spirit 40 fluidounces; macerate in a closed vessel for ten days; press out 20 fluidounces of liquor and set this aside. Mix the pressed residue with 12 pints (Imperial) of water and macerate at 71.1° C. (160° F.) for sixteen hours, then strain and press out the liquid; dissolve 5 av. ozs. sugar in this, and evaporate in a water-bath to about 18 fluidounces. Mix the two liquids, and make up the volume to 40 fluidounces by the addition of distilled water.—*Br.*

The relative strength of the two fluid extracts is practically alike. The first process appears to be well adapted for exhausting the root and preserving the fluid extract, which contains about one-third its measure of alcohol. The second formula is an improvement of that of the former Br. P.; the exhaustion of the root is more complete, but the long exposure in the evaporation of 240 to 18 fluidounces could be materially reduced by percolating the powdered root.

Uses.—It probably contains whatever active elements belong to sarsaparilla, and serves as a basis or as a vehicle for other medicines. *Dose*, Gm. 2–4 (ɱxxx–lx).

EXTRACTUM SARSAPARILLÆ FLUIDUM COMPOSITUM, *U. S.*—Compound Fluid Extract of Sarsaparilla.

Extrait liquide de salsepareille composé, Fr.; *Zusammengesetztes flüssiges Sarsaparilla-Extrakt*, G.

Preparation.—Sarsaparilla, in No. 30 powder 750 Gm.; Glycyrrhiza, in No. 30 powder, 120 Gm.; Sassafras-bark, in No. 30 powder, 100 Gm.; Mezereum, in No. 30 powder, 30 Gm.; Glycerin, 100 Cc.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix the glycerin with 300 Cc. of alcohol and 600 Cc. of water, and, having moistened the mixed powders with 400 Cc. of the mixture, pack them firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward a mixture of alcohol and water, made in the proportion of 300 Cc. of alcohol to 600 Cc. of water, until the powder is exhausted. Reserve the first 800 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough of a mixture of alcohol and water, using the last-named proportions, to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the mixed ground drugs should be moistened with about 10 fluidounces of a menstruum composed of alcohol 7½ fluidounces, water 14½ fluidounces, and glycerin

2½ fluidounces, subsequent percolation being continued with a mixture of alcohol 1 volume, water 2 volumes. The first 19½ fluidounces of percolate should be set aside as reserve, and the final volume of finished product made up to 24 fluidounces.

The preparation is fairly permanent. The frequent use which is made of the above combination of drugs probably renders such a fluid extract desirable, though it seems to be unnecessary, since the introduction of concentrated preparations of licorice-root and mezereum affords the opportunity of giving these and sarsaparilla in any proportion that may be desired.

Uses.—The only active ingredient in this preparation besides the sarsaparilla is mezereum. It would appear to be a less eligible medicine than the compound decoction of sarsaparilla, which contains also guaiacum, and whose efficiency is established. *Dose*, Gm. 2–4 (ɱxxx–fʒj).

EXTRACTUM SCILLÆ FLUIDUM, *U. S.*—Fluid Extract of Squill.

Extrait liquide de scille, Fr.; *Flüssiges Meerzwiebel-Extrakt*, G.

Preparation.—Squill, in No. 20 powder, 1000 Gm.; Alcohol, Water, each, a sufficient quantity, to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water, and, having moistened the powder with 200 Cc. of the mixture, pack it in a cylindrical percolator, then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the squill is exhausted. Reserve the first 750 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 5 fluidounces of menstruum (alcohol 3 volumes, water 1 volume), and the first 18½ fluidounces of percolate set aside as reserve. The final volume of finished product should be made up to 24 fluidounces.

Squill yields with cold water from 55 to 65 per cent., and with diluted alcohol from 35 to 45 or 50 per cent., of extract. Alcohol, which does not dissolve the gummy matter, yields much less, but appears to be a solvent for all the medicinally-valuable principles. The fluid extract is of a dark brown-red color, and has the bitter and acrid taste of the drug.

The menstruum will yield a fluid extract equally as satisfactory as alcohol alone (directed in 1880), and is preferable to diluted alcohol, because but very little gummy matter, if any, enters into solution.

Extractum scillæ, *F. Cod.*, is made with alcohol sp. gr. 0.914. It is brown-yellow and soluble in water and diluted alcohol.

Uses.—This preparation is a concentrated and convenient form of squill. It is especially adapted for use as a diuretic. *Dose*, Gm. 0.20–0.30 (ɱiij–v), largely diluted.

EXTRACTUM SCOPARII FLUIDUM, *U. S.*—Fluid Extract of Scoparius.

Fluid extract of broom, E.; *Extrait liquide de genêt à balais*, Fr.; *Flüssiges Besenginster-Extrakt*, G.

Preparation.—Scoparius, in No. 60 powder, 1000 Gm.; Diluted Alcohol, a sufficient quantity, to make 1000 Cc. Moisten the powder with 350 Cc. of diluted alcohol and pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the scoparius is exhausted. Reserve the first 850 Cc. of the percolate; by means of a water-bath, distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 9 fluidounces of menstruum (diluted alcohol), and the first 21 fluidounces of percolate set aside as reserve. The final volume of finished product should be made up to 24 fluidounces.

This fluid extract has a dark-olive color, characteristic odor, and bitter taste.

Uses.—It may be doubted whether the fluid extract has a diuretic operation equal to that of the decoction of broom. But it may be used to reinforce the latter. *Dose*, Gm. 1 to 4 (ɱxv to fʒj).

EXTRACTUM SCUTELLARIÆ FLUIDUM, *U. S.*—Fluid Extract of Scutellaria.

Fluid extract of skull-cap, E.; *Extrait liquide de scutellaire*, Fr.; *Flüssiges Helmkraut-Extrakt*, G.

Preparation.—Scutellaria, in No. 40 powder, 1000 Gm.; Diluted Alcohol a sufficient quantity, to make 1000 Cc. Moisten the powder with 350 Cc. of the menstruum, and pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum until the scutellaria is exhausted. Reserve the first 800 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 9 fluidounces of menstruum, and the first 19½ fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

The Pharmacopœia has increased the alcoholic strength of the menstruum slightly above that of 1880, but we think that a change to alcohol 2 volumes and water 1 volume would have been still better. As pointed out by A. Robbins (1883), diluted alcohol does not yield a permanent preparation.

The fluid extract will have a green-brown color.

Uses.—Whatever medicinal virtues (if any) belong to scutellaria may be exhibited by this preparation of it. The *dose* is stated at Gm. 4–8 (f℥j–ij).

EXTRACTUM SENEGÆ FLUIDUM, *U. S.*—Fluid Extract of Senega.

Extrait liquide de polygale de Virginie, Fr.; *Flüssiges Senega-Extrakt*, G.

Preparation.—Senega, in No. 40 powder, 1000 Gm.; Ammonia-water 50 Cc.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix the ammonia-water with 750 Cc. of alcohol and 200 Cc. of water, and, having moistened the powder with 450 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and then a mixture of alcohol and water, made in the proportion of 750 Cc. of alcohol to 250 Cc. of water, until the senega is exhausted. Reserve the first 850 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10½ fluidounces of a menstruum composed of alcohol 18 fluidounces, water 4¾ fluidounces, and ammonia-water 1¼ fluidounces, subsequent percolation to be continued with a mixture of alcohol 3 volumes, water 1 volume. The first 21 fluidounces of percolate should be set aside as reserve, and the final volume of finished product made up to 24 fluidounces.

Water is a better solvent for senegin than a strongly alcoholic menstruum, but it has also the disadvantage of dissolving a considerable proportion of various pectin compounds, which are apt after some time to convert the liquid into a gelatinous mass.

We cannot see any advantage in the use of so strongly alcoholic a menstruum as that recommended by the Pharmacopœia; experience has shown that a mixture of alcohol 2 volumes, water 1 volume, thoroughly exhausts the drug, and that with the present increase of ammonia-water to 5 per cent. by volume the preparation keeps very well. The fluid extract is of a dark-brown color, and possesses the characteristic odor and acrid taste of the root.

Extractum senegæ.—Extract of senega, E.; Extrait de polygale, Extrait de sénéca, Fr.; Senegaextrakt, G.—This has been dismissed from the U. S. P. and P. G., which authorities prepared it with diluted alcohol, obtaining about 30 per cent. of extract. The French Codex orders alcohol sp. gr. 0.914, which yields from 16 to 20 per cent. of extract. It may be prepared extemporaneously by evaporating the fluid extract to the proper consistence.

Uses.—The special object of this preparation is apparently to supersede the decoction, all of whose virtues it possesses. *Dose*, Gm. 0.30–1.30 (♏ v–xx).

EXTRACTUM SENNÆ FLUIDUM, *U. S.*—Fluid Extract of Senna.

Extrait liquide de séné, Fr.; *Flüssiges Senna-Extrakt*, G.

Preparation.—Senna, in No. 30 powder, 1000 Gm.; Diluted Alcohol, a sufficient quantity; to make 1000 Cc. Moisten the powder with 400 Cc. of the menstruum, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the senna is exhausted. Reserve the first 800 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of menstruum, and the first 19½ fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

The fluid extract of 1850 was a thick syrup flavored with oil of fennel and Hoffmann's anodyne, the latter added to prevent fermentation. In 1860 these additions were dropped, and in 1870 glycerin was substituted for sugar. Properly prepared, these fluid extracts kept well, although a deposit took place, but they were inconveniently thick. The present formula yields a thinner fluid extract, which separates insoluble inert matter on the sides and bottom of the bottle. From the observation of A. Robbins (1883), it appears that the addition of glycerin to the menstruum causes the precipitate to collect at the bottom. Freed from the precipitate, the fluid extract is of a dark-brown color and has the odor and taste of senna-leaves.

Uses.—This fluid extract may be prescribed as a laxative in *doses* of Gm. 4 (f℥j), and as a purgative in doses of Gm. 8 (f℥ij). It is apt to gripe severely without the addition of a carminative, such as oil of anise or oil of peppermint.

EXTRACTUM SERPENTARIÆ FLUIDUM, *U. S.*—Fluid Extract of Serpentaria.

Extrait liquide de serpentaire, Fr.; *Flüssiges Schlangenwurzel-Extrakt*, G.

Preparation.—Serpentaria, in No. 60 powder, 1000 Gm.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix 800 Cc. of alcohol with 200 Cc. of water, and, having moistened the powder with 300 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the serpentaria is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 7½ fluidounces of menstruum, alcohol 4 volumes, water 1 volume, and the first 22 fluidounces of percolate set aside as reserve. The final volume of finished product should be made up to 24 fluidounces.

There is scarcely any difference in the results obtained with this and with the formula of 1880. The virtues of serpentaria are well exhausted and properly preserved by this process. The fluid extract has a red-brown color and the peculiar odor and bitter taste of the drug.

Uses.—It is a convenient and efficient substitute for the infusion of serpentaria. *Dose*, Gm. 2 (f℥ss). It is said to be an excellent application to parts *poisoned* by *rhus toxicodendron*.

EXTRACTUM SPIGELIÆ FLUIDUM, *U. S.*—Fluid Extract of Spigelia.

Extrait liquide de spigélie, Fr.; *Flüssiges Spigelien-Extrakt*, G.

Preparation.—Spigelia, in No. 60 powder, 1000 Gm.; Diluted Alcohol a sufficient quantity, to make 1000 Cc. Moisten the powder with 300 Cc. of diluted alcohol and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the

powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the spigelia is exhausted. Reserve the first 850 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 7½ fluidounces of menstruum and the first 21 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

Originally, the fluid extract was saccharine, and in 1870 the sugar was replaced by glycerin. It was found, however, that it will keep unaltered in the form of a concentrated tincture, as by the present formula. It is a dark-brown liquid.

EXTRACTUM SPIGELIÆ ET SENNÆ FLUIDUM.—Fluid extract of spigelia and senna, *E.*; Extrait liquide de spigélie et séné, *Fr.*; Flüssiges Spigelien- und Senna-Extrakt, *G.*—After 1860 this preparation was made by mixing fluid extract of spigelia 10 fluidounces with fluid extract of senna 6 fluidounces and oils of caraway and of anise each 20 minims. A more elegant and satisfactory preparation, however, is obtained, according to Mr. Alonzo Robbins (1883), by preparing it from the drugs, as originally suggested by Procter (1848), omitting the alkali; the proportions are—spigelia 60 parts (15 oz. av.), senna 30 parts (7½ oz. av.), anise and caraway each 5 parts (1¼ oz. av.); the menstruum is diluted alcohol, and the yield is 100 parts by measure (24 fluidounces).

Uses.—It possesses fully the virtues of spigelia, and may be given in the *dose* of Gm. 4 (f℥i) and upward.

Fluid extract of spigelia and senna represents in a concentrated form the well-tried and popular remedy "worm tea." It should be prescribed in *doses* of Gm. 4 (f℥i), at intervals of an hour, until it begins to purge.

EXTRACTUM STILLINGIÆ FLUIDUM, *U.S.*—Fluid Extract of Stillingia.

Extrait liquide de stillingie, Fr.; *Flüssiges Stillingien-Extrakt*, G.

Preparation.—Stillingia, in No. 40 powder, 1000 Gm.; Diluted Alcohol a sufficient quantity, to make 1000 Cc. Moisten the powder with 300 Cc. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until the stillingia is exhausted. Reserve the first 850 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough diluted alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 7½ fluidounces of menstruum, and the first 21 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

Fluid extract of stillingia will sometimes become gelatinous on standing, which difficulty may be overcome by the addition of sugar (about 10 or 12 per cent. of the weight of drug used); a somewhat stronger alcoholic menstruum (alcohol 3 volumes, water 1 volume) also seems to improve the preparation materially. It is of a dark red-brown color and has the bitterish, pungent taste of the root.

Uses.—It may be employed in various chronic diseases, and especially scrofula, diseases of the skin, syphilis, etc. *Dose*, Gm. 2 (f℥ss).

EXTRACTUM STRAMONII SEMINIS, *U. S.*—Extract of Stramonium-seed.

Extractum stramonii, U. S. 1880; Br.—*Extract of stramonium*, E.; *Extrait de semences de stramoine*, Fr.; *Stechapfelsamen-Extrakt*, G.

Preparation.—Stramonium-seed, in No. 60 powder, 1000 Gm.; Diluted Alcohol a sufficient quantity. Moisten the powder with 300 Gm. of diluted alcohol, and pack it firmly in a cylindrical percolator; then add enough diluted alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding diluted alcohol, until

3000 Cc. of tincture are obtained or the stramonium-seed is exhausted. Reserve the first 900 Cc. of the percolate, evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to 100 Cc., mix the residue with the reserved portion in a porcelain capsule, and by means of a water-bath evaporate, at or below the before-mentioned temperature, to a pilular consistence.—*U. S.*

25 av. ozs. of the powdered seed should be moistened with about 7½ fluidounces of menstruum. About 75 fluidounces of percolate will be found sufficient to exhaust the drug, of which the first 22 fluidounces should be set aside as reserve; the remainder should be evaporated to 2½ fluidounces before it is mixed with the reserve portion for final evaporation.

The presence of about 25 per cent. of fixed oil in the seed renders the preparation of this extract troublesome in spite of the diluted alcohol; we have found that the previous removal of the oil by treatment with benzin very materially improves the process, and also facilitates the reduction of the seed to No. 60 powder as directed.

According to the British Pharmacopœia, the coarsely-powdered seeds are first exhausted with washed ether for removing the fixed oil; the residue is then percolated with proof spirit sp. gr. 0.920, the tincture distilled to recover the alcohol, and finally evaporated to the proper consistence. The yield is about 12½ per cent. The extract of the French Codex is made by digestion with alcohol spec. grav. 0.914; after distilling and evaporating the tincture the residue is dissolved in four times its weight of distilled water, filtered to remove oily and resinous matter, and the filtrate evaporated to the proper consistence. The yield is about 7 per cent.

EXTRACTUM STRAMONII FOLIORUM, *U. S. P.* 1870, was prepared from the dry leaves with alcohol and diluted alcohol; the yield is about 20 per cent. EXTRACTUM STRAMONII, *P. G.* 1872, was the inspissated juice of the fresh plant; yield, 3–3½ per cent.

Dose.—Its commencing *dose* should not exceed Gm. 0.016 (gr. ¼).

EXTRACTUM STRAMONII SEMINIS FLUIDUM, *U. S.*—FLUID EXTRACT OF STRAMONIUM-SEED.

Extractum stramonii fluidum, U. S. 1880.—*Fluid extract of stramonium*, E.; *Extrait liquide de semences de stramoine*, Fr.; *Flüssiges Steehapfelsamen-Extrakt*, G.

Preparation.—Stramonium-seed, in No. 60 powder, 1000 Gm.; Alcohol, Water, each a sufficient quantity, to make 100 Cem. (24 fluidounces). Mix 750 Cc. of alcohol with 250 Cc. of water, and, having moistened the powder with 200 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the strammonium-seed is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to a soft extract: dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the powdered seed should be moistened with about 5 fluidounces of menstruum, and the first 22 fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

The fixed oil in strammonium-seed being without medicinal virtue, we think its removal with benzin, as already suggested in the preceding article, would prove advantageous, and in that case a weaker alcoholic menstruum (alcohol 2 volumes and water 1 volume, or diluted alcohol) would suffice to exhaust the drug. The fluid extract is of a brown color.

Dose.—The commencing *dose* should not exceed Gm. 0.06–0.12 (♏j–ij).

EXTRACTUM TARAXACI, *U. S., Br., P. G.*—EXTRACT OF TARAXACUM.

Extract of dandelion, E.: *Extrait de pissenlit* (*de dent de lion*), Fr.; *Löwenzahn-Extrakt*, G.; *Estratto di tarassaco*, It.

Preparation.—Fresh Taraxacum, gathered in autumn, a convenient quantity; Water a sufficient quantity. Slice the taraxacum and bruise it in a stone mortar, sprinkling on it a little water, until reduced to a pulp; then express and strain the juice, and evaporate it in a vacuum-apparatus or in a shallow porcelain dish, by means of a water-bath, to a pilular consistence.—*U. S.*

Take of fresh dandelion-root 4 pounds. Crush the root, press out the juice, and allow

it to deposit; heat the clear liquor to 212° F., and maintain the temperature for ten minutes; then strain, and evaporate by a water-bath, at a temperature not exceeding 160° F., until the extract has acquired a suitable consistence for forming pills.—*Br.*

The juice of taraxacum contains albumen, which is very properly removed in the second process by heating the juice for a short time to the boiling-point and straining from the coagulum. Collected in the autumn, the fresh root yields 8 to 10 per cent. of extract; the fresh spring root, with the leaves, yields a smaller amount, varying between 4½ and 6 per cent., and, after drying by exhaustion with cold water, from 25 to 40 per cent. This is the extract recognized by the German Pharmacopœia, that of the French Codex being made from the fresh leaves, with a yield of 2½ to 3 per cent. The extract is of a brown color, and should yield a nearly clear solution with water.

Uses.—Owing to its liability to spoil, this extract is not an eligible preparation. It may be prescribed in the *dose* of Gm. 0.60 (gr. x) and upward, dissolved in some aromatic water and taken after meals.

EXTRACTUM TARAXACI FLUIDUM, *U. S.*—Fluid Extract of Taraxacum.

Extractum taraxaci liquidum.Br.—*Liquid extract of dandelion*, E.; *Extrait de liquide de pissenlit*, Fr.; *Flüssiges Löwenzahn-Extrakt*, G.

Preparation.—Taraxacum, in No. 30 powder, 1000 Gm.; Diluted Alcohol, a sufficient quantity to make 1000 Cc. Moisten the powder with 300 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the taraxacum is exhausted. Reserve the first 850 Cc. of the percolate; by means of a water-bath distil off the alcohol from the remainder, and evaporate the residue to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 7½ fluidounces of menstruum, and the first 21 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

The present fluid extract is similar to that of 1860 and 1880, except that it contains a stronger alcohol; that of 1870 contained one-fourth its measure of glycerin. On keeping, these preparations deposit a slight precipitate of inert matter. Prepared from good dandelion-root the fluid extract is an efficient preparation, of a reddish-brown color and bitterish-sweet taste. We have seen commercial fluid extracts bearing this name which, to judge from their appearance and their more decided bitterness, were evidently made from chicory-root.

Extr. taraxaci liquidum, *Br.*, contains half its measure of proof spirit.

Uses.—It is a more permanent preparation than the decoction of dandelion, and at the same time quite as operative. *Dose*, Gm. 4 (f℥j), largely diluted.

EXTRACTUM TRITICI FLUIDUM, *U. S.*—Fluid Extract of Triticum.

Fluid extract of couch-grass, E.; *Extrait liquide de chiendent*, Fr.; *Flüssiges Quecken-Extrakt*, G.

Preparation.—Triticum, finely cut, 1000 Gm.; Alcohol, Water, each a sufficient quantity, to make 1000 Cc. Pack the triticum in a cylindrical percolator, pour boiling water upon it and allow percolation to proceed, supplying boiling water as required, until the triticum is exhausted. Evaporate the percolate to 750 Cc., and, having added to it 250 Cc. of alcohol, mix well and set it aside for forty-eight hours. Then filter the liquid, and add to the filtrate enough of a mixture composed of 3 volumes of water and 1 volume of alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of finely-cut couch-grass should be exhausted by percolation with boiling water, and the infusion evaporated to 18 fluidounces; after addition of 6 fluidounces of alcohol the mixture is set aside for forty-eight hours, filtered, and to the filtrate enough of a menstruum, composed of alcohol 1 volume and water 3 volumes, added to bring the final volume of the finished product up to 24 fluidounces.

The manipulation for preparing this fluid extract will be successful only if suitable provision be made to let the liquid pass from the percolator in drops, the drug being too coarse and unyielding to permit its packing like most of the other powders. We consider

digestion preferable to percolation, since the drug is thus easily exhausted, and by shortening the process fermentation of the strongly saccharine liquid is prevented. For the reason stated, the liquid should be rapidly concentrated. The fluid extract is of a brown color and sweet taste.

EXTRACTUM GRAMINIS, *P. G.* 1882.—Couch-grass 1 part, boiling water 5 parts; digest for 6 hours, strain, boil down to 3 parts, filter, and evaporate to the proper consistence. The yield varies between 25 and 35 per cent. The French Codex directs exhaustion with cold water, boiling, straining, and evaporating; the yield is stated to be 9 or 10 per cent.

Uses.—The fluid extract diluted with water or added to some emollient infusion, such as that of flaxseed or of barley, may be freely used in irritations of the genito-urinary tract, of the intestinal canal, of the bronchia, etc. A decoction of the fresh plant is to be preferred.

EXTRACTUM UVÆ URSI, *U. S.*—EXTRACT OF UVA URSI.

Extrait de busserole, Fr.; *Bärentraubenblätter-Extrakt*, G.

Preparation.—Uva Ursi, in No. 30 powder, 1000 Gm.; Alcohol, Water, each a sufficient quantity. Mix 200 Cc. of alcohol with 500 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, using the same proportions of alcohol and water as before, until the uva ursi is exhausted. Reserve the first 900 Cc. of the percolate; evaporate the remainder, at a temperature not exceeding 50° C. (122° F.), to 100 Cc. Mix this with the reserved portion, and evaporate, at or below the before-mentioned temperature, in a porcelain capsule, on a water-bath, to a pilular consistence.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of menstruum, composed of alcohol 2 volumes, water 5 volumes, and the first 22 fluidounces of percolate set aside as reserve; the remainder of the percolate should be evaporated to 2½ fluidounces before it is mixed with the reserve portion for final evaporation.

Dose, Gm. 0.6 (gr. x).

EXTRACTUM UVÆ URSI FLUIDUM, *U. S.*—FLUID EXTRACT OF UVA URSI.

Extrait liquide de busserole, F.; *Flüssiges Bärentraubenblätter-Extrakt*, G.

Preparation.—Uva Ursi, in No. 30 powder, 1000 Gm.; Glycerin, 300 Cc.; Alcohol, Water, each a sufficient quantity, to make 1000 Cc. Mix the glycerin with 200 Cc. of alcohol and 500 Cc. of water, and, having moistened the powder with 400 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding, first, the remainder of the menstruum, and afterward a mixture of alcohol and water, made in the proportion of 200 Cc. of alcohol to 500 Cc. of water, until the uva ursi is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough of the mixture of alcohol and water to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 10 fluidounces of the mixture composed of alcohol 4¾ fluidounces, water 12 fluidounces, and glycerin 7¼ fluidounces, subsequent percolation to be continued with a menstruum of alcohol 2 volumes, water 5 volumes; the first 22 fluidounces of percolate should be set aside as reserve, and the final volume of finished product made up to 24 fluidounces.

The increase of glycerin to nearly four times the quantity directed in 1880 appears to us unnecessary; in fact, glycerin may be omitted entirely, since experience has shown that diluted alcohol completely exhausts the drug and yields a fluid extract which keeps well. We should prefer the latter menstruum both for this and the preceding preparation. The fluid extract is of a dark-brown color and possesses a bitter astringent taste.

Uses.—It probably possesses all the virtues of the plant. Like nearly all medicines intended to act upon the urinary organs, it should be given largely diluted. *Dose*, Gm. 4 (f℥j).

EXTRACTUM VALERIANÆ FLUIDUM, *U. S.*—Fluid Extract of Valerian.

Extrait liquide de valériane, Fr.; *Flüssiges Baldrian-Extrakt*, G.

Preparation.—Valerian, in No. 60 powder, 1000 Gm.; Alcohol, Water, each a sufficient quantity, to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water, and, having moistened the powder with 300 Cc. of the mixture, pack it firmly in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the valerian is exhausted. Reserve the first 850 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 7½ fluidounces of menstruum, alcohol 3 volumes, water 1 volume, and the first 21 fluidounces of percolate set aside as reserve; the final volume of the finished product should be made up to 24 fluidounces.

The present menstruum does not differ much from that of 1880, but a mixture of alcohol, 7 volumes, and water 3 volumes, would correspond still more closely, and such a menstruum has been found to yield excellent results; a stronger alcoholic mixture is quite unnecessary. The fluid extract is of a deep red-brown color, and has the characteristic odor and taste of valerian. Little loss of oil will occur if proper care is observed in the percolation and evaporation.

Extractum valerianæ has been dismissed from most pharmacopœias. The French Codex directs it to be made with alcohol sp. gr. 0.914; the yield is 19 or 20 per cent. It may be readily prepared by concentrating the fluid extract at the heat of a water-bath.

Uses.—An efficient preparation of this valuable drug. *Dose*, Gm. 4 (f℥j).

EXTRACTUM VERATRI VIRIDIS FLUIDUM, *U. S.*—Fluid Extract of Veratrum Viride.

Fluid extract of American veratrum, E.; *Extrait de liquide de vératre américain*, Fr.; *Flüssiges Grüngermer-Extrakt*, G.

Preparation.—Veratrum Viride, in No. 60 powder, 1000 Gm.; Alcohol, a sufficient quantity, to make 1000 Cc. Moisten the powder with 300 Cc. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until the veratrum viride is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 7½ fluidounces of menstruum, and the first 22 fluidounces set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

The resins and alkaloids are readily taken up and held in solution by the menstruum directed, and the fluid extract is therefore two and a half times as strong as the tincture of the same drug.

Uses.—This preparation is a very potent depresser of the heart's action. *Dose*, Gm. 0.05–0.15 (♏ j–iij).

EXTRACTUM VIBURNI OPULI FLUIDUM, *U. S.*—Fluid Extract of Viburnum Opulus.

Fluid extract of cramp-bark, E.

Preparation.—Viburnum Opulus, in No. 60 powder, 1000 Gm.; Water, each, a sufficient quantity, to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water, and, having moistened the powder with 300 Cc. of the mixture, pack it moderately in a cylindrical percolator; then add enough menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum,

using the same proportions of alcohol and water as before, until the viburnum is exhausted. Reserve the first 850 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 7½ fluid ounces of menstruum, and the first 21 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

Fluid extract of cramp-bark has a reddish-brown color, slight odor, and somewhat astringent taste.

Dose, Gm.4–8 (1–2 fluidrachms).

EXTRACTUM VIBURNI PRUNIFOLII FLUIDUM, *U. S.*—Fluid Extract of Viburnum Prunifolium.

Fluid extract of blackhaw-bark, E.; *Extrait liquide de viburne*, Fr.; *Flüssiges Viburnum-Extrakt*, G.

Preparation.—Viburnum, in No. 60 powder, 1000 Gm.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water, and, having moistened the powder with 300 Cc. of menstruum, pack it moderately in a cylindrical percolator; then add enough of the menstruum to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding menstruum, until the viburnum is exhausted. Reserve the first 650 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough menstruum to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 7½ fluidounces of menstruum, alcohol 3 volumes, water 1 volume, and the first 21 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

The fluid extract is of a deep brown-red color and of the astringent and bitter taste of the bark.

Uses.—Doubtless this preparation represents the undetermined virtues of viburnum. *Dose*, Gm. 2–4 (ɱxxx–lx).

EXTRACTUM XANTHOXYLI FLUIDUM, *U. S.*—Fluid Extract of Xanthoxylum.

Fluid extract of prickly ash, E.; *Extrait liquide d'écorce de clavalier*, Fr.; *Flüssiges Zahnwehrinden-Extrakt*, G.

Preparation.—Xanthoxylum, in No. 40 powder, 1000 Gm.; Alcohol, a sufficient quantity; to make 1000 Cc. Moisten the powder with 250 Cc. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until the xanthoxylum is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 6 fluidounces of the menstruum, and the first 22 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

A newly-introduced fluid extract of a reddish-brown color, and possessing the acrid taste of the bark.

Uses.—It is probable that this preparation contains all the active constituents of xanthoxylum. Its *dose* is stated to be Gm. 2–4 (fʒss–j).

EXTRACTUM ZINGIBERIS FLUIDUM, *U. S.*—Fluid Extract of Ginger.

Extrait liquide de gingembre, Fr.; *Flüssiges Ingwer-Extrakt*, G.

Preparation.—Ginger, in No. 40 powder, 1000 Gm.; Alcohol, a sufficient quantity; to make 1000 Cc. Moisten the powder with 250 Cc. of alcohol, and pack it firmly in a

cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until the ginger is exhausted. Reserve the first 900 Cc. of the percolate, and evaporate the remainder to a soft extract; dissolve this in the reserved portion, and add enough alcohol to make the fluid extract measure 1000 Cc.—*U. S.*

25 av. ozs. of the drug should be moistened with about 6 fluidounces of menstruum (alcohol), and the first 22 fluidounces of percolate set aside as reserve; the final volume of finished product should be made up to 24 fluidounces.

Ginger is readily exhausted by alcohol; the brownish-red fluid extract is five times stronger than the tincture of ginger, and has the same sensible properties, but in a higher degree. It is used in preparing Syrupus zingiberis, *U. S.*

Uses.—It is a convenient substitute for the tincture on account of its greater strength, and for the infusion on account of its smaller bulk. *Dose*, Gm. 0.60 (ℳx).

FABIANA.—Fabiana.

The branches of Fabiana imbricata, *Ruiz et Pavon.*

Nat. Ord.—Solanaceæ, Nicotianeæ.

Origin and Description.—The plant is tree-like, or more frequently shrubby, and grows in sandy fields and on dry hills in Chili, where it is known as *pichi*. It is about 4.5–5 M. (15 or 18 feet) high, and bears single flowers terminating the numerous branches, and having a tubular white and purplish corolla 12–19 Mm. ($\frac{1}{2}$ to $\frac{3}{4}$ inch) long, much exceeding the small calyx; the fruit is a small, two-celled, and two-valved capsule, containing few subglobular and angular seeds. The larger branches are covered with a thin, smoothish, somewhat warty, brown-gray bark, which adheres firmly to the yellowish tough wood. The younger branches are 2–5 Mm. ($\frac{1}{12}$ to $\frac{1}{5}$ inch) thick, and are densely covered by the scale-like and closely-imbricated leaves, which are about 1 Mm. ($\frac{1}{24}$ inch) long, sessile, ovate, entire, smooth, and of a bluish-green color. The drug has a peculiar aromatic odor and a disagreeable bitter taste.

Constituents.—Dr. Rusby's experiments (1885) indicated the presence of an alkaloid. Dr. Lyons (1886) obtained about 0.1 per cent. of this alkaloid, which is soluble in ether, forms crystallizable bitter salts, and yields precipitates with the usual reagents; also, a considerable quantity of bitter resin soluble in alcohol, ether, chloroform, and alkalies; a tasteless crystalline, neutral body, soluble in benzin and ether, and crystallizing from the alcoholic tincture; some volatile oil and a fluorescent compound resembling æsculin in behavior and possessing a very bitter taste. Benzin dissolves about 3 per cent., and ether about 33 per cent., of the drug; the alcoholic tincture yields a dense precipitate with water.

Action and Uses.—Pichi, or fabiana, is a popular medicine in Chili for *urinary disorders*, and has even been credited with cures of stone and gravel. It was also used in dyspeptic, and especially hepatic, diseases. Relief obtained by a prominent citizen from its use in some vesical affection attracted attention, and induced Dr. Ramirez to inquire into its real value. It was found to resemble very closely that of various terebinthinate, balsamic and other medicines that impregnate the urine and either heal or protect the mucous lining of the urinary passages. Like them, it is totally unfit for use in structural diseases of the kidneys. Several cases illustrating its utility in *vesical catarrh* and in renal and vesical *calculi* have been published (Wyman, *Therapeutic Gaz.*, x. 221; Fenwick, *ibid.*, xi. 703; Green, *ibid.*, xii. 368; also *Med. Record*, xxxii. 623; xxxviii. 5; *Therap. Gaz.*, xii. 240, 594). The virtue attributed to it in *hepatic disease* is believed to depend upon its favorable influence upon gastric digestion. Pichi is regarded by the Chilian shepherds as very efficacious in a disease of sheep which is supposed to be hydatids of the liver.

A decoction prepared by boiling Gm. 32 (℥j) of the coarsely powdered twigs in Gm. 1000 (2 pints) of water should be taken in four equal portions in twenty-four hours; or a fluid extract, of which a tablespoonful represents Gm. 8 (℥ij) of the plant, may be given, diluted, at similar intervals. Fenwick states the dose of the fluid extract at ℥ss. to ℥j, and of the infusion a wineglassful.

FARINA TRITICI, *Br.*—Wheaten Flour.

Wheat flour, E.; *Farine de blé (de froment)*, Fr.; *Weizenmehl*, G.; *Harina de trigo*, Sp.

The grain of wheat, Triticum sativum, *Lamarck*, s. Tr. vulgare, *Villars*, ground and sifted. Bentley and Trimen, *Med. Plants*, 294.

Nat. Ord.—Graminaceæ, Hordeæ.

Origin.—An annual or biennial herb which, though now unknown in the wild state, is probably indigenous to Central Asia, but has been under cultivation from a very early period, and is at present raised in most countries of the temperate zones in numerous varieties produced by cultivation, some having the chaff awnless or the lower paleæ more or less awned, and the fruit of a white or reddish color. Spring or summer wheat (Tr. æstivum) is awned or bearded, winter wheat (Tr. hybernum) mostly awnless. The fruit is oval-oblong, obtuse, grooved on the upper side, and of a yellowish or brownish color.

Of other cultivated species the following may be mentioned: Trit. turgidum, *Linné*, of which Tr. compositum, or Egyptian wheat, is a variety with compound spikes; Tr. durum, *Desfontaines*, or *horny wheat*, with long awns, including several varieties; Tr. Spelta, *Linné*, or *spelt*, with triangular ovate and obtuse grains, which are little mealy, and Tr. monococcum, *Linné*, or *one-grained wheat*, with small spikes, each spikelet producing one somewhat triangular grain.

Wheat grain, like the similar graminaceous fruits, has the integuments of the fruit and seed united; underneath this covering is a layer of cells containing *gluten*, and then follows the cellular tissue of the so-called albumen or endosperm, this being filled with *starch;* the embryo is located at the base of the endosperm. Wheat is most generally prepared for food by grinding, and separating by means of sieves the broken integuments, or *bran*, from the fine amylaceous white portion, or *flour*.

Description.—Wheaten flour is a very fine white powder, without odor and of an insipid taste. The starch-granules, which largely compose it, are described with other starches (see Amylum).

Composition.—Air-dry wheat contains, according to Millon (1854), 12 to 17 per cent. of water, 8 to 16 per cent. of gluten, about 2 per cent. of fat, about 2 per cent. of cellulose, and 1½ to 2 per cent. of ash. Older analyses of different kinds of wheat were principally made by A. Vogel (1818), Proust (1820), and Henry and Vauquelin (1822). The amount of starch varies between 60 and 70 per cent., and the weight of nitrogen between 1.6 and 2.7 per cent.; the ash contains nearly 50 per cent. of phosphoric acid. Clifford Richardson and C. A. Crampton (1886) found in the embryo some wax, a rapidly drying oil, ½ per cent. of allantoin, and about 18 per cent. of cane-sugar and highly dextrogyrate sugar. The bran contains over 7 per cent. of ash, while the nitrogenated principles enter chiefly the flour. If the latter be kneaded with cold water as long as the liquid becomes milky, a yellowish-gray elastic and glutinous mass remains, which is the *gluten* of Beccaria, retains about 70 per cent. of water, and consists, according to Von Bibra, in the dry state, of about 70 per cent. *vegetable fibrin*, 3.8 to 9.3 *vegetable casein*, 7.5 to 19.5 *glutin*, and 4.6 to 8.2 per cent. of fat. On drying it assumes a horn-like appearance and partly loses its solubility in phosphoric acid and potassa.

To purify it, Ritthausen (1862–67) dissolves it in cold very dilute potassa solution (1 to 1000 parts of water), decants from the undissolved starch, and precipitates with acetic acid. The precipitate is repeatedly treated with fresh portions of alcohol, commencing with spec. gr. .914, and increasing the strength finally to absolute alcohol. After another washing with ether the insoluble portion constitutes *gluten-casein*, which is slightly soluble in acetic acid, freely soluble in potassa, and becomes insoluble by heat. On evaporating the united alcoholic liquids to one-half and cooling, *gluten-fibrin* is separated, which is purified by dissolving it repeatedly in 50 and 60 per cent. alcohol. It is freely soluble in dilute acetic acid, and when boiled with water, in which it is insoluble, it is converted into a jelly. After the separation of gluten-fibrin the greater portion of the alcohol is evaporated; the precipitate appearing on cooling is treated with a little alcohol, washed with ether, dissolved in a little 65 per cent. alcohol, and precipitated by absolute alcohol. The precipitate is *mucedin;* the solution contains *gliadin*. Both principles are freely soluble in diluted alcohol and in weak acids and alkalies. The above are the most important *vegetable protein compounds*, and contain between 0.5 and 1 per cent. of sulphur, and between 15 and 18 per cent. of nitrogen.

Allied Drugs.—Farina Fabæ, from the seeds of Vicia Faba, *Linné* (Faba vulgaris, *Mœnch*); Windsor bean, Horse bean, *E.;* Fève de marais, *Fr.;* Saubohne, *G.;* Haba, *Sp.* The seeds contain starch 36, legumin 24, fat 2, sugar 2, and gummy matters about 9 per cent.

Farina Phaseoli from the seeds of Phaseolus vulgaris, *Linné;* Kidney bean, *E.;* Haricot, *Fr.;* Gartenbohne, *G.;* Frijol, *Sp.* The seeds contain starch 38, legumin 25, fat 3, sugar 0.5, and gummy matters about 11 per cent.

Action and Uses.—Wheaten flour is often used as a dusting-powder to allay the heat and pain of local inflammations, such as superficial *burns* and *scalds*, *erysipelas*, *erythema*, *intertrigo*, *prickly heat*, etc. But it is very far inferior for such purposes to powdered starch, and even to rye flour. Its dietetic uses need not here be considered, but one among them, which is also partly medicinal, is worthy of notice: it is the administration of an uncooked paste made from wheaten flour in many cases of *diarrhœa*, and especially in those depending upon debility. The summer diarrhœas of this climate are usually curable by this simple remedy if the patient rests and abstains from other food. Flour roasted in a skillet is, like toasted bread, astringent, and excellent in chronic and subacute diarrhœas.

Faba vulgaris, or horse bean, has been used as food from time immemorial. Bean flour, like other analogous products, is a popular remedy for diarrhœa, and the ash of burned bean-stalks and husks infused in white wine is a popular diuretic in France (Cazin). Quite recently a watery infusion of the flowers has been vaunted as an efficient remedy for attacks of *gravel* and for the nodosities caused by *gout* (*Bull. de Thérap.*, cxvi. 232, 354).

FEL BOVIS, *U. S.*—Ox-Gall.

Fel bovinum, *Fel tauri*, *Bilis bubula.*—*Ox-bile*, E.; *Bile* (*Fiel*) *de bœuf*, F. Cod.; *Ochsen galle*, *Rindsgalle*, G.; *Hiel de toro*, *Bilis de buey*, Sp.

The fresh bile of Bos Taurus, *Linné.*

Class Mammalia. Order Ruminantia.

Origin and Properties.—Bile is a green or brownish-green viscid, transparent, or more frequently translucent, liquid which is separated by the liver in the gall-bladder; it has a peculiar odor, which becomes prominent on heating, a nauseous, sweet, and bitter taste, a specific gravity of about 1.02, a slight alkaline or sometimes a neutral reaction, and dissolves completely when agitated with water. On warming it becomes thinner, and may then be readily strained through moistened muslin, whereby fragments of tissue, epithelial cells, etc. are removed. When mixed with its own weight or twice its bulk of alcohol a precipitate is produced in fresh bile consisting almost exclusively of mucilaginous matter, and the liquid filtered from it and freed from alcohol by evaporation resists putrefaction for a long time.

"A mixture of 2 drops of ox-gall and 10 Cc. of water, when treated, first, with a drop of a freshly prepared solution of 1 part of sugar in 4 parts of water, and afterwards with sulphuric acid, cautiously added, until the precipitate first formed is redissolved, gradually acquires a cherry-red color, changing, successively, to carmine, purple, and violet."—*U. S.*

Constituents.—The principal coloring matter of bile appears to be *bilirubin*, formerly called *colepyrrhin*, $C_{16}H_{18}N_2O_3$, which is slightly soluble in alcohol and ether, but dissolves in chloroform, carbon disulphide, and benzene; it forms an amorphous or crystalline orange-colored or red powder. It is accompanied by *bilifuscin*, a dark olive-brown powder soluble in alcohol and in hot chloroform; *biliprasin*, a green-black powder insoluble in chloroform, soluble in alcohol, with a green, or in the presence of ammonia with a brown, color; and *bilihumin*, a blackish powder insoluble in simple solvents and often found in biliary concretions. *Biliverdin*, formed by the oxidation of bilirubin, is a dark-green powder soluble in alcohol with a green color and insoluble in water, ether, and chloroform (Städeler, 1864). The fatty matter of bile is chiefly *cholesterin*, $C_{26}H_{44}O$, which is also an ingredient of the brain, the nerves, the yelk of eggs, etc. It crystallizes in colorless laminæ or prisms, is unchanged by boiling potassa, dissolves in ether, chloroform, and hot alcohol, and is chemically a monatomic alcohol. Ox-gall contains about 3 per cent. each of the sodium salts of two peculiar acids, named *glycocholic* (the *cholic acid* of some older authors) and *taurocholic* (Strecker's *choleic*) *acid*, a part of the former of which, together with the remaining pigments, is precipitated by neutral lead acetate from fresh bile previously decolorized by animal charcoal. When to the filtrate from this precipitate lead subacetate is carefully added until the insoluble compound formed has a white color, the precipitate will consist of lead glycocholate and taurocholate, and the filtrate contains only taurocholic acid, which is precipitated on the further addition of basic lead acetate. Hüfner (1874) observed that glycocholic acid usually crystal-

lizes out when fresh beef-gall is mixed with an excess of hydrochloric acid and ether. Emich (1882) prefers the use of benzene in the place of ether, and ascertained that in those cases where crystals are not obtained by this treatment the glycocholate has been reduced to about $\frac{3}{4}$ per cent. and the taurocholate increased to about $5\frac{1}{2}$ per cent. Glycocholic acid, $C_{26}H_{43}NO_6$, is in very fine white needles of a silky lustre and a sweetish-bitter taste. At 20° C. (68° F.) it requires for solution 11,100 parts of benzene, 9090 parts of chloroform, 1075 parts of ether, 36.3 parts of 50 per cent. alcohol or 3030 parts of water, but is much more soluble in solutions of taurocholic acid. On being boiled with acids it is converted into insoluble *paraglycocholic acid*, melting at 183° C. (361.4° F.), while glycocholic acid melts at 132° C. (269.6° F.). Its salts have a sweet taste and are mostly soluble in water and alcohol. Boiled with alkalies, it takes up 1 molecule of water and splits into *glycocol* (*glycin* or *amidoacetic acid*), $C_2H_5NO_2$, and *cholic acid* (*cholalic acid* of Strecker), $C_{24}H_{40}O_5$, which has a bitter and afterward sweetish taste. *Taurocholic acid*, $C_{26}H_{45}NSO_7$, is in silky acicular crystals easily soluble in water and alcohol, and when boiled with alkalies decomposed into *cholic acid* and *taurin* (*amido-isethionic acid*), $C_2H_7NSO_3$.

Ox-bile contains the two biliary acids in nearly equal proportions; human bile mainly taurocholic acid, which is found in dog-bile almost to the exclusion of other acids. Both acids, dissolved in water and mixed with a little syrup and afterward with oil of vitriol, acquire a red color, changing to carmine, purple, and violet (*Pettenkofer's test for bile*). This is due to the decomposition of the sugar under the influence of sulphuric acid, by which furfurol is formed, which then forms the colored compounds with biliary acids. Using syrupy phosphoric in place of sulphuric acid, Drechsel (1881) observed that the reaction is less interfered with by an excess of sugar. Cholic acid shows a similar behavior, and the coloration is also obtained with unpurified bile, and with glucose as well as cane-sugar; according to Van den Brock (1846), the principal constituents of bile give the reaction with sulphuric acid without the previous addition of sugar.

Pharmaceutical Preparations.—FEL BOVIS PURIFICATUM, *U. S.*; FEL BOVINUM PURIFICATUM, *Br.*; FEL TAURI DEPURATUM.—Purified ox-gall or ox-bile, *E.*; Fiel de bœuf purifié, Bile purifié, *Fr.*; Gereinigte Ochsengalle, *G.*—Fresh ox-gall 300 Cc.; Alcohol 100 Cc. Evaporate the ox-gall in a porcelain capsule on the water-bath to 100 Gm.; then add to it the alcohol, agitate the mixture thoroughly, and let it stand, well covered, for three or four days. Decant the clear solution, filter the remainder, and, having mixed the liquids and distilled off the alcohol, evaporate to a pilular consistence. —*U. S.* The British Pharmacopœia directs fresh ox-bile 1 pint to be evaporated to 5 fluidounces, and precipitated with 10 fluidounces of rectified spirit; the remainder of the process is identical with the foregoing. The object is the removal of the mucilage, whereby ox-gall is rendered less prone to change.

FEL BOVIS INSPISSATUM, EXTRACTUM FELLIS BOVINI.—Inspissated ox-gall, *E.*; Fiel épaissi, Extrait de bile de bœuf, *Fr.*; Eingedickte Rindsgalle, *G.*—Fresh ox-gall 100 parts; to make 15 parts. Heat the ox-gall to a temperature not exceeding 80° C. (176° F.); strain it through muslin, and evaporate the strained liquid, on a water-bath in a porcelain capsule, to 15 parts.—*U. S.* 1880. By this process the fragments of tissue present in bile are strained off and the water is mostly evaporated. Following strictly the letter of the directions, the product must vary in consistence and permanence. The French Codex more properly directs the evaporation to be continued until a firm extract is obtained; the yield is from 11 to 13, or sometimes 15, per cent.

Both preparations are deep yellowish-green extract-like masses having the peculiar odor, taste, and behavior of bile, and being completely soluble in water. Only purified ox-gall is completely soluble in spirit, and its aqueous solution is not precipitated by alcohol.

The German Pharmacopœia of 1872 directed a still purer article, from which, besides the mucilage, the biliary coloring matters also have been removed; the decoloration is effected after the removal of the mucilage by distilling off the alcohol and then adding to the residue recently-purified and well-washed still moist animal charcoal; 8 to 10 parts of it will be sufficient for 100 parts of bile. The mixture is occasionally agitated, and when the liquid shows only a slight yellow color it is passed through a moistened filter, evaporated in a porcelain capsule by means of a water-bath, and then completely exsiccated in a drying closet or by means of a sand-bath, the heat of which must not be allowed to rise above 100° C. (212° F.). If spread upon glass plates it may be scaled, or the dry mass is reduced to powder and preserved in small well-corked vials. The yield is nearly 7 per cent. It forms a yellow or yellowish-white powder, which attracts moist-

ure from the atmosphere and dissolves completely in water and alcohol, the solutions being of a yellowish color and of the sweet and bitter taste of bile. When heated to redness it burns, leaving a small amount of a white alkaline ash. This preparation is sometimes sold as *sodium choleate* or *choleinate*.

Action and Uses.—Ox-gall (or pig-gall, which is supposed to be more analogous to human bile) is thought to be an efficient remedy for habitual *constipation* depending upon atony of the intestine. After its use the bowel is not so apt to become torpid as after that of ordinary purgatives. It is perhaps of some interest to note that the medicine which most nearly resembles it in this respect is aloes, which, like bile, is very bitter and tends to irritate the rectum. The *dyspeptic* derangements which are apt to attend constipation, and which often depend upon a distended colon compressing the liver or its ducts, usually subside under purgation of any kind. It is very doubtful if ox-gall exhibits any of the special virtues which have been attributed to it under these circumstances. In *jaundice* depending upon catarrh of the bile-ducts this medicine is sometimes found advantageous, probably in virtue both of its purgative operation and of its supplying for duodenal digestion the agent which the liver fails to secrete. The objection to its use, that it will be absorbed into the blood already overcharged with bile, is more specious than sound. Bile has been used as a *vermifuge* for lumbricoid ascarides. As a topical remedy it has been applied with alleged success to the treatment of various *glandular* hypertrophies and indurations, but this method has not been accepted. Speculative notions have led to the use of ox-gall in continued *fevers*, but no clinical proof of its efficiency exists.

The administration of bile in a liquid state is too disgusting to be recommended. It may be given in the form of inspissated bile, which is officinal. Gm. 0.33 (gr. v.) of this preparation are estimated to be equal to Gm. 7.60 (gr. c) of fresh bile. It may be made into pills coated with gelatin or enclosed in gelatin capsules. If taken after meals this coating delays the escape of the bile until the food is ready to pass through the pylorus. About Gm. 0.60 (gr. x) may be given at a dose.

FERRI ARSENAS, *Br.*—Iron Arsenate.

Ferrum arsenicicum, *Arsenias ferrosus*.—*Ferrous arsenate*, E.; *Arséniate de fer*, Fr.; *Arsensaures Eisen*, G.

Formula $3Fe(FeO)AsO_4.16H_2O$. Molecular weight 1086.74.

Preparation.—Dissolve Sodium Arsenate (dried at 300° F.), 15¾ ounces, in about 5 pints, and Ferrous Sulphate, 20¾ ounces, in about 6 pints, of boiling Distilled Water; mix the two solutions, and add Sodium Bicarbonate, 4½ ounces, dissolved in a little distilled water; stir thoroughly; collect the white precipitate which has formed on a calico filter, and wash until the washings cease to be affected by a dilute solution of barium chloride. Squeeze the washed precipitate between folds of strong linen in a screw press, and dry it on porous bricks in a warm air-chamber whose temperature shall not exceed 100 F°. —*Br.*

The reaction takes place between 3 mol. of ferrous sulphate and 2 mol. of sodium arsenate, which corresponds with the above quantities of crystallized salts, but the Pharmacopœia directs the sodium salt, dried at 300° F., which is an excess of about 66 per cent. On mixing the two solutions, ferrous arsenate ($Fe_3As_2O_8$) is precipitated, but a portion remains dissolved in the acid liquid, and is recovered by nearly neutralizing with sodium bicarbonate, carbon dioxide being evolved. The white precipitate is very bulky, and while being washed to free it from the mother-liquor and dried it is oxidized and converted into ferroso-ferric arsenate of the formula given above (Wittstein, 1866). The change is indicated by the gradual disappearance of the white color until the salt finally becomes olive-green or blue-green. In the reaction and final result the process corresponds nearly with the one for the blue iron phosphate.

Properties.—Iron arsenate is a green or blue-green amorphous powder insoluble in water and in alcohol, but dissolving readily in dilute hydrochloric acid, yielding a bright-yellow solution in which blue precipitates are produced with both ferrocyanide and ferricyanide of potassium, and which yields with hydrogen sulphide first a milkiness (sulphur) and afterward a yellow precipitate of arsenic sulphide. It contains 31.68 per cent. of As_2O_5 and 26.4 per cent. of water, most of which is expelled when heated to 100° C. (212° F.), the remainder being given off at a red heat without loss of arsenic. It may be distinguished from iron phosphate, which resembles it in appearance, by boiling a small portion with an excess of caustic soda, filtering and neutralizing exactly with nitric

acid, when a brick-red precipitate of silver arsenate will be produced on the addition of silver nitrate. Iron phosphate similarly treated yields a yellow precipitate. To determine the amount of ferrous salt, which theoretically corresponds to 19.82 per cent. of ferrous oxide, the British Pharmacopœia directs the dissolving of 100 grains in an excess of diluted sulphuric acid, and adding thereto gradually volumetric solution of potassium dichromate until a drop of the acid liquid ceases to give a blue precipitate with potassium ferricyanide; at least 225 grain-measures of the test-solution should be required for the purpose, indicating 3.78 per cent. of iron in the ferrous state.

Action and Uses.—It is difficult to conjecture on what grounds this compound was made officinal, since the proportion of iron contained in the dose of it recommended, Gm. 0.004 (gr. $\frac{1}{16}$), is too inconsiderable to have any curative action. Iron and arsenic are, both of them, medicines the dose of which must vary greatly and frequently with the nature of the disease and the special condition of the patient, and it is better that they should be given separately. To any liquid preparation of iron the solution of potassium arsenite may be added at the time of administration. The arseniate of iron may be given in a pill, and in the *dose* of Gm. 0.003 (gr. $\frac{1}{20}$), gradually increased to Gm. 0.03 (gr. $\frac{1}{2}$).

FERRI BROMIDUM.—Ferrous Bromide.

Ferrum bromatum.—Bromide of iron, E.; *Bromure ferreux*, Fr.; *Eisenbromid, Ferrobromid*, G.

Formula $FeBr_2$. Molecular weight 215.4.

Preparation and Properties.—It is prepared by gradually adding 2 parts of bromine to 1 part of iron filings or wire and 10 parts of water, and digesting until the liquid has a greenish color, when it is filtered and evaporated in an iron dish to dryness. It forms a grayish-black mass which, on exposure to air, acquires a brown color through oxidation. From its hot concentrated solution in water it may be obtained in transparent pale-green rhombic plates of the composition $FeBr_2,6H_2O$. On being heated to redness in contact with the atmosphere it is converted into ferric oxide and ferric bromide, the latter subliming in yellow scales. An aqueous solution of ferrous bromide preserved by sugar, has been proposed as a convenient preparation. (See Syrupus Ferri Bromidi.)

Action and Uses.—It may seem singular that two agents so physiologically antagonistic as iron and bromine should have been united in the same medicine, since the one tends to produce what the other is employed to subdue. Practically, however, the bromine of the compound is its only active element. This preparation has been recommended as an energetic astringent and antistrumous medicine, and has been prescribed in *hypertrophy* of the *heart* and *uterus*, for *scrofulous glandular swellings*, both topically and internally, in *spermatorrhœa*, *blennorrhœa*, *leucorrhœa*, *hysteria*, *chorea*, and pulmonary *phthisis*. It has been given in doses of from Gm. 0.3–0.12 (gr. ss–ij). There is not the slightest evidence of it ever having been useful as a medicine, and, as it is dangerously poisonous, it ought never to be used internally. It is now, says Husemann, entirely obsolete, and Trousseau and Pidoux pronounced it unworthy of special notice.

FERRI CARBONAS SACCHARATUS. *U. S., Br.*—Saccharated Ferrous Carbonate.

Ferrum carbonicum saccharatum, P. G.; *Carbonas ferrosus saccharatus.—Saccharated carbonate of iron*, E.; *Saccharure de proto-carbonate de fer* (*de carbonate ferreux*), Fr.; *Zuckerhaltiges Ferrocarbonat*, G.

Formula of ferrous carbonate $FeCO_3$ (anhydrous). Molecular weight 115.73.

The mixture of ferrous carbonate with sugar contains 20.5 per cent. *Br.*, 9.5–10 per cent. *P. G.*, about 7.25 per cent. *U. S.*, of metallic iron.

Preparation.—Ferrous Sulphate, 50 Gm.; Sodium Bicarbonate, 35 Gm.; Sugar, in fine powder, 80 Gm.; Distilled Water, a sufficient quantity, to make 100 Gm. Dissolve the Ferrous Sulphate in 200 Cc. of hot Distilled Water and the Sodium Bicarbonate in 500 Cc. of Distilled Water at a temperature not exceeding 50° C. (122° F.), and filter the solutions separately. To the solution of sodium bicarbonate contained in a flask having a capacity of about 1000 Cc. add, gradually, the solution of ferrous sulphate, and mix thoroughly by rotating the flask. Fill up the flask with boiling distilled water, cork it loosely, and set the mixture aside. When the precipitate has subsided, draw off the clear, supernatant liquid by means of a siphon, and then fill the flask again with hot distilled

water in the same manner, until the decanted liquid gives not more than a slight cloudiness with barium chloride test-solution. Finally bring the precipitate on a muslin strainer, and, when it has thoroughly drained, transfer it to a porcelain capsule containing the sugar, and mix intimately. Evaporate the mixture to dryness, by means of a water-bath, reduce it to powder, and mix intimately with it, if necessary, enough well-dried sugar to make the final product weigh 100 Gm. Keep the product in small, well-stoppered bottles.—*U. S.*

To make 4 av. ozs. of saccharated ferrous carbonate, use 2 av. ozs. of ferrous sulphate dissolved in one-half pint of hot distilled water and 612.5 grains of sodium bicarbonate dissolved in 1¼ pints of warm distilled water; mix as directed above in a 40 oz. flask, and after washing the precipitate thoroughly, incorporate it with 1400 grains of finely powdered sugar, evaporate to dryness, and finally add enough sugar to bring the weight up to 1750 grains (4 av. ozs.)

Both the British and German Pharmacopœias mix the iron and alkali solutions while hot, and thereby avoid absorption of oxygen during cooling; in other respects the manipulation does not materially differ. For 10 parts of ferrous sulphate there are ordered 7 parts of sodium bicarbonate, *P. G.*, 6¾ parts of ammonium carbonate, *Br.*; and the ferrous carbonate thus obtained is mixed with sugar 5 parts, *Br.* (yield 9¾ parts)—first with milk-sugar 2 parts and sugar 6 parts—and when dry with sufficient sugar to make 20 parts, *P. G.*

Ferrous sulphate and sodium bicarbonate decompose each other, forming ferrous carbonate, carbon dioxide, and sodium sulphate; thus: $FeSO_4 + 2NaHCO_3 = FeCO_3 + CO_2 + H_2O + Na_2SO_4$. The operation must be performed with the air excluded as much as possible; hence the importance of employing boiling water from which the air has been expelled, of generating carbon dioxide during the operation by the use of sodium bicarbonate, of performing the washing by decantation in deep cylindrical and well-covered vessels, and of collecting and draining, or, as directed by the Br. P., expressing the precipitate rapidly; the subsequent addition of the sugar will, in a measure, protect it against oxidation until it has been finally dried.

Properties.—Ferrous carbonate forms small lumps or a gray or greenish-gray inodorous powder having a neutral reaction to moistened litmus-paper and a sweet taste like that of sugar, followed by a very feeble chalybeate taste. On exposure to dry air it is slowly, or in damp air rapidly, oxidized, and is therefore best preserved in small well-filled and sealed vials; if it has changed to a brown color and effervesces only slightly with acids, it should be rejected. When heated in contact with the air it becomes black, evolving the odor of burning sugar, and is finally converted into red-brown ferric oxide. Water dissolves only the sugar, but the powder is completely dissolved with effervescence in dilute hydrochloric acid, and this solution gives a blue precipitate with both potassium ferricyanide and ferrocyanide, showing the presence of ferrous and of ferric salt. Pure ferrous carbonate represents 53.7 per cent. of ferrous oxide; the anhydrous salt, $FeCo_3$ (mol. weight 115.73), represents 62.07 per cent. of the oxide.

Tests.—The powder, placed upon moistened red litmus-paper, should not change the red color to blue (absence of alkali). The solution in diluted hydrochloric acid should yield no precipitate or but a slight turbidity with barium chloride, indicating only traces of sulphate left behind from the mother-liquor.

"If 1.16 (1.1573) Gm. of saccharated ferrous carbonate be dissolved in 10 Cc. of diluted sulphuric acid, and the solution diluted with water to about 100 Cc. it should require about 15 Cc. of decinormal potassium permanganate solution before the pink tint imparted to the liquid ceases immediately to disappear, corresponding to about 15 per cent. of ferrous carbonate (each Cc. of the volumetric solution indicating 1 per cent. of pure ferrous carbonate)."—*U. S.* The Br. P. demands about one-third of anhydrous ferrous carbonate, and that 3 Gm. are oxidized by at least 20.75 Cc. of the volumetric solution of potassium dichromate, indicating not less than 16.1 per cent. iron or 28.32 per cent. carbonate. If none of the ferrous salt had been oxidized, the powder would contain 20.85 per cent. *U. S.*, *P. G.*, 42.8 per cent. *Br.*, of anhydrous ferrous carbonate. The German Pharmacopœia determines the total iron only.

Action and Uses.—This preparation is intended to take the place of the subcarbonate, one of the oldest pharmaceutical preparations of iron, and to be a substitute for rust of iron, which from time immemorial had been used in medicine. It is one of the most employed members of its class, and may be recommended in all forms of *anæmia* and *anæmic chlorosis*, and in *neuralgia*, *chorea*, and other nervous affections depending upon a deficiency of red corpuscles in the blood. In large doses, mixed with water, it

may be resorted to when the hydrated peroxide cannot be procured in cases of poisoning by *arsenious acid*. The *dose* is Gm. 0.30 (gr. v) and upward.

Soluble saccharated oxide of iron (Ph. G.) is said not to discolor the teeth or derange the digestion, and has been recommended, on account of its sweetish taste and ready solubility, for children and females. Dose, Gm. 0.30–1.3 (gr. v–xx) three times a day.

FERRI CHLORIDUM, *U. S.*—Ferric Chloride.

Ferrum sesquichloratum, P. G.; *Ferrum muriaticum oxydatum*, *Chloridum vel Chloruretum ferricum*, *Ferri perchloridum*.—*Sesquichloride* (*Perchloride*) *of iron*, E.; *Perchlorure de fer*, *Chlorure ferrique*, F.; *Eisenchlorid*, G.

Formula $Fe_2Cl_6.12H_2O$. Molecular weight 539.5.

Preparation.—Iron, in the form of fine bright wire and cut into small pieces, 15 Gm.; Hydrochloric Acid, Nitric Acid, Distilled Water, each a sufficient quantity. Put the iron wire into a flask capable of holding about 200 Cc., pour upon it 54 Gm. of hydrochloric acid previously diluted with 25 Cc. of distilled water, and let the mixture stand until effervescence ceases; then heat it to the boiling-point, filter through paper, and, having rinsed the flask and iron wire with a little boiling distilled water, pass the rinsings through the filter. To the filtered liquid add 28 Gm. of hydrochloric acid, and pour the mixture slowly and gradually, in a stream, into 8 Gm. of nitric acid contained in a capacious porcelain vessel. After effervescence ceases apply heat, by means of a sand-bath, until the liquid is freed from nitrous odor and ceases to yield a blue precipitate with freshly-prepared test-solution of potassium ferricyanide. Should this reagent produce a blue color, add a little more nitric acid, drop by drop, as long as effervescence is observed, and evaporate off the excess. Then add 5 Gm. of hydrochloric acid and enough distilled water to make the whole weigh 60 Gm., and set this aside, covered with glass, until it forms a solid crystalline mass. Lastly, break it into pieces, and keep the fragments in a glass-stoppered bottle protected from light.—*U. S.*

To make about 4 av. ozs. of ferric chloride will require 1 av. oz. of iron wire; 5 av. ozs. and 350 grains of hydrochloric acid, divided into 3 portions of 3 av. ozs. and 263 grains, 1 av. oz. and 380 grains, and 145 grains respectively; 234 grains of nitric acid. The first portion of hydrochloric acid is diluted with 1½ fluidounces of distilled water, and after all hydrochloric acid has been used as directed above, enough distilled water is added to make the liquid weigh 4 av. ozs.; it is then set aside to crystallize.

In making this salt an excess of iron is advantageously used to facilitate the saturation of the first portion of hydrochloric acid; the metal, in combining with the chlorine of the acid, will produce ferrous chloride, $FeCl_2$, hydrogen being given off. The whole liquid should be passed through a paper filter, and the filtrate at once mixed with hydrochloric acid to prevent the deposition of ferric oxychloride, which would be formed by the oxidizing influence of the atmospheric air. The mixture may now be heated to near boiling, and the nitric acid poured in small portions down the side of the porcelain capsule, and the mixture continually stirred; or, to avoid loss of hydrochloric acid, the cold acid solution is now directed to be poured into nitric acid, when effervescence will commence and the oxidation be completed on applying heat. The extrication of the red vapors causes the liquid to froth considerably, hence the necessity of using a capsule holding at least three times the measure of the liquid. Diehl (1867) prefers to heat about three-fourths of the nitric acid, and to add to it gradually the hot mixture of ferrous chloride and hydrochloric acid,; afterward more nitric acid as required; frothing is avoided by this manipulation. The object of this part of the process is to transform the ferrous into ferric chloride; the hydrochloric and nitric acids react upon each other, with the production of chlorine, which unites with the ferrous chloride, and of nitric oxide, which escapes, water being formed at the same time, according to the equation $6FeCl_2 + 6HCl + 2HNO_3 = 3Fe_2Cl_6 + 2NO + 4H_2O$. The liquid should now be tested for ferrous salt by placing a drop upon a porcelain plate and adding a drop of freshly-dissolved potassium ferricyanide. If a blue color or precipitate is produced a little more nitric acid is required. Should the brown color be merely darkened, the iron has been all oxidized; but there may be an excess of nitric acid, which is detected by placing a drop of the liquid upon a plate in contact with a little ferrous sulphate and adding a drop of strong sulphuric acid. The production of a black color indicates the presence of free nitric acid, which cannot be completely removed by boiling, but requires the addition of a little hydrochloric acid and the application of heat to expel the nitric oxide and chlorine formed, until no more nitric acid is shown by the test. During this and the

subsequent operation the use of iron spatulas or stirrers must be carefully avoided; only porcelain or glass should be used.

On evaporating a solution of ferric chloride to the crystallizing-point, vapors containing hydrochloric acid are given off as soon as the temperature reaches a certain point, which varies with the strength of the solution: and if the heat is raised to the boiling-point ferric chloride is mechanically carried off. Should evaporation become necessary, it should be done at a gentle heat, and it will be found of advantage to have a slight excess of hydrochloric acid at the beginning of the evaporation. If this acid has been of the official strength, about 63 Gm. of crystallized ferric chloride will be finally obtained. The crystallization may be effected by keeping the capsule in a warm place until the contents solidify, but the crystals will then be very damp from enclosed moisture. It is far better to follow the directions of the Pharmacopœia, and have the liquid of less weight than the expected salt; on cooling, the mass will now remain liquid, and is set aside loosely covered to protect it from dust and other impurities, and at the same time to admit the atmosphere, from which it will attract moisture and gradually crystallize. The crystals begin to form as small circular nodules having a radiated appearance, floating upon the liquid, and increasing in size until the entire liquid forms a solid mass, which adheres firmly to the vessel. By warming it slightly the mass is readily detached, and should be at once broken into pieces and put into dry, well-stoppered bottles.

Properties.—The official ferric chloride forms orange-colored wart-like pieces which have a crystalline texture and a slight odor of hydrochloric acid, are very deliquescent, forming a thick red-brown liquid having a density of about 1.55, and formerly known as *Oleum martis per deliquium*. The salt is readily and completely soluble in water and alcohol, also in a mixture of 1 part of ether and 3 parts of alcohol, yielding yellowish-brown solutions of an acid reaction and a strongly styptic ferruginous taste. The crystals fuse at 35.5° C. (96° F.); at a higher temperature they are decomposed and partly volatilized. The aqueous solution shows the reactions of ferric salts and chlorides in yielding a red-brown precipitate with ammonia-water or other alkalies, a blue one with potassium ferrocyanide, and a white one, insoluble in nitric acid, with silver nitrate.

Tests.—The complete solubility in the solvents mentioned is generally an indication of the absence of other metallic salts. The presence of nitric acid or of ferrous salt is detected as described above. A moderately dilute aqueous solution of the salt, to which a small crystal of ferrous sulphate has been added, should, on the addition of an equal volume of strong sulphuric acid, not show a black or brown-black color, and a few drops of a similar solution should, on the addition of a drop of freshly-prepared solution of potassium ferricyanide, produce a pure brown color, without a tinge of green or greenish-blue. A solution of the chloride in water should not be precipitated by barium chloride (absence of sulphate), and when precipitated by an excess of ammonia the filtrate, on evaporation to dryness, should leave only ammonium chloride, which is completely volatilized at a red heat (absence of alkalies, alkaline earths, zinc, etc.). Copper, if present, is detected by the black precipitate formed in the ammoniacal filtrate with hydrogen sulphide, and zinc by the white precipitate formed under the same condition. A 1 per cent. solution of the salt in distilled water, when heated to boiling in a test-tube, should remain clear (absence of oxychloride); the hot liquid is of a dark red-brown color, and is precipitated by sodium chloride, the precipitate being soluble again in pure water, but on continuing the heat the liquid becomes permanently soluble (Kreeke, *Jour. Prak. Chem.*, 1871, iii. p. 286). "If 0.56 (0.5588) Gm. of the salt be dissolved in a glass-stoppered bottle (having a capacity of about 100 Cc.), in 10 Cc. of water and 2 Cc. of hydrochloric acid, and, after the addition of 1 Gm. of potassium iodide, the mixture kept for half an hour at a temperature of 40° Cc. (104° F.), and then allowed to cool, it should, after the addition of a few drops of starch test-solution, require 20 Cc. of decinormal sodium thiosulphate solution to discharge the blue or greenish color of the liquid (each Cc. of the volumetric solution indicating 1 per cent. of metallic iron)."—*U. S.*

The volumetric determination of iron by means of potassium iodide and sodium thiosulphate depends upon the well-known reaction of the former salt and ferric chloride, whereby iodine is liberated in proportion to the chlorine present; thus $Fe_2Cl_6 + 2KI = I_2 + 2FeCl_2 + 2KCl$, the ferric salt being at the same time reduced to the ferrous state; 323.98 parts of anhydrous or 539.5 parts of official ferric chloride correspond to 253.06 parts of iodine, and hence each cubic centimeter of sodium thiosulphate solution necessary to discharge the blue color caused by the action of iodine on the starch will represent 0.05395 Gm. of $Fe_2Cl_6.12H_2O$, corresponding to 0.005588 Gm. of metallic iron. The iodine liberated is held in solution by an excess of potassium iodide.

Allied Salt.—Ferrum chloratum, *P. G.* 1872; Ferrum muriaticum oxydulatum, Chloridum ferrosum.—Ferrous chloride, *E.;* Protochlorure de fer, *Fr.:* Eisenchlorür, *G.* Formula $FeCl_2.2H_2O$. Molecular weight 162.7—520 parts of hydrochloric acid are allowed to act upon 110 parts of iron wire, finally with the application of heat, until hydrogen gas ceases to be given off, when the solution is rapidly filtered. If now 1 part of hydrochloric acid and sufficient distilled water to make the whole weigh 1000 parts are added, *Liquor ferri chlorati* (s. *muriatici oxydulati*) is obtained. The salt is prepared by evaporating the solution immediately after filtration, and very rapidly, until a pellicle is formed, when 1 part of hydrochloric acid is added, and the evaporation continued with stirring until the mass becomes rather stiff; the capsule is now removed from the fire, and the salt, after it has solidified, is powdered. It is a greenish-white powder, and dissolves in its own weight of water, affording a green solution, which, on being mixed with three times its measure of alcohol, yields no precipitate (absence of ferrous sulphate, etc.). Since ferrous chloride is very easily oxidized on exposure to air, Hager recommended to deoxidize the recently-prepared and powdered salt by exposing it in a thin layer for several hours to the direct sunlight. It contains 34.3 per cent. of iron, 43.6 of chlorine, and 22.1 of water of crystallization. Its concentrated aqueous solution yields crystals containing $4H_2O$ = 36.2 per cent., which are deliquescent in moist air and on exposure rapidly turn yellowish-green.

Action and Uses.—Chloride of iron is a powerful astringent and hæmostatic. It is chiefly used topically for stanching *hæmorrhage*, as in epistaxis, in hæmoptysis (by inhaling an atomized solution), in bleeding from leech-bites, from the jaw after the extraction of teeth, from the tonsils, from ulcers of the neck of the uterus, from the umbilical cord, from the uterus during and subsequent to abortion, from fungous tumors of various parts, etc. It is reported to have acted favorably as a caustic upon *lupoid* or *scrofulous* ulcers when dissolved in 2 parts of water, and upon various chronic *diseases of the skin* when applied in an ointment (1 : 20). St. Germain claims to have cured vascular *nævi* by injecting them once a week with a single drop of a solution made with 5 parts of "perchloride of iron," 3 parts of chloride of sodium, and 12 parts of distilled water (*Practitioner*, xxvi. 261). Chloride of iron, if kept in a bottle, gradually deliquesces, and may then be applied with a glass rod or brush. As a hæmostatic 5 parts of the chloride may be dissolved in 100 parts of distilled water and applied on lint.

(A more detailed account of the action and uses of this preparation will be found in the article on Solution of Chloride of Iron.)

Ferrous chloride, it is stated by German authorities, may be given internally in doses of from Gm. 0.06–0.20 (gr. j–iv).

FERRI CITRAS, *U. S.*—Ferric Citrate.

Ferrum citricum oxydatum, P. G.; *Citras ferricus.—Citrate of iron*, E.; *Citrate de sesquioxide de fer*, *Citrate ferrique*, Fr.; *Eisencitrat*, *Citronensaures Eisenoxyd*, *Ferricitrat*, G.

Formula $Fe_2(C_6H_5O_7)_2$ (anhydrous). Molecular weight 488.84.

Preparation.—Solution of Ferric Citrate a convenient quantity. Evaporate the solution at a temperature not exceeding 60° C. (140° F.) to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales.—*U. S.*

At a higher temperature than indicated by the formula the salt is slowly reduced to a ferrous compound. When the solution is concentrated to a thick, syrupy liquid it is spread on plates, and then dried in a dry or warm place. Failure in scaling is usually due to the incomplete saturation of the citric acid with ferric hydroxide, occasionally to the presence of saline impurities retained by the carelessly washed hydroxide. The yield is from 42 to 44 per cent.

The amount of water of hydration varies considerably, and hence no definite formula can be assigned to the official scale salt; much confusion exists in the literature upon the subject, some authors assigning as low as 3.5 per cent., while others claim 18–20 per cent. of water. F. B. Power (1891) found the amount of water present in scales of ferric citrate, carefully prepared by himself, to average 31.9 per cent.; the same author also determined that all water of hydration is eliminated at 100° C. (212° F.). The variable proportion of water may be due to difference in temperature employed, subsequent exposure, etc. The U. S. Ph. requires the presence of at least 16 per cent. of metallic iron, which is somewhat less than the last Pharmacopœia (26 per cent. Fe_2O_3 = 18.2 per cent. metallic iron); the Germ. Pharm. requires 19–20 per cent. of iron.

Properties.—If of the proper composition, the salt readily comes off the plates in the form of thin, transparent, garnet-red scales which yield a red-brown powder, are permanent in the air, inodorous, and have a faint ferruginous taste and an acid reaction. It is

insoluble in alcohol, and dissolves completely but slowly in cold water, and easily in boiling water, but diminishing in solubility by age. Its solution is darkened, but not precipitated, by ammonia. When strongly heated the salt is decomposed, emitting fumes having the odor of burnt sugar and leaving an ash consisting of ferric oxide. On being boiled with an excess of potassa solution the salt or its solution yields a precipitate of ferric hydroxide, and the filtrate, on being neutralized with acetic acid and then boiled with test-solution of calcium chloride, gives a white granular precipitate of calcium citrate. With potassium ferrocyanide test-solution it affords a bluish-green color or precipitate, which is increased and rendered dark blue by the subsequent addition of hydrochloric acid (difference from soluble *citrate of iron*). If heated with potassium hydroxide test-solution, it affords a brownish-red precipitate, without evolving any vapor of *ammonia*.

Tests.—Ferric citrate is not liable to adulteration. The presence of tartaric acid would be detected by acidulating the solution with a few drops of hydrochloric acid, and then adding some potassium acetate, when cream of tartar would be precipitated. The ash obtained by incinerating the salt should not have an alkaline reaction (absence of fixed alkalies). "If 0.56 (0.5588) Gm. of the salt be dissolved in a glass-stoppered bottle (having a capacity of about 100 Cc.) in 15 Cc. of water and 2 Cc. of hydrochloric acid, with the aid of a gentle heat, and, after the addition of 1 Gm. of potassium iodide, the mixture kept for half an hour at a temperature of 40° C. (104° F.), and then allowed to cool, it should, after the addition of a few drops of starch test-solution, require about 16 Cc. of decinormal sodium thiosulphate solution, before the blue or greenish color of the liquid is discharged (each Cc. of the volumetric solution indicating 1 per cent. of metallic iron."—*U. S.*

The object of heating the ferric citrate with hydrochloric acid is to convert the citrate into chloride, after which the determination proceeds as explained under that salt.

Iron and ammonium citrate is sometimes sold as *soluble citrate of iron;* it resembles the former in appearance and behavior, except that it has a neutral reaction, is more readily soluble in cold water, gives off the odor of ammonia when heated with an excess of potassa solution, and does not strike a blue color on mixing its solution with potassium ferrocyanide unless it be acidulated with hydrochloric acid.

Action and Uses.—This is a mild preparation, and suitable for children and persons of delicate stomach. It should be given in a watery solution and in the *dose* of Gm. 0.30–1.20 (gr. v–xx). Citrate of iron, employed hypodermically in the treatment of *anæmia* and *chlorosis*, has been proved by competent observers to be as useless in practice as the notion of its employment was physiologically crude (Hirschfeld, *Bull. de Thérap.*, cxl. 19, 79).

FERRI ET AMMONII CITRAS, *U. S., Br.*—Iron and Ammonium Citrate.

Citras ammonico-ferricus, F. Cod.; *Ferrum citricum ammoniatum*, *Ferri ammonio-citras*, *Ferro-ammonium citricum.*—*Ammonio-ferric citrate*, *Ammonio-citrate of iron*, *Soluble citrate of iron*, E.; *Citrate de fer et d'ammoniaque* (*de fer ammoniacal*), *Citrate ferrique ammoniacal*, Fr.; *Ferriammoncitrat*, *Citronensaures Eisenoxyd-Ammonium* (*Ammoniak*), G.

Preparation.—Take of Solution of Ferric Citrate 100 Cc.; Ammonia-water 40 Cc. Mix the solution of iron with the ammonia-water, evaporate the mixture, at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and spread it on plates of glass, so that when dry the salt may be obtained in scales. Keep the product in well-stoppered bottles in a dark place.—*U. S.*

5 fluidounces of solution of ferric citrate require the addition of 2 fluidounces of ammonia-water.

Mix 16 fl. oz. of solution of ammonia with 40 oz. of distilled water, and to this add gradually 10 fl. oz. of solution of persulphate of iron, previously diluted with 40 oz. of distilled water, stirring them constantly and briskly, and taking care that the ammonia is, even finally, in slight excess, as indicated by the odor. Let the mixture stand for two hours, stirring it occasionally; then put it on a calico filter, and when the liquor has drained away wash the precipitate with distilled water until that which passes through the filter ceases to give a precipitate with barium chloride. Dissolve 4 oz. of citric acid in 4 oz. of distilled water, and, having applied the heat of a water-bath, add the ferric hydroxide, previously well drained, and stir them together until nearly the whole of the hydroxide has dissolved, or until the citric acid is saturated (more ferric hydroxide being

added if necessary). Let the solution cool, add 5½ fl. oz. of solution of ammonia, filter through flannel (adding some distilled water if necessary), evaporate to the consistency of a syrup, the presence of a very slight excess of ammonia being maintained, and dry in thin layers on flat porcelain or glass plates at a temperature not exceeding 37.8° C. (100° F.). Remove the dry salt in flakes, and keep it in a stoppered bottle.—*Br.*

The second formula requires the preparation of ferric hydroxide by decomposing ferric sulphate with ammonia. It is washed, and then dissolved in citric acid to obtain a solution of ferric citrate, which, without being filtered, is mixed with ammonia. The turbid liquid at once becomes deeper-colored, and is filtered and concentrated. The United States Pharmacopœia, recognizing a solution of ferric citrate, simply requires it to be mixed with ammonia and concentrated.

Properties and Tests.—The salt closely resembles ferric citrate in appearance and behavior, except as stated above. Impurities, if present, may be determined in the same manner. On ignition the salt yields about 30 per cent., *Br.*, of ferric oxide. Being made from normal ferric citrate with the addition of ammonia, it is probably a mixture or compound of ammonio-ferric citrate with ferric oxycitrate. As in the case of ferric citrate, so also here, the Pharmacopœia requires the presence of at least 16 per cent., of metallic iron, which is determined as follows: "If 0.56 (0.5588) Gm. of the salt be dissolved in a glass-stoppered bottle (having a capacity of about 100 Cc.) in 15 Cc. of water and 2 Cc. of hydrochloric acid, and, after the addition of 1 Gm. of potassium iodide, the mixture be kept for half an hour at a temperature of 40° C. (104° F.), and then allowed to cool, it should, after the addition of a few drops of starch test-solution, require about 16 Cc. of decinormal sodium thiosulphate solution, before the blue or greenish color of the liquid is discharged (each Cc. of the volumetric solution indicating 1 per cent. of metallic iron)."—*U. S.*

Action and Uses.—The advantages of an iron salt containing ammonia are more than contestible upon theoretical grounds, and there is no clinical evidence of its special value. The addition to a solution of the salt of a solution of citric acid causes effervescence. The *dose* is Gm. 0.30 (gr. v). The case is recorded of a man who, after taking Gm. 1.30 (gr. xx) three times a day of this preparation for several weeks, was seized with symptoms of intestinal obstruction. Under treatment he evacuated a large quantity of insoluble sulphide of iron (*Practitioner*, xl. 54). It has been used hypodermically with success in *chlorosis* (*Ther. Gaz.*, xv. 766).

FERRI ET AMMONII SULPHAS, *U. S.*—Iron and Ammonium Sulphate.

Ferrum sulfuricum oxydatum ammoniatum, *Ferrum ammonio-sulphuricum*, *Ferri ammonio-sulphas*, *Sulphas ammonico-ferricus*, *Alumen ammoniacale ferricum.*—*Ammonio-ferric sulphate*, *Ammonio-ferric alum*, E.; *Sulfate de fer et d'ammoniaque*, *Sulfate ferrique ammoniacal*, *Alun de fer ammoniacal*, Fr.; *Ferriammonsulfat*, *Schwefelsaures Eisenoxyd-Ammonium*, *Ammoniakalischer Eisenalaun*, G.

Formula $(NH_4)_2Fe_2(SO_4)_4.24H_2O$. Molecular weight 962.1.

Preparation.—Take of Solution of Ferric Sulphate 2 pints; Ammonium Sulphate 4½ troyounces. Heat the solution of ferric sulphate to the boiling-point, add the ammonium sulphate, stirring until it is dissolved, and set the liquid aside to crystallize. Wash the crystals quickly with very cold water, wrap them in bibulous paper, and dry them in the open air.—*U. S.* 1870.

On dissolving the ammonium sulphate in the liquid with the aid of heat a double salt is formed which crystallizes on cooling; the mother liquor will yield another crop of crystals on being concentrated to about one-half.

Properties.—This salt crystallizes like alum in regular octahedrons, which are transparent and colorless or of a pale amethyst or violet color, particularly if crystallized from a solution containing a little free acid. They have the spec. grav. 1.712, are inodorous, of an acid and strongly astringent taste, and efflorescent on exposure to air. The salt suffers decomposition when continually heated in the water-bath or kept in the melted state, even in closed vessels. On the application of heat it melts, parts with its water of crystallization, and is further decomposed, leaving ultimately a light-brown or red-brown residue. The salt is insoluble in alcohol and ether; at 15° C. (59° F.) it requires 3 parts, and at the boiling temperature 0.8 part, of water for solution. The aqueous solution has an acid reaction and is of a brown-yellow color, which gradually changes to red, a basic salt being afterward deposited, and the decomposition being has-

tened by continued boiling of the solution. This shows the chemical reactions of ferric salts, sulphuric acid, and ammonia, yielding a blue precipitate with potassium ferrocyanide, a white one insoluble in hydrochloric acid with barium chloride, and a red-brown one with potassa solution, an excess of which on heating causing the evolution of vapors of ammonia.

Tests.—If the solution be boiled with an excess of potassa solution, and the colorless alkaline filtrate heated with excess of ammonium chloride, or neutralized with hydrochloric acid and again rendered alkaline by ammonia, it should not yield a white gelatinous precipitate of aluminum hydroxide. The Pharmacopœia requires an amount of ferric sulphate corresponding to at least 11.6 per cent. of metallic iron, as shown by the following test: "If 0.56 (0.5588) Gm. of the salt be dissolved in a glass-stoppered bottle (having a capacity of about 100 Cc.) in 15 Cc. of water and 2 Cc. of hydrochloric acid and, after the addition of 1 Gm. of potassium iodide, the mixture is kept for half an hour at a temperature of 40° C. (104° F.), and then allowed to cool, it should, after the addition of a few drops of starch test solution, require not less than 11.6 Cc. of decinormal sodium thiosulphate solution before the blue or greenish color of the liquid is discharged (each Cc. of the volumetric solution indicating 1 per cent. of metallic iron)."—*U. S.*

Action and Uses.—Like most of the compounds of sulphuric acid with metals, this one is astringent, but its astringency appears to be modified by the ammonia in its composition. Crystals of the salt have been applied within the neck of the uterus in various cases of *hæmorrhage* from that organ. It may be advantageously used in chronic *mucous fluxes* of the bowels, vagina, and bronchia when these affections are prolonged by general feebleness and a relaxation of the tissues. *Dose*, Gm. 0.30–1.0 (gr. v–xv).

FERRI ET AMMONII TARTRAS, *U. S.*—Iron and Ammonium Tartrate.

Ferri ammonio-tartras, Ferrum tartaricum ammoniatum.—Ammonio-ferric tartrate, Ammonio-tartrate of iron, E.; *Tartrate de fer et d'ammoniaque, Tartrate ferrique ammoniacal*, Fr.; *Ferriammontartrat, Weinsaures Eisenoxyd-Ammonium*, G.

Preparation.—Solution of Ferric Sulphate, 100 Cc.; Tartaric Acid, 29 Gm.; Distilled Water, 200 Cc.; Ammonia-water, Water, each a sufficient quantity. To 110 Cc. of ammonia-water, previously diluted with 250 Cc. of cold water, add, under constant stirring, the solution of ferric sulphate, previously diluted with 1300 Cc. of cold water. When the precipitate has subsided, draw off the clear, supernatant liquid by means of a siphon, then mix the precipitate intimately with about 1500 Cc. of cold water, again draw off the clear liquid, and repeat the washing in the same manner until the decanted liquid gives not more than a slight cloudiness with barium chloride test-solution. Then bring the precipitate on a wet muslin strainer, allow it to drain, and express the water as completely as possible. Dissolve one-half of the tartaric acid in the distilled water, neutralize the solution exactly with ammonia-water, then add the other half of the tartaric acid, and dissolve it by the application of a gentle heat. Now bring in the moist ferric hydroxide, in successive portions, stirring constantly, and continuing the heat which should not exceed 60° C. (140° F.), until the hydroxide is dissolved. Filter the solution while hot, evaporate it in a porcelain vessel, at or below the above-mentioned temperature, to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in well-stoppered bottles, in a dark place.—*U. S.*

If 5 fluidounces of solution of ferric sulphate be used, it will require 662 grains of tartaric acid, 16 fluidounces of distilled water and ammonia-water a sufficient quantity.

This formula is essentially that suggested by Prof. Procter (1841). By neutralizing one-half of the tartaric acid with ammonia-water, ammonium tartrate is formed, which is converted into the acid salt by the addition of reserved tartaric acid. On digesting this with ferric hydroxide a solution is obtained, which, by careful evaporation and drying upon plates, yields the official salt in scales.

Properties.—It is in transparent, garnet-red, inodorous scales of a sweetish and slightly ferruginous taste, and yields a rust-colored powder. The Pharmacopœia permits the salt if of a reddish-brown color. In dry air it is permanent; in a moist atmosphere it is hygroscopic, but scarcely deliquescent. When heated it gives off water and ammonia, is then charred, with the odor of burning sugar, and finally leaves a residue of ferric

oxide. The salt is not soluble in alcohol or ether, but dissolves slowly and freely in glycerin and water. The latter solution is neutral to test-paper, is darkened, but not precipitated by ammonia or by cold solutions of fixed alkalies or their carbonates, and is not colored blue by potassium ferrocyanide unless acidulated. When acidulated with hydrochloric acid and mixed with potassium acetate, potassium bitartrate is precipitated. When heated with potassa solution in excess, a red-brown precipitate of ferric hydroxide is deposited, ammonia is given off, and the colorless filtrate, when cooled and strongly acidulated with acetic acid, yields a white crystalline precipitate of potassium bitartrate.

Tests.—The ash obtained on incineration should not have an alkaline reaction; this test readily distinguishes this salt from the next. The amount of iron present is determined volumetrically and should correspond to about 17 per cent. of metallic iron, as may be seen from the pharmacopœial test: "If 0.56 (0.5588) Gm. of the salt be dissolved in a glass-stoppered bottle (having a capacity of about 100 Cc.) in 15 Cc. of water and 2 Cc. of hydrochloric acid, and, after the addition of 1 Gm. of potassium iodide, the mixture be kept for half an hour at a temperature of 40° C. (104° F.), and then allowed to cool, it should, after the addition of a few drops of starch test-solution, require about 17 Cc. of decinormal sodium thiosulphate solution before the blue or greenish color of the liquid is discharged (each Cc. of the volumetric solution indicating 1 per cent. of metallic iron."—*U. S.*

Action and Uses.—The only advantage of this salt is the one it shares with the other ammonium salts—viz. that of great solubility. In proportion to its bulk, like them also, it contains but little iron. Its *dose* is Gm. 0.60–2.0 (gr. x–xxx).

FERRI ET POTASSII TARTRAS, *U. S.*—Iron and Potassium Tartrate.

Ferrum tartaratum, Br.; *Ferri potassio-tartras, Ferri-Kali tartaricum, Ferrum tartarizatum, Tartras ferrico-potassicus, s. potassio-ferricus, s. ferrico-kalicus.—Potassio-ferric tartrate, Tartarated (tartarized) iron, Ferro-tartrate of potassium*, E.; *Tartrate de fer et de potasse, Tartrate ferrico-potassique, Tartre chalybé, Tartre martial*, Fr.; *Ferrikalitartrat, Weinsaures Eisenoxyd-Kali, Eisenweinstein*, G.

Preparation.—Solution of Ferric Sulphate, 100 Cc.; Potassium Bitartrate, 38 Gm.; Distilled Water, 300 Cc.; Ammonia-water, Water, each a sufficient quantity. To 110 Cc. of ammonia, previously diluted with 250 Cc. of cold water, add, under constant stirring, the solution of ferric sulphate, previously diluted with 1300 Cc. of cold water. When the precipitate has subsided, draw off the clear, supernatant liquid by means of a siphon, then mix the precipitate intimately with about 1500 Cc. of cold water, again draw off the clear liquid, and repeat the washing with water in the same manner until the decanted liquid gives not more than a slight cloudiness with barium chloride test-solution. Then bring the precipitate on a wet muslin strainer, allow it to drain, and express the water as completely as possible. Mix the potassium bitartrate, in a porcelain vessel, with the distilled water, heat the mixture on a water-bath, to a temperature not exceeding 60° C. (140° F.), and gradually add the moist ferric hydroxide, stirring constantly until it is dissolved. Filter the liquid while hot, and let the filtrate stand in a cool, dark place for twenty-four hours. Then stir it well with a porcelain or glass spatula, so that the precipitate which has formed in it may be thoroughly incorporated with the liquid. Now add, very cautiously, just enough ammonia-water to dissolve the precipitate, evaporate the solution in a porcelain vessel, at or below the above-mentioned temperature, to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in well-stoppered bottles, in a dark place.—*U. S.*

If 5 fluidounces of solution of ferric sulphate be used, it will require 867 grains of acid potassium tartrate, 15 fluidounces of distilled water, and ammonia-water a sufficient quantity.

The formula of the British Pharmacopœia is like the above, the proportions used being solution of persulphate of iron 6 fluidounces, solution of ammonia 11 fluidounces, and acid potassium tartrate 2 ounces. As in the preceding case, ferric hydroxide is first formed, and this is used for saturating the potassium salt. A salt of the formula $K_6Fe_2(C_4H_4O_6)_6$ is probably first formed, which would yield somewhat over 12 per cent. (Dulk found 12.78 per cent.) of ferric oxide; the British Pharmacopœia requires about 30; Soubeiran and Capitaine obtained 30.8 per cent. of ferric oxide, and regarded the salt as having the composition $K(FeO)C_4H_4O_6$. It is likely that different basic com-

pounds may be formed by prolonged digestion. To render the salt perfectly and readily soluble in water, the U. S. P. now directs the addition of a little ammonia-water to the filtered solution before evaporation—a course recommended for this and analogous salts by Mr. G. H. C. Klie in 1876.

Properties and Tests.—In its physical properties, as well as in its behavior to solvents, alkalies, and potassium ferrocyanide, it resembles iron and ammonium tartrate, from which it differs in giving off a slight odor of ammonia when heated with potassa solution, and, when incinerated, in leaving ash which has an alkaline reaction to test-paper and effervesces on the addition of hydrochloric acid. As indicated by the following test, the Pharmacopœia requires for this compound an amount of ferric tartrate equivalent to 15 per cent. of metallic iron: "If 0.56 (0.5588) Gm. of the salt be dissolved in a glass-stoppered bottle (having a capacity of about 100 Cc.), in 15 Cc. of water and 2 Cc. of hydrochloric acid, and, after the addition of 1 Gm. of potassium iodide, the mixture be kept for half an hour at a temperature of 40° C. (104° F.), and then allowed to cool, it should, after the addition of a few drops of starch test-solution, require about 15 Cc. of decinormal sodium thiosulphate solution before the blue or greenish color of the liquid is discharged (each Cc. of the volumetric solution indicating 1 per cent. of metallic iron)."—*U. S.*

Action and Uses.—This salt is one of the richest in iron, the most agreeable to the taste, the least irritating to the bowels and oppressive to the stomach, and the least apt to occasion constipation, of all the ferruginous preparations. *Dose*, Gm. 0.30–1.20 (gr. v–xx) three times a day before meals.

Tartarus ferratus, as above stated, is made into balls which in France are known as *boules de Mars* and *boules de Nancy*, and, dissolved in hot water, are added to baths as a substitute for natural chalybeate waters. It is also given internally in carbonated water, sherry wine, or syrup.

FERRI ET QUININÆ CITRAS, *U. S.*, *Br.*—Iron and Quinine Citrate.

Ferri et quiniæ citras, Br.; *Chininum ferro-citricum*, P. G.; *Citras ferrico-quinicus.*—*Citrate de fer et de quinine*, Fr.; *Ferrichinincitrat*, *Eisenchinineitrat*, *Citronsaures Eisen-Chinin*, G.

Preparation.—Ferric Citrate, 85 Gm.; Quinine, dried at 100° C. (212° F.) to a constant weight, 12 Gm.; Citric Acid, 3 Gm.; Distilled Water, a sufficient quantity, to make 100 Gm. Dissolve the Ferric Citrate in 160 Cc. of distilled water by heating on a water-bath at a temperature not exceeding 60° C. (140° F.). To this solution add the quinine and citric acid, previously triturated with 20 Cc. of distilled water, and stir constantly until the quinine is dissolved. Lastly, evaporate the solution, on a water-bath, at a temperature not exceeding 60° C. (140 F.), to the consistence of syrup, and spread it on plates of glass, so that when dry, the salt may be obtained in scales. Keep the product in well-stoppered bottles, in a dark place.—*U. S.*

To make 2 av. ozs. of this compound dissolve 744 grains of ferric citrate in 3½ fluidounces of warm distilled water; to the solution add 105 grains of quinine dried at 100° C., and 26 grains of citric acid previously triturated with 3 fluidrachms of distilled water. When the quinine has all been dissolved evaporate as directed above.

Take of solution of persulphate of iron 4½ fluidounces; sulphate of quinia 1 ounce; diluted sulphuric acid 12 fluidrachms; citric acid 3 oz. 30 gr.; solution of ammonia, distilled water, each a sufficiency. Mix 8 fluidounces of the solution of ammonia with 2 pints of distilled water, and to this add the solution of persulphate of iron, previously diluted with 2 pints of distilled water, stirring them constantly and briskly. Let the mixture stand for 2 hours, stirring it occasionally, then put it on a calico filter, and when the liquid has drained away wash the precipitate with distilled water until that which passes through the filter ceases to give a precipitate with chloride of barium. Mix the sulphate of quinia with 8 ounces of distilled water, add the diluted sulphuric acid, and when the salt is dissolved precipitate the quinia with a slight excess of solution of ammonia. Collect the precipitate on a filter and wash it with 1½ pints of distilled water. Dissolve the citric acid in 5 ounces of distilled water, and, having applied the heat of a water-bath, add the oxide of iron previously well drained; stir them together, and when the oxide has dissolved add the precipitated quinia, continuing the agitation until this also has dissolved. Let the solution cool, then add, in small quantities at a time, 12 fluidrachms of solution of ammonia diluted with 2 fluidounces of distilled water, stirring

the solution briskly, and allowing the quinia, which separates with each addition of ammonia, to dissolve before the next addition is made. Filter the solution, evaporate it to the consistence of a thin syrup, and then dry it in thin layers on flat porcelain or glass plates at a temperature of 100° F. Remove the dry salt in flakes and keep it in a stoppered bottle.—*Br.*

The process of the U. S. Pharmacopœia consists simply in dissolving quinine in solution of ferric citrate with the aid of citric acid. The apparently complicated process of the British Pharmacopœia in its first part directs the preparation of ferric hydroxide and quinine, which are successively dissolved in citric acid; it corresponds closely to the next following preparation in the subsequent addition of ammonium citrate, by which the physical properties of the resulting scales are changed.

The corresponding salt of the German Pharmacopœia again differs in containing, besides quinine, both ferric and ferrous salt, but no ammonia; it is made by digesting powdered iron 3 parts with citric acid 6 parts and water 500 parts, adding afterward quinine 1 part, freshly precipitated by soda solution from 1.3 parts of quinine sulphate; the solution is then evaporated and scaled.

Properties.—The product of the first process is in transparent, inodorous scales of a yellowish green-brown to reddish-brown color, varying according to their thickness. When heated to near redness, like other citrates, it emits fumes having the odor of burnt sugar, and it finally leaves a brown ash free from alkaline reaction to test-paper. The salt, according to the U. S. P., is slowly deliquescent in damp air; it dissolves slowly in cold, more readily in hot, water, is slightly soluble in alcohol, and insoluble in ether; its solubility diminishes by age. The solution is slightly acid to test-paper, has a bitter and mildly chalybeate taste, and yields with tannin a grayish-black precipitate consisting of the mixed tannates of iron and quinine. On the addition of ammonia the liquid darkens in color, yields a white curdy precipitate of quinine, and the filtrate gives a blue precipitate with potassium ferrocyanide after the addition of hydrochloric acid. The solution of the salt on being heated with excess of potassa solution gives a precipitate of ferric hydroxide and quinine, without evolving vapors of ammonia, and the filtrate after the addition of calcium chloride, again filtering, and then boiling, yields a white granular precipitate of calcium citrate.

The product of the British Pharmacopœia corresponds with the behavior and tests described above, except that it is readily soluble in cold water; it is of a greenish-golden yellow color and in the air somewhat deliquescent.

Tests.—"Dissolve 1.12 (1.1176) Gm. of iron and quinine citrate in a capsule, with the aid of a gentle heat, in 20 Cc. of water. Transfer the solution, together with the rinsings of the capsule, to a separating funnel, allow the liquid to become cold, then add 5 Cc. of ammonia water, and 10 Cc. of chloroform, and shake. Allow the liquids to separate, remove the chloroform layer, and shake the residuary liquid twice more with 10 Cc. of chloroform. Allow the combined chloroformic extracts to evaporate spontaneously in a tared capsule, and dry the residue at a temperature of 100° C. (212° F.) to a constant weight. This residue should weigh not less than 0.1288 Gm. (corresponding to at least 11.5 per cent. of dried quinine), and should correspond to the reactions and tests of quinine. (See QUININA.) Heat the aqueous liquid, from which the quinine has been removed in the manner just described, on a water-bath, until the odor of chloroform and ammonia has disappeared, and allow it to cool. Then dilute it with water to the volume of 50 Cc., transfer 25 Cc. of the liquid to a glass-stoppered bottle (having the capacity of about 100 Cc.), add 2 Cc. of hydrochloric acid and 1 Gm. of potassium iodide, and allow the mixture to stand for half an hour at a temperature of 40° C. (104° F.). After it has been allowed to cool, and been mixed with a few drops of starch test-solution, it should require about 14.5 Cc. of decinormal sodium thiosulphate solution before the blue or greenish color of the liquid is discharged (each Cc. of the volumetric solution indicating 1 per cent. of metallic iron).—*U. S.*

"50 grains dissolved in a fluidounce of water and treated with a slight excess of ammonia give a white precipitate which, when dissolved by chloroform, and this evaporated, weighs 8 grains; the precipitate is almost entirely soluble in ether, and when burned leaves but a minute residue."—*Br.* "If the solution of 1 Gm. of the salt in 4 Cc. of water be precipitated with soda solution, and then agitated with 10 parts of ether, the ethereal liquid on being evaporated should leave behind at least 0.09 Gm. of quinine."—*P. G.* The salt contains 16 per cent. *Br.*, 12 per cent. *U. S.*, 10 per cent. *P. G.* of quinine.

The pharmacopœial method prescribed for the determination of quinine and iron is

identically that proposed by Prof. Power, and possesses the great advantage of using the same weighed sample for both operations; although 12 per cent. of quinine is directed in the formula, a little allowance for shortage is very properly made, owing to the variable quantity of water present. The amount of anhydrous ferric citrate represented by 14.5 per cent. of metallic iron is 63.42 per cent.

Action and Uses.—This preparation has no demonstrable advantage over an extemporaneous union of its components except in the convenience of dispensing it. 5 parts of it contain about 1 part of quinine, and it may be prescribed in pill or solution, before meals, in the *dose* of about Gm. 0.30 (gr. v).

FERRI ET QUININÆ CITRAS SOLUBILIS, *U. S.*—Soluble Iron and Quinine Citrate.

Preparation.—Ferric Citrate, 85 Gm.; Quinine, dried at 100° C. (212° F.) to a constant weight, 12 Gm.; Citric Acid, 3 Gm.; Ammonia-water, Distilled Water, each a sufficient quantity, to make 100 Gm. Dissolve the Ferric Citrate in 160 Cc. of Distilled Water, by heating on a water-bath, at a temperature not exceeding 60° C. (140° F.). To this solution add the Quinine and Citric Acid previously triturated with 20 Cc. of Distilled Water, and stir constantly until the Quinine is dissolved. Then add gradually, and with constant stirring, 50 Cc., or a sufficient quantity of ammonia-water, so that, after the addition of each portion of the latter, the precipitated quinine will be redissolved and the liquid acquire a greenish-yellow tint. Lastly, evaporate the solution on a water-bath, at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in well-stoppered bottles, in a dark place.—*U. S.*

This preparation differs from the preceding in the addition of ammonia-water prior to evaporation of the liquid, whereby the solubility of the scale compound is vastly increased; whenever iron and quinine citrate is to be dispensed in form of solution the "soluble" should be used, whereas the official salt without ammonia is to be employed for pill masses, tablet form, etc., on account of its lesser tendency to absorb moisture on exposure to air.

Properties and Tests.—Soluble iron and quinine citrate occurs in thin transparent scales of a greenish, golden-yellow color, and is rapidly soluble in cold water; if a portion of the salt be heated with potassa solution, vapor of ammonia is evolved. In all other respects it corresponds to the preceding compound, and should contain exactly the same amount of quinine and iron when assayed by the method there prescribed.

Uses.—This compound is of the same strength as Ferri et Quininæ Citras, and may be used in the same manner as this. It is intended especially for solutions.

FERRI ET STRYCHNINÆ CITRAS, *U. S.*—Iron and Strychnine Citrate.

Citrate de fer et de strychnine, Fr.; *Citronensaures Eisen-Strychnin*, G.

Preparation.—Iron and Ammonium Citrate 98 Gm.; Strychnine 1 Gm.; Citric Acid 1 Gm.; Distilled Water 120 Cc.; to make 100 Gm. Dissolve the iron and ammonium citrate in 100 Cc. of distilled water, and the strychnine, together with the citric acid, in 20 Cc. of distilled water. Mix the two solutions, evaporate the mixture by means of a water-bath, at a temperature not exceeding 60° C. (140° F.), to the consistence of syrup, and spread it on plates of glass, so that when dry the salt may be obtained in scales. Keep the product in well-stoppered bottles in a dark place.—*U. S.*

A small quantity of this scale salt may be prepared by dissolving 490 grains of iron and ammonium citrate in 1½ fluidounces of distilled water, adding a solution of 5 grains of strychnine and 5 grains of citric acid in 1 fluidrachm of distilled water, and evaporating as directed.

This is simply a mixture of strychnine citrate with ammonio-ferric citrate, scaled in precisely the same manner as the other iron preparations.

Properties.—It closely resembles ammonio-citrate of iron in appearance, and has the same behavior to reagents as described above, but differs from it in the distinctly bitter taste and in the white precipitate produced by ammonia, the precipitate being soluble in boiling alcohol, from which, if the solution is sufficiently concentrated, crystals will be obtained giving the peculiar reactions of strychnine. The alkaloid will also be obtained

by adding potassa solution to the salt, agitating with chloroform, and evaporating the chloroform solution.

Tests.—"Dissolve 2.24 (2.2352) Gm. of Iron and Strychnine Citrate, in a glass separator, in 15 Cc. of water, add 5 Cc. of ammonia water and 10 Cc. of chloroform, and shake. Allow the liquids to separate, remove the chloroform layer, and shake the residuary liquid twice more with 10 Cc. of chloroform. Allow the combined chloroformic extracts to evaporate spontaneously in a tared capsule, and dry the residue at a temperature of 100° C. (212° F.) to a constant weight. This residue should weigh not less than 0.02 Gm., nor more than 0.0224 Gm. (corresponding to not less than 0.9, nor more than 1 per cent. of strychnine), and should respond to the reactions and tests of strychnine. (See STRYCHNINE). Heat the aqueous liquid, from which the strychnine has been removed in the manner just described, on a water-bath, until the odor of chloroform and ammonia has disappeared, and allow it to cool. Then dilute it with water to the volume of 50 Cc., transfer 25 Cc. of the liquid to a glass-stoppered bottle (having the capacity of about 100 Cc.), add 2 Cc. of hydrochloric acid and 1 Gm. of potassium iodide, and allow the mixture to stand for half an hour, at a temperature of 40° C. (104° F.). After it has been allowed to cool, and been mixed with a few drops of starch test-solution, it should require about 16 Cc. of decinormal sodium thiosulphate solution before the blue or greenish color of the liquid is discharged (each Cc. of the volumetric solution indicating 1 per cent. of metallic iron)."—*U. S.*

These tests, also suggested by Prof. Power, demand about 1 per cent. of strychnine, and practically 79 per cent. of anhydrous ferric citrate, corresponding to 16 per cent. of metallic iron. The limits of 0.9 and 1.0 per cent. are based on the variability of water present.

Action and Uses.—This very unnecessary officinal compound may be prescribed in *doses* of Gm. 0.05–0.10 (gr. j–ij), and cautiously increased. Dr. Squibb has pointed out that its solution is not permanent, and its decomposition may lead to alarming if not dangerous effects.

FERRI FERROCYANIDUM.—FERRIC FERROCYANIDE.

Ferri ferrocyanuretum, Ferrum ferrocyanatum s. borussicum, s. zooticum), Ferrocyanidum ferricum, Cyanuretum ferroso-ferricum, Cœruleum borussicum.—Ferrocyanuret of iron, Prussian blue, Williamson's blue, Paris blue, E.; *Ferrocyanure (Prussiate, Cyanure) de fer, Bleu de Prusse (de Berlin)*, Fr.; *Ferrocyaneisen, Berliner Blau*, G.

Formula, $Fe_4(FeCy_6)_3 = Fe_4 3Fe(CN)_6$. Molecular weight 858.8.

Preparation.—Take of Potassium Ferrocyanide 9 troyounces; Solution of Ferric Sulphate a pint; Water 3 pints. Dissolve the potassium ferrocyanide in 2 pints of the water, and add the solution gradually to the solution of ferric sulphate previously diluted with the remainder of the water, stirring the mixture during the addition. Then filter the liquid, and wash the precipitate on the filter with boiling water until the washings pass nearly tasteless. Lastly, dry it and rub it into powder.—*U. S.* 1870.

The process is one of simple decomposition, the basylous radicals exchanging their acids; thus, $3K_4FeCy_6 + 2Fe_2(SO_4)_3 = 6K_2SO_4 + Fe_4(FeCy_6)_3$. The precipitate requires considerable washing to free it from the potassium salt, and when dried at a temperature of about 40° C. (104° F.) or less it retains $18H_2O$ in combination, which it gradually loses at a higher temperature.

For uses in the arts Prussian blue is made by precipitating ferrous sulphate with potassium ferrocyanide, and exposing the bluish-white precipitate to the air or treating it with oxidizing agents until it has acquired the proper shade; the commoner varieties contain alumina and other impurities. The pigment was accidentally discovered by Diesbach, a manufacturer of colors in Berlin, and a notice of the discovery published in 1710; but processes for preparing it were first published by Woodward, John Brown, and Stephane F. Geoffroy (1724–25); most of the noted chemists of the past and of the early part of the present century were engaged in the investigation of its composition and of that of allied compounds.

Properties.—Ferric ferrocyanide is in hard dark-blue masses which exhibit upon the fresh somewhat conchoidal fracture a reddish metallic lustre and yield a deep-blue powder. It is inodorous, tasteless, insoluble in water, alcohol, and dilute mineral acids, but dissolves while moist in solution of ammonium nitrate with a violet-blue color, and yields with oxalic acid, equal to one-sixth or upward of its own weight, a powder which dissolves completely in water, and which has been used as *wash-blue* and *blue ink;* the

residue left on evaporating the solution to dryness has been known as *Bleu suisse* or *Swiss blue*. Commercial Prussian blue should be previously purified for this purpose by treating it with dilute hydrochloric or sulphuric acid and washing it with water. Concentrated mineral acids decomposs it, with the liberation of hydrocyanic acid; when boiled with alkalies ferric hydroxide is separated and alkali ferrocyanide dissolved; and when heated in contact with air ammoniacal vapors are given off and a rust-colored residue is left containing ferric oxide and potassium cyanate, the latter resulting from potassium compounds present in the pigment. Prussian blue is hygroscopic, and contains about 28 per cent. of water.

Impurities and Adulterations.—On boiling impure Prussian blue with dilute hydrochloric acid, the presence of carbonates will be indicated by effervescence, and the potassium sulphate, alumina, and ferric hydroxide will enter into solution. Ammonia-water added to the solution will precipitate some of these impurities, and the filtrate may be tested for calcium by oxalic acid or evaporated to dryness and ignited, when no residue should be left. The ammonia, if any, is evolved when boiled with potassa solution, which leaves ferric hydroxide behind, and, if alumina should have been present, the clear liquid will yield a white precipitate on being neutralized with hydrochloric acid and again rendered alkaline by ammonia. On incinerating Prussian blue and treating the residue with strong hydrochloric acid, barium sulphate (heavy spar) will be left undissolved, and the clear acid filtrate, when diluted with water, will yield a black precipitate with hydrogen sulphide should lead or allied metals have been present.

Allied Compounds.—Soluble Prussian Blue. On adding a solution of a ferric salt (anhydrous ferric chloride 1 part) to a solution of potassium ferrocyanide 3 parts (not the reverse), keeping the latter in excess, the deep blue precipitate will become soluble in water as soon as the greater portion of the foreign salts has been washed out; the precipitate is *potassium ferri-ferrocyanide* $K_2Fe_2'''(Fe''Cy_6)_2$. A similar soluble precipitate is obtained by adding a ferrous salt (ferrous sulphate 11 parts) to a solution of red prussiate of potash (potassium ferricyanide), but it has the composition $K_2F_2''(Fe_2'''Cy_{12})$, and is *potassium ferro-ferricyanide*.

Turnbull's Blue, Ferricyanidum ferrosum, $Fe_3(Fe_2Cy_{12})$, was discovered by Gmelin (1827), and is obtained by adding potassium ferricyanide to the solution of a ferrous salt.

Action and Uses.—The daily *dose* of this preparation is stated by certain authorities to be from Gm. 2–20 (ʒss–v). It is probably inert. To this statement, contained in the first edition of the present work, may be added the more recent conclusions of Hayem from a series of careful and minute observations. Ferrocyanide of potassium is valueless as a chalybeate, and has no influence in regenerating the blood. Its iron remains inert, and the elements of the cyanogen exert no poisonous action. It may be taken for weeks and months in the daily dose of several Gm. without in the least affecting the health, and in doses of from 2 to 6 Gm. it neither alters the quantity of the urine nor the elimination of urea. A case, however, is recorded (*Zeitschrift f. klin. Med.*, xiv. 515) in which a quantity of it taken in milk produced severe gastro-enteric symptoms. Cases of anæmia which, after a prolonged trial it failed entirely to benefit, were readily and permanently cured by the soluble salts of iron—the chloride, for example.

FERRI HYPOPHOSPHIS, *U. S.*—Ferric Hypophosphite.

Ferrum hypophosphorosum, *Hypophosphis ferricus.*—*Hypophosphite of iron*, E.; *Hypophosphite de fer*, Fr.; *Ferrihypophosphit*, *Unterphosphorigsaures Eisenoxyd*, G.

Formula $Fe_2(PH_2O_2)_6$. Molecular weight 501.04.

Preparation.—A solution of sodium hypophosphite which is free from carbonate is added to a solution of ferric chloride or ferric sulphate, which should not contain any excess of acid. The precipitate is well washed with distilled water and dried with a moderate heat. It is a process of double decomposition between the sodium and ferric salts. The presence of carbonate in the former would contaminate the salt with a corresponding quantity of ferric hydroxide, while an excess of acid would occasion loss by preventing the ferric hyphosphite from being precipitated.

By this method a slight loss is occasioned by the partial solubility of the freshly precipitated ferric hypophosphite in water. Moerk suggests to prepare the salt as follows: Place 30 Gm. of calcium hypophosphite into a flask with 100 Cc. of distilled water; add gradually 49.5 Gm. of ferric chloride solution, shaking well after each addition. Allow the mixture to stand three days with frequent agitation, then filter and wash until all calcium has been removed. This is said to yield about 93 per cent. of a very pure salt, based upon the quantity of ferric chloride used.

Properties.—It is a white or grayish powder, inodorous, nearly tasteless, slightly soluble in water, more so in hypophosphorous acid, but freely so in hydrochloric acid. Like other insoluble or sparingly-soluble ferric salts, it dissolves in solutions of an alkali citrate, with a green color. It is readily oxidized by nitric acid and other oxidizing agents, and when heated in the dry state evolves inflammable hydrogen phosphide and leaves ferric pyrophosphate. Its formula is given above; it contains, in addition, water of hydration, the amount of which has not been determined.

Tests.—"If to 0.5 Gm. of the salt 5 Cc. of acetic acid be added, no effervescence should occur (absence of carbonate), and if the mixture be subsequently heated to boiling, the filtrate upon cooling, should afford no turbidity with ammonium oxalate test-solution (absence of calcium). If 0.5 Gm. of the salt be boiled with 10 Cc. of sodium hydroxide test-solution, a reddish-brown precipitate is produced, and if to the filtrate from the latter slightly acidulated with hydrochloric acid, magnesia mixture be added, and subsequently an excess of ammonia water, no crystalline precipitate should be produced (absence of phosphate). If 0.1 Gm. of ferric hypophosphite be mixed with 10 Cc. of water, then 10 Cc. of diluted sulphuric acid and 50 Cc. of decinormal potassium permanganate solution added, and the mixture boiled for fifteen minutes, it should require not more than 3 Cc. of decinormal oxalic acid solution to discharge the red color (corresponding to at least 98.1 per cent. of the pure salt)."—*U. S.*

The volumetric determination of ferric hypophosphite depends upon the oxidation of hypophosphorous into phosphoric acid by means of potassium permanganate; in this case some free phosphoric acid is formed along with the ferric phosphate; thus $5Fe_2(PH_2O_2)_6 + 12K_2Mn_2O_8 + 36H_2SO_4 = 5Fe_2(PO_4)_2 + 20H_3PO_4 + 12K_2SO_4 + 24MnSO_4 + 36H_2O$. 2505.2 parts of ferric hypophosphite requiring 3784.08 parts of potassium permanganate for complete oxidation, each Cc. of decinormal $KMnO_4$ solution must represent 0.0020877 Gm. of $Fe_2(PH_2O_2)_6$, and hence 50—3 = 47, multiplied by this factor, will show 0.0981219 or 98.1 per cent. in the above test.

Action and Uses.—It is theoretically assumed to possess virtues belonging to phosphorus as well as iron—an assumption which nothing justifies. It may be given in *doses* of from Gm. 0.30–0.60 (gr. v–x).

FERRI IODIDUM SACCHARATUM, *U. S.*—Saccharated Ferrous Iodide.

Ferrum iodatum saccharatum.—Saccharated iodide of iron, E.; *Saccharure d'iodure de fer*, Fr.; *Eisenjodürzucker*, G.

Formula of ferrous iodide FeI_2. Molecular weight 308.94.

Preparation.—Iron, in the form of fine bright wire, and cut into small pieces, 6 Gm.; Reduced Iron, 1 Gm.; Iodine, 17 Gm.; Distilled Water, Sugar of Milk, recently dried, each a sufficient quantity to make 100 Gm. Mix the iron wire, iodine, and 20 Cc. of distilled water in a flask of thin glass, shake the mixture occasionally, until the reaction ceases and the solution has acquired a green color and lost the smell of iodine; then filter it through a small wetted filter into a porcelain capsule containing 40 Gm. of sugar of milk. Rinse the flask and iron wire with a little distilled water, pass the rinsings through the filter into the capsule, and evaporate, on a water-bath, with frequent stirring, until a dry mass remains. Transfer this quickly to a heated iron mortar, reduce it to powder, and mix it intimately, by trituration, with the reduced iron and enough sugar of milk to make the final product weigh 100 Gm. Transfer the powder at once to small and perfectly dry bottles, which should be securely stoppered and kept in a cool and dark place.—*U. S.*

If the above quantities be multiplied by 17½ and then reckoned as grains, the resulting finished product will weigh 4 av. ozs.

This is the process of the German Pharmacopœia of 1872, modified only by slightly increasing the iodine, so that the finished preparation may contain fully 20 per cent. of ferrous iodide. Iodine unites with the iron in the presence of water, heat being produced, which may increase to such an extent that some iodine may be volatilized; should violet-colored vapors make their appearance in the flask, the violence of the reaction should be checked by immersing the flask in cold water; toward the end of the process it may, on the other hand, become necessary to hasten the combination of the last portions of iodine by the application of a gentle heat. Instead of bringing the whole of the iodine in contact with the whole amount of iron, as directed in the formula, it is better to add one of these in several portions, waiting after each addition until the reaction has nearly ceased. In warm weather especially it will be preferable, in order to avoid loss

by evaporation, to introduce the iodine and water into the flask and to add the iron gradually. The green liquid, being a very concentrated solution of ferrous iodide, should be passed through a small wetted filter, and the flask and filter should be well rinsed twice with a small quantity of distilled water to recover all the iodide. 17 parts of iodine will yield 20.75 parts of ferrous iodide if all loss has been avoided.

Properties.—Saccharated ferrous iodide is a yellowish or grayish-white powder, very hygroscopic, odorless, having a sweetish ferruginous taste and a slightly acid reaction. It is soluble in 7 parts of water at 15° C. (59° F.), forming an almost clear and nearly colorless solution, and is only partially soluble in alcohol. When strongly heated the compound swells up, chars, evolves the odor of iodine and of burnt sugar, and on ignition leaves a residue which should yield nothing soluble to water (absence of alkali salts). The aqueous solution yields a light-greenish precipitate with ammonia, and a blue precipitate with test-solution of potassium ferricyanide. If mixed with some gelatinized starch, and afterward with a little chlorine-water, the solution assumes a blue color.

Tests.—The aqueous solution of saccharated ferrous iodide should not be colored blue on the addition of gelatinized starch (absence of free iodine).

"If 1.55 (1.5447) Gm. of saccharated ferrous iodide be dissolved in about 20 Cc. of water, in a small flask, and the liquid well mixed with 22 Cc. of decinormal silver nitrate solution, it should, after the addition of 5 Cc. each of diluted nitric acid and of ferric ammonium sulphate test-solution, require not more than 2 Cc. of decinormal potassium sulphocyanate solution to produce a reddish-brown tint which does not completely disappear on shaking (corresponding to about 20 per cent. of pure ferrous iodide)."—*U. S.*

This volumetric test depends upon the formation of insoluble silver iodide, and, as it is somewhat difficult to determine exactly when the precipitate ceases to form, the Pharmacopœia purposely directs the addition of an excess of silver nitrate solution, which excess is to be ascertained by residual titration with potassium sulphocyanate solution, ammonio-ferric alum being used as an indicator; the reddish-brown tint produced by formation of ferric sulphocyanate will not be permanent until all the silver nitrate in excess has been changed to sulphocyanate. Each Cc. of decinormal $AgNO_3$ solution corresponds to 0.015447 Gm. of ferrous iodide.

Allied Preparations.—Ferri iodidum, Ferrum iodatum, *P. G.;* Ioduretum ferrosum.—Ferrous iodide, Iodide of iron, *E.;* Iodure de fer, *Fr.;* Eisenjodür, *G.*—This unstable salt has been dismissed from the Pharmacopœia. It may be made by uniting iodine and iron in the proportion given above and in the presence of water, filtering the green solution, and evaporating it rapidly in a dish of polished iron until a drop of the solution taken out on the end of an iron wire solidifies on cooling. The liquid should now be poured out on a porcelain dish, and as soon as it has solidified should be broken into fragments and enclosed in a well-stopped bottle. The solution of ferrous iodide, on evaporation, is readily oxidized; hence the direction to evaporate in a polished iron dish, which, however, cannot prevent the formation of oxide, or possibly oxyiodide, of iron. The residuary salt is therefore never completely soluble in water. The German Pharmacopœia orders the salt to be prepared extemporaneously by combining iodine 82 parts and powdered iron 30 parts under distilled water 100 parts; the filtered liquid contains 100 parts of ferrous iodide, and is used in this condition for liquid preparations, or if required in pills the solution is rapidly evaporated in an iron dish.

According to De Luca, pure anhydrous ferrous iodide is white, and in the presence of moisture greenish. The Pharmacopœias require it to be green with a tinge of brown. By the above process, however, it is usually obtained as a steel-gray laminated mass, with a metallic lustre, fusing at about 177° C. (350° F.) and evolving vapors of iodine. It is deliquescent when pure, dissolves readily with a green color in water, also in glycerin and alcohol, the solution yielding a dark-blue precipitate with potassium ferricyanide, and separating iodine on the addition of a little chlorine-water, when on the further addition of mucilage of starch a blue color will be produced.

Solid ferrous iodide is at best a very unsatisfactory medicinal preparation, owing to the unavoidable changes occurring under ordinary circumstances. It would be better, by far, when ferrous iodide is desired in a solid form, to evaporate a definite quantity of the official syrup, and convert that at once into pills by the addition of some vegetable powder. The saccharated ferrous iodide is to a certain extent, though not indefinitely, protected by the sugar.

Action and Uses.—They are sufficiently described under Syrupus Ferri Iodidi, which, with *Pilulæ ferri iodidi*, is the only other officinal preparation (*U. S. P.*) that contains iodine and iron in combination. The *dose* of this iodide may be stated at Gm. 0.30 (gr. v) three times a day. It should be prescribed in pilular form and taken after meals.

FERRI LACTAS, *U. S.*—Ferrous Lactate.

Ferrum lacticum, P. G.; *Lactas ferrosus.—Lactate of iron*, E.; *Lactate ferreux, Lactate de fer*, Fr.; *Eisenlactat, Milchsaures Eisenoxydul*, G.

Formula $Fe(C_3H_5O_3)_2.3H_2O$. Molecular weight 287.34.

Preparation.—A formula for the preparation of this salt was given by the U. S. P. 1870: a fluidounce of lactic acid diluted with a pint of distilled water is digested in an iron vessel with ½ ounce of iron filings until the action has ceased, when the hot solution is filtered and crystallized. In this process the iron unites directly with the acid, displacing the basylous hydrogen, the solution of ferrous lactate merely requiring to be evaporated and crystallized. It may also be prepared from crystalline calcium lactate, $Ca(C_3H_5O_3)_2.5H_2O$, obtained in the preparation of lactic acid (see page 69) by dissolving 31 parts of it in 750 or 800 parts of water, and mixing this with a solution of 28 parts of crystallized ferrous sulphate; by double decomposition ferrous lactate is formed and remains in solution, while most of the calcium sulphate is precipitated, the remainder being removed by mixing the liquid with one-tenth volume of alcohol; the filtrate is finally evaporated and crystallized. A similar process has been adopted by the French Codex.

Both these processes involve considerable evaporation, which may be avoided, according to Pagenstecher (1842), by mixing an alcoholic solution of sodium lactate (see Boutron and Frémy's process for lactic acid, page 69) with a freshly-prepared solution of ferrous chloride, when nearly the whole of the ferrous lactate will crystallize out, and the alcohol used may be recovered by distilling the mother-liquor. Thus prepared, the salt is less prone to oxidation.

Properties.—Ferrous lactate forms a greenish-white or yellowish crystalline powder or crusts consisting of small needle-shaped crystals containing 19 per cent. of water of crystallization, and having a slight peculiar odor, a sweetish and mild chalybeate taste, and a slightly acid reaction. The dry salt is nearly permanent in dry air, but in a damp atmosphere is gradually converted into ferric salt. It is almost insoluble in cold alcohol, but may be crystallized from boiling diluted alcohol; it dissolves slowly at 15° C. (59° F.) in 40 parts, *U. S.*, *P. G.*, of water, and in 12 parts of boiling water, the solutions being of a greenish-yellow color, and it is freely soluble with a green color in solutions of alkali citrates. On the application of heat it turns brown and black, and then, with frothing, emits white acid vapors having the odor of burnt sugar, and finally leaves brownish-red ferric oxide, amounting to about 27.7 per cent. The aqueous solution yields a dark-blue precipitate with potassium ferricyanide, and a light-blue one with potassium ferrocyanide; in contact with the air it turns speedily brown, forming ferric lactate, and then yields at once a dark-blue precipitate with potassium ferrocyanide. The salt, boiled for fifteen minutes with an excess of nitric acid diluted with an equal bulk of water, yields on cooling white granules of mucic acid.

Ferrous lactate should be kept in well-stoppered bottles.

Tests.—"A 2-per-cent. aqueous solution of the salt should not afford, with lead acetate test-solution, or after acidulation with hydrochloric acid, with hydrogen sulphide test-solution, more than a whitish opalescence (limit or absence of sulphate, chloride, citrate, tartrate, malate, etc., and of foreign metals). The aqueous solution, acidulated with nitric acid, should not afford more than a slight opalescence with barium chloride test-solution, or with silver nitrate test-solution (limit of sulphate or chloride). If 25 Cc. of the aqueous solution (1 in 50) be boiled for a few minutes with 5 Cc. of diluted sulphuric acid, then an excess of potassium or sodium hydroxide test-solution added, the filtrate, after the addition of a few drops of alkaline cupric tartrate solution, and heated to boiling, should not afford a red precipitate (absence of sugar). If a portion of the salt be triturated with strong sulphuric acid, no odor of butyric acid, or gas should be evolved (absence of carbonate), and the mixture, after standing for some time, should not assume a brown color (absence of sugar, gum, or other organic impurities). If 1 Gm. of the salt, contained in a porcelain crucible, be moistened with nitric acid, and carefully ignited, it should leave a residue of ferric oxide weighing not less than 0.270 nor more than 0.278 Gm. This residue should not have an alkaline reaction to litmus paper, nor yield anything soluble to water (absence of foreign salts)."—*U. S.*

Action and Uses.—Lactate of iron has been alleged to be more assimilable than other ferruginous salts, upon the ground that lactic acid is a normal secretion of the stomach. Admitting this ground to be settled, the inference is illogical. Clinically, it

may be said that lactate of iron is a very unirritating salt, and that owing to its feeble flavor it is taken without repugnance. The statements made of its curative powers are neither more nor less than may be made of other mild salts of iron. It may be given in the *dose* of Gm. 0.06 (1 or more grains) in pill or solution. Owing to its difficult solution in water and its liability to oxidation, it should not be dispensed in a liquid form, but it may be dissolved in hot syrup to the extent of about 4 grains to the fluidounce. Attempts have been made to cure *erectile tumors* by injecting them with a solution of "8 grains of lactate of iron to a drachm of distilled water." The statement is incorrect, since the salt requires 48 parts of cold water to dissolve it.

Albuminate of iron has been recommended upon the same grounds as the lactate. It is claimed to be very digestible and unirritating, and hence peculiarly adapted to the treatment of *gastric ulcer* and irritable *dyspepsia* occurring in anæmic persons, and to the derangements of the *menopause* under like conditions. The average dose is stated as about Gm. 0.06 (gr. j), of which one half is oxide of iron. Like the citrate, this preparation has been injected hypodermically.

FERRI OXIDUM HYDRATUM, *U. S.*—Ferric Hydroxide (Hydrate).

Ferri peroxidum, *Hydras ferricus.—Hydrated oxide of iron; Moist peroxide of iron*, E.; *Sesquioxide (Peroxyde) de fer hydraté humide; Hydrate de peroxyde de fer gélatineux*, Fr.; *Feuchtes Eisenoxydhydrat*, G.

Formula of freshly-prepared ferric hydroxide $Fe_2(OH)_6$. Molecular weight 213.52.

Preparation.—Solution of Ferric Sulphate 100 Cc.; Ammonia-water 110 Cc.; Water a sufficient quantity. To the ammonia-water, previously diluted with 250 Cc. of cold water, add, under constant stirring, the solution of ferric sulphate, previously diluted with 1000 Cc. of cold water. As soon as the precipitate has subsided, draw off the clear liquid by means of a siphon, then mix the precipitate intimately with about 1000 Cc. of cold water, again draw off the clear liquid after subsidence of the precipitate, and repeat this operation, until a portion of the decanted liquid gives not more than a slight cloudiness with barium chloride test-solution. Finally transfer the precipitate to a wet muslin strainer, and, after it has drained, mix it with sufficient cold water to make the mixture weigh 250 Gm.

When ferric hydroxide is to be made in haste for use as an antidote, the washing may be performed more quickly, though less perfectly, by bringing the precipitate at once on a wet muslin strainer, pressing forcibly with the hands until no more liquid passes, and then adding enough water to make the whole weight about 250 Gm.

Note.—The ingredients for preparing ferric hydroxide as an antidote should always be kept on hand in bottles containing, respectively, 200 Cc. of the solution of ferric sulphate, and 220 Cc. of ammonia-water.—*U. S.*

The official ferric hydroxide may also be prepared by adding a mixture of 3½ fluidounces of solution of ferric sulphate and 2 pints of water, with constant stirring, to 4 fluidounces of ammonia-water previously diluted with 10 fluidounces of water.

Ferric hydroxide is prepared from the solution of the sulphate by decomposing the salt with ammonia (*U. S. P.*), or with soda (*Br.* 1867), the latter authority ordering 4 fluidounces of its solution of persulphate after diluting with a pint (Imp.) of distilled water, to be gradually poured into 33 fluidounces of soda solution, and to set aside for 2 hours before straining and washing the precipitate upon the strainer. In the one case ammonium sulphate, in the other sodium sulphate, is formed—salts which are readily soluble in water and almost completely removed by washing and decantation, as directed above. The brown ferric hydroxide remaining behind has the formula $Fe_2(OH)_6$. It combines very easily with weak acids, and for this reason is an effectual antidote to arsenic, which forms with it an insoluble salt. It cannot be dried without losing water and being converted into oxyhydrate of the formula $Fe_2O_2(OH)_2$, which has a more decided reddish tint and combines less readily with acids, and not at all with arsenous acid. This change is retarded by keeping the hydroxide, as obtained by the above process, mixed with water in the form of a magma; but after some time it parts with half its water of hydration, forming the reddish-brown ferric oxyhydrate, $Fe_2O_3.Fe_2(OH)_6$, which has lost the power of combining with weak acids, such as arsenous or acetic acid. A similar effect may be wholly or partly obtained during the preparation of the hydroxide if the mixture be allowed to become hot. Its effectiveness as an antidote is due to two conditions—the making of the hydroxide at the *ordinary*, not at an elevated, temperature, and its *recent* preparation; the magma with water should be smooth, not granular, and should be easily

soluble in acetic acid without effervescence; if insoluble, it is not effectual as an antidote to arsenic.

But since the apothecary does not receive previous notice when the antidote will be required, it is best to make it fresh, when needed, by a process which will occupy but a few minutes. This may be accomplished by at once collecting upon a strainer and expressing as directed by the United States Pharmacopœia; the mixture will then contain some ammonium sulphate and a little ammonia; the latter, however, should be scarcely recognizable by the odor. The same object is attained extemporaneously by substituting magnesia for the more caustic ammonia or soda. (See FERRI OXID. HYDRAT. C. MAGN.)

Other Forms of Ferric Oxide.—FERRI PEROXIDUM HYDRATUM, *Br.;* Ferrum oxydatum fuscum, Ferrum hydricum, Oxydum ferricum hydratum, Ferrugo, Rubigo.—Hydrous peroxide of iron, Ferric oxyhydrate, *E.;* Hydrate ferrique, Sesquioxyde de fer hydraté, Hydrate de sesquioxyde de fer sec, *Fr.;* Eisenoxydhydrat, Ferrihydrat, *G.* Formula $Fe_2O_3.H_2O = Fe_2O_2(OH)_2$. Molecular weight 177.60.—It is obtained by drying the moist ferric hydroxide described above at a temperature not exceeding 100° C. (212° F.), and is identical with the ferric hydroxide used by the U. S. P. for preparing iron plaster and troches of iron. It is of a dark red-brown color, and is nearly insoluble in acetic acid, but should dissolve freely and without effervescence in diluted hydrochloric acid, and when heated to dull redness should yield about 10 per cent. of moisture.

FERRI SUBCARBONAS, *U. S.* 1870, CROCUS MARTIS APERITIVUS (APERIENS).—Subcarbonate of iron, *E.;* Safran de mars apéritif, *Fr.;* Eisensafran, *G.*—It is prepared by mixing solutions of 8 ounces of ferrous sulphate and 9 ounces of sodium carbonate, washing thoroughly with water, and drying without heat. The French Codex directs ferrous sulphate 15 parts and sodium carbonate 18 parts.

On mixing a solution of sodium carbonate with a solution of pure ferrous sulphate in boiled water, a white precipitate of ferrous carbonate is obtained, which in contact with the air rapidly darkens, changing in color through various shades of green, blue, and olive into brown, carbon dioxide being at the same time given off. This change of color is accompanied with its conversion into ferric hydroxide, with the exception of small and variable proportions of ferrous carbonate, which escape oxidation. This preparation must therefore be regarded as identical, or nearly so, with ferric hydroxide.

It is an amorphous reddish-brown powder, inodorous and almost tasteless, and closely resembling ferric hydroxide. Dilute hydrochloric acid dissolves it with slight effervescence, the yellow liquid yielding blue precipitates with ferricyanide (difference from pure ferric hydroxide) and ferrocyanide of potassium, but not with barium chloride (absence of sulphates). If it has been dried at an elevated temperature it is of a brighter red color, does not readily dissolve in warm dilute hydrochloric acid, and consists mainly of the oxyhydrate, $Fe_2O_2.(OH)_2$. Dried at ordinary temperature, it consists chiefly of the oxyhydrate, $Fe_2O_3.Fe_2(OH)_6$.

FERRI OXYDUM RUBRUM, CROCUS MARTIS ADSTRINGENS, COLCOTHAR, CAPUT MORTUUM.—Ferric oxide, *E.;* Colcothar, Safran de mars astringent, *Fr.;* Eisenoxyd, Rother Eisensafran, Englisch-Roth, Todtenkopf, *G.*—It is obtained by heating to redness either one of the above hydroxides or by igniting ferrous sulphate in contact with air, when the salt is decomposed, water and sulphuric and sulphurous acids being given off. It is brown-red, more or less gritty, inodorous, tasteless, and insoluble in diluted acids. It is no longer employed medicinally, the ferric hydroxide being used instead, but it is extensively used in the arts. It forms the main constituent of iron paint, which is sold as *English red, Berlin red* (Minium de fer, *Fr.;* Eisenmennige, *G.*), and under various other names, and usually consists of ferric oxide mixed with from 5 to 50 per cent. of alumina or other insoluble compound. When obtained as a fine powder by elutriation it is known as *polishing rouge, terre douce de vitriol, rouge anglais, Polirroth*, and employed for polishing metals. The mineral *hematite* or *red hematite, ferret d'Espagne, sanguine, Blutstein*, is ferric oxide, while the various *brown hematites* are different ferric hydroxides.

FERRI OXIDUM MAGNETICUM, FERRUM OXYDATUM MAGNETICUM, OXYDUM FERROSO-FERRICUM.—Ferroso-ferric oxide, Black oxide of iron, Magnetic oxide of iron, *E.;* Oxyde ferroso-ferrique, Oxyde de fer noir (magnétique), Ethiops martial, *Fr.:* Magneteisen, Ferroferrioxyd, Eisen-oxyd-Oxydul, *G.* Formula $Fe_3O_4 = FeO.Fe_2O_3$. Molecular weight 231.48.—Take of solution of persulphate of iron 5½ fluidounces; sulphate of iron 2 ounces; solution of soda 4 pints; distilled water a sufficiency. Dissolve the sulphate of iron in 2 pints of the water, and add to it the solution of persulphate of iron; then mix this with the solution of soda, stirring them well together. Boil the mixture; let it stand for two hours, stirring it occasionally; then put it on a calico filter, and when the liquid has drained away, wash the precipitate with distilled water until what passes through the filter ceases to give a precipitate with chloride of barium. Lastly, dry the precipitate at a temperature not exceeding 120° F.—*Br.* 1867.

Magnetic oxide, which is found in Sweden as magnetic iron ore, consists of 1 molecule each of ferrous and ferric oxides. When solutions of ferrous and ferric salts are mixed in molecular proportions, and then precipitated by a caustic alkali, the same compound is thrown down in the form of hydroxide. The mixture should without delay be boiled for some time until the precipitate has become denser and settles readily. It may then without difficulty be washed by decantation, and finally upon the filter, without being prone to oxidation, as before the boiling. It is an inodorous and tasteless brownish-black powder, which is strongly attracted by the mag-

net and dissolves without effervescence in warm hydrochloric acid diluted with half its volume of water. This solution yields blue precipitates with both potassium ferrocyanide and ferricyanide. When heated in a test-tube it gives off moisture, and when the heat is continued in contact with the air red ferric oxide is left. Lefort (1852) found magnetic oxide of iron to contain 1 molecule, or 7.2 per cent., of water. According to the British Pharmacopœia, it contains about 20 per cent. Its purity is ascertained by the tests given, and by hydrogen sulphide added to the dilute solution in hydrochloric acid, which should produce only a white turbidity from separated sulphur, but not a black precipitate (absence of copper, etc.). Should it have been insufficiently washed, the alkali sulphates or chlorides may be detected in the distilled water shaken with a portion of the oxide. Under the name of *Æthiops martialis* various pharmacopœias formerly recognized black ferroso-ferric oxide, which varied in composition according to the different methods of preparation.

Ferrum oxidatum saccharatum, *P. G.*—Saccharated oxide of iron, Saccharated iron, *E.;* Saccharate de fer, Saccharure d'oxyde de fer soluble, *Fr.;* Eisenzucker, Lösliches Eisenoxyd, *G.*—To a mixture of 30 parts of solution of ferric chloride (sp. gr. 1.281) and 150 parts of water add gradually and with frequent stirring a solution of 26 parts of sodium carbonate in 150 parts of water until precipitation has been completed; the precipitate is repeatedly washed with water by decantation until all chlorides have been removed, then drained and expressed on a muslin filter. 50 parts of powdered sugar and 5 parts of solution of soda (sp. gr. 1.70) are added to the residue, the mixture is heated to perfect solution, and then evaporated to dryness and powdered; finally sufficient powdered sugar is added to make the weight of the finished product 100 parts. —*P. G.*

It is a reddish-brown powder, has a sweet and mild chalybeate taste, and is entirely soluble in distilled water, yielding a deep reddish-brown solution of a feeble alkaline reaction. It contains 3 per cent. of metallic iron. The aqueous solution is not altered by potassium ferrocyanide, except after the addition of hydrochloric acid, when it is colored a dingy green, then dark-blue, a precipitate being slowly produced.

Syrupus ferri oxydati, *P. G.*—Syrup of soluble ferric oxide, *E.:* Sirop d'oxyde de fer soluble, Sirop de saccharate de fer, *Fr.:* Eisenzuckersyrup, *G.*—Saccharated oxide of iron, distilled water, and simple syrup, of each equal parts; dissolve. It is of a deep red-brown color and contains 1 per cent. of iron.

Action and Uses.—Hydrated oxide of iron is chiefly used as an antidote to arsenic. But although the chemical relations of an arsenical solution may favor the precipitation of its arsenic by freshly-prepared hydrated oxide of iron, there is good reason to suppose that in ordinary cases of arsenical poisoning the greater part of the poison remains in the stomach undissolved, and the iron, so far as it is useful, operates chiefly as a mechanical antidote by enveloping the arsenic and shielding the stomach until the bulk of the mass or an emetic causes its discharge, in the same manner as the subcarbonate of iron does in similar cases. This statement is inferred from the fact that a very large excess of the oxide is essential to its efficiency.

The *subcarbonate of iron* of the earlier editions of the Pharmacopœia seems to have been discarded on account of its speedily losing its original character by the action of the oxygen of the atmosphere. Whether or not that change impairs its therapeutic virtues cannot perhaps be so readily determined. At all events, it is one of the oldest pharmaceutical preparations of iron, and was intended to imitate and take the place of rust of iron, which from time immemorial had been used in medicine. It continues to be one of the most employed members of its class, but is ineligible whenever it is desired to introduce a large amount of iron into the blood. It has been used in all forms of *anæmia* and *anæmic chlorosis*, and in *neuralgia*, *chorea*, and other nervous affections depending upon a deficiency of red corpuscles in the blood. In a disease of a different order, *tetanus*, a number of cures have been attributed to this medicine, but of late years it has been entirely supplanted by other means, and the question of its utility is unsettled. Subcarbonate of iron in large doses, mixed with water, may be resorted to when the hydrated oxide cannot be procured in cases of poisoning by *arsenious acid*. Four grave cases of poisoning by very large doses of arsenious acid were treated in this manner by Leale, and all recovered (*Am. Jour. of Med. Sci.*, Jan. 1880, p. 80). The *dose* of subcarbonate of iron is from Gm. 0.30 (gr. v) upward. In some cases of neuralgia it has been taken by the teaspoonful. Caution should be exercised, lest it accumulate in the bowels and obstruct them. Powdered "subcarbonate of iron" is one of the many dry powders which have been used in the treatment of indolent *ulcers*.

For the reasons now given the subcarbonate has been supplanted by the oxide of iron, protected by the sugar surrounding it from peroxidation. It is probable that from this cause it more readily combines with the acids of the stomach and enters the circulation, so that for all the purposes above mentioned it is more suitable than the old subcarbonate of iron, the case of arsenical poisoning alone excepted. In that case the subcarbonate no doubt acts partly by its mass in a mechanical manner, and partly by combining with

the arsenious acid. The soluble saccharated carbonate is one of the most efficient of all the ferruginous preparations, and one of the most acceptable to the stomach. It should be taken a short time before meals to ensure its thorough solution and absorption, and in doses of from Gm. 0.20–1 (gr. iij–xv). *Syrup of soluble oxide of iron* is a convenient form for the administration of iron to children, and in teasponful doses.

FERRI OXIDUM MAGNETICUM has been but little used of late, owing to the want of uniformity in its composition. It is, however, rich in iron, and may be prescribed in all cases for which the subcarbonate is employed. The *dose* is Gm. 0.30–1.30 (gr. v–xx), and should be taken after meals.

FERRI OXIDUM HYDRATUM CUM MAGNESIA, *U. S.*—FERRIC HYDROXIDE (HYDRATE) WITH MAGNESIA.

Antidotum arsenici.—Arsenic antidote, E.; *Contre-poison de l'arsenic*, Fr.; *Gegengift des Arseniks*, G.

Preparation.—Solution of Ferric Sulphate, 50 Cc.; Magnesia, 10 Gm.; Water, a sufficient quantity. Mix the solution of ferric sulphate with 100 Cc. of water, and keep the liquid in a well-stoppered bottle. Rub the magnesia with cold water to a smooth and thin mixture, transfer this to a bottle capable of holding about 1000 Cc., and fill it up with water. When the preparation is wanted for use, mix the two liquids by adding the magnesia mixture, and making it thoroughly homogeneous by shaking, gradually, to the iron solution, and shake them together until a homogeneous mass results. NOTE.—The diluted solution of ferric sulphate, and the mixture of magnesia with water, should always be kept on hand, ready for immediate use.—*U. S.*

Using wine-measure, it will be found convenient to keep on hand, in separate bottles, 2 fluidounces of ferric sulphate solution, diluted with 4 fluidounces of water, and 180 grains of magnesia made into a smooth mixture with one-half pint of water; the amount of water to be mixed with the magnesia will be found quite sufficient.

The magnesia is used in excess, more than is necessary for separating all the ferric hydroxide, and the mixture is prevented from becoming heated by the previous diffusion of the magnesia in water. Neither filtration nor straining is requisite, the compounds of the mixture being ferric and magnesium hydroxides and magnesium sulphate, none of which has any caustic or otherwise injurious effect nor forms a soluble compound with arsenic. The mixture being made only when needed, the ferric hydroxide is in that condition in which it readily combines with arsenous acid and has not become inert for the purpose by long keeping.

Uses.—If freshly made and promptly administered in large doses, it is probable that this mixture is a more efficient antidote to arsenic than either of its ingredients would be alone.

FERRI PHOSPHAS SOLUBILIS, *U. S.*—SOLUBLE FERRIC PHOSPHATE.

Ferri Phosphas, U. S, 1880.—*Ferri et sodii citro-phosphas; Ferrum phosphoricum cum natrio citrico.—Soluble phosphate of iron, Sodio-ferric citro-phosphate*, E.; *Citro-phosphate de fer et de soude*, Fr.; *Natriumferricitrophosphat*, G.

Preparation.—Ferric Citrate, 50 Gm.; Sodium Phosphate, uneffloresced, 55 Gm.; Distilled Water, 100 Cc. Dissolve the ferric citrate in the distilled water by heating on a water-bath. To this solution add the sodium phosphate, and stir constantly until it is dissolved. Evaporate the solution on a water-bath, at a temperature not exceeding 60° C. (140° F.), to the consistence of thick syrup, and spread it on plates of glass, so that when dry the salt may be obtained in scales. Keep the product in dark amber-colored, well-stoppered bottles.—*U. S.*

To prepare a small quantity of soluble ferric phosphate 1 av. oz. of ferric citrate should be dissolved in 2 fluidounces of hot distilled water; to the solution add 481 grains of uneffloresced sodium phosphate and proceed as stated above.

The official title of this preparation has very appropriately been changed by addition of the adjective, to distinguish it at once from other commercial varieties of ferric phosphate which are insoluble in water. The formula has also been changed, and the proportion of the two salts is based upon the assumption that carefully prepared ferric citrate in scales contains 10 molecules of water, and has the formula $Fe_2(C_6H_5O_7)_2,10H_2O$; it is important that uneffloresced sodium phosphate be used, as otherwise the excessive amount of the latter will cause the scales to become white on standing.

Properties and Tests.—"Thin, bright green, transparent scales, without odor, and having an acidulous, slightly saline taste. The salt is permanent in dry air when excluded from light, but becomes dark and discolored on exposure to light. Freely and completely soluble in water, but insoluble in alcohol. The aqueous solution of the salt has a slightly acid reaction. With potassium ferrocyanide test-solution, the solution affords a blue color, but does not yield a blue precipitate, unless it has been acidulated with hydrochloric acid. If 1 Gm. of the salt be boiled with 10 Cc. of potassium or sodium hydroxide test-solution, a reddish-brown precipitate is produced, and if the colorless filtrate from the latter be strongly acidulated with hydrochloric acid, then magnesia mixture added, and subsequently a slight excess of ammonia water, an abundant, white, crystalline precipitate is produced. If the filtrate from this precipitate be acidulated with acetic acid, and heated to boiling, no further precipitate should be produced (absence of *pyrophosphate*). If 0.56 (0.5588) Gm. of the salt be dissolved in a glass-stoppered bottle (having a capacity of about 100 Cc.) in 15 Cc. of water and 2 Cc. of hydrochloric acid, and, after the addition of 1 Gm. of potassium iodide, the mixture be allowed to stand for half an hour at a temperature of 40° Cc. (104° F.), and then allowed to cool and mixed with a few drops of starch test-solution, it should require about 12 Cc. of decinormal sodium thiosulphate solution to discharge the blue or greenish color of the liquid (each Cc. of the volumetric solution indicating 1 per cent. of the metallic iron."—*U. S.*

This compound is required to contain 2 per cent. more of metallic iron than the next following.

Composition.—The exact composition of the soluble ferric phosphate cannot be stated, and it is possible that no less than four salts are present—viz.: sodium and ferric phosphates and sodium and ferric citrates; if the interchange of acid radicals were complete, the chemical formula might be written as $Fe_2(PO_4)_2 2Na_2HC_6H_5O_7 + Aq$.

True Phosphates of Iron.—FERRI PHOSPHAS, *Br.*—Ferrum phosphoricum, Phosphas ferroso-ferricus.—Phosphate of iron, Ferroso-ferric phosphate, *E.*; Phosphate de fer, Phosphate ferroso-ferrique, *Fr.*; Ferroferriphosphat, Phosphorsaures Eisenoxydul-Oxyd, *G.* Formula $Fe_3(PO_4)_2.FePO_4.12H_2O$. Dissolve 3 ounces of ferrous sulphate in 30 ounces of boiling distilled water, and $2\frac{3}{4}$ ounces of sodium phosphate in a similar quantity of water. When each solution has cooled to between 37.8° and 54.4° C. (100° and 130° F.) add the latter to the former, pouring in also a solution of $\frac{3}{4}$ ounce of sodium bicarbonate in a little distilled water. Mix thoroughly. Transfer the precipitate to a calico filter, and wash it with hot distilled water till the filtrate ceases to give a precipitate with barium chloride. Finally, dry the precipitate at a temperature not exceeding 48.9° C. (120° F.).—*Br.*

The mineral *vivianite*, which forms pale-blue crystals, is mainly ferrous phosphate. On bringing together solutions of ferrous sulphate and sodium phosphate a white precipitate of ferrous phosphate is produced, which on exposure and during the washing is oxidized, and acquires a more or less blue, greenish-blue, or grayish-blue color. During the reaction a portion of the sulphuric acid is set free, and retains phosphates of iron in solution, to obtain which sodium acetate is added, which, reacting with the free sulphuric acid, forms sodium sulphate and free acetic acid, in which the phosphates of iron are insoluble. Or the free acid may be nearly neutralized with sodium carbonate or bicarbonate, as directed above. The washing of the precipitate must be continued until the filtrate fails to give a reaction for sulphuric acid.

Thus prepared, it is a tasteless and inodorous bluish powder, varying somewhat in shade. It is insoluble in water, but dissolves in hydrochloric acid, yielding a yellow solution in which dark blue precipitates are produced by both potassium ferro- and ferricyanide. If the acid solution is treated with sufficient tartaric acid, and then with an excess of ammonia, no precipitate is produced, but on the addition of magnesium sulphate a white precipitate of ammonio-magnesium phosphate falls. When the powder is boiled with caustic soda the filtrate, after being neutralized, yields a yellow precipitate with silver nitrate. Both precipitates indicate phosphoric acid. The chemical composition varies to some extent, and is influenced by its exposure to the atmosphere while moist, the temperature at which it is dried, etc. The above formula is that of Rammelsberg. Wittstein obtained a somewhat different result. The British Pharmacopœia regards it as containing at least 47 per cent. of ferrous phosphate ($Fe_3(PO_4)_2 8H_2O$); 3 Gm. dissolved in hydrochloric acid should require for complete oxidation not less than 27.9 Cc. of the volumetric solution of potassium dichromate, which indicates 46.7 per cent. of the ferrous salt.

The salt should yield nothing to hot distilled water (insufficient washing), and the

solution in hydrochloric acid should yield only a white turbidity of sulphur with hydrogen sulphide, but not a black (copper, etc.) or a yellow (arsenic) precipitate. The same solution, digested with bright copper, should not form a dark deposit of arsenic upon the metal.

FERRI PHOSPHAS ALBUS, PHOSPHAS FERRICUS.—Ferric phosphate, White phosphate of iron, *E.*; Phosphate ferrique, *Fr.*; Ferriphosphat, *G.* $Fe_2(PO_4)_2 4H_2O$; molecular weight 373.8.—On mixing 4 fluidounces of solution of ferric sulphate with a solution of 1 ounce of sodium acetate, and adding solution of sodium phosphate, a white precipitate of ferric phosphate is obtained. After washing and drying at 100° C. it is a white or yellowish-white tasteless powder having the composition stated, is decomposed by alkalies, and dissolves readily in dilute mineral acids, in citric and tartaric acid, and in alkali citrates, the latter solutions having a green color. The freshly precipitated and washed salt, mixed with water until the mixture contains 1.0 or 1.2 per cent. of ferric phosphate, has been used under the name of *Lac ferri*, *milk of iron*.

Action and Uses.—Owing to its insolubility in water phosphate of iron must be given in pill or in powder, of which the latter is preferable, in the *dose* of from Gm. 0.30–0.60 (gr. v–x). It is extremely doubtful whether the phosphoric acid in its composition confers any special virtues upon it.

FERRI PYROPHOSPHAS SOLUBILIS. *U. S.*—SOLUBLE FERRIC PYROPHOSPHATE.

Ferri pyrophosphas, U. S. 1880.—*Ferri et sodii citro-pyrophosphas*, *Ferrum pyrophosphoricum cum sodio citrico*, *Pyrophosphas ferricus cum citrate sodico.*—*Pyrophosphate of iron with sodium citrate*, *Sodio-ferric citro-pyrophosphate*, E.; *Citro-pyrophosphate de fer et de soude*, Fr.; *Pyrophosphorsaures Eisenoxyd mit Citronensaurem Natron*, G.

Preparation.—Ferric Citrate, 50 Gm.; Sodium Pyrophosphate, uneffloresced, 50 Gm.; Distilled Water, 100 Cc. Dissolve the Ferric Citrate in the Distilled Water, by heating on a water-bath. To this solution add the Sodium Pyrophosphate, and stir constantly, until it is dissolved. Evaporate the solution, on a water-bath, at a temperature not exceeding 60° C. (140° F.), to the consistence of thick syrup, and spread it on plates of glass, so that, when dry, the salt may be obtained in scales. Keep the product in dark amber colored, well-stoppered bottles.—*U. S.*

As seen by the above formula, ferric citrate and sodium pyrophosphate are used in the proportion of equal weights; this change from the last Pharmacopœia is based on the recommendations of Lake and Power, in order to ensure better scaling of the compound. In view of the insolubility in water of true ferric pyrophosphate, the addition of the word "soluble" to the official title was desirable.

On precipitating a solution of sodium pyrophosphate by ferric sulphate a white precipitate of *ferric pyrophosphate*, $Fe_4(P_2O_7)_3$, is obtained, which, like other insoluble ferric salts, is readily soluble in alkali citrates, forming green solutions. Formerly ammonium citrate was used for this purpose, but owing to the slow volatilization of the ammonia, the salt gradually became insoluble.

Properties and Tests.—The salt is obtained in inodorous transparent apple-green scales, which are permanent in dry air when excluded from the light, but turn dark on exposure to light. The salt has an acidulous, slightly saline, and scarcely chalybeate taste and a slightly acid reaction, is insoluble in alcohol, but dissolves freely in water yielding a greenish solution; this gives with potassium ferrocyanide a blue color, but no precipitate unless acidulated with hydrochloric acid. "If 1 Gm. of the salt be boiled with 10Cc. of potassium or sodium hydroxide test-solution, a reddish-brown precipitate is produced, and, if the colorless filtrate from the latter be strongly acidulated with hydrochloric acid, then magnesia mixture test-solution added, and subsequently a slight excess of ammonia water, no precipitate should be produced (distinction from and absence of *ferric phosphate*). If the liquid be then acidulated with acetic acid, and heated to boiling, an abundant, white, flocculent precipitate (pyrophosphate) is produced. If 0.56 (.05588) Gm. of the salt be dissolved in a glass-stoppered bottle (having a capacity of about 100 Cc.) in 10 Cc. of water, then 10 Cc. of hydrochloric acid, and subsequently 40 Cc. of water added, and, after the addition of 1 Gm. of potassium iodide, the mixture be allowed to stand for half an hour at a temperature of 40° C. (104° F.), and then allowed to cool, and mixed with a few drops of starch test-solution, it should require about 10 Cc. of decinormal sodium thiosulphate test-solution to discharge the

blue or greenish color of the liquid (each Cc. of the volumetric solution indicating 1 per cent. of metallic iron)."—*U. S.*

Like the soluble ferric phosphate, this preparation is evidently of a complex nature, and as in all the scale compounds of iron the amount of water of hydration is variable.

Composition.—Regarding the chemical composition of this and similar preparations two views have been entertained. According to the one, they are double salts of ferric pyrophosphate and alkali citrate; according to the other, which has been advocated by Rother (1876), they should be regarded as mixtures of alkali-ferric pyrophosphate, $Fe_4(P_2O_7)_3 3Na_4P_2O_7$, with alkali-ferric citrate and ferric citrate. The formula given for the double pyrophosphate corresponds with that of Gladstone for sodio-ferric pyrophosphate, for which Fleitmann and Persoz (1848) gave the formula $Fe_4(P_2O_7)_3.2Na_4P_2O_7$.

Allied Salt—Ferri et sodii pyrophosphas, Natrium pyrophosphoricum ferratum.—Sodio-ferric pyrophosphate, *E.*: Pyrophosphate de fer et de soude, *Fr.*: Natrium ferri-pyrophosphat, *G.*—It is prepared by adding to a solution of 200 parts of sodium pyrophosphate in 400 parts of water so much ferric chloride in aqueous solution that a permanent precipitate is not produced, and mixing with the greenish liquid 1000 parts of alcohol. A white amorphous powder is thus obtained, which according to Fleitmann, contains 7 molecules (9 per cent.) of water, and dissolves slowly in water, yielding a greenish solution; this on boiling separates a white precipitate, acquires with ammonia a red color, is not precipitated by alkali carbonates, phosphates, or acetates, but with sodium chloride yields a precipitate of the double salt, while the addition of ferric chloride causes the precipitation of ferric pyrophosphate.

Action and Uses.—The tastelessness, solubility, and richness in iron of this salt render it one of the best ferruginous preparations. *Dose*, Gm. 0.13–0.30 (gr. ij–v). The dose of pyrophosphate of iron and sodium is stated at from Gm. 0.10–0.30 (gr. ij–v).

Salicylate of iron has had attributed to it qualities which are unlike those of any other iron salt, such as "promoting secretion and stimulating the skin," while it "promotes perspiration, lowers the temperature, and reduces the pulse." It has been recommended for *diphtheria*, *aphthæ*, *erysipelas*, etc. (White, *Glasgow Med. Jour.*, Aug. 1879). It has also been thought to possess peculiar advantages in *infantile diarrhœa* accompanied by fetid stools, which is credible, and to cure *acute* articular *rheumatism*, which is much less so. Sosio claims that it is the best ferruginous salt for hypodermic use.

FERRI SULPHAS, *U. S. Br.*—Ferrous Sulphate.

Ferrum sulfuricum, P. G.; *Sulfas ferrosus*, *Ferrum vitriolatum purum*, *Vitriolum martis purum.*—*Sulphate of iron*, E.; *Sulfate* (*Protosulfate*) *de fer*, *Sulfate ferreux*, Fr.; *Ferrosulfat*, *Schwefelsaures Eisenoxydul*, G.

Formula of crystallized or precipitated ferrous sulphate $FeSO_4.7H_2O$; molecular weight 277.42; of exsiccated ferrous sulphate, approximately, $2FeSO_4+3H_2O$; mol. weight 357.28.

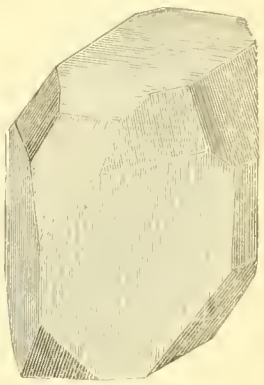
Preparation.—Take of Iron Wire 4 ounces; Sulphuric Acid 4 fluidounces; Distilled Water 1½ pints. Pour the water on the iron placed in a porcelain dish, add the sulphuric acid, and when the disengagement of gas has nearly ceased boil for ten minutes. Filter now through paper, and after the lapse of twenty-four hours separate the crystals which have been deposited from the solution. Let these be dried on filtering-paper placed on porous bricks, and preserved in a stoppered bottle.—*Br.*

Ferrous sulphate is obtained on a large scale from alum shale and by roasting iron pyrites, exposing it to the air, and exhausting the mass with water; also by passing solutions of copper sulphate over scraps of iron, whereby copper is precipitated, the iron entering into solution. It is also obtained as a by-product in various manufactures where sulphuric acid is used for the purpose of purifying certain products. The article thus obtained is usually impure and not fit for medicinal purposes, except for disinfecting, and in this impure state is known in commerce as *Copperas*, or *green vitriol* (Ferrum sulphuricum crudum, *P. G.*; Couperose verte, Vitriol vert, *Fr.*; Kupferwasser, Eisenvitriol, Grüner Vitriol, *G.*). For medicinal use it should be prepared directly from sulphuric acid acting upon iron wire or clean iron filings in the presence of water, when hydrogen is evolved, ferrous sulphate remaining in solution; $Fe_2+2H_2SO_4$ yields $2H_2+2FeSO_4$. The salt is prone to oxidation if its chemically neutral solution is evaporated to crystallization, but in the presence of some free sulphuric acid yields crystals which are far more permanent. This explains the necessity of having some free sulphuric acid in the liquid from which ferrous sulphate is crystallized. The crystals are collected upon a diaphragm,

washed rapidly with a little water, and, according to the French Codex, with a little alcohol, to remove the mother-liquor, and then dried.

Properties.—Ferrous sulphate is in transparent bluish-green monoclinic prisms, or sometimes in rhombic crystals having the specific gravity 1.9. When crystallized from neutral solutions the salt is pale-green, and in the presence of ferric salt of deeper, more emerald-green, color. It is inodorous, has a styptic and somewhat saline taste, a slight acid reaction, melts by heat in its water of crystallization, leaving finally a whitish residue, and when exposed to the air effloresces and is gradually oxidized; the efflorescence takes place more rapidly above 35° C. (95° F.), and when finally heated to 115° C. (239° F.) the loss of water of crystallization amounts to 38.84 per cent. The salt is insoluble in alcohol and ether, but dissolves at 15° C. (59° F.) in 1.8 and at 100° C. (212° F.) in 0.3 parts of water, U. S. The aqueous solution yields a white precipitate insoluble in hydrochloric acid with barium chloride, a dark-blue one with potassium ferricyanide, and a bluish-white one with potassium ferrocyanide.

FIG. 123.



Crystal of Ferrous Sulphate.

Tests.—Impurities are rarely present if the salt has been prepared from iron and sulphuric acid. The aqueous solution treated with hydrogen sulphide should not give a blackish precipitate (copper), and when completely precipitated by ammonium sulphide the filtrate, on evaporation and ignition, should not leave more than a trace of residue (limit of salts of the fixed alkalies—*U. S.*). The aqueous solution, after being oxidized with nitric acid and supersaturated with ammonia, should yield a filtrate which is not affected by hydrogen sulphide (zinc, manganese); and if the oxidized liquid be supersaturated with potassa solution, the filtrate neutralized with hydrochloric acid and again supersaturated with ammonia, no precipitate (alumina) should occur. "If 1.39 (1.3871) Gm. of the salt be dissolved in about 25 Cc. of water, and the solution acidulated with sulphuric acid, not less than 50 Cc. of decinormal potassium permanganate solution should be required to impart to the liquid a permanent pink color (each Cc. of the volumetric solution indicating 2 per cent. of crystallized ferrous sulphate)."—*U. S.*

Each molecule of potassium permanganate is capable of converting 10 molecules of ferrous salt into ferric salt; thus, $10\,FeSO_4.7H_2O + K_2Mn_2O_8 + 8H_2SO_4 = 5\,Fe_2(SO_4)_3 + K_2SO_4 + 2MnSO_4 + 78H_2O$; hence each Cc. $\frac{N}{10}$ permanganate solution used in the above test corresponds to 0.027742 Gm. of ferrous sulphate (crystals), which is equal to 2 per cent. of the weight of the sample used, for 1.3871 : 0.027742 :: 100 : 2.

Pharmaceutical Uses.—Nearly all the official compounds of iron, with the exception of the chloride, iodide, sulphide, and nitrate, are prepared from the sulphate, either directly or indirectly.

FERRI SULPHAS GRANULATUS, *U. S.*; FERRI SULPHAS GRANULATA, *Br.*; FERRI SULPHAS PRÆCIPITATUS, *U. S.* 1880.—Precipitated or granulated ferrous sulphate or sulphate of iron, *E.*; Sulfate ferreux précipité, *Fr.*; Præcipitirtes Ferrosulfat, *G.*—Ferrous Sulphate, 100 Gm.; Distilled Water, 100 Cc.; Diluted Sulphuric Acid, 5 Cc.; Alcohol, 25 Cc. Dissolve the ferrous sulphate in the distilled water previously heated to boiling, add the diluted sulphuric acid, and filter the solution while hot. Evaporate the solution immediately in a tared porcelain capsule, on a sand-bath, until it weighs 150 Gm., and then cool it quickly, under constant stirring. Place the product into a glass funnel stopped with a plug of absorbent cotton, and, when it has thoroughly drained, pour upon it the alcohol. When this has also drained, spread the crystalline powder on bibulous paper, dry it quickly in the sunlight or in a dry room, at the ordinary temperature, and transfer it at once to perfectly dry well-stoppered bottles.—*U. S.*

Granulated ferrous sulphate may also be prepared by dissolving 8 av. ozs. of the pure salt in 8 fluidounces of boiling distilled water, and adding 2½ fluidrachms of diluted sulphuric acid. After filtration the solution is evaporated to 12 av. ozs., as directed above, and the granules are washed with 2 fluidounces of alcohol.

The present official directions differ materially from those of 1880, when the precipitation of the salt was directed with a large volume of alcohol, and also a subsequent washing with alcohol until all free acid was removed. The addition of sulphuric acid (as already stated on the preceding page) is to prevent the oxidation of the ferrous salt, and the washing of the granular product with alcohol removes acid and water, but not entirely.

The British Pharmacopœia gives the same directions as for the crystallized salt, except

that on filtering the solution is collected in a jar containing 8 fluidounces of alcohol, which quantity is insufficient for precipitating all the ferrous sulphate. The German Pharmacopœia likewise directs the salt to be prepared from iron wire, but directs the aqueous solution to be filtered into about half its volume of alcohol under constant agitation; the granular precipitate is transferred to a filter, washed with alcohol, expressed, and dried rapidly. The salt thus prepared is a very pale bluish-green powder, which, if it has been properly dried, is less readily oxidized on exposure than the crystals, but in other respects shows precisely the same behavior as the crystallized salt, and is tested in the same manner.

FERRI SULPHAS EXSICCATUS, *U. S.*; FERRI SULPHAS EXSICCATA, *Br.*; FERRUM SULFURICUM SICCUM, *P. G.*—Dried (exsiccated) ferrous sulphate or sulphate of iron, *E.*; Sulfate ferreux desséché, *Fr.*; Entwässertes Ferrosulfat, *G.*—Ferrous Sulphate, in coarse powder, 100 Gm. Allow the salt to effloresce at a temperature of about 40° C. (104° F.), and then heat it in a porcelain dish, on a water-bath, until the product weighs from 64 to 65 Gm. Lastly, reduce the residue to a fine powder, and transfer it at once to perfectly dry well-stoppered bottles.—*U. S.*

The British Pharmacopœia directs the use of a porcelain or iron dish, and the heat to be raised only to 100° C. (212° F.). At a somewhat higher temperature the yield is about 61 per cent. The German Pharmacopœia employs the same method as the U. S. Crystallized ferrous sulphate contains 45.3 per cent. of water of crystallization, a portion of which is lost in a dry atmosphere at the ordinary temperature, the remainder, except 1 molecule, at 115° C. (239° F.). The last molecule of water is expelled only at about 280° C. (536° F.), and, if proper care be taken, without the loss of sulphuric acid.

Exsiccated ferrous sulphate forms a grayish-white powder which dissolves slowly in cold, more rapidly in hot, water, leaving only a small quantity of ferric oxysulphate. Otherwise, the behavior and tests of purity are the same as for the crystalline salt, nearly 10 parts of which are represented by 6 parts of the exsiccated salt.

Action and Uses.—The intense astringency of the sulphates of iron renders them, as a rule, ineligible for internal administration, except when it is intended to exert a directly constringing action upon the capillaries either of the alimentary canal or of remote organs. If the dose much exceeds Gm. 0.06–0.12 (gr. j–ij), it is apt to occasion gastric pain and vomiting, and the prolonged use of even smaller doses is not free from the risk of impairing the digestive function. This preparation is one of the iron compounds most liable to remain undissolved in the bowels and occasion their obstruction. It is best removed by means of saline purges. Yet in small doses it is one of the best adjuncts of aloes in relieving *constipation* caused by torpor of the colon. Besides passive *hæmorrhages*, it is well adapted to control excessive secretions produced by debility, as *sweating*, *gastric catarrh*, *gastric ulcer*, *chronic diarrhœa*, *leucorrhœa*, *gleet*, and *hydruria*. Externally, it has been applied to the skin in superficial traumatic *erysipelas*, but it is quite useless in the idiopathic form of the disease. A solution of Gm. 16 (½ ounce) of the salt in a pint of water, or an ointment containing Gm. 8 (2 drachms) to the ounce of lard, may be employed in the former affection. An ointment made with 1 or 2 parts of the dried sulphate to 30 of lard is a useful application in cases of obstinate local *diseases of the skin*, such as eczema, intertrigo, and impetigo. It may also aid in healing the sores occasioned by *rupia*, *ecthyma*, *syphilis*, and *scrofula*, but has no advantage over zinc ointment for this purpose.

FERRI SULPHIDUM.—FERROUS SULPHIDE.

Sulphuretum ferrosum.—Sulphide of iron, E.; *Sulfure de fer*, Fr.; *Schwefeleisen*, G.
Formula FeS. Molecular weight 87.86.

Preparation.—Iron unites with sulphur in various proportions, some of the compounds, like iron pyrites, FeS_2, being found in nature. The monosulphide, which is employed for generating hydrogen sulphide, is made by mixing 3 parts of iron filings with 2 parts of sublimed sulphur, introducing the mixture in small portions into a crucible heated to bright redness and kept covered after each addition; or a rod of iron is raised nearly to a white heat and then brought into contact with sulphur; ferrous sulphide will at once form and melt, and should be permitted to drop into cold water to solidify.

Properties.—It is in yellowish-black or blackish masses or irregular pieces, which have a metallic lustre and are permanent in dry air, but are oxidized when kept in a damp atmosphere. It dissolves readily in dilute sulphuric or hydrochloric acid, with the

evolution of hydrogen sulphide, and without leaving any residue when the sulphide is pure. As met with, it sometimes contains an excess of sulphur, but usually has an excess of iron, and the hydrogen sulphide evolved is mixed with hydrogen.

Hydrogen sulphide, or *hydrosulphuric acid* is a colorless gas having a disgusting odor suggesting that of rotten eggs. Its specific gravity is 1.19; water dissolves three times its volume of the gas; the solution is not permanent in the air, but is oxidized, water being formed and white sulphur deposited. The formula of hydrogen sulphide is H_2S, its molecular weight 33.98.

This compound has no direct medicinal value. It is used solely for the production of hydrogen sulphide.

Action and Uses.—The alleged cure of *phthisis* by injecting the bowel with sulphuretted hydrogen, which was much in vogue about 1885, proved it to be not only deceptive, but injurious. The mineral spring waters impregnated with this gas and with iron are used with advantage in many *cutaneous* diseases and in chronic *bronchitis*. In the latter affection pulverized sulphur waters are much employed in Europe.

FERRI VALERIANAS, *U. S.*—Ferric Valerianate.

Ferrum valerianicum.—*Valerianate of iron*, E.; *Valérianate de fer*, Fr.; *Ferrivalerianat, Baldriansaures Eisenoxyd*, G.

Ferric valerianate should be kept in small well-stoppered bottles, in a cool and dark place.

Preparation.—This salt is best obtained by adding to a cold solution of ferric sulphate or ferric chloride a cold solution of sodium valerianate as long as a precipitate is produced, collecting this upon a filter, washing it with a little water, and drying it at a temperature not exceeding 20° C. (68° F.). The salt is formed by double decomposition, sodium sulphate or chloride remaining in solution, while ferric valerianate is precipitated. An elevated temperature and continued washing should be avoided, since valerianic acid would be removed and a more basic salt remain behind.

Properties.—The salt is a dark brick-red light amorphous powder of somewhat varying chemical composition, which has a slight odor and a taste of valerianic acid. It is insoluble in cold water, but readily soluble in alcohol. Mineral acids decompose the salt with liberation of valerianic acid. When slowly heated it gradually parts with all its acid without melting, but when rapidly heated it fuses and gives off dense inflammable vapors having only a faint odor of valerianic acid, but a strong odor of butyric acid. The salt is with difficulty moistened with cold water, but boiling water decomposes it, gradually setting free all the acid and leaving ferric hydroxide. The salt is easily soluble in hydrochloric acid (Wittstein, 1845). On treating freshly-precipitated ferric hydroxide with valerianic acid, Ludwig (1849) obtained a granular dark red-brown powder which was only partly soluble in alcohol, leaving a basic salt behind.

Test.—"If 0.56 (0.5588) Gm. of the salt be dissolved in a glass-stoppered bottle (having a capacity of about 100 Cc.) in 2 Cc. of hydrochloric acid and 15 Cc. of water, and subsequently 1 Gm. of potassium iodide added, the mixture allowed to stand for half an hour at a temperature of 40° C. (104° F.), and then allowed to cool, and mixed with a few drops of starch test-solution, it should require not less than 15, nor more than 20 Cc. of decinormal sodium thiosulphate solution, to discharge the blue or greenish color of the liquid (each Cc. of the volumetric solution indicating 1 per cent. of metallic iron)."—*U. S.*

From the foregoing test (which is the same as that recommended for the ferric scale compounds) it will be seen that the U. S. P. requires a salt containing between 15 and 20 per cent. of metallic iron; such a salt upon complete ignition will leave a residue of between 21.42 and 28.57 per cent. of ferric oxide.

Composition.—The formula $Fe_2(C_5H_9O_2)_6$, mol. weight 716.38, requires 22.28 per cent. Fe_2O_3. Ludwig's alcoholic solution, when spontaneously evaporated, left a salt yielding 21.5 per cent. Fe_2O_3; the formula $Fe_2(C_5H_9O_2)_6.H_2O$ requires 21.77 per cent. Dried at 50° C. (122° F.), the same salt yielded 30 per cent., and Wittstein's salt, dried at 20° C. (68° F.), gave 27 per cent. Fe_2O_3; the formula $Fe_2(C_5H_9O_2)_6.FeOC_5H_9O_2$ requires 26.22 per cent. The variable composition of the salt depends on the process, the care with which it has been washed, and the temperature at which it has been dried.

Action and Uses.—It was expressly stated, when this preparation was first introduced into medicine, that it would be an error to regard it as a true antispasmodic, on account of the valerianic acid in its composition, and that its value depended mainly

upon the iron it contained, the acid acting only as an adjuvant. It should have been added that the iron might be introduced into the system under many more eligible forms and in more suitable doses than were recommended for this salt. It is probably but little used, even for the affections for which it was originally recommended, and which were described as "chlorosis with hysterical or epileptiform attacks." It was prescribed in pills in the *dose* of Gm. 0.05–0.15 (gr. j–iij) several times a day.

FERRUM, *U. S., Br.*—Iron.

Mars.—*Fer*, Fr.; *Eisen*, G.

Symbol Fe. Atomicity bivalent and sexivalent (Fe_2). Atomic weight 55.88.

Metallic iron, in the form of fine, bright, and non-elastic wire, *U. S.;* wrought iron in the form of wire or nails free from oxide, *Br.*

Origin.—Iron is the most useful and one of the most widely-diffused metals in nature, being present in most rocks and soils, and generally forming one of the constituents of the ashes of plants and animals. It is rarely found in the metallic state. It is often combined with sulphur, as *iron pyrites*, more frequently oxidized, as *magnetic iron*, *spathic iron*, *hematite*, and other ores, and likewise in combination with mineral acids. It is found in large quantities in several states of North America and in Great Britain, Sweden, Germany, France, and other European countries.

The manufacture of metallic iron must of necessity vary with the nature of the ore, but the principle is in all cases the same. The ore frequently requires roasting or calcination, mainly for the purpose of rendering it more porous and better adapted for the smelting process; this process is conducted in blast-furnaces, the ore being mixed with carbonaceous matter—coke and the like—some flux, either lime or clay, being added at the same time, whereby a more readily fusible silicate of aluminum and calcium is formed, which on cooling forms the glass-like slag. The crude iron obtained from the blast-furnace is called *pig* or *cast iron*, and contains various proportions of carbon, silicon, sulphur, phosphorus, and other impurities, from which it must be purified to adapt it for various uses in the arts. In the *refining* or *puddling* process it is fused, and by stirring brought into contact with a blast of air, by which the impurities are oxidized, or the oxidation is effected with the aid of an impure oxide of iron (iron scales). The slag still remaining in the iron is then at a white heat pressed out under a steam-hammer, and the iron thus purified rolled out into bars. For many purposes a further purification is requisite.

Properties.—Iron is a grayish metal of the spec. grav. 7.7 to 7.9. Its tenacity or strength is nearly twice as great as that of any other metal commonly used, and when heated to redness it possesses a ductility admitting of its being drawn into the thinnest wire. At a white heat it becomes pasty and may be welded, but it can be fused only by the full heat of a blast-furnace, and on congealing it expands somewhat in volume. Iron remains unchanged in dry air, but in the presence of moisture its surface becomes covered with brown-red oxide (*rust*). It enters into combination with nearly all the elements, and forms the base of two important series of salts, the *ferrous* and *ferric*, in the former of which it is bivalent. Fe'', in the latter sexivalent $Fe^{VI} = (Fe_2)'''$.

Ferrous salts, when anhydrous, are mostly white, and bluish-green in the hydrated state; the oxalate is yellow. When moist or in solution they are easily oxidized on exposure to the air or under the influence of oxidizing agents. Their aqueous solutions are colored brownish-black by nitric oxide, and yield black precipitates with ammonium sulphide and white ones, changing to green, black, and brown, with alkalies and their carbonates; the precipitation, particularly with ammonia, is incomplete. Soluble phosphates precipitate white ferrous phosphate, changing to greenish-blue; potassium ferrocyanide produces a bluish-white precipitate, changing to dark-blue, and potassium ferricyanide a dark-blue one. Ferrous solutions free from ferric salt are not affected by potassium sulphocyanate or tannin. The soluble normal ferrous salts have an acid reaction to test-paper; those insoluble in water dissolve is hydrochloric acid.

Ferric salts are either normal or basic: the normal salts, when soluble, have an acid reaction, are mostly white when anhydrous, and brown or brown-yellow when hydrated: the basic salts are of a darker brown or reddish-brown color. Those insoluble in water dissolve in hydrochloric acid. Hydrogen sulphide reduces ferric to ferrous salts, sulphur being separated; ammonium sulphide produces the same reduction, and afterward a black precipitate. Alkalies and alkali carbonates added in excess separate brown ferric hydroxide, in the latter case with the evolution of carbon dioxide; the precipitation is

prevented by the presence of tartaric acid and some other organic compounds. Alkali acetate, added in the cold, colors the solutions deep brown-red, the color disappearing on the addition of hydrochloric acid; on boiling a brown precipitate of basic ferric acetate or ferric hydroxide is deposited. Solutions of ferric salts treated with metallic iron, sulphurous acid, or other deoxidizing agents are reduced to ferrous salts. Sodium phosphate precipitates white ferric phosphate, which is insoluble in acetic acid, becomes brown by ammonia, and if excess of sodium phosphate be present dissolves in ammonia with a red-brown color. Sodium arsenate has a behavior similar to that of the phosphate. Gallotannic acid causes a blue-black color and precipitate (writing ink). Meconic acid and sulphocyanates color the solutions blood-red, the color produced by the latter reagent being destroyed by corrosive sublimate and by strong mineral acids. Potassium ferricyanide darkens the solutions of ferric salts to an olive-brown color; potassium ferrocyanide precipitates Prussian blue.

Pharmaceutical Uses.—Besides the salts of iron treated of elsewhere, the following may be noticed:

FERRI BENZOAS.—Ferric benzoate, *E.* $Fe_2(C_7H_5O_2)_6 6H_2O$; mol. weight 945.8.—Solution of ferric sulphate is precipitated by a concentrated solution of sodium or ammonium benzoate, the precipitate collected on a filter, washed with a little cold water, pressed, and dried. It is a brownish orange-colored powder having little taste, and turning brown when heated to about 135° C. (275° F.), with the loss of water; at a higher temperature benzoic acid sublimes and the salt is decomposed. Water and alcohol dissolve a portion of the compound, leaving a basic salt. Basic ferric benzoates of a reddish or pale-brownish color are obtained from solution of subsulphate of iron or of ferric chloride mixed with ammonia-water insufficient in quantity for precipitation by adding solution of ammonium benzoate.

FERRI MALAS.—Ferrous malate, *E.* Impure malate of iron is recognized by several European pharmacopœias as EXTRACTUM FERRI POMATUM, which is prepared by digesting the expressed juice of sour apples with 3 or 4 per cent. of iron filings until the reaction has ceased, filtering, and evaporating. It has a blackish-green color, and contains a variable quantity of iron, sometimes as much as 8 per cent. 1 part of it dissolved in 9 parts of cinnamon-water, containing one-tenth its weight of alcohol, is known as TINCTURA FERRI POMATA, *P. G.*

FERRI OXALAS.—Ferrous oxalate, *E.* $FeC_2O_4.H_2O$; mol. weight 161.62.—This salt may be prepared by mixing solutions of oxalic acid and ferrous sulphate, but as the ferrous oxalate is somewhat soluble in diluted sulphuric acid, it is best to neutralize the oxalic acid in part with ammonia before adding the iron solution, in order to increase the yield of precipitate. The following formula will answer: Dissolve 436 grains of oxalic acid in 1 pint of water; to two-thirds of the solution add enough ammonia-water to exactly neutralize it; then add the remaining third, thus forming an acid ammonium oxalate; having dissolved 960 grains of ferrous sulphate in two pints of distilled water, filter and mix with the solution of ammonium oxalate. Set aside for a while, and wash the precipitate well with water until free from acid. It occurs as a pale lemon-yellow, inodorous, crystalline powder, sparingly soluble in cold as well as boiling water (about 1 part in 4500). It dissolves in cold hydrochloric acid and in hot dilute sulphuric acid.

FERRI SALICYLAS.—Ferrous salicylate, *E.* According to Eberle (1886) this salt is best prepared by dissolving freshly precipitated ferrous carbonate in water by means of salicylic acid with the aid of a gentle heat, filtering and evaporating the solution to dryness on a water-bath. The ferrous carbonate can be readily prepared by dissolving 100 parts of ferrous sulphate and 110 parts of sodium carbonate each in 200 parts of boiling water, filtering, and mixing when cold; the precipitate is washed by decantation until free from sulphate, transferred to a porcelain dish and dissolved as above directed.

FERRI TANNAS.—Ferric tannate, *E.* Ferric tannates, free from gallate and containing but little of ferrous compound, are produced by precipitating cold solutions of ferric salts with tannin; a mixture of ferrous salt and tannin exposed to the air likewise deposits ferric tannate. Wittstein (1874) found these precipitates to contain between 8.4 and 56.25 per cent. of ferric oxide, the nature of the iron salt and the order of mixing the solutions influencing the composition of the precipitate. A compound containing about one-third its weight of ferric oxide is obtained by preparing the hydroxide from 3 fluidounces of solution of ferric sulphate, and triturating the washed and pressed precipitate with 1 troyounce of tannin and sufficient alcohol, after which it is dried in a water-bath. Tannate of iron is a black or bluish-black powder which is decomposed by mineral and the stronger organic acids. When boiled with water the ferric is reduced to ferrous salt.

Action and Uses.—Naturally, iron is indicated chiefly when the proportion of red corpuscles in the blood is permanently diminished. Their transient loss by hæmorrhage is better repaired by food, out of which the constituents of the blood are normally elaborated, supposing that the assimilative functions are not impaired. But when such impairment exists the speediest and the surest cure is brought about by the introduction of iron into the economy. By its means the proportion of red corpuscles in the blood appears to be, if it is not actually, increased, and their condition, as seen under the micro-

scope, is changed from pale and shrivelled to red and full; through them more oxygen is introduced into the system, and a more active assimilation of nutriment, as well as a more perfect renewal of tissue, is secured. The cases in which *anæmia* may be thus remedied comprise those associated or not with chlorosis, hypochondria, convalescence from prolonged and exhausting diseases, malarial and saturnine and some other cachexiæ attended with imperfect elaboration of the blood or its habitual waste, certain varieties of dyspepsia, some forms of albuminuria, etc. But in these and other diseases which do not involve incurable organic lesions it often happens that iron remains inoperative—in all probability because it is not digested, and not received, if at all, into the system in such a form as to make it an efficient oxygen-bearer in the blood. It has been proved that in such cases the inhalation of oxygen gas exerts a powerful although a transient stimulating influence upon the nutritive and animal functions, and that to render its action more permanent a prolonged systematic treatment by iron is essential. Conversely, it is a fact familiar to practitioners that the mere administration of iron forms but one element of the treatment in all cases of chronic anæmia. What may be accomplished medicinally by means of oxygen is more effectually and certainly attained by those various hygienic measures, including exercise, active and passive, change of scene, etc., which increase the activity of the respiratory act while stimulating the whole nervous system. Although in the greater number of *chronic nervous diseases* distinguished by morbid susceptibility the condition of the blood is impaired, and the restoration of this fluid to its normal state is an essential element of the cure, yet it often happens that the disorder is apparently limited to the nervous system, especially when the latter has been directly affected by the morbid cause. In such cases the use of iron is more prejudicial than profitable; it oppresses and does not invigorate; it impairs the appetite, constipates the bowels, and induces a dangerous plethora. Such a mode of action doubtless explains the injurious effect of iron in the greater number of cases of *epilepsy*—a disease which experience shows to be benefited, as a rule, by agents that diminish the amount of blood in the brain (vegetable diet, belladonna, the alkaline bromides), and not by those which, like iron, increase it. There may be cases of the disease in which the attacks are rendered more frequent by a morbid susceptibility of the nervous system induced by sexual, and especially by unnatural sexual, excitement, and an associated anæmia; in these it is quite intelligible that iron should be salutary, especially in conjunction with appropriate hygienic measures. It was probably such cases that Gowers has reported to have been ameliorated or cured by means of iron (*Times and Gaz.*, April, 1880, p. 447). When anæmia constitutes only one out of many symptoms of a disease, the use of iron will be more or less efficient in proportion as the anæmia depends or not upon removable causes. The anæmia of tuberculosis, of cancer, the interstitial form of Bright's disease, and some other affections is subordinate to an incurable lesion, and iron can therefore act only as a palliative. In these, and indeed in nearly all forms of anæmia, iron is food, and, like other food, must be productive of good or evil according to the patient's need of it and his power of assimilating it.

Scanty as well as excessive *menstruation* may be appropriately treated by iron, for either may be due to a deficiency of normal blood. When the catamenia are profuse but watery, they are diminished by iron and the proportion of solids in the discharge is increased; on the other hand, when they are both scanty and pale iron is the best agent for increasing them. The former case is the more hopeful one, because it shows a certain energy, with a due supply of material; the latter, in its chronic type, is usually a sign of progressive and incurable exhaustion, but sometimes also it results from uterine congestion, which must first be treated before iron can be of much avail. This object is usually sought by means of aloetic purges and other stimulant and derivative agencies. In all cases of active *uterine hæmorrhage*, if there be any such independently of disease of the womb, iron should not be given internally, no matter how great may be the anæmia which excessive and repeated losses occasion; but when the flow is passive the case enters the category of *passive hæmorrhages* generally; and for these, whether they take place from the organ named, from the rectum, bladder, kidneys, or other part, iron becomes one of the best remedies—not as iron merely, but iron in combination with a mineral acid, in which the astringency is derived from the acid rather than from the ferruginous base. The combinations of hydrochloric and of sulphuric acid with iron are in this respect the most efficient. The stimulant action of iron salts renders them less appropriate for *pulmonary* than for other internal hæmorrhages, except in the form of astringent atomized solutions. Iron is useful in regulating the *heart* when it becomes irregular through weakness, whether or not the condition be aggravated

by valvular disease. By giving tone to this, as well as to other organs, it sometimes promotes the removal of dropsies dependent upon cardiac obstruction.

Various *nervous disorders* more or less dependent upon impoverishment of the blood may be cured by iron. Of these the most directly amenable to its operation is *neuralgia*, especially of the fifth pair, and next to this of the gastric nerves, and *chorea*, which very often, like neuralgia, is the result of debility and, remotely, of impoverishment of the blood. Among other nervous affections for which iron is appropriate are various irritations of the *bladder* and *urethra* tending to occasion *retention* or *incontinence of urine*, in which the tincture of the chloride or the syrup of iodide of iron may be used with much confidence in its virtues. *Seminal emissions* in weak, nervous, and excitable persons may sometimes be prevented by the same agent, especially if associated with belladonna or ergot, which, indeed, renders the cure more prompt and certain. The same is true of the use of iron in certain cases of *incontinence of urine*.

The cure of *insanity* and of *whooping cough* may be promoted by iron, like that of neuralgia and chorea, when associated with exhaustion of the nervous system. One of the most valuable results of recent experience in regard to insanity consists in the proof that good food and other hygienic means are essential elements of its proper treatment. In like manner, iron is not a specific for whooping cough; it only changes the soil in which that disease tends to gain strength. Iron is contraindicated in *epilepsy*, with the proviso above mentioned; that is to say, unless the patient's condition, upon other grounds, requires the use of chalybeate medicines.

Intermittent fever is cured by iron only when the disease is prolonged by exhaustion of the system and impoverishment of the blood, and this occurs especially when the sick remain in malarial localities and when an appropriate antiperiodic treatment has not been employed. Hence the use of quinine after a course of iron is found to be more efficient than before it in the cases alluded to. Enlargement of the *spleen* may be rapidly lessened by iron if the affection be not inveterate. In a word, the efficacy of iron in malarial affections is wholly subordinate to its renovating action upon the blood.

The same statement is, in the main, true respecting the use of iron in *dyspepsia*. The medicine acts chiefly by improving the blood, and thereby increasing the secretion of gastric juice and the muscular power of the stomach. But if acid preparations are used, they act also as local stimulants. Hence the latter should be given immediately before meals, but other martial preparations either along with the food or directly after meals. In either case cinchona and its derivatives are important adjuvants.

The salutary action of iron in *albuminuria* probably is mainly due to its lessening the destruction of the red blood-disks, and in a subordinate degree to its local action upon the kidneys. The latter is, however, less probable than the former, since it is alleged that the iron cannot be detected in the urine. It nevertheless lessens the proportion of albumen discharged, and in the desquamative forms of Bright's disease often effects a stable cure. This is particularly evident in albuminuria and *dropsy* occurring after scarlatina or from the action of cold and dampness upon the skin. But the medicine is still the best even in granular and in amyloid degeneration of the kidney. The form of its administration is of secondary importance, but probably a solution of muriated tincture of iron in acetate of ammonia, with an excess of acetic acid, is to be preferred.

Iron is one of the most important aids to a proper diet in the treatment of *diabetes;* it tends to sustain the general health even when it does not directly cause a diminution in the proportion of sugar excreted. Basham's mixture (which represents the solution mentioned in the last paragraph) appears to be the best form for its administration. In chronic *mucous fluxes* of every description iron is invaluable—in those of the bowels, by its direct application partly, and in the rest by its influence upon the blood, and perhaps also by constringing the capillary vessels. It is of great value in the treatment of intestinal *worms*—not so much, probably, by directly destroying them as by rendering the intestinal secretions more healthy, and thereby depriving the parasites of their nidus. Among mucous profluvia, *chronic bronchitis* is often cured by iron, especially when the sputa are mucо-purulent. Hence the reputation of the compound iron mixture as an antihectic medicine, and hence also the error of applying the same treatment to consumption of the lungs. True pulmonary *phthisis*, with tissue-degeneration, is benefited by iron mainly in so far as its use is proportioned to the diminished blood-formation belonging to that affection. It may be not only tolerated, but useful, while active exercise can be taken, but unless great care is exercised it increases the tendency to hæmoptysis and possibly hastens the progress of the disease. It is most readily borne by the dull and lymphatic, when there is but little tendency to febrile irritation, and when the

consumption is essentially chronic. As iron is a constituent of the body, and by its function in the blood one of its most important constituents, the amount of it consumed in food or medicine must bear a certain relation to the needs of the economy. It is just as possible to create a surfeit of iron as of meat and drink, of fatty food, or of cod-liver oil. Doubtless in every case there is a physical reason for the repugnance which one may acquire for certain articles of diet—the saturation, that is, of the system by their peculiar constituents; and in the case of iron it is evident that if the demand for it is not sustained by such a physiological tissue-waste as exercise, etc. produce, it will more or less speedily induce an oppressive and dangerous plethora. Iron is more appropriate in *scrofula*, a disease histologically allied to, but clinically quite different from, phthisis; but even in this affection its value, except to meet incidental conditions, such as anæmia and dyspepsia, is not great. The iodide of iron is probably useful in glandular scrofula in virtue of the iodine it contains. In *syphilis* and *cancer*, for which iron has been recommended, it has no other virtues than arise from its power of sustaining the general health, or, in the case of the former disease, of mitigating the mischiefs of an excessive use of mercury.

The most efficient remedy in idiopathic *erysipelas* is the tincture of the chloride of iron given in full and repeated doses, such as from Gm. 1.30–2.60 (20 to 40 drops), every two or three hours, properly diluted. Smaller doses are quite useless. Its action is probably to constringe the capillary blood-vessels, although its acid element may directly tend to antagonize the febrile poison.

The same preparation has been reported to act very favorably in low forms of *scarlatina*, *measles*, and *puerperal fever*, but, although there is no reason to reject its use, there is not enough to recommend it. The use of iron as an internal remedy in *diphtheria* has been highly commended by several physicians, but a critical examination of their reports demonstrates that there is no more reason to attribute the measure of success they achieved to the tincture of the chloride or the subsulphate of iron they employed, the one internally and the other topically, than to the quinine and chlorate of potassium and inhalations of lime-water that were used at the same time. While there are good grounds, therefore, for using this compound treatment, there are none whatever for assigning to iron a controlling share in the results obtained. The sulphuret of iron has been proposed as an antidote to constitutional *poisoning by lead* and as a means of neutralizing the salts of *mercury*, *lead*, *antimony*, *copper*, and especially *arsenic*, in the stomach. For the last named the hydrated oxide is generally employed, but, as elsewhere stated, it probably acts by mechanically enveloping the particles of arsenic rather than as a chemical antidote. The same remark applies to the insoluble saccharated oxide of iron, and less absolutely to the hydrated oxide of iron with magnesia.

The *contraindications* to the use of iron it is essential to keep in mind. The one which surpasses all others in importance is feverishness. Almost the only exception to this statement is that tincture of chloride of iron cures *erysipelas*, but it doubtless acts, not as an hæmatic, but as a powerful astringent. In nearly all other cases fever (several exceptions were noted in the last paragraph), or even feverishness, should exclude iron, whether it be produced by chronic disease, as phthisis, or by local irritations, such as *dyspepsia* with *constipation*. In the last-named affection the complexion is often muddy and the tongue coated, not by continuous or any other "sympathy" with the gastro-intestinal disorder, but because the local affection produces general feverishness. Under such circumstances purgation is an essential preliminary to the favorable action of iron, and hence the saline chalybeate mineral waters are very efficient in curing this condition.

The local therapeutical uses of iron are numerous, but they owe their value to the astringency of the acid compounds of the metal rather than to the metal itself. Solutions and ointments of the sulphate have been applied with apparent advantage in traumatic *erysipelas*, in *phlegmasia alba*, and in various chronic eruptions of the *skin* occurring in persons in whom these affections tend to ulcerate or to persist unchanged. The subsulphate, in strong solution, has been applied to the cure of nasal, aural, and other *polypi*, and in weak solution to arrest chronic *mucous discharges* from the urethra, vagina, etc. Solution of chloride of iron represses *fungous granulations* in cases of *ingrown toe-nail*, *ulcerated gums*, etc.

Like other astringents, mineral salts of iron are used in treating varicose or simply dilated *blood-vessels* of the *conjunctiva* and relaxed conditions of the *fauces*. Solution of chloride of iron is said to be useful as a local application in *diphtheria*, and it probably is most so when the exudation is in its forming stage and of limited extent. In the

decline of the disease gargles containing a small proportion of the solution tend to constringe the part and renew its healthy action. The subsulphate has been applied in the same manner. The chlorides and the sulphates of iron are hæmostatics, and have often arrested threatening *hæmorrhage* in epistaxis, hæmorrhage from the stomach, from the extraction of teeth, leech-bites, the excision of tonsils, cancerous ulceration, and after delivery. In the last case it has been sufficiently diluted with water and carefully pumped into the uterine cavity. In pulmonary hæmorrhage an atomized weak solution (1 part of the tincture to 10 parts of water) has been inhaled with prompt effect. The injection of solutions of the lactate, the perchloride, and other salts of iron into varicose and other *aneurisms* would form an eligible method of treatment if it were not extremely dangerous. In a number of instances the operation has been speedily followed by the patient's death, either suddenly by embolism or later by ulceration.

Tannate of iron is an astringent resembling, but milder than, sulphate of iron. *Malate* of iron and its tincture are adapted to cases requiring the use of mild chalybeates, and their taste renders them suitable to children and fastidious females. They do not stain the teeth. The former is recommended to be given in doses of Gm. 0.20–0.30 (4 or 5 grains), and the latter in doses of Gm. 1.20 (20 or more drops).

In this place may perhaps be most conveniently mentioned the relative value of different preparations of iron used by subcutaneous injection. The experiments of Neuss upon this subject led him to the following conclusions: "The citro-sodic pyrophosphate of iron is superior to all other preparations of iron for this purpose. It contains 26.6 per cent. of iron, is soluble in 6 parts of distilled water, causes no annoyance, and may be detected in the urine within half an hour. Next in value comes Friedländer's albuminate, which contains less iron, however, and is more apt to undergo decomposition. After these must be ranked pyrophosphate of iron with citrate of ammonia, which, at least in one patient out of three, occasioned considerable irritation. According to these experiments the following compounds are unfit for hypodermic use: the oxycitrate of iron, the citrate of iron and quinine, the soluble saccharate of iron oxide, and dialyzed iron (glycerinated)" (*Zeitschrift f. klin. Med.*, iii. 9). Rosenthal has recommended the peptonate and also the oleate of iron for subcutaneous use (*ibid.*, viii. 95).

The special therapeutical uses of FERRI OXALAS are not generally recognized, but according to Hayem, whose authority cannot be doubted, it is preferable to all other ferruginous compounds (*Bull. de Thérap.*, cxviii. 538). ? The *dose* is stated to be Gm. 0.10–0.15 (gr. ii–iij).

FERRUM REDUCTUM, *U. S., P. G.*—REDUCED IRON.

Ferrum redactum, Br.; *Ferrum hydrogenio reductum*, *Ferrum ope hydrogenii paratum.*—*Iron reduced by hydrogen*, *Iron by hydrogen*, E.; *Fer réduit par l'hydrogène*, Fr.; *Reducirtes Eisen*, G.

Preparation.—Take of Strong Solution of Perchloride of Iron, Solution of Ammonia, Zinc (granulated), Sulphuric Acid, Calcium Chloride, Distilled Water, of each a sufficiency. Dilute the solution of iron with 5 volumes of water; pour the mixture into such a quantity of solution of ammonia, diluted with 5 volumes of water, that the whole after thorough stirring has a distinct odor of ammonia. Wash the precipitate until the washings are no longer rendered cloudy by solution of silver nitrate. Dry the precipitate and introduce the resulting ferric oxyhydrate into an iron tube, confining it to the middle part of the tube by plugs of asbestos. Pass the tube through a furnace, and when it has been raised to a strong but not bright red heat cause it to be traversed by a stream of hydrogen gas developed by the action on the zinc of some of the sulphuric acid diluted with eight times its volume of water. The gas before entering the tube must be rendered quite dry by being made to pass first through the remainder of the sulphuric acid, and then through a tube 18 inches long packed with small fragments of the calcium chloride. The farther end of the tube is to be connected by a cork with a bent tube dipping under water, and when the hydrogen is observed to pass through the water at the same rate that it bubbles through the sulphuric acid the furnace is to be allowed to cool down to the temperature of the atmosphere, a slow current of hydrogen being still continued. The reduced iron is then to be withdrawn and enclosed in a dry, stoppered bottle.—*Br.*

The present process differs merely in the use of freshly-prepared peroxide of iron, and in all essential details is identical with the one of the U. S. P. 1870, which was elaborated by Prof. Procter. The drying of the hydrogen is unnecessary, but pro-

vision must be made to prevent the acid liquid in which hydrogen is generated from being mechanically carried over; this is effected by passing the gas through an empty vessel before it enters the reduction-tube, or through basic lead acetate, which will retain also gaseous impurities with which the hydrogen may be contaminated from impurities of the zinc or acid. The reduction-tube, we think, should be filled with hydrogen gas before it is heated to redness, and the heat is best kept at dull redness, so as to obtain the metal in a finely-divided state, and not more or less granular, which would result from carrying on the operation at a bright-red heat. At the high temperature the ferric hydroxide is converted into ferric oxide, and this is decomposed by the hydrogen, with the liberation of iron and the production of water; $Fe_2O_3 + 3H_2$ yields Fe_2 and $3H_2O$. That the reduction has been completed is ascertained from the absence of aqueous vapor in the bubbles breaking through the water, or from the uniform rapidity with which the bubbles pass both through the water and through the liquid placed between the generator and reduction-tube. After the fire is withdrawn the reduced iron would burn again to ferric oxide if it were allowed to come into contact with oxygen while warm; the hydrogen must therefore be continually passed through the reduction-tube until the temperature has been lowered to that of the surrounding atmosphere. Using 2 pounds of ferric hydroxide, the process occupies from five to eight hours. It is scarcely necessary to state that the ferric hydroxide should have been well washed.

Various other methods have been suggested for obtaining reduced iron, but they do not appear to be used on a large scale. For reduction in a current of hydrogen Peligot (1844) proposed ferrous chloride, and Woehler (1855) ferrous oxalate, or an oxide obtained by strongly heating a mixture of ferrous sulphate and sodium chloride and washing out the soluble salt. A. Morgan (1854) recommended the calcination of a mixture of ferric oxide, potassium ferrocyanide, and potassium carbonate, each previously deprived of water. Zaengerle (1857) used ferrous oxalate instead of ferric oxide. After cooling, the mass requires to be well washed and dried. The metallic iron reduced by electricity from ferrous sulphate (Boettger, 1846), or from ferrous chloride (Collas), has no advantage over that prepared with hydrogen.

Properties.—Reduced iron is a very fine gray (grayish-black, *U. S.*, *Br.*) powder, free from metallic lustre, but exhibiting metallic streaks when rubbed with firm pressure in a mortar, and yielding a lustrous scale when struck on an anvil with a hammer. It is without odor or taste, and is not altered in dry air, but is gradually oxidized and becomes rust-colored in a damp atmosphere, and when touched with a lighted taper ignites and is converted into black ferroso-ferric oxide. It is strongly attracted by a magnet, and is insoluble in all simple solvents, but is wholly dissolved by dilute hydrochloric or sulphuric acid, with the evolution of hydrogen, the solution showing the reactions of ferrous salts.

Tests.—On treating reduced iron with diluted hydrochloric acid, the undissolved residue should not weigh more than 1 per cent. (carbon), *U. S.*, *P. G.* The hydrogen should be free from noxious odor, and should not impart a black color to filtering-paper moistened with solution of lead acetate and stretched over the orifice of the test-tube; the black color would be due to the presence of sulphur, resulting from the sulphate which remains in incompletely-washed ferric hydroxide. The solution in hydrochloric acid should not assume a red color when tested with potassium sulphocyanate (absence of ferric or magnetic oxide). The presence of magnetic oxide is also indicated by the black instead of gray color of the powder. "If 1 Gm. of reduced iron be shaken with 5 Cc. of water, the liquid should not change the color of litmus-paper. If 0.5 Gm. of reduced iron be added to 5 Cc. of arsenic-free hydrochloric acid, and the mixture be poured upon a filter while still effervescing, 1 Cc. of the clear filtrate should, after the addition of 2 Cc. of stannous chloride test-solution, together with a small piece of pure tin-foil, and gentle heating, show no brown coloration within half an hour (limit of arsenic). Introduce 0.56 (0.559) Gm. of reduced iron into a glass-stoppered bottle, add 50 Cc. of mercuric chloride test-solution, and heat the bottle, well stoppered, during one hour on a water-bath, frequently agitating. Then allow it to cool, dilute the contents with water to the volume of 100 Cc., and filter. To 10 Cc. of the filtrate, contained in a glass-stoppered bottle (having a capacity of about 100 Cc.), add 10 Cc. of diluted sulphuric acid, and subsequently decinormal potassium permanganate solution, until a permanent red color is produced. The number of Cc. of the volumetric solution required, when multiplied by *ten* (10), will indicate the percentage of metallic iron. To confirm the assay, decolorize the liquid by a few drops of alcohol, then add 1 Gm. of potassium iodide, and digest for half an hour at a temperature of 40° C. (104° F.). The cooled

solution, mixed with a few drops of starch test-solution, should require not less than 8 Cc. of decinormal sodium thiosulphate solution to discharge the blue or greenish color (each Cc. of the volumetric solution indicating 10 per cent. of metallic iron)."—*U. S.*

The reactions in the foregoing test involve, first, reduction of mercuric to mercurous chloride with formation of ferrous chloride, which enters into solution, $2HgCl_2 + Fe = FeCl_2 + Hg_2Cl_2$, the ferrous chloride is then oxidized by means of potassium permanganate and converted into ferric chloride, and this is finally determined iodometrically, as explained under FERRIC CHLORIDE. The U. S. P., as stated in the test, requires at least 80 per cent. of metallic iron; the Germ. Ph. requires at least 90 per cent. by the same test.

Treated with iodine or bromine, dissolved in solution of potassium iodide or bromide, the black oxide remains behind, and its weight should not exceed 50 per cent.; this residue should be completely soluble in hydrochloric acid.—*Br.*

Mr. Creuse (*Proc. Amer. Phar. Assoc.*, 1874, p. 435) suggested to determine the amount of pure iron from the measure of the hydrogen given off; the presence of oxides, however, appears to interfere with the correctness of the results. Schacht (1877) regards the following as sufficient evidence of purity: It is "a very fine gray powder without gloss; when heated in the air it burns to ferric oxide. It is completely soluble in warm diluted pure hydrochloric acid, with the evolution of hydrogen, which is indifferent to lead-paper. When treated for half an hour, at the ordinary temperature and with occasional agitation, with twenty-five times its weight of solution of ferric chloride sp. gr. 1.30, it is completely dissolved."

FERRUM PULVERATUM, S. ALCOHOLISATUM, S. PORPHYRISATUM, *P. G.*, or *pulverized iron*, may be mistaken for reduced iron. It is made in Europe on a large scale from a good quality of cast iron, and therefore contains carbon. It has the general properties of reduced iron, from which it differs in being denser, having a distinct metallic lustre, and in not igniting when touched with a lighted taper; the hydrogen evolved by it has a distinct odor, but should contain traces only of hydrogen sulphide. The solution of iron in hydrochloric acid should not yield a dark color or precipitate with hydrogen sulphide (absence of lead, copper, etc.), and when oxidized with nitric acid and treated with ammonia in excess the filtrate should be colorless (copper, etc.), and not be rendered turbid by ammonium sulphide.

When tested by the method given under REDUCED IRON, pulverized iron should contain at least 98 per cent. of pure metallic iron.—*P. G.*

Action and Uses.—This preparation was originally proposed as a substitute for subcarbonate of iron. It was less bulky, and therefore more likely to agree with the stomach; but not improbably there happened in this case what has often been observed when the nutritious elements of food are substituted for those forms of it which Nature has provided. In point of fact, it is even more likely to derange the stomach than the preparation mentioned, partly on account of the impurities it sometimes contains to the extent of 50 per cent., and partly because it is very apt to cause the formation in the stomach, and the eructation, of sulphuretted hydrogen. Moreover, when given in pills and pastilles they often escape the solvent power of the digestive juices, and are evacuated in the same form in which they were swallowed. The only way in which it can be administered with an assurance of its solution and absorption is to give it at mealtimes or immediately afterward in a wafer or suspended in a little water. It may be prescribed in the *dose* of Gm. 0.05–0.30 (gr. j–v).

FICUS, *U. S., Br.*—FIG.

Caricæ; Ficus passa, Fici, Fructus caricæ.—Figue, Fr.; *Feige*, G.; *Higo*, Sp,

The fleshy receptacle, bearing fruits upon its inner surface, of Ficus Carica, *Linné*. Steph. and Church, *Med. Bot.* plate 154; Bentley and Trimen, *Med. Plants*, 228.

Nat Ord.—Urticaceæ, Artocarpeæ.

Origin.—The fig tree is indigenous to Western Asia, from Asia Minor and Syria eastward to Lake Aral, and has been under cultivation from a very remote period. At present it is cultivated in most countries of the Old and New Worlds which lie in the warmer temperate regions, in many of which it is also found wild. It attains a height of about 7.5 M. (25 feet), is irregularly branched, has rough palmately-lobed, irregularly-toothed subcordate leaves, in the axils of which appear the fleshy hollow receptacles, upon the inner surface of which the minute flowers are situated, the few staminate flowers being placed near the mouth.

Fig. 124.

Ficus carica, *Linné*; *a*, section of fig *b*, staminate flower; *c*, pistillate flower.

Description.—The receptacle, erroneously called fruit, is pear-shaped, short-stalked, or with a circular stalk-scar at the base, and about 75 M. (3 inches) long; in the green state it contains a milky, acrid juice, which changes to saccharine, the color of the receptacle becoming yellowish and purplish. The orifice is surrounded by several fleshy scales, and the greater portion of the inner surface is covered in the ripe fig by numerous small yellowish akenes, popularly called seeds. Figs have a peculiar fruity odor and a very sweet somewhat mucilaginous taste. A warm and dry climate is best adapted for growing figs with the view of preserving them in the dry state.

They are dried either by artificial heat or by exposure to the sun, and packed in this condition (*natural figs*), or they are rendered pliant by kneading and squeezing, and then packed and pressed into boxes (*pulled figs*). In the latter condition they are always of a very irregular shape, yellowish, somewhat translucent, and covered with effloresced sugar. The large puffy figs are known as *Turkey* or *Smyrna figs*, the small and dried ones as *Greek figs*. In Italy the early figs which appear in the axils of the previous year's leaf scars are known as *grossi* and *orni*, while those produced in the axils of leaves are known as *fornìti* or as *cratiri*, the latter name being given to those which ripen after the fall of the leaves.

Constituents.—Exclusive of the akenes, which, together with the cellular tissue, Bley (1831) found to constitute about 15 per cent. of the weight of figs, he obtained 16 per cent. of water, 62.5 per cent. of sugar (glucose), the remainder being gum, fat, and saline constituents.

Allied Plants.—Brosimum alicastrum, *Swartz*. This large tree bears a globular fruit of the size of a nutmeg, imbedded in the receptacle. The seeds are known in Jamaica as *bread-nuts*, and have a taste resembling that of chestnuts. The milk-juice of old branches is acrid.

Brosimum Galactodendron, *Don*, s. Galactodendron utile, *Kunth*, is the *cow tree*, *palo de vaca*, or *palo de leche*, of tropical America. On making incisions into the bark it yields a milk-juice which resembles, and is used like, cow's milk; this contains, according to Bonssingault, 58 per cent. of water and 42 per cent. of fixed matter, the latter consisting of wax and fat 32.2, sugar 2.8, proteids 1.7, salts 0.5, and undetermined substances 1.8 parts.

Artocarpus incisa, *Linné*, is indigenous to the Moluccas and the islands of the Southern Pacific. The nearly-ripe pistillate inflorescence, known as *bread-fruit*, forms a globular sorosis about 6 inches (15 Cm.) in diameter, and consists of a mealy and spongy receptacle in which the oblong angular akenes are imbedded. A similar product, known as *jack-fruit*, is yielded by Artocarpus integrifolia, *Linné*; it is nearly pear-shaped, and is largely used in India and the East Indian islands.

Action and Uses.—The saccharine and mucilaginous constituents of figs render them nutritive, and in their fresh state laxative. The latter operation of dried figs is mainly due to the indigestibility of their seeds and tough skins, which also tend to occasion flatulence. They form an agreeable addition to the various ptisans employed in *catarrhal affections* of the air-passages and other mucous canals, and roasted figs have from time immemorial formed convenient cataplasms for *gum-boils*, *abscesses* of the *anus*, *vulva*, etc. (Isaiah xxxviii. 21). It is stated by Billroth that poultices made with dried figs and milk neutralized the *fetor* of cancerous and other ulcers which resisted all the usual deodorizers (*Med. Record*, xix. 308).

FŒNICULUM, *U. S.*—Fennel.

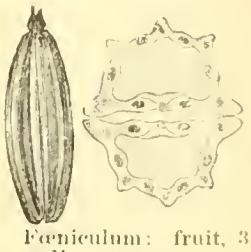
Fœniculi fructus, Br.; *Fructus fœnículi*, P. G.; *Semen fœnículi.*—*Fennel-fruit*, *Fennel-seed*, E.; *Fenouil*, Fr.; *Fenchel*, G.; *Hinojo*, Sp.

The fruit of Fœniculum capillaceum *Gilibert* (s. F. officinale, *Allioni*, s. F. vulgare, *Gaertner*, s. Anethum (Meum, *Sprengel*) Fœniculum, *Linné*. Bentley and Trimen, *Med. Plants*, 123.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—The fennel is indigenous to Southern Europe, and is frequently found wild in Western and South-eastern Europe and in Western Asia. Commerce is mainly supplied with the fruit from Germany and France, where the plant is extensively cultivated. It is an herbaceous annual or perennial, varying in cultivation considerably in size and in its fruit. The stem is 0.9–1.8 M. (3 to to 6 feet) high, somewhat furrowed, green, and glaucous; the leaves are decompound or twice-pinnate, with the pinnæ very narrow; the umbels are at the top of the stem or branches, compound, large, and without involucre or involucel. All parts have an agreeable, aromatic odor and a sweetish-aromatic taste.

Fig. 125.



Fœniculum: fruit, 3 diameters; transverse section, 8 diameters.

Description.—Fennel-fruit is about 4 to 8 Mm. ($\frac{1}{6}$ to $\frac{1}{3}$ inch) long, oblong in shape, nearly cylindrical, and readily splitting at maturity into the two mericarps, which often become somewhat curved. The face is broad and flat, the back rounded, and has five prominent obtuse ribs of a light-brown color, the intervening furrows being almost blackish-brown. There are usually six oil-tubes, one under each furrow, and two, or in some varieties two pairs, on the face. The odor and taste of fennel are agreeably sweetish-aromatic and anise-like.

The commercial varieties are *Saxon* or *German fennel*, which is about $\frac{1}{4}$ inch (6 Mm.) long and of a brownish tint; and *Roman fennel*, which is nearly twice as large, mostly strongly curved, of a distinct greenish tint, with broader and rather sharper ribs, and of a stronger and more pleasant odor. The latter is often referred to Fœn. dulce, *De Candolle*, but appears to be merely a variety of F. vulgare, produced by cultivation.

Fennel-root is somewhat employed in Europe. It is 15 to 25 Cm. (6 to 10 inches) long, above nearly 25 Mm. (one inch) thick, several headed, cylindrical, little-branched, but beset with numerous thin and wrinkled radicles. The root is externally light-brown, annulate, and longitudinally wrinkled, internally white; the bark thick, fleshy, with several circles of brown resin-cells, and the meditullium yellowish and radially striate. It has an aromatic odor and a sweet fennel-like taste.

Constituents.—Fennel contains about 12.5 per cent. of fixed oil, some sugar, and from 2 to 4 per cent. of volatile oil, to which the sweet taste of the fruit is chiefly due. (See Oleum Fœniculi.) The root contains a small quantity of volatile oil, more sugar, and considerable starch.

Pharmaceutical Uses.—Syrupus fœniculi.—Syrup of fennel, *E.*—Digest for 3 hours 2 parts of bruised fennel with 12 parts of hot water in a closed vessel, and dissolve in 10 parts of the infusion 18 parts of sugar.—*P. G.* 1872.

Action and Uses.—Employed by the ancients as a carminative and digestive stimulant and to promote the secretions, it continues to be used for like purposes at the present day. It is still alleged to increase the secretion of milk, urine, perspiration, and mucus, and to be an active emmenagogue. It is most commonly used as an ingredient of carminative compounds or in a simple infusion for the relief of *nausea* and *colic*. It is very appropriate in hot infusion, as an adjuvant, in the treatment of *amenorrhœa* from uterine congestion and for re-establishing the *lacteal secretion* when suppressed. An infusion of fennel may be made with Gm. 4 (gr. lx) of the bruised seed in Gm. 250 ($\frac{1}{2}$ a pint) of boiling water. Of this a teaspoonful may be given at short intervals to an infant and a wineglassful to an adult.

FŒNUM GRÆCUM.—Fenugreek.

Semen fænugræci, P. G.; *Fenugrec, Sénégrain*, Fr.; *Bockshornsamen*, G.; *Alholva*, Sp.

The seeds of Trigonella Fœnum græcum, *Linné*. Bentley and Trimen, *Med. Plants.*, 71.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—Fenugreek is an annual herb indigenous to Western Asia and naturalized in India, Eastern and Northern Africa, and Southern Europe; it is extensively cultivated in Asia and Africa. The plant is about 30 Cm. (1 foot) high, nearly simple, has trifoliate leaves with articulated obovate or wedge oblong denticulate leaflets, solitary sessile pale yellowish flowers, and produces linear-curved compressed legumes with a slender beak and containing about sixteen seeds.

Description.—The seeds are 3 Mm. ($\frac{1}{8}$ inch) long and broad, 2 Mm. ($\frac{1}{12}$ inch) thick, of an oblique rhombic shape, flattened, pale brownish-yellow, on both flat surfaces with a deep groove extending in a diagonal direction, very hard, of a strong, unpleasantly aro-

matic odor, suggesting that of melilot, and a mucilaginous and bitterish taste. The thin hard testa encloses a yellowish embryo having a thick radicle, which is strongly bent upon the edges of the cotyledons and has its position externally indicated by the grooves. The embryo is surrounded by a colorless hornlike tissue, which is regarded as the inner seed-coat or by some authors as a thin layer of albumen.

Constituents.—Fenugreek was examined by Basson, who ascertained the presence of volatile and fixed oil, mucilage, and a bitter principle which was not obtained pure. The mucilage is contained in the integuments of the seeds, and amounts to about 28 per cent.; the fixed oil, about 6 per cent., resides in the embryo. Jahns obtained 3.4 per cent. of nitrogen, which would indicate 22 per cent. of albumen. A small amount of tannin is present in the testa, but no starch.

Adulterations.—Being usually kept in the ground condition, fenugreek is liable to be adulterated with farinaceous substances, in which case it will acquire a blue color on the addition of iodine.

Allied Plants.—The seeds of other species of Trigonella have similar properties, but are much smaller.

Action and Uses.—Fœnum græcum is one of those simple medicines which figured largely in the materia medica of the Greeks and their successors, and which possessed hardly any other than emollient virtues. Like flaxseed, marshmallow, and slippery elm, it was used to prepare cataplasms for inflamed parts and soothing pessaries for the uterus and vagina; its decoction was similarly employed, and injected into the rectum, and also formed a ptisan for affections of the throat and air-passages. Its oil, like linseed and olive oil, was applied to burns, excoriations, etc. It may be used in a decoction prepared with Gm. 30 to Gm. 500 (℥j to Oj). Poultices may be made of the ground seeds.

FRANCISCEA.—Franciscea.

Franciscea uniflora, *Pohl.*

Nat. Ord.—Solanaceæ, Salpiglossideæ.

Origin and Description.—This shrub is indigenous to Brazil, and, according to Martius (1829), is known there as *manacán*, and in some parts as *geratacáca* or *camgambá;* in Para it is called *mercurio vegetal.* The stem, which is about 1.8 M. (6 feet) high, together with the root, has been introduced under the name of *manaca*, and is seen in commerce in pieces 15–20 Cm. (6 or 8 inches) long and 6–25 Mm. (¼ to 1 inch) thick. The bark is quite thin, adheres firmly to the wood, is smooth and dark-brown, and on older parts scaly and rust-brown; the wood is reddish-yellow, tough and hard, and encloses a thin pith; the drug is inodorous and has a bitter taste. The leaves, which are also employed, are short-petioled, about 5 Cm. (2 inches) long, 12 Mm. (1 inch) broad, elliptic, acute, entire, and on the lower side grayish-green. The bell-shaped corolla is white and purplish, the fruit capsular, two-celled, and the seeds somewhat triangular and finely pitted. *White* and *red* manaca have been met with in commerce, the two kinds being probably of different origin; and in some parts of South America the bark of Piscidia Erythrina, *Jacquin*, is said to be known as manaca.

Constituents.—R. Lenardson (1884) analyzed red manaca, which, from the microscopic structure, he believes may belong to the Apocynaceæ. Besides fat, resin, 1.07 per cent. of ash, 11.25 starch, and various other compounds, a poisonous alkaloid, manacine, and a fluorescent compound were isolated. The latter is readily soluble in alcohol, chloroform, and spirit of ether, less freely in water, benzene, and ether, reduces alkaline copper solution, is not a glucoside, and is probably identical with *gelsemic acid;* the aqueous solution has an acid reaction, is yellow in transmitted light and blue in reflected light, the fluorescence being increased by ammonia. *Manacine* is a weak base, has a slight bitter taste, dialyzes readily, but has not been obtained in crystals; it dissolves readily in water, alcohol, and methyl alcohol, is insoluble or nearly so in other liquids, is easily decomposed in solution, with separation of a brown resin, the hydrochloric acid solution being more stable than others, and is precipitated from its more or less concentrated solution by the reagents for alkaloids, but not by alkalies; the precipitate by phospho-molybdic acid dissolves in potassa with a blue color. Characteristic color reactions were not observed. The alkaloid *franciscine*, which is stated to have been recently extracted from manaca, is probably the same as that just described.

Action and Uses.—In 1867, Edmon, who lived on the Amazon, reported that at Para the flowers of manaca, or franciscea, were applied to indolent ulcers, and that a

decoction of the root was regarded as a sovereign remedy for "rheumatism." It was given in a decoction, which at first produced pains in the head and back, and afterward a profuse critical perspiration. Manaca, we are further told, is in small doses emeto-cathartic diaphoretic and diuretic, and in large doses an acrid poison. It was employed not only in rheumatism, but in syphilis and other diseases "in which mercury is indicated" (*Therap. Gaz.*, v. 24). This description suggests the operation of sarsaparilla, guaiacum, and mezereon. From other sources we learn that the "rheumatism" here spoken of was the muscular and tendinous form of the disease, and also that the whole plant, but the root especially, acts as an irritant of the stomach and bowels, causing vomiting and purging, abortion in pregnancy, and even death (*Kobert's Jahresbericht*, 1885, p. 310).

Franciscea has been employed almost exclusively in the treatment of "rheumatism," but the reporters have not always distinguished between muscular and articular rheumatism, nor between the acute and chronic forms of both, between the simple and the syphilitic forms, etc., nor between the effects of the medicine and the natural tendency of the disease under favorable hygienic conditions to get well. The chief contributors to the history of this matter are Gottheil (*Med. Record*, xxiv. 258) Pepper (*Therap. Gaz.*, Sept., 1882), Rogers (*ibid.*, Dec. 1884, p. 532), Garland (*Boston Med. and Surg. Jour.*, July, 1885, p. 80), and Caldwell (*Med. Record*, xxvi. 31). After a careful comparison of the statements of these witnesses, we have reached the conclusion that manaca has little or no influence on the course or issue of articular rheumatism, and that it may be used, as numberless other diaphoretics, sedatives, etc. are employed, with more or less advantage in the so-called muscular form of the disease. The fluid extract of manaca may be given in doses of Gm. 0.60–4 (♏x–f℥j).

FRANGULA, *U. S.*—Frangula.

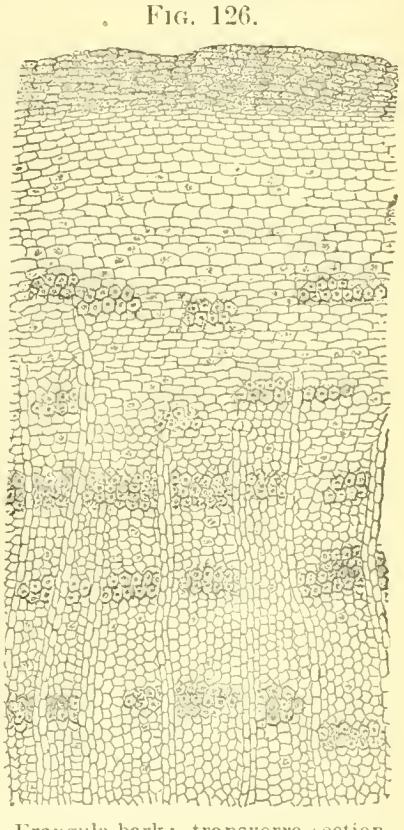
Rhamni frangulæ cortex, Br.; *Cortex frangulæ*, P. G.—*Alder buckthorn*, E.; *Écorce de Bourdaine, Bourgène*, Fr.; *Faulbaumrinde*, G.

The bark of Rhamnus Frangula, *Linné*, s. Frangula vulgaris, *Reichenbach*, s. Frangula Alnus, *Miller*, collected at least one year before being used. Bentley and Trimen, *Med. Plants*, 65.

Nat. Ord.—Rhamneæ.

Origin.—The alder buckthorn is a shrub about 3 to 4.5 M. (10 to 15 feet) high, which grows in wet places from the northern coast of Africa throughout Europe, and extending eastward into Siberia. It has alternate elliptic, oval, or obovate entire leaves, which are obtuse or slightly pointed at the apex; greenish hermaphrodite flowers in axillary clusters of three or five, and red, finally black, berries of the size of a pea and containing two or three roundish-angular seeds. The bark is collected in the spring from the younger trunks and large branches. The Norwegian and the United States Pharmacopœias require it to be used not sooner than a year after it has been collected. The shrub is also known in different parts of Europe as *black alder*, *aune noir*, and *Schwarzerle*, which names are perhaps more properly restricted to species of Alnus (see page 155).

Fig. 126.



Frangula-bark; transverre section, magnified 80 diameters.

Description.—Frangula-bark is in small quills about 1 or 1.5 Mm. ($\frac{1}{25}$ or $\frac{1}{16}$ inch) thick, externally gray or grayish-brown, or from the younger branches blackish-brown, marked with numerous small, whitish, transversely-elongated suberous warts; the inner surface is smooth, orange-yellow or brownish-yellow. When fresh it has a disagreeable odor and taste, but in the dried state it has scarcely any odor, a sweet and bitterish taste, and breaks in the inner layer with a fibrous fracture, showing the yellow bast-fibres, a greenish middle layer, and a purplish-colored corky layer. When moistened with lime-water it acquires a red color. With cold water it yields a yellow, and with hot water a brown, infusion, which is colored dark-brown, but not precipitated, by ferric chloride.

Constituents.—The bark was analyzed by Gerber (1828), Binswanger (1849), L. A. Buchner (1853), Casselmann (1857), Phipson (1859), and others. The constituent which possesses most interest is *frangulin* or *rhamnoxanthin*, $C_{20}H_{20}O_{10}$, which is extracted from the bark by carbon disulphide and obtained pure by recrystallization from alcohol and ether. It is a lemon-yellow crystalline mass of a slightly silky lustre, without odor and taste; by sublimation it is obtained in yellow needles. It is insoluble in water, slightly soluble in cold alcohol and ether, and freely soluble in alkalies, with a bright-purple color. It dyes silk, wool, and cotton, and is resolved by acids into sugar and frangulic acid, $C_{14}H_{10}O_5$. The bark contains also a yellow resinous principle, tannin, an amorphous bitter principle which appears to have a purgative action, and various ordinary principles. It yields 5 or 6 per cent. of ash. The odor of the fresh bark is due to a volatile principle which has not been isolated. Liebermann and Waldstein (1876) obtained *emodin*, $C_{15}H_{10}O_5$, from old frangula bark, by boiling with diluted sulphuric acid those constituents which are soluble in soda and are reprecipitated from this solution by hydrochloric acid. Kubly's *avornin* was impure frangulin.

Action and Uses.—The fresh bark excites nausea, colic, vomiting and violent purging, but by drying it loses in some degree its acrid qualities, and is then used in Germany as a domestic purgative. A lad, after eating and chewing some of the berries, including the stones, was seized with vertigo, headache, convulsions, unconsciousness, dilatation of the pupil, rapid, full pulse, and faint respiration. The poisonous effects were attributed to hydrocyanic acid contained in the seeds (*Amer. Jour. Phar.*, lviii. 252). It gives a deep-yellow color to the fæces and urine. It is stated to be employed as a substitute for rhubarb, but its action is much harsher, and indeed it may be ranked among the drastic cathartics. Its active properties are ascribed to frangulin, a substance analogous to cathartin, or to frangulic acid, which is said to be purgative in the dose of 1 grain. In Germany frangula is a popular purgative, and is said to resemble senna in its operation. Dr. Squibb claims that its action is milder than that of senna or rhubarb (*Ephemeris*, iii. 1051); that it is a laxative rather than a purgative, especially for delicate organisms; that a teaspoonful of the fluid extract at bed-time is the proper dose for temporary costiveness; and that for habitual constipation 20 minims in a little water, one, two, or three times a day, is the better dosage, especially for females. He does not recommend it as an evacuant to supplant senna, castor oil, etc. A decoction of it is sometimes used in *dropsy*, and the same preparation, as well as an ointment prepared with the fresh bark, is employed in treating the *itch*. The decoction may be prepared with half an ounce of the bark or Gm. 15 to Gm. 250 ($\frac{1}{2}$ a pint) of water, and given in tablespoonful doses.

FRAXINUS.—Ash.

Frêne, Fr.; *Esche*, G.; *Fresco*, Sp.

Nat. Ord.—Oleaceæ, Fraxineæ.

Description.—Fraxinus excelsior, *Linné*, the European ash, which is sometimes cultivated in the United States as a shade tree, attains a height of 30 to 45 M. (100 to 150 feet), has a straight trunk, a tough, whitish, elastic wood, which is difficult to split and very durable, and lax racemes of polygamous flowers without calyx or corolla. The *bark*, which is collected from the branches in spring, is in quills having a gray or greenish-gray color externally, numerous small gray or brownish-white suberous warts, and a smooth inner surface of a yellowish or yellowish-brown color. It is inodorous, has a bitter, astringent taste, and breaks with a smooth and, in the inner layer, fibrous fracture. The *leaves* are pinnate, composed of eleven or thirteen nearly sessile leaflets, which are almost smooth, about 5 Cm. (2 inches) long, vary in shape between elliptic-oblong and oblong-lanceolate, have a wedge-shaped and entire base, and are sharply serrate above; in some varieties the leaves have a crisp margin or a whitish or variegated color. The *fruit* is a linear-oblong samara about 37 Mm. ($1\frac{1}{2}$ inches) long and 6 Mm. ($\frac{1}{4}$ inch) broad, brownish, round at the base, at the apex extended into a long many-nerved, somewhat oblique wing, and contains a single pendulous seed having an astringent, bitter, and acrid taste.

Fraxinus americana, *Linné*, s. Fr. alba. *Marsh*, s. Fr. epiptera, *Michaux*, the North American *white ash*, is a handsome forest tree growing from Nova Scotia southward to the Mexican Gulf and westward to Lake Superior and Eastern Kansas. It attains a height of 18 to 24 M. (60 to 80 feet), has a durable, tough wood, seven or nine ovate-oblong, acuminate leaflets, and a terete fruit extended above into a spatulate-linear

wing. The bark, which has been employed, is collected from the trunk and the root, the latter being preferred. It is 3 to 6 Mm. ($\frac{1}{8}$ to $\frac{1}{4}$ inch) in thickness, usually freed from the corky layer, whitish or yellowish, sometimes brownish, frequently with ridges of a warty cork adhering, and upon the inner surface yellowish and smooth; it breaks with a very fibrous fracture, and has a slight aromatic odor and a bitter and somewhat acrid taste.

FRAXINUS VIRIDIS, *Michaux.* The *green ash* of North America is used in Mexico, the bark and leaves being considered tonic and the root diuretic.

Constituents.—The European ash contains in the bark tannin, the bitter glucoside *fraxin* (see HIPPOCASTANUM), and a crystalline principle obtained by Keller by a process similar to that by which salicin may be obtained; it was at first named *fraxinin*, but was recognized as mannit by Stenhouse and Rochleder. Garot (1853) found in the leaves calcium malate; and in addition to this Gintl and Reinitzer (1882) obtained free malic acid, tannin, mannit, inosit, a little quercitrin, glucose, gum, and volatile oil of the formula $C_{10}H_{20}O_2$. Mouchon's *fraxinit* is extract-like and said to be purgative. The *fruit* contains, according to Keller, a green oil of a disagreeable odor, an acrid resin, a bitter principle, tannin, and mucilaginous matter.

The *white-ash bark*, examined by Howard M. Edwards (1882), contains a mild aromatic volatile oil, an alkaloid which has not been investigated, resin, starch, sugar, and coloring matter producing a blue-black color with ferric chloride. J. M. Bradford (1882) believes that tannin is also present.

Pharmaceutical Uses.—EXTRACTUM FRAXINI AMERICANÆ. Made with alcohol, the yield is about 22 per cent.; with weaker alcohol 30 to 32 per cent. of extract may be obtained.

EXTRACTUM FRAXINI AMERICANÆ FLUIDUM. Edwards proposed as the menstruum alcohol containing 20 per cent. of glycerin; it is of a blackish-red color.

VINUM FRAXINI AMERICANÆ has been made by T. S. Wiegand (1882) with sherry wine, and represents 4 troyounces of the bark in the pint.

Action and Uses.—No accurate description of the operation of this medicine has been published. Infusions of the leaves are said to be either diaphoretic or diuretic. The bark at one time enjoyed a certain vogue in Europe as a remedy for *intermittent fever*, and there seems to be no doubt that it was often used with success in cases which had proved rebellious to cinchona, so that it may be included in the large class of succedanea for Peruvian bark and its derivatives. The leaves are more or less purgative, and are said to operate like senna, but their more important use appears to have been in the treatment of *gout*. There seems to be conclusive evidence of their efficacy when administered in an infusion made with Gm. 2 (30 grains) of the leaves in half a pint of water, strained and sweetened, and taken twice or thrice daily. A similar method is said to have been successful in *articular rheumatism* (Pouget and Peyraud. *Amer. Jour. of Med. Sci.*, April, 1853, p. 492). According to Pliny, serpents will avoid even the shadow of the ash, and he affirms as of his own knowledge that if a snake is enclosed in a circle of ash-leaves in the centre of which is burning coals, it will plunge into the fire rather than touch the leaves. A similar fact or superstition exists in regard to the white ash (F. americana). On the land where it grows no rattlesnake will be found, "and it is the practice of hunters and others having occasion to traverse the woods in the summer months to stuff their boots or shoes with white-ash leaves as a preventive of the bite of the rattlesnake." We have several times known this precaution to be taken with full faith in its efficacy. A vinous preparation of the white ash is alleged to be useful in *dysmenorrhœa* and associated uterine disorders.

Of *Chionanthus virginica*, says Griffith, the root-bark is *tonic* and *febrifuge*, with some acro-narcotic properties which gave the shrub the name of *poison ash;* this bark is used in a cataplasm as an application to *wounds* and *ulcers*. Porcher states that he has heard it spoken of as diuretic and as a lotion for yaws and ulcers occurring in native Africans. More recently it has been described as purgative and cholagogue (Henning, *Therap. Gaz.*, x. 230). The leaves and bark of *Ligustrum vulgare*, or privet, were formerly used as astringents in *diarrhœa*, *hæmorrhage*, *sore mouth*, *sore throat*, etc. The leaves of *L. alaternus*, as well as of *L. vulgare*, have been used to repress the *secretion of milk*.

FUCUS VESICULOSUS.—BLADDER-WRACK.

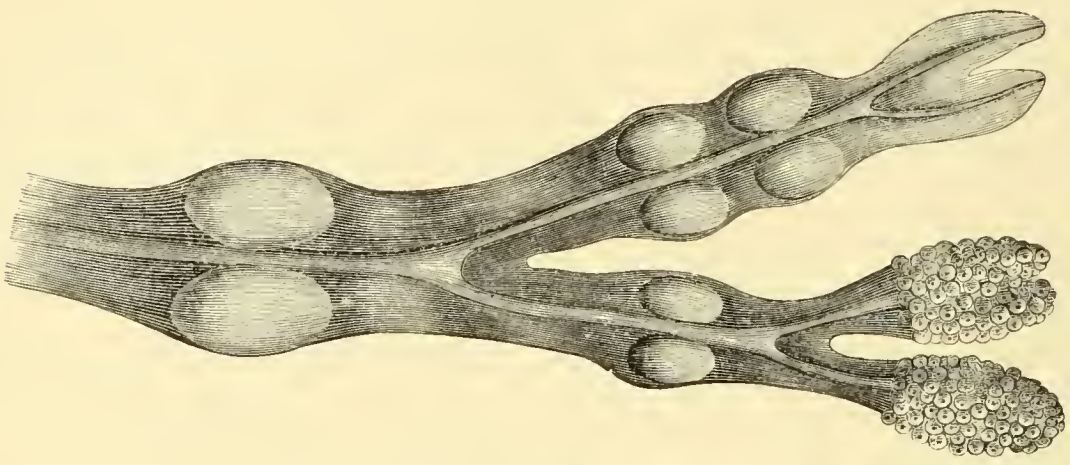
Quercus marina.—*Sea-wrack*, *Kelp-ware*, *Blacktang*, *Cut-weed*, E.; *Varech vésiculeux*, Fr. Cod.; *Blasentang*, *Seetang*, *Meereiche*, G.; *Encina de mar*, *Fuco avejigado*, Sp.

Fucus vesiculosus, *Linné*. Bentley and Trimen, *Med. Plants*, 304.

Nat. Ord.—Algæ, Fucoideæ.

Description.—It grows on the rocky shores of the North Atlantic and of the North Pacific Ocean, attains a length of 0.6 to 1.2 M. (2–4 feet), and has a flat branching

Fig. 127.



Fucus vesiculosus: fruiting branch, natural size.

thallus 12 to 25 Mm. (½–1 inch) wide, with the margin entire and a distinct midrib through its entire length. The air-vesicles are usually in pairs, separated by the midrib, spherical or oblong in shape, and occasionally attaining the size of a hazel-nut. The reproductive organs are found at the ends of the branches, forming more or less elongated receptacles, with many spherical conceptacles containing the numerous minute oblong antheridia and few larger globose sporangia. In the fresh state bladder-wrack is of a brownish-green color, which becomes nearly black on drying. It has the peculiar odor of sea-weeds and a mucilaginous and saline taste.

Allied Species.—Fucus nodosus, *Linné* (Fucodium nodosum, *Agardh*), is 1.2 to 1.8 M. (4–6 feet) long, and has a narrower frond or thallus without midrib, and with single vesicles, which are ovate or oblong, and usually large.

Fucus serratus, *Linné*, has a veined and serrate frond without vesicles.

Fucus siliquosus, *Linné*, s. Cystoseira (Halidrys, *Lyngbye*) siliquosa, *Agardh*. The frond is very narrow, 0.6 to 1.2 M. (2–4 feet) long, with short branches, articulated vesicles of a pod-like appearance, and lanceolate flattened tubercular fructification. This and the preceding species are permitted by the French Codex to be employed in the place of F. vesiculosus.

Fucus natans, *Linné*, s. Sargassum bacciferum, *Agardh*, is the *Gulf-weed* of the Atlantic Ocean, and is often found in immense masses floating in the sea. The frond is terete, and has linear and serrate branches and globular aculeate and stipitate vesicles of the size of a pea.

Constituents.—These plants are very similar in composition. They contain mucilage, mannit, odorous oil, a bitter principle, and between 14 and 20 per cent. of ash, calculated for the dried plant. Gödeschen, James, and others found the mineral constituents of the bladder-wrack, as collected from different places, to vary to the same extent. Marchand (1865) obtained from the ash of the bladder-wrack 0.719 per cent. of iodine and 0.603 of bromine, and from F. serratus 0.834 iodine and 1.007 bromine. Frisby (1880) obtained from anhydrous bladder-wrack .72 per cent. iodine, .84 bromine, and .47 chlorine; the ash amounted to 15.9 per cent.

Action and Uses.—The medicinal virtues of F. vesiculosus depend apparently upon the iodine and bromine which it contains in common with the allied species of sea-weed. It has been applied externally, bruised, to enlarged *scrofulous* glands, and internally it was at one time recommended as a means of lessening *obesity*. It was administered chiefly in a decoction made with from Gm. 8 to 16 (℥ij–iv) of the plant in a pint of water, and was alleged not to occasion atrophy of the mammæ or testes, while it reduced the fat in a notable degree. For this purpose it had a brief vogue, but is now almost forgotten.

FUMARIA.—Fumitory.

Fumeterre, Fr.; *Erdrauch*, *Feldraute*, G.; *Hiel de tierra*, *Pajarilla*, Sp.

Fumaria officinalis, *Linné*.

Nat. Ord.—Fumariaceæ.

Description.—Fumitory is a low annual about 30 Cm. (12 inches) high, and is common in the fields throughout Europe and more or less naturalized in most civilized countries. The entire plant is of a glaucous gray-green color; the stem is angular and much branched; the leaves are alternate, finely-dissected, compound, with spatulate or obovate-oblong rather acute lobes; the flowers are in terminal and axillary racemes, and have short, acute, and sharply-toothed sepals, and a pale-red and crimson or purplish corolla, which is one-spurred at the base. The fresh plant has a somewhat heavy odor and a saline, bitter, and rather acrid taste.

Constituents.—Winckler (1831) isolated *fumaric acid*, $C_4H_4O_4$, which had been obtained by Lassaigne (1819) from malic acid, $C_4H_6O_5$; the latter, heated to 150° C. (302° F.), is almost completely resolved into fumaric acid and water. Fumaric acid crystallizes in colorless prisms, volatilizes partly unaltered above 200° C. (392° F.), and when heated with hydriodic acid or under the influence of nascent hydrogen is converted into succinic acid. Peschier discovered the alkaloid *fumarine*. Pommier (1853) obtained it by exhausting the fresh herb with water acidulated with acetic acid and precipitating with ammonia. It is white, crystalline, bitter, not freely soluble in water, but soluble in alcohol. The analysis of Merck proved the presence of the usual constituents of herbs.

Action and Uses.—This is one of many medicines reputed to be purifiers of the blood. Its bitter taste and slightly laxative and diuretic qualities suggest its analogies with dandelion. Its reputation also is partly of the same kind as a remedy for *dyspeptic* derangements attributed to torpor of the liver, but generally due to constipation. But its greatest credit has been acquired in the treatment of diseases of the *skin* depending on scrofulous and diuretic disorders. For *crusta lactea* a decoction of the plant in milk has been used topically. The expressed juice of the fresh plant is its most efficient preparation. A decoction or infusion may be made with Gm. 32 (an ounce) of the herb to Gm. 500 (℥j to Oj) of water.

FUNGUS CHIRURGORUM, *P. A., P. G.*—Surgeon's Agaric.

Agaricus (*s. Boletus*) *chirurgorum*, *s. igniarius.*—*Spunk*, *Touchwood*, E.; *Amadou* (Codex), *Agaric de chêne*, *Bolet amadouvier*, Fr.; *Wundschwamm*, *Feuerschwamm*, *Zunder*, G.; *Esca focaja*, It.; *Agarico yesca*, Sp.

Polyporus (Boletus, *Linné*) fomentarius, *Fries*.

Nat. Ord.—Fungi, Hymenomycetes.

Origin.—This fungus grows on beech and oak trees in Southern and Middle Europe; it is sessile, obliquely triangular, and hoof-shaped, 10 to 30 Cm. (4–12 inches) broad, at the base 5 to 10 Cm. (2–4 inches) thick, brown-gray or whitish externally and yellowish-brown internally; the hymenium on the lower side is in the form of small tubular pores. This and the hard rind are removed and the fungus is cut into thin slices, which are soaked in water, boiled in weak lye, washed, and beaten with mallets until soft. It is then ready for surgical purposes. For use as tinder it is soaked in a saturated solution of potassium nitrate before it is dried.

Description.—Surgeon's agaric is in thin, flat pieces, tasteless, inodorous or of a faint odor, of a cinnamon-brown color, glossy, very soft and velvety. Under the microscope it is seen to consist of interlaced filiform cells. It readily absorbs twice its weight of water, and when this is expressed and evaporated only a minute residue should be left.

Allied Drugs.—Polyporus (Boletus, *Linné*) igniarius and marginatus, *Fries*, yield a similar but harder product; the former is internally rust-brown or dark cinnamon-brown, and very hard, while the latter is yellowish, and not spongy.

Cibotium Baromez, *J. Smith*, C. djambianum, *Hasskarl*, and other large ferns (Nat. Ord. Cyatheaceæ)of Sumatra and South-eastern Asia are covered at the base of the fronds with chaffy hairs, 2 or 3 Cm. (about 1 inch) long, soft, glossy, brown or yellowish, flat, inodorous and tasteless; these are known in the East as *penghawar djambi*.

Cib. Schiedei, *Schlechtendal*, and perhaps some allied species yield *ocopetate* or *cola de mono* of Mexico, which resembles the preceding drug. *Pulu* or *pulu-pulu*, from Cib. glaucum, *Hooker*, and allied species of the Sandwich Islands, is very soft and slightly curly.

Alsophila lurida, *Hooker*, and allied ferns of Java, yield *paku kidang*, the hairs being about 5 Cm. (2 inches) long, thicker, more stiff and less soft than the preceding drugs.

Surgical Action and Uses.—On account of its combined lightness, elasticity, toughness, and porosity this substance has long been used to arrest *hæmorrhage* from

slight wounds, and especially from leech-bites. It should be secured in its place by a bandage or other pressure. When prepared with nitrate or with chlorate of potassium it may be formed into cylinders and used as a *moxa*. Its physical qualities give it a superiority over all other substances to be insinuated between the ulcerated skin and an *ingrown toe-nail*. The success of this treatment depends upon preventing any movement of the parts by means of a narrow strip of adhesive plaster wound around the toe.

Pinghawar djambi has been used as a hæmostatic in Sumatra from time immemorial. Its power of coagulating freshly-drawn blood is greater than that of several other absorbents employed as hæmostatics, and is due to the capillarity of its fibres, which absorb the serum of the blood (*Med. Record*, xxxiv. 478). Many years ago this property was described by Vinke (*N. Amer. Med.-Chi. Rev.*, iv. 736). He, however, stated that the plant acts more efficiently when crumbled than when entire. Gm. 0.30 (gr. v) are said to arrest a considerable *hæmorrhage*, and more than Gm. 1.30 (gr. xx) is never applied. It is pressed for two or three minutes against the bleeding surface and secured in its place. During the Franco-German War, according to Junker, it proved useful in capillary hæmorrhage and in bleeding from small vessels (*London Med. Rec.*, Dec. 15, 1885).

FUNGUS MUSCARIUS.—Fly Agaric.

Fly fungus, E.; *Agaric mouche*, *Fausse orange*, Fr.; *Fliegenschwamm*, G.

Amanita muscaria, *Persoon*, s. Agaricus muscarius, *Linné*.

Nat. Ord.—Fungi, Agaricini.

Origin.—This European fungus grows in autumn, chiefly under pine trees; allied poisonous species are met with in most countries. Some species of the same genus are edible.

Description.—The stalk is tuberous at the base, 7 to 15 Cm. (3 to 6 inches) high, and about 18 Mm. ($\frac{3}{4}$ inch) thick, white. The cap (pileus) is 10–15 Cm. (4 to 6 inches) broad, at first globular, afterward flattish or convex, scarlet or orange-red, more or less covered with white warts, internally yellowish, and on the under side with white lamellate gills (hymenium). It has a disagreeable odor and a burning, acrid taste. Infused with milk, it is used for poisoning flies; hence the name.

Constituents.—The poisonous principle, according to Apoiger (1851), is a crystallizable acid soluble in ether and precipitated by lead acetate. Leteiller (1866) called it *amanitin*, which is a brown, amorphous, tasteless glucoside, insoluble in ether, and not precipitated by lead salts or gallic acid. Schoenbrodt (1864) isolated a white crystalline powder, *agaricin*, by exhausting the alcoholic extract with 50 per cent. alcohol, evaporating and crystallizing from a mixture of alcohol and ether; it is insoluble in ether and sparingly soluble in water, and has at first an insipid, afterward sweet, bitter, and acrid taste. Sicard and Schoras (1865) announced that various toadstools contain a poisonous volatile alkaloid; the volatile alkaloid obtained by Apoiger had a very disagreeable odor, but was not poisonous. Schmiedeberg and Koppe (1869) separated a poisonous alkaloid, *muscarine*, $C_5H_{15}NO_3$, which is colorless, inodorous, crystalline, very deliquescent, insoluble in ether, and sparingly soluble in chloroform; it is a strong base, and yields deliquescent salts, which are precipitated by mercuric chloride, auric chloride, and potassio-mercuric iodide. It is accompanied by *choline*, $C_5H_{15}NO_2$, which was isolated by Harnack (1876) as *amanitine*, and was afterward found by him identical with the choline of hog-bile.

Action and Uses.—At one time this fungus had a doubtful reputation for the cure of *epilepsy*. It was also used externally in the treatment of chronic *eruptions* and *ulcers* of the skin. Its most important use is to combat profuse *sweating*, for which purpose the related white agaric has long been employed, as is elsewhere stated. Dr. Murrell successfully used Agaricus muscarius in the treatment of 26 cases of the night-sweating of phthisis. He found that 5 minims of the 1 per cent. solution of the extract was the smallest dose on which reliance could be placed. It was given three times a day, or at intervals of about an hour before bed-time. It did not begin to act on the first night, but on each successive night became more efficient, and it stopped the sweating without producing any abnormal dryness of the skin. Even in the dose of 15 minims it produces no bad effects. But care should be taken to test the activity of the preparation used by its power of arresting the action of the frog's heart (*loc. sup. cit.*).

GALANGA.—Galangal.

Rhizoma (*Radix*) *galangæ* (*minoris*), P. G.; *Galanga*, Fr., Sp.; *Galgant*, G.

The rhizome of Alpinia officinarum, *Hance*. Bentley and Trimen, *Med. Plants*, 271.

Nat. Ord.—Scitamineæ (Zingiberaceæ), Zingibereæ.

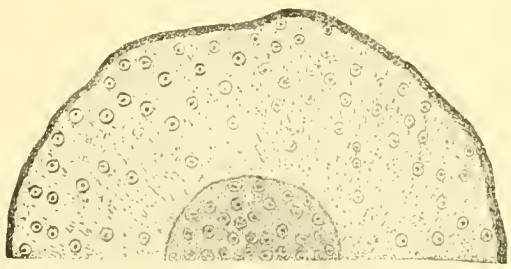
Origin.—The galangal-plant resembles a flag, and has stems about 1.2 M. (4 feet) high, and white flowers, veined with red, in terminal racemes. It is indigenous to the island of Hainan in the south of China, and probably also to the adjacent mainland.

Description.—The rhizome appears in commerce in sections about 5 Cm. (2 inches) long, 0.5 to 2 Cm. ($\frac{1}{4}$–$\frac{4}{5}$ inch) in diameter, frequently with one or two short branches.

Fig. 128.

Galanga.

Fig. 129.



Galanga: transverse section, magnified 3 diam.

It has externally a rust-brown color, and is somewhat wrinkled and transversely annulated with the short remnants of the leaf-sheaths. It is rather tough, breaks with a somewhat fibrous fracture, is internally pale grayish-brown, and on transverse section shows the endoderm as a dark-colored circular line, enclosing a central portion of about the same width as the cortical layer; the tissue contains starch-grains and scattered oil-cells and wood-bundles, the latter being more numerous in the central portion. Galangal has an agreeable aromatic odor, which becomes more prominent on bruising the rhizome, and a pungent taste somewhat resembling that of ginger.

Constituents.—Galangal contains about $\frac{1}{2}$ per cent. of a pale-yellow or brownish-yellow volatile oil which has the density 0.921 at 15° C., boils between 170° and 275° C., and contains considerable *cineol*, to which the oil owes its camphor-like odor (Schimmel and Co., 1890). The water distilled from galangal contains ammonium carbonate (Vogel, 1844). The pungent taste of the rhizome, according to Bucholz, is due to a soft resin which has not been further examined. Brandes (1839) obtained tasteless and inodorous crystals of *kæmpferid*, which by crystallization from alcohol yielded to Jahns (1881) three yellow compounds,—*kæmpferid*, *galangin*, and *alpinin*, crystallizing in the order named, and melting respectively at 221°, 214°, and 173° C. Mucilage, starch, fat, and extractive matter are likewise present.

Allied Drug.—Alpinia Galanga, *Willdenow*, of Java, yields the *greater galangal*, *Radix galangæ majoris*, which is rarely seen in our commerce. It resembles the preceding, but is longer and thicker, externally brown-red, internally buff-colored, and is weaker in odor and taste.

Medical Action and Uses.—Galangal is an aromatic, and therefore a local and general stimulant. It resembles ginger in its qualities and effects. It was formerly held in high repute as a stomachic for promoting *digestion* and relieving *flatulence*, and was employed to correct nausea and prevent *vomiting* due to indigestible food, and also when they occurred in febrile diseases of a typhoid type. Its somewhat acrid taste renders it unsuitable for administration in powder, which may, however, be prescribed in the *dose* of Gm. 1.30 or 2.00 (20–30 grains). It may also be given in an infusion made with Gm. 32 (an ounce) of the bruised root to a pint of water. A tincture is also employed in the *dose* of Gm. 4 (f℥j).

GALBANUM, *Br., P. G.*—Galbanum.

Gummi-resina galbanum.—*Galbanum*, F.; *Mutterharz*, *Galban*, G.; *Galbano*, Sp.

The gum-resin obtained from Ferula galbaniflua, *Boissier et Buhse*, and probably from other allied plants. Bentley and Trimen, *Med. Plants*, 128.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—This plant is indigenous to Northern Persia. The stem is about 1.5 M. (5 feet) high; the radical leaves are large, triangular, decompound pinnate, and pinnatifid, with the ultimate sections linear and obtuse; the stem-leaves are small; the fruit is somewhat winged near the face of the mericarps; the ribs are prominent and slender, and the

oil-tubes solitary in each groove and absent in the commissure, or often there are two narrow ones. The plant, with the one noticed below, was originally (1844) described by Boissier under the name of Fer. erubescens, subsequently (1856) as F. gummosa.

Fer. rubricaulis, *Boissier*, grows in Southern (and probably also in Northern) Persia, and has the leaves with wider segments and the oil-tubes narrower and more numerous than the preceding. Fer. Schair, *Borszczow*, a native of the Kirgheez country, yields also a gum-resin similar to galbanum, which, however, does not appear to be collected. The gum-resin exudes spontaneously, and, as far as known, no incisions are made to promote the exudation. It enters commerce chiefly through Russia and from the Levant.

Description.—The best quality of galbanum is met with in tears varying in size from a pin's head to a pea and larger; sometimes it is soft and semifluid. The tears adhere to one another, forming a more or less compact mass; they are of a reddish-, brownish-, or greenish-yellow color externally, internally whitish or yellowish, with a waxy gloss, and are somewhat translucent. It has a peculiar, unpleasant balsamic odor and a disagreeable, bitter, and acrid taste. Moistened with alcohol, a fine purple color will be produced on the addition of a little strong hydrochloric or nitric acid. Hydrochloric acid remaining in contact with galbanum for about an hour acquires a red color, and on the gradual addition of alcohol and warming the mixture to 60° C. (140° F.) becomes transiently dark violet-colored (difference from ammoniac, which is not colored). Water in contact with galbanum shows a blue fluorescence on the addition of a minute quantity of ammonia-water.

Lump galbanum consists sometimes of soft or harder masses, in which some tears are distinctly observed; sometimes a mass is offered which from its odor and behavior seems to be of a different origin.

For medicinal use galbanum should be exposed to a low temperature until brittle, then powdered, and by sifting freed from the impurities.—*P. G.*

Constituents.—According to the older analyses by Neumann, Pelletier, and others, galbanum contains 6 to 8.5 per cent. of volatile oil, 15 to 20 per cent. of gummy matter, and 60 to 66 per cent. of resin, besides 7 to 14 per cent. of impurities. Volatile fatty acids were found by Moessmer (1861) in the emulsion remaining after distilling off the volatile oil. The *volatile oil* is colorless, turns yellowish and thick on exposure, varies in specific gravity between .88 and .92, has the boiling-point 160° to 165° C. (320° to 329° F.), is dextrogyre, and consists of several hydrocarbons of the composition $C_{10}H_{16}$. The resin is yellowish-brown, soluble in ether, alcohol, carbon disulphide, and alkalies. On being heated it yields a beautiful indigo-blue volatile oil which, according to Kachler (1871), consists of a colorless oil, $C_{10}H_{16}$, boiling at 240° C. (364° F.), and of a deep-blue oil, $C_{30}H_{18}O_3$, which boils at 281° C. (538° F.), appears to be identical with the blue portion of the oil of German chamomile, and yields with potassium a hydrocarbon, $C_{30}H_{48}$, the solution of which in much aqueous ether gives with an ethereal solution of bromine an azure-blue color, changing to green and brown. Galbanum resin, treated with fusing potassa, yields several volatile fatty acids and *resorcin*, the solution of which is colored dark-purple by ferric chloride (Hlasiwetz and Barth, 1864).

An aqueous infusion of galbanum on the addition of ammonia assumes a blue fluorescence, which disappears again on the addition of an acid. This reaction is due to *umbelliferon*, $C_9H_6O_3$, which may be obtained in colorless needles by heating galbanum with hydrochloric acid to 100° C. (212° F.), agitating the liquid with ether or chloroform, and evaporating the latter solution. It was first obtained by C. Sommer (1859) from sumbul-root, and has since been procured from various umbelliferous resins and from mezereon. It crystallizes from hot water in colorless rhombic prisms which melt at 240° C. (464° F.) and sublime without decomposition. It is easily soluble in ether and alcohol, but dissolves sparingly in cold water, the latter solution showing a blue color in reflected light; when fused with potassa it yields resorcin.

Action and Uses.—Galbanum is generally described as partaking of the virtues both of asafœtida and ammoniac, affecting the nervous system like the former, and acting as a local irritant like the latter. Applied to the skin, it occasions a papular eruption, and, if the true skin is exposed, causes it to ulcerate. Upon the system generally it probably acts as a stimulant, for in large doses it is said to cause fulness of the head and tension of the pulse. Moreover, its therapeutical virtues are observed only in cases that call for stimulation; these are such as the resins and gum-resins are applicable to, and, especially *chronic bronchitis*, *chronic intestinal*, *uterine*, *and vaginal catarrh*, *amenorrhœa*, etc. In most of these cases its effect is to lessen excessive mucous secretion. It is seldom given alone, and hence virtues are apt to be attributed to it that belong to its associated

medicines. In the compound galbanum pill it is united with asafetida and myrrh. Even for external use it is associated with other irritants. The *dose* of galbanum is Gm. 0.30–1.30 (gr. v–xx). It is best administered in emulsion.

GALEGA.—Goat's Rue.

Herba rutæ capraríæ.—Galega, Rue de chèvre, Fr.; *Geisraute*, G.

Galega officinalis, *Linné.*

Nat. Ord.—Leguminosæ, Papilionaceæ.

Description.—Goat's rue is found in the countries bordering on the Mediterranean and northward to Central Europe. It has a perennial several-headed root and an erect stem about 90 Cm. (3 feet) high; the smooth, oddly-pinnate leaves are furnished with six or eight pairs of lanceolate or ovate-lanceolate, obtuse, and finely mucronate leaflets. 2–5 Cm. ($\frac{3}{4}$ to 2 inches) long, and with lanceolate stipules, which are sagittate on one side. The purplish or whitish flowers are in axillary racemes, and produce narrow almost cylindrical legumes. The herb is inodorous and has a mucilaginous and somewhat bitter and astringent taste. Its constituents have not been investigated.

Action and Uses.—Galega was at one time held to be diaphoretic, diuretic, and anthelmintic, and was used as a stimulant in nervous affections of an *hysterical* or *spasmodic* nature, in low *fevers*, and especially in the *plague*. It is said, also, to favor the *mammary secretion* (*Therap. Gaz.*, xv. 216; *Univ. Med. Mag.*, iii. 430).

GALIUM VERUM.—Yellow Bedstraw.

Caille-lait jaune, F. Cod.; *Megerkraut, Liebfrauenstroh, Labkraut*, G.; *Cuajaleche*, Sp.

Nat. Ord.—Rubiaceæ, Galieæ.

Origin and Description.—Galium verum, *Linné*, is a perennial herb indigenous to Europe and Northern Asia, and naturalized in New England. It has a light-reddish root, an ascending smoothish stem, whorls of eight narrow linear roughish leaves, compact panicles of small yellow odorous flowers, and a smoothish akene-like twin-fruit. The herb has a somewhat astringent, acidulous, and bitter taste.

Constituents.—The iron-greening tannin of this and allied herbs was described (1852) by R. Schwarz as *galitannic acid;* citric and rubichloric acid are likewise present, besides starch and other common principles of herbs.

Allied Plants.—G. mollugo, *Linné.*—Whiptongue, *E.;* Caille-lait blanc. *F. Cod.;* Waldstroh, *G.* It is indigenous to Europe, somewhat naturalized in the United States, has a smooth stem, oblanceolate or oblong-linear, somewhat rough and mucronate leaves in whorls of eight, and long panicles of whitish flowers yielding smooth fruits.

Galium Aparine, *Linné.*—Cleavers, *E.;* Grateron, Rièbel, *Fr.;* Klebkraut, *G.*—It grows in thickets in North America, Europe, and Northern Asia, has a weak, retrorsely prickly, quadrangular stem 1 M. (40 inches) long; linear lanceolate and mucronate-prickly leaves in whorls of six or eight; small whitish flowers, and one-seeded twin-carpels, armed with hooked prickles.

G. triflorum, *Michaux.*—Sweet-scented bedstraw, *E.*—It is indigenous to North America, resembles the preceding, but has elliptic-lanceolate slightly rough bristle-pointed leaves in whorls of six, three-flowered pedunceles, and acquires an agreeable odor on drying.

The constituents of these plants appear to be the same as those of the first species; oxalic acid is sometimes present, and *aspertannic acid* in species of asperula.

Von Cotzhausen (1876) determined the odorous principle of Galium triflorum to be *coumarin*, to which is also due the agreeable odor of the nearly-allied Asperula odorata, *Linné*, known in France as *aspérule odorante* and in German as *Waldmeister*. The roots of several species, like Galium tinctorium, *Linné*, contain red coloring matter resembling that of Madder, and are popularly known as *wild madder*. The leaves of others, like Galium circæzans, *Michaux*, and G. lanceolatum, *Torrey*, have a sweet liquorice-like taste, and the plants are sometimes called *wild liquorice*.

Rubia tinctorum, *Linné.*—Madder, Dyer's madder, *E.;* Garance, *F. Cod.:* Krapp, Färberröthe, *G.*; Granza, *Sp.*—This herbaceous perennial is indigenous to the Levant and largely cultivated for its creeping rhizome and numerous long, light blood-red, cylindrical roots of the thickness of a quill, which have an easily separable gray-red corky layer, a thin dark brown-red inner bark, and a spongy red wood, with irregular medullary rays, a feeble color, and a sweetish, bitterish, somewhat acrid and astringent taste. Madder is usually found in the shops in the form of a coarse powder. The fresh root contains a yellow coloring matter, while the commercial article contains the decomposition-products, many being glucosides, yielding *alizarin*. *Rubian*

is amorphous, dark-yellow, bitter. *Rubihydran* and *rubidehydran* are gum-like (Schunck 1847–56). Rochleder's *ruberythrinic acid*, $C_{20}H_{22}O_{11}$ (1855, etc.), crystallizes in silky yellow prisms. The most important constituent is *alizarin*, $C_{14}H_8O_4$, which crystallizes in orange-red sublimable needles, is soluble in boiling water, alcohol, and ether, and yields purple or red-colored compounds with bases. Other compounds obtained from madder are *rubitannic acid*, *rubichloric acid*, *purpurin*, *rubiretin*, etc. The artificial production of alizarin was discovered by Graebe and Liebermann, and it is now manufactured from *anthracene*, $C_{14}H_{10}$, a crystalline constituent of coal-tar, which is oxidized to *anthraquinone*, $C_{14}H_8O_2$; this is then converted into a sulphonic acid or a bromo-compound, which by the action of alkalies yields alizarin.

Action and Uses.—Galium verum and G. aparinum have been used in Europe chiefly in *dropsy* and *jaundice*, and for *scaly skin diseases*, especially of a *scrofulous* nature. They have been alleged to cure *epilepsy* and *cancer* of the tongue. Fresh G. verum, reduced to a paste in a mortar, is used in Great Britain as a poultice for chronic *ulcers* (*Edinb. Med. Jour.*, xxix. 173; *Med. Press*, June 16, 1886). Notwithstanding the virtues attributed to galium at various times, it does not seem to have established its claims to confidence. A decoction is prepared with Gm. 16 to Gm. 500 (half an ounce of the plant to a pint of water) and given in wineglassful doses. The fresh inspissated juice is preferable, given in f℥ij doses three times a day.

Madder is an obsolete medicine, but was formerly in high repute as an *emmenagogue*. It was administered in *doses* of Gm. 2–4 (℥ss–℥j) four times a day.

GALLA, *U. S., Br.*—Nutgall.

Gallæ, P. G.; *Galla halepense*, *G. turcica*, *G. levantica*, *G. tinctoria*, *G. quercina*.—*Galls*, E.; *Galle de chêne*, *Noix de galle*, Fr. Cod.; *Galläpfel*, *Gallen*, G.; *Agallas de Levante*, Sp.

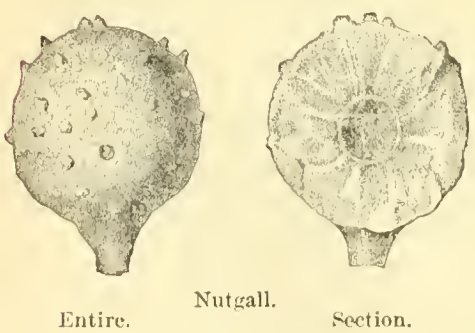
Excrescences on Quercus lusitanica, *Lamarck* (Q. infectoria, *Olivier*), caused by the punctures and deposited ova of Cynips (Diplolepis, *Latreille*) Gallæ tinctoriæ, *Olivier* (Class Insecta, Order Hymenoptera). Bentley and Trimen, *Med. Plants*, 249.

Nat. Ord.—Cupuliferæ.

Origin.—Quercus lusitanica is a polymorphous species indigenous to the basin of the Mediterranean, the leaves varying between ovate and obovate, mostly rounded at base and acute at apex, variously and either obtusely or acutely toothed or lobed. The dyer's oak is a small tree, or oftener a shrub, 1.2–1.8 M. (4 to 6 feet) high, and is found in the eastern section of the Mediterranean basin from Greece to Persia. The tender bark of the young branches is punctured by the female of the hymenopterous insect named above, and one or more eggs are deposited in the wound. The irritation produced by this operation causes the formation of an excrescence enclosing the larva, which undergoes therein its transformations. The term *gall* is generally used to designate such excrescences formed upon any part of a plant in consequence of the puncture of an insect.

Description.—Nutgalls are sub-globular, about 25 Mm. (one inch) or less in diameter, with a short stipe and a nearly smooth surface, or, more frequently, more or less tuberculated in the upper portion. They are dense, and in color externally of a deep blackish olive-green or blackish-gray; if the gall remains upon the branch, it gradually becomes lighter, and finally of a pale yellowish-brown tint, the texture becoming spongy and the weight decreasing at the same time. Galls are hard, but are readily broken with a hammer, exhibiting a more or less close granular fracture, which has sometimes a waxy lustre. Internally, they are yellowish- or pale brownish-gray, with a central nucleus or cavity containing either the more or less fully developed insect or pulverulent fragments of the cellular tissue. In the latter case the insect has usually escaped through a cylindrical canal which it has bored from the cavity to the surface, the outer aperture being just below the middle and having a diameter of 2–3 Mm. ($\frac{1}{12}$ to $\frac{1}{8}$ inch). The cellular tissue of the nucleus, if still present, is mostly filled with small starch-granules and surrounded by a layer of thick-walled cells forming a shell, on the outside of which is the cellular tissue containing the tannin. This tissue has often a radiated appearance near the shell, and contains toward the sur-

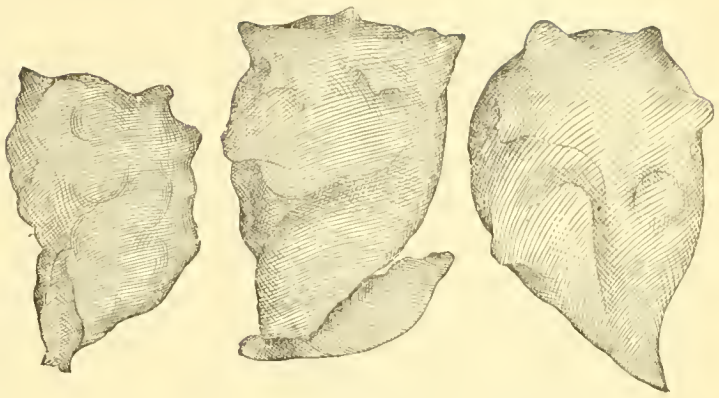
Fig. 130. Fig. 131.



Entire. Nutgall. Section.

face small scattered bundles of vascular tissue. Nutgalls are nearly inodorous and have a very astringent taste. Light, spongy, and whitish-colored nutgalls should be rejected.

Fig. 132.



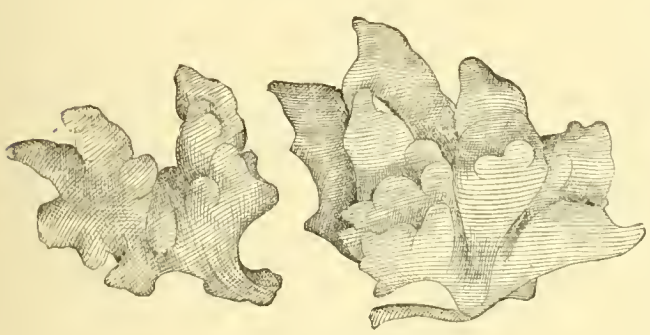
Chinese Nutgalls.

Nutgalls are distinguished in commerce according to their color, the *blue* or *black galls* of Syria (Aleppo) being preferred. *Smyrna galls* are usually of a grayish olive-green, more spongy in texture, and intermixed with *white galls;* the latter are the least valuable. *Sorian galls* are of the size of a pea, blackish, and internally not radiate. The galls which are produced upon the European oaks by different species of Cynips are of a lighter color and more spongy texture, but have an astringent taste and contain tannin.

Constituents.—The principal constituent of nutgalls is *tannin* or *gallotannic acid*, of which they contain about 60 per cent. Bowman (1869) assayed selected galls, finding 80 per cent., and in white galls only 30.7 per cent. 2 or 3 per cent. of gallic acid is likewise found, together with some sugar, resinous and albuminous matter, and, as stated before, starch in the nucleus.

Allied Drugs.—Chinese and Japanese Galls, although known from a much earlier period, were not a regular article of commerce until Pereira (1844) directed attention to them again. They are produced upon the leaves or leaf-stalks of Rhus semialata, *Murray*, by an insect provisionally named Aphis chinensis, *Bell*, and usually contain between 70 and 80 per cent. of tannin. They are of a very irregular shape, mostly thin, as if stalked, toward the base, much inflated above, irregularly lobed, and with few or many protuberances; they are of a reddish-brown color, but densely covered with a gray down, consist of a thin fragile shell, and contain in the interior numerous small dead insects. The Japanese nutgalls agree in all essential characteristics with this description, but are usually more slender and have a larger number of lobes and protuberances; their origin has been referred to Rhus japonica, *Siebold*. C. Hartwich (1881) found also their pubescence quite dense and light-brown, and the tissue to contain unaltered starch-granules; while Chinese galls have the pubescence less dense and greenish-brown, and the starch is pasty.

Fig. 133.



Japanese Nutgalls.

Vallonea.—Valonia, Acorn-cups, *E.;* Valloné, Vélanéde, Gallon, *Fr.;* Knoppern, Walonen, *G.*—Several varieties are occasionally met with. *Hungaria valonia* are the cups of Quercus Robur, *Linné*, rendered irregular in shape and more or less winged by the excrescences produced from the sting of Cynips Quercus calycis. *Oriental valonia* consist of the unaltered fruit-cups of Quercus Vallonea, *Kotschy*, and of several allied species or varieties of Qu. Ægilops, *Linné*, indigenous to Southeastern Europe and the Levant; they are about 25 Mm. (an inch) or more in diameter, have thick spreading or recurved scales, possess a strongly astringent taste, and are largely employed for tanning. The cups of our indigenous species are likewise astringent.

American Nutgalls, as obtained from Quercus alba, *Linné*, and other species, are light and spongy, and generally not very rich in tannin. The galls from Quercus virens, *Aiton*, produced in Texas, are more analogous to Aleppo galls, but not tuberculate; they contain about 40 per cent. of tannin. The so-called *California oak-balls*, recently introduced, are derived from Quercus lobata, *Engelmann*, are about 5 Cm. (2 inches) in diameter, orange-brown and somewhat glossy externally, soft and spongy within, and appear to contain much tannin.

Tamarisk Galls are collected from Tamarix orientalis, *Forskal*, which grows in Southern and South-western Asia. They are 3–12 Mm. ($\frac{1}{8}$ to $\frac{1}{2}$ inch) thick, subglobular, knotty, and are said to contain from 40 to 50 per cent. of tannin. Similar galls are obtained in Algeria and Morocco from Tam. africana, *Poiret*. The brown-red, fibrous, bitter, and astringent bark of Tam. gallica, *Linné*, and the leaves of the same plant, are used in Southern Europe.

Action and Uses.—From the most ancient times nutgall has been used in medicine, for its astringency. This property is due to gallotannic acid, but a bitter extractive

ascribed to nutgall gives it a tonic action. These qualities account for its efficacy in the treatment of chronic *diarrhœa*. It has been used as an *antidote* to tartar emetic and poisonous vegetable alkaloids; and whatever degree of efficacy it then exerts is partly due to its constringing the stomach and delaying the absorption of its contents. An infusion made from Gm. 16–32 (half an ounce to an ounce) of coarsely-powdered nutgall in Gm. 500 (a pint) of boiling water may be given in the dose of a wineglassful three or four times a day, for the purposes referred to; and it may be locally applied to the *relaxed mucous membrane* of the mouth, throat, vagina, and rectum.

GARCINIA.—Mangosteen.

Mangostane, Fr., G.

Several species of Garcinia.

Nat. Ord.—Guttiferæ (Clusiaceæ).

Origin.—The trees belonging to the genus Garcinia inhabit tropical countries, and are chiefly found in India and the East Indian islands. They have unisexual or subdiœcious flowers with four sepals, four petals, and numerous stamens, which in the pistillate flowers are often reduced to staminodes; the ovary is four- to ten-celled, each cell containing one seed; the fruit is a fleshy berry.

Description.—Garcinia mangostana, *Linné*, is a large tree with a bitter and very astringent bark, and glossy elliptic-oblong or oblong-lanceolate leaves. The fruit is of the size of an ordinary orange, of a brown or brown-gray color, mottled with yellow and crowned by the sessile four-lobed stigma. The pericarp is bitterish and astringent, somewhat spongy, and encloses six or eight seeds, which are covered with a white juicy pulp of a delicious odor and taste. W. Schmid (1855) isolated from the pericarp, besides tannin, golden-yellow *mangostin*, $C_{20}H_{22}O_5$, which crystallizes in scales, is fusible, soluble in alcohol and ether, and colored yellowish-brown by alkalies and green-black by ferric salts.

The fruit of Garcinia Kydia, *Roxburgh*, which is dark-yellow and of the size of a small orange, and of Garc. pedunculata, *Roxburgh*, which is much larger and of a yellow color, contain an acidulous pulp which is very inferior to that of the first species.

Garcinia indica, *Choisy*, s. G. purpurea, *Roxburgh*, s. Brindonia indica, *Du Petit-Thouars* (Bentley and Trimen, *Med. Plants*, 32), is a medium-sized tree, with oblong-lanceolate or oblong-oval, glabrous leaves, and with a dull-red or purplish fruit of the size of a small orange and containing from five to eight seeds imbedded in an acid purple pulp, which is used in India in curries and in the dried state. The seeds are about 12 Mm. ($\frac{1}{2}$ inch) long, oblong-reniform, somewhat compressed and wrinkled, and contain an oily embryo. After bruising the seeds and boiling them with water an oil collects on the surface, which is moulded by hand into egg-shaped balls, and is known as *kokum-butter* or *concrete oil of mangosteen* (Beurre de Kokum, Suif de Goa, *Fr.*; Kokum-butter, *G.*). This oil is in various-shaped cakes, has a whitish or yellowish color, and is firm, friable, and crystalline. J. Bouis and D'Oliveira Pimentel (1857) obtained from the seeds by ether 30 per cent. of oil, melting near 40° C. (104° F.), and containing about 50 per cent. of tristearin. Flückiger found after saponification also myristic and oleic acid. After filtration, whereby brown tannic matters are removed, the oil begins to melt at 42.5° C., fuses entirely at 45° C., and concretes again at 27.5° C. (*Pharmacographia*).

Allied Fruits.—Mammea americana, *Linné*, a guttiferous tree of the West Indies, has a brown-yellow, subglobular fruit about 12 Cm. (5 inches) in diameter and containing three or four ovate-oblong rough seeds. The fruit, which is known as *mammee-apple*, has a leathery bitter rind and contains a yellow aromatic pulp of a very agreeable taste. The fruit of Lucuma (Achras, *Linné*) mammosa, *Jussieu*, Nat. Ord. Sapotaceæ, is likewise known in the West Indies as *mammee*; it is an ovoid-oblong, rust-brown, and rough berry about 15 Cm. (6 inches) long, having a yellow or reddish sweet, mucilaginous pulp, and containing usually one large yellowish-brown polished seed.

Garcinia Kola, *Heckel*, is the *male kola* or *kola bitter* of Western Africa. The somewhat triangular seeds contain a yellowish-white embryo, which consists of a large radial, and has a bitter, astringent, and somewhat coffee-like taste.

Action and Uses.—The bark, the wood, and also the rind of the fruit of G. mangostana are very astringent, and have been employed in the treatment of *diarrhœa*, *dysentery*, *leucorrhœa*, and *gonorrhœa*, as a gargle in *tonsillitis*, in decoction as a lotion for foul *ulcers* and *prolapsus* of the *rectum* and *vagina*, etc. The concrete oil of G. indica has been chiefly used in some pharmaceutical preparations.

GAULTHERIA.—Gaultheria.

Folia gaultheriæ.—*Wintergreen, Teaberry, Partridgeberry, Boxberry, Checkerberry*, E.; *Feuilles de gaulthérie* (*de palommier*), *Thé du Canada, Thé de Terre-neuve*, Fr.; *Canadischer Thee, Bergthee*, G.

The leaves of Gaultheria procumbens, *Linné* (s. G. humilis, *Salisbury*; Gaultiera repens, *Rafinesque*). Bigelow, *Med. Bot.*, t. 22; Bentley and Trimen, *Med. Plants*, 164.

Nat. Ord.—Ericaceæ, Ericineæ.

Origin.—Teaberry is found in cool damp woods, usually in the shade of evergreens, in Canada and the United States. The plant is a small shrub with a slender creeping stem and ascending branches, about 12 Cm. (5 inches) high, bearing the alternate evergreen leaves near the summit, axillary, nodding, whitish flowers, and five-celled berry-like pods, which are enclosed in the bright-red fleshy calyx. The leaves are collected late in summer or in autumn.

Fig. 134.

Leaf of Gaultheria procumbens, natural size.

Description.—The leaves are short-petiolate, about 4 Cm. (1½ inches) long and 19–25 Mm. (¾ to 1 inch) wide, obovate or roundish-oval in shape, with a wedge-shaped base, coriaceous in texture, mucronate and slightly toothed, the teeth having the elongated points appressed to the thickish margin; they are smooth, of a glossy-green color above, and paler beneath. The odor is agreeably aromatic, taste astringent and aromatic.

Constituents.—We are not acquainted with a complete analysis of the leaves. They contain a volatile oil (see Oleum Gaultheriæ) and tannin. Jefferson Oxley (1872) found, besides grape-sugar, gum, coloring matter, and a principle analogous to gallic acid, *arbutin*, *ursone*, and *ericolin*—principles which are likewise present in the leaves of chimaphila and in uva ursi.

Action and Uses.—Gaultheria is stimulant and somewhat astringent. It has sometimes been employed as a substitute for Chinese tea in country places, where it is also popularly used as an *emmenagogue* and *galactagogue* and in chronic *bowel complaints*. In the former cases a hot infusion of the leaves is best; in the latter a cold infusion, made with the leaves in water Gm. 32 to Gm. 500 (℥j in Oj) may be taken freely. The action and most important use of gaultheria are described in connection with its oil.

GELATINA. *Br.*—Gelatin.

Gelatine, Fr.; *Gelatin*, G.; *Gelatina*, Sp.

Origin and Preparation.—When bone-cartilage, animal skin, tendons, and ligaments are boiled for a long time with water, they become soluble therein, and on cooling the solution forms a jelly. During the boiling the animal tissues are placed upon a sieve or perforated diaphragm which is inserted above the bottom of the boiler. When sufficiently saturated the solution is drawn off and allowed to cool, the jelly being then cut into thin cakes, and these are placed upon nettings to dry. When made from carefully-selected material (fresh bones) it constitutes the *gelatin* of commerce, known also as *artificial isinglass*. The offal of slaughter-houses and of tanneries yields an impurer gelatin, known as *colla*, s. *colla animalis*, s. *glutinum*—glue, *E.*; colle, colle forte, *Fr.*; Leim, *G.* The importation into the United States of gelatin has increased from 139,000 pounds in 1876 to 476,000 pounds in 1882.

Properties.—Gelatin is met with in commerce in very thin, rectangular, transparent pieces bearing the impressions of the netting upon which it has been dried, or in smooth sheets which are either thin and transparent, or thicker, more or less porous, and opaque. It is not unfrequently cut into shreds, and the transparent kind is often variously colored. Glue is in similar pieces, but usually thicker, and varies in color between pale-yellowish and dark-brown, or nearly black in the commonest varieties, and has an offensive animal odor, which is more apparent after it has been dissolved in hot water. To be adapted for dietetic or pharmaceutical purposes gelatin should not alter in color after being digested in hot water, and the solution should be free from smell.

It is to a small extent soluble in cold glycerin, dissolves freely in hot water, forming on cooling a tremulous transparent jelly, and is insoluble in alcohol and ether. Its solution in water is not precipitated by dilute solutions of alum, ferric chloride, or lead sub-

acetate (distinction from *chondrin*), but yields precipitates with tannin, chlorine-water, corrosive sublimate, and platinic chloride. The tissues yielding gelatin likewise unite with tannin, forming leather. Gelatin dissolves in acetic and in dilute mineral acids, the solutions being known as *liquid glue*. When its solution in water is boiled for a long time it loses the property of gelatinizing on cooling. By dry distillation gelatin yields ammonium carbonate and a number of volatile bases, which are contained in *Dippel's animal oil*. Boiled with solution of potassa or with sulphuric acid, ammonia, *glycocoll*, $C_2H_5NO_2$, and *leucin*, $C_6H_{13}NO_2$, are obtained among other products.

Composition.—Gelatin, also called *glutin*, consists of about 50 per cent. of carbon, 18 of nitrogen, 6.5 of hydrogen, 25 of oxygen, and 0.5 of sulphur.

Chondrin, which is obtained from the permanent cartilages by boiling with water, has a similar composition, but contains less nitrogen and more oxygen. In addition to the differences pointed out above, it is distinguished from gelatin by being precipitated by acetic and the mineral acids.

Pharmaceutical Uses.—Gelatin is employed as a reagent for *estimating tannin*, a convenient solution for the purpose being made by dissolving about 50 Gm. of it, together with 8 or 10 Gm. of alum, in a liter of distilled water; before use the strength of the solution must be determined with a fresh solution of pure tannin. It should, however, be remembered that the different tannins require for complete precipitation different amounts of gelatin, so that the results obtained are not absolutely correct. The pectic acid of oak-bark, according to P. Büchner (1867), is likewise precipitated by a solution containing both gelatin and alum.

Gelatin is used for preparing the ordinary *court plaster* (see p. 603) and for the coating of pills. (See PILULÆ.) Dried in very thin layers, it has been recommended, under the name of *devorative* or *folding capsules*, for the administration of powders, the thin sheets being used in precisely the same manner as paper, except that after the introduction of the powder they are permanently closed by moistening the edges, and are swallowed, together with the powder, after having been softened by being dipped in water. *Medicated gelatin* is prepared by pouring a concentrated solution of gelatin, in which the medicinal substance has been dissolved, upon a polished and perfectly level surface; the sheet thus obtained is then divided into squares or disks in such a manner that each represents a definite weight of the medicine. *Gelatin capsules* are made by dipping oblong moulds of the desired size and shape into a gelatin solution; after the surface has been sufficiently coated, the capsule, while still pliant, is removed, filled with the powder or liquid, and the orifice closed by a drop of solidifying gelatin; or for extemporaneous use an empty capsule is slipped over the open end of another containing the medicine.

Within a few years so-called *medicinal pearls*, containing ether or other liquid, have been introduced. Hager recommends them to be made of gelatin, gum-arabic, sugar, and honey rolled out into sheets, one of which, while still rather soft, is placed upon an iron plate containing suitable cavities, into which the mass sinks; the liquid is then introduced, the orifices are closed by another sheet of the gelatin compound, the whole covered by a second iron plate having depressions exactly corresponding to those of the first, and after screwing the plates together their position is reversed. The pearls are finally separated by subjecting the entire arrangement to powerful pressure.

Gelatin has also been used as a base for the preparation of *medicated suppositories*, vaginal as well as rectal, and for *bougies*. The material consists of about 3 parts of gelatin, which, after having been soaked in water, is dissolved in 7 parts of glycerin. The medicating substance should be soluble in the vehicle. Substances containing tannin are evidently not adapted for this mode of medication.

Liquid glue may be made in various ways, either by dissolving glue in acetic acid or by adding to a strong aqueous solution of glue, nitric acid, equal to one-sixth or one-seventh of the weight of the glue. A solution of glue in spirit of nitrous ether is stated to be very serviceable, particularly if a little caoutchouc has been added to it. A solution of phosphoric acid in water, nearly neutralized by ammonium carbonate, has likewise been recommended for preparing liquid glue. The glue becomes water-proof by the addition of about 2 per cent. of potassium bichromate immediately preceding the application of its solution, and afterward exposing to the sunlight.

Gelatin also forms the chief constituent of the mass of which *hectographs* are made: 40 parts of gelatin or light-colored glue, after having been softened by water, are dissolved with the aid of heat in 100 parts of glycerin, to which 10 parts of simple syrup and 5 parts of mucilage of gum-arabic have been added; the scum is removed and the mass poured out. Finely-powdered whiting or terra-alba is sometimes added to the mass.

Hectograph inks are made by dissolving 1 part of aniline violet or other similar compound in 10 parts each of acetic acid and water. After copying, the ink which is still adhering to the mass is removed with a sponge moistened with diluted vinegar.

Action and Uses.—Veit (*Zeitsch. f. Biologie*, 1872, S. 297) concluded from his experiments that gelatin contributes nothing directly to the growth of the tissues, but that owing to its ready decomposition it may, by substitution for the albumen, limit the destruction of albuminous tissues, and in some degree also the waste of fat, whose function is analogous to its own. In the form of calves'-feet jelly it is employed during convalescence from acute disease, but its utility probably depends in part upon the sugar, wine, and spices that season it. Solutions of gelatin are sometimes used to allay the irritation of the mouth, stomach, etc. produced by *corrosive poisons*. It has been given by enema as a lenitive in *ulceration of the rectum*, and a coating of it has been applied to *cutaneous eruptions* to protect them from the air. It is also dissolved in baths for chronic diseases of the skin, to remove the crusts or epidermic scales, or simply to render the skin soft and pliable. For this purpose about Gm. 500 (a pound) of gelatin dissolved by boiling water is added to the bath when it is taken. Gelatin has also been used in the same manner as starch to prepare an immovable apparatus for *fractures*, etc. Catti has proposed the introduction of gelatinous cylinders or pencils charged with astringent or disinfecting agents into the nostrils in the treatment of chronic *coryza*, *ozæna*, etc.; and Pick strongly advocates the use of medicated gelatin, instead of ointments, in the treatment of *diseases of the skin*, and especially of *eczema* (*Centralb. f. Ther.*, i. 147).

Gelosine has the property of imbibing liquids with great increase of bulk, and of retracting again by drying. This quality has been made use of in bougies formed with it for the treatment of *strictures* (*Bull. et Mém. Soc. Thérap.*, 1886, p. 193). A jelly obtained from it by hot water has been used as an excipient for many medicines (*Bull. de Thérap.*, cxi. 31).

GELSEMIUM, *U. S.*, *Br.*—Gelsemium.

Radix gelsemii.—*Yellow jessamine or jasmine*, E.; *Jasmin sauvage*, Fr.; *Gelsemie, Giftjasmin*, G.; *Gelsemio*, Sp.

The rhizome and roots of Gelsemium (Bignonia, *Linné;* Lisianthus, *Miller;* Anonymos, *Walter*) sempervirens, *Persoon*, s. Gels. nitidum, *Michaux*, s. G. lucidum, *Poiret*. Bentley and Trimen, *Med. Plants*, 181; Meehan, *Native Flowers*, i. 9.

Nat. Ord.—Loganiaceæ, Gelsemieæ.

Origin.—The yellow jessamine is indigenous to the Southern United States, growing in moist woods from Virginia to Florida and Alabama, and flowering early in the spring, beginning to bloom in Florida in January, and farther north in March or April. It has a high climbing stem with opposite, ovate-lanceolate, entire, smooth, and coriaceous leaves, and solitary or axillary clusters of very fragrant flowers, which have a bright-yellow, funnel-form, five-lobed corolla 25–38 Mm. (1 to 1½ inches) long, and produce a flattened two-celled fruit containing four to six winged seeds in each cell. The root and the subterranean stem are the parts used in medicine.

Description.—The rhizome is about 25 Mm. (one inch) or more in diameter, is externally brown-yellow with purplish-brown longitudinal lines, and breaks with a tough splintery fracture, showing silky bast-fibres in the inner closely-adhering bark, a porous yellowish wood which is traversed by whitish medullary rays, and a darker-colored central pith. The roots are thinner, similar in color externally, beset with numerous thin fibres, and marked by irregular longitudinal wrinkles and small scars. A transverse section shows a thin yellowish-brown bark covering a hard, pale-yellowish meditullium without a central pith, but radially striate by numerous whitish medullary rays. Fragments of the thin purplish over-ground stem are occasionally present in the commercial article. The drug has a peculiar heavy aromatic odor, which is more marked when a larger quantity is examined. The taste of the bark is not unpleasantly bitter; that of the wood is but slight.

Fig. 135.

Gelsemium sempervirens, *Allen:* transverse section of root.

Constituents.—An analysis made by M. H. Kollock (1855) proved the existence of an alkaloid, *gelsemine*, besides volatile oil, starch, and gummy pectinaceous and resinous principles. The existence of the alkaloid was corroborated by C. L. Eberle (1868) and Prof. Wormley (1870); the latter obtained it (1877) by acidulating a concentrated tincture with acetic acid, precipitating the resin by water, concentrating the aqueous fil-

trate, removing from the solution *gelsemic* or *gelseminic acid* by ether, liberating the alkaloid by sodium carbonate, and extracting it by ether or chloroform. Dragendorff (1878) recommended a similar process, removing gelsemic acid from the acid liquid by chloroform, and, after rendering the liquid alkaline, extracting the alkaloid with benzin and chloroform. It is amorphous, white, intensely bitter, strongly alkaline, and slightly soluble in cold water, in which its salts dissolve quite readily. Sulphuric acid produces a red color, changing to purple when heated, nitric acid a greenish, and hydrochloric acid a yellowish, color. C. A. Robbins (1876) obtained for it the empirical formula $C_{11}H_{19}NO_2$, and observed that ceroso-ceric oxide imparts to the sulphuric acid solution a rose-cherry-red color. E. Schwarz (1882) has studied its reactions, and considers the most characteristic one to be with sulphuric trihydrate in excess, followed by potassium chromate (or in place thereof manganese dioxide, ceric oxide, or lead dioxide), when a cherry-red color is produced, changing to dingy gray-brown, and finally to green. Fröhde's reagent colors roe-brown or red-brown, finally yellowish-green. *Brouardet-Boutmy's reagent* (potassium ferricyanide, followed by weak solution of ferric chloride; this produces Prussian blue with most of the *ptomaïnes* or cadaver alkaloids) gives an intense green color; *Schneider's reagent* (sugar and strong sulphuric acid) colors cherry-red; and *Selmi's reagent* (iodic acid suspended in sulphuric acid), rose-red.

Robbins regarded the *gelsemic acid* to be identical with *æsculin*, $C_{15}H_{16}O_9$, a principle present in the bark of the horse-chestnut (Æsculus hippocastanum, *Linné*), in quassia, red saunders, etc. It crystallizes in colorless prisms, is soluble in 400 parts of cold water, and nearly insoluble in chloroform and ether, possesses a bitterish taste, and yields with alkalies in extremely dilute solutions a characteristic fluorescence, being yellow in transmitted and blue in reflected light, and destroyed by acids. Æsculin is a glucoside, being split by dilute acids into glucose and *æsculetin*, $C_9H_6O_4$, which is colored yellow by alkalies and dark-green by ferric chloride. Dragendorff and Schwarz noticed the strong fluorescence of gelsemic acid, but did not examine into its alleged identity with æsculin. But Prof. Wormley (1882) has shown the former to be quite distinct; it crystallizes very readily, dissolves in 2912 parts of water, in 330 parts of ether, and, with a yellowish color, in cold or warm sulphuric acid, and is insoluble in hydrochloric acid; its solution is precipitated by silver nitrate, brownish-yellow, darkening to blue-black; by corrosive sublimate, yellowish, crystallizing in needles; by bromine, green, turning bluish and brownish; by copper sulphate, dirty brown, turning dull red and crystallizing; and by lead acetate, yellow, crystallizing. Wormley obtained on an average 0.2 per cent. of the alkaloid and 0.4 per cent. of the acid. The ash of air-dry root amounts to 4 per cent. (Kollock).

Action and Uses.—Gelsemine induces paralysis both of sensation and motion, sometimes of the one first, and sometimes of the other, lowers the force and rate of the pulse and respiration, reduces the temperature, dilates the pupils, projects the eyeballs, and does not suspend the heart's action until after respiration has ceased. Death is apt to be preceded by intermittent tetanoid convulsions, which cannot be immediately reproduced like those excited by strychnine. Dr. Wormley found that $\frac{1}{8}$ grain given subcutaneously to a strong cat caused death in one and a half hours, with symptoms of great debility; that $\frac{1}{6}$ grain given to a frog caused prostration, followed by tetanic convulsions and death in four hours; and when $\frac{1}{2}$ grain was injected into the peritoneum of a frog the animal opened its mouth convulsively, the jaws fell at intervals, and there was great muscular prostration. In twenty minutes the body was completely relaxed, and reflex irritability of the muscles was abolished, including that of the heart, which was arrested in diastole (*Am. Jour. of Phar.*, July, 1882, p. 343). According to Dr. C. G. Davis, the alkaloid hastens and intensifies the tetanizing action of strychnine (*Jour. Amer. Med. Assoc.*, ii. 128), doubtless by lowering the tone of the nervous system, just as it causes tetany when given alone. The results of Moritz's experiments may be summarized thus: Gelsemine produces in warm-blooded animals excitation, followed by depression, and even paralysis of the brain and spinal marrow. It first quickens, and afterward slows, the respiration and renders it shallower. On the heart it acts only through the respiration. Applied to one eye, it dilates the pupil and disturbs visual accommodation. The peculiar tremor caused by it in cold-blooded animals is of spinal origin, as are also its influence on the mode of respiration, as just described, and the slowing of the heart in the last stage of the lethal action of the poison (*Archiv f. Pathol. u. Physiol.*, xi. 299; compare Rouch, *Bull. de Thérap.*, civ. 527).

Gelsemium appears to be one of the too-numerous remedies which have been used in a great variety of sthenic febrile diseases upon no better ground than their power of lower-

ing the pulse and depressing the nervous system. Incalculable mischief has been caused by them, and still more is likely to be occasioned by gelsemium in febrile affections. Some persons who have loudly eulogized it as an antipyretic have been at great pains to explain, in opposition to the popular doctrine, that heat is death and cold is life; that we have only to reduce the fever temperature to the normal standard or below it to cure febrile disease; and, that, therefore, gelsemium will cure fever. Unfortunately for this mode of medical reasoning, gelsemium does not reduce the temperature, except in so far as it threatens to destroy life through its poisonous operation. But such is probably not the reduction that its advocates had in view. Among a host of incongruous diseases which are said to have been "cured" by this agent, the one in regard to which very positive testimony exists is acute or rheumatic *neuralgia*, especially of the first and second branches of the fifth nerve (*Times and Gaz.*, Sept. 1886, p. 421; *Boston Med. and Surg. Jour.*, Sept. 1888, p. 243). The most usual testimony is, that the medicine is nearly inoperative when the pain affects the third branch of the fifth pair or the intercostal nerves. And there are cases in which, when the trigeminus alone is involved, it relieves the inferior dental even more than the other branches. Undoubtedly, acute attacks produced by cold are more promptly cured than others, as, indeed, they are by all remedies that cure neuralgia at all. But some physicians have abandoned its use, because it was found necessary to push it until its physiological effects are produced (*Therap. Gaz.*, ix. 69). It has also been employed in *tetanus* (*Med. Record*, xxvi. 34) and in *torticollis* (*Med. News*, lv. 543). Dr. Bulkley recommends the tincture of gelsemium for the relief of *itching* in chronic eczema, giving it in 10-drop doses every half hour or hour until the pruritus is relieved (*New York Med. Jour.*, Jan. 1881). It is claimed to relieve the suffering in chronic inflammation of the neck of the bladder (*Med. Record*, xxx. 68). Dr. Edson claims that the following lotion is of great service in *poisoning* by Rhus radicans: R. Acid. carbolic. ʒss; Ext. gelsemii fʒij; Glycerinæ ʒss; Aquæ ad. ʒiv.—S. To be kept applied on cloths, while internally 2 minims of fluid extract of gelsemium are given every three hours (*Med. Record*, xxii. 121). Gm. 0.20–60 (♏ iij–x) of the fluid extract, or three times that quantity of the tincture, may be given every two hours. Like digitalis, aconite, veratrum, and antimony, it may, by reducing the pulse, prove useful in some attacks of *coryza*, *congestion of the brain*, *mania*, *and meningitis*. To the same category belongs the excited stage of *poisoning by opium* (*Ther. Gaz.*, xi. 429) and of *sunstroke* (*ibid.*, p. 645). It has been claimed that gelsemium produces tolerance of quinine in certain cases intolerant of the antiperiodic alone; that it is efficient in convulsions produced by teething or by indigestion; that it exhibits peculiar virtues in rattlesnake-bites; that it expedites labor due to uterine rigidity, and relieves various forms of uterine congestion, etc. (Davis, *loc. cit.*). The evidence in favor of these claims does not appear to be sufficient. The proper *antidote* to poisoning by gelsemium is morphine hypodermically administered. The experiments of Rehfuss (*Inaug. Thesis, Univ. Pa.*, 1884; *Ther. Gaz.*, ix. 655) ascribe an equal efficacy to atropine, but deny to both a power of neutralizing a lethal dose of gelsemium. Tincture of nux vomica is said to have had a similar effect (*Canad. Phar. Jour.* and *Ann. de Thérap.*, 1888, p. 321). General stimulation by mechanical means, rubefacients, and heat, and the administration of ammonia, coffee, and alcohol, the last hypodermically, should be employed after the stomach has been evacuated by mustard and water, sulphate of zinc, tickling the fauces, etc. Rehfuss, however, found that in animals alcohol displayed but feeble antidotal powers, and that ammonium carbonate intensified the action of the poison.

GENTIANA, *U. S.*—Gentian.

Gentianæ radix, Br.; *Radix gentianæ*, P. A., P. G.; *Radix gentianæ rubræ vel luteæ (vel majoris).*—*Gentian-root*, E.; *Racine de gentiane (de gentiane jaune)*, Fr.; *Enzianwurzel, Bitterwurzel, Rother (Gelber) Enzian*, G.; *Genciana*, Sp.

The root of Gentiana lutea, *Linné*. Steph. and Church, *Med. Bot.*, plate 132; Bentley and Trimen, *Med. Plants*, 182.

Nat. Ord.—Gentianaceæ.

Origin.—Gentian is indigenous to the mountainous regions of Southern and Central Europe, from Portugal eastward to Bosnia, and as far north as Central Germany. It has a thick hollow stem 0.6 to 1.2 M. (2–4 feet) high, opposite, entire, five- to seven-nerved leaves, and axillary clusters of pedicellate flowers with a bright-yellow, five-lobed, spotted corolla, and producing a one-celled, ovate capsule containing numerous oval, compressed, and winged seeds.

The following species agree in medicinal properties with the preceding, and their roots are recognized by different pharmacopœias, and are collected indiscriminately in localities where the plants grow. GENT. PURPUREA, *Linné*, has yellowish-purple flowers, and grows in the Alps and Carpathian Mountains and in Southern Norway. GENT. PANNONICA, *Scopoli*, has dark-purple flowers, and is met with in the mountains of Austria. GENT. PUNCTATA, *Linné*, with yellow, but purple-dotted, flowers, is indigenous to the Alps and eastward to the Balkan Mountains.

Description.—The fleshy and branching usually several-headed root attains a length of over 60 Cm. (2 feet) and a diameter of about 38 Mm. (1½ inches), but appears in commerce always in shorter pieces, the thicker ones being longitudinally sliced before drying. The abrupt or concave somewhat conical heads are closely annulated; below this portion the root is deeply wrinkled longitudinally, with an overlapping bark in the longitudinally split pieces; it is of a yellowish-brown color, the surface darker and grayish and the fracture short, of a slight waxy lustre, and with numerous minute brown dots. The transverse section shows a faint radiating arrangement only near the dark cambium-line, and a fleshy meditullium which is about six times thicker than the bark. Liber-fibres and wood-fibres are wanting, and are replaced by axially somewhat elongated parenchyma; the spiral and scalariform ducts are accompanied by sieve-tubes. The root is very hygroscopic, contains 14 to 18 per cent. of water, and is tough and flexible in damp weather. It has a faint but heavy characteristic odor, which is more prominent in a hot infusion; its taste is sweetish, then strongly bitter, but free from astringency or acridity. The importation of gentian into the United States averages about 200,000 pounds annually.

The roots of the other species of Gentiana mentioned above are rather shorter and thinner, and those of G. PANNONICA are scarcely annulate.

Constituents.—Kromayer (1862) was the first who isolated the pure bitter principle, which in many previous analyses had been obtained in an impure extract-like form. The yellow crystalline *gentianin* of Henry and Caventou (1821) was in 1837 proven, by Trommsdorff and by Leconte, to be tasteless, and merely contaminated with some of the bitter matter. This *gentisin*, *gentisic* or *gentianic acid*, may be obtained by washing the alcoholic extract of gentian with cold water to remove the bitter principle, afterward with some cold ether to remove fat, and crystallizing from alcohol. Its composition is $C_{14}H_{10}O_5$. It forms bright-yellow, tasteless crystals requiring 5000 parts of water, 2000 parts of ether, and nearly 500 parts of cold alcohol for solution; it is soluble in alkalies and by ferric chloride colored brown (Leconte). Patch (1881) determined it to be soluble in 280 parts of cold and 120 parts of hot alcohol and in 400 parts of ether, to become dark-green with nitric acid, and to dissolve unchanged in sulphuric acid; it melts above 100° C., and on cooling congeals crystalline. Hlasiwetz and Habermann (1875) obtained from it, by fusion with caustic potassa, *phloroglucin*, *acetic* and *oxysalicylic* (*gentisinic*) *acid*, the latter being $C_7H_6O_4$, and isomeric with protocatechuic acid. The infusion of gentian yields with gelatin a slight precipitate, which, after having been washed with water, is not colored dark with ferric chloride. We showed (1876) the absence of tannin from gentian-root, and this was corroborated by Van Itallie (1888). J. Ville (1877) was inclined to regard gentisin as *gentio-tannic acid*. But after the separation of pectin compounds the infusion yields no precipitate with gelatin, and fresh hide fails to remove any principle reacting with ferric salts. Prof. Patch (1881), however, has shown that the resinous matter is associated with a principle giving a greenish-black color with ferric chloride, and precipitates with cinchonidine sulphate, tartar emetic, and gelatin after, respectively, two, six, and twenty-four hours; this principle has not been isolated.

Gentiopicrin, $C_{30}H_{30}O_{12}$, the bitter principle of gentian, is contained in the aqueous solution of the alcoholic extract, from which it is absorbed by animal charcoal; this is boiled with alcohol, the solution concentrated, treated with lead oxide to remove color, freed from lead by hydrogen sulphide, agitated with ether, and crystallized. It is very soluble in water and diluted alcohol, insoluble in ether, dissolves with alteration in alkalies, and by dilute acids is split into glucose and *gentiogenin*, $C_{14}H_{16}O_5$, which is yellowish-brown, bitter, insoluble in water, and has the same composition as *physalin* (from Physalis Alkekengi). Kromayer states that crystallizable gentiopicrin is obtainable only from fresh, not from dried, gentian-root.

Gentian contains no starch, but a considerable amount of pectin and 12 to 15 per cent. of amorphous sugar, to which the hygroscopic nature of the root is due. A. Meyer (1882) obtained a slightly-sweet, fermentable crystalline sugar, *gentianose*, $C_{16}H_{66}O_{31}$, which does not reduce Fehling's solution. By fermentation a potable spirit is obtained from it in

Switzerland and Southern Germany. The air-dry root yields 8.28 per cent. of ash, consisting mainly of calcium carbonate (Flückiger).

American Gentians.—Several of the blue-flowering gentians of North America are botanically very similar, and some confusion has existed concerning their identity, which is best shown by placing the species and their synonyms together, as at present recognized. We thus have—

(1) G. puberula, *Michaux*; G. Saponaria, var. puberula (Gray's *Man.*, edit. 1); G. Catesbæi, *Elliott*; and G. Elliottii, *Chapman*.

(2) G. Saponaria, *Linné*; G. Catesbæi, *Walter*.

(3) G. Andrewsii, *Grisebach*; G. Saponaria, *Frœlich*; G. fimbriata, *Vahl*.

The first species is indigenous to the States south of North Carolina, and to most States from the Alleghanies to the Mississippi; the second is met with from the mountains of North Carolina to New York and westward to Minnesota; the third species is common in the Middle States and northward. We believe that the *blue gentian-root*, as found in commerce, is collected indiscriminately from the above three species. It is the Gentiana Catesbæi, *U. S.* 1870.

The subterraneous part of these plants consists of an indistinctly annulated head about 13 Mm. (½ inch) long and 3 Mm. (⅛ inch) thick, which, at its base, is furnished with a number of fleshy nearly simple rootlets about 37 Mm. (3 inches) or more in length. When dry they are of a pale-brownish color, with a distinct yellow or orange hue, and short, deep longitudinal wrinkles, devoid of fibres, quite brittle, and breaking with a short or somewhat spongy fracture, which is pale-yellow. The bark is thick and the ligneous cord quite thin. The odor and taste are gentian-like. We have found it occasionally mixed with a root of unknown origin of similar dimensions and appearance, but having a gray hue, a tough fibrous bark, and a sweetish scarcely bitter taste. From experiments made with the root we conclude that its constituents are probably identical with those of G. lutea.

Frasera Carolinensis, *Walter* (Fr. Walteri, *Michaux*), is a tall biennial or triennial herb growing from the Alleghany Mountains westward to the Mississippi. From the appearance of the dried transverse slices the root became known as *American colombo* (*Radix colombo americanæ*: *Racine de colombo de Mariette* (*d'Amérique*), Fr.; *Amerikanische Colombowurzel*, G.). It is easily distinguished from calumba by the absence of the projecting vascular bundles in the interior and of the radiating zone near the cambium. It is now generally dried in longitudinal slices, the bark overlapping. The tissue upon transverse section is pretty uniform in appearance, the vascular bundles being nearly imperceptible in the fleshy parenchyma; the rather thick bark shows two different colored layers, and a dark-brown cambium-line separates it from the meditullium. When dry it has a slight odor; the odor of the infusion is similar to that of gentian; its taste is sweet and bitter and free from astringency. G. W. Kennedy (1873) obtained from the drug *gentiopicrin*. Prof. J. U. Lloyd (1880) prepared the coloring matter in tufts of lemon-yellow silky needles; Prof. Patch (1881) proved it to differ from gentisic acid of gentian; and Trimble and Lloyd (1891) separated it into two principles, melting at 114° and 178° C. respectively, both being nearly insoluble in water, sparingly soluble in benzin and benzol, soluble in alcohol, ether, and chloroform, colored dark-green by ferric salts, and not precipitated by lead acetate. American colombo is therefore closely analogous to gentian, from which it appears to differ chemically in containing less of the bitter principle than the latter, and a larger proportion of two distinct yellow coloring matters.

Medical Action and Uses.—Gentian is a pure and simple bitter. In moderate doses it excites the appetite and strengthens the digestion and does not constipate. If used too long or too freely, it is apt to occasion headache and a full pulse and to render the sweat and urine bitter. It is a valuable remedy for *atonic dyspepsia*, such as accompanies general debility, and especially that which is apt to occur in persons of a gouty habit. It was formerly used in the cure of mild intermittent fevers. The nominal *dose* of gentian in powder is from Gm. 0.60 to 2.00 (10–30 grains), but it is always prescribed in the form of extract, fluid extract, or compound tincture, all of which are officinal.

American gentian is employed to some extent in popular practice in the southern portion of the United States for the same diseases and in the same manner as European gentian. *Frasera*, when fresh, is said to have emetic and purgative properties, and has been compared in its action to rhubarb. The dried root is also reputed to have the tonic properties of simple bitters, and may be given in an infusion made with Gm. 32 to Gm. 500 (℥i to Oj) of boiling water. *Dose*, Gm. 30–60 (1 to 2 fluidounces).

GERANIUM, *U. S.*—Geranium.

Cranesbill-root, E.; *Racine de geranium maculé*, *Bec-de-grue tacheté*, *Pied-de-corneille*, Fr.; *Fleckstorchschnabel*, G.; *Geranio*, Sp.

The rhizome of Geranium maculatum, *Linné*. Bigelow, *Med. Bot.*, i. t. 8; Bentley and Trimen, *Med. Plants*, 42.

Nat. Ord.—Geraniaceæ.

Origin.—This perennial herb is very common in rich woods in most parts of Canada and the United States westward to Kansas, and it flowers from April to July. The stem

Fig. 136.

Geranium maculatum: rhizome and transverse section of rhizome and rootlets, natural size.

is from 30 to 60 Cm. (1–2 feet) high; the hairy leaves, when old, become blotched with white, and are palmately five- or seven-lobed, with wedge-shaped divisions, which are coarsely toothed above; the light-purple flowers are in loose terminal umbels; the fruit is long-beaked, with five one-seeded carpels, which separate when ripe, curving upward together with the style, which separates from the beak. The horizontal rhizome should be collected late in summer or in autumn.

Description.—It is 5 to 7 Cm. (2–3 inches) long, 6 to 12 Mm. ($\frac{1}{4}$–$\frac{1}{2}$ inch) in diameter when fresh, little branched, but tuberculated with the remnants of the stems, longitudinally wrinkled, with indistinct nodes, dark-brown externally, pale red-brown internally. It breaks with a nearly smooth fracture, showing a thin bark and the small, yellowish, broadly wedge-shaped wood-bundles arranged in a circle near the cambium, separated by broad medullary rays, and enclosing a large central pith. It has no odor; its taste is purely astringent. The rootlets are mostly on the lower side, and are much shrunken, fragile, and branched into hair-like fibres.

Constituents.—The analyses of Staples (1829), Bigelow (1833), and Mayers (1889) indicate, besides tannin, the presence of gallic acid, starch, resin, sugar, mucilage, etc. Bowman (1869) found 13 to 17 per cent., and Mayers 11.5 per cent., of tannin, which has not been further investigated. A crystalline principle, observed by Staples, was ascertained by Mayers to be soluble in alcohol, ether, and petroleum benzin. The red color of the tissue is due to phlobaphen.

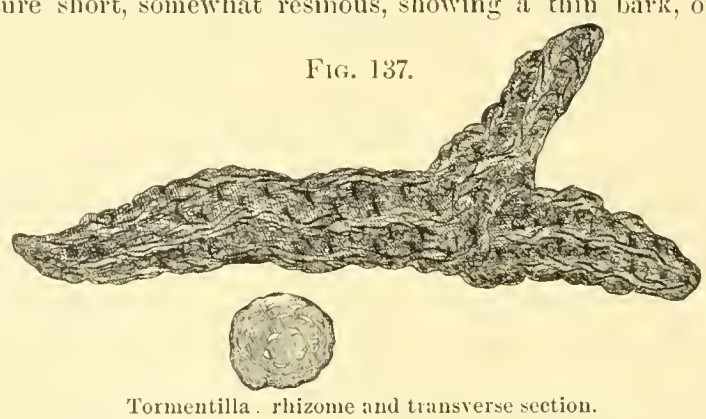
Allied Plants and Drugs.—Geranium Robertianum, *Linné.*—Herb Robert, *E.;* Herbe *à* Robert, *Fr.;* Ruprechtskraut, *G.*—It grows in shady thickets and woods in Europe, in Canada, and from New England westward to Missouri: has an erect branching stem, deeply dissected and pinnatifid leaves, and rose- or purplish-colored flowers. It has a strong rather unpleasant odor and a bitterish, saline, and astringent taste. It contains tannin and a bitter principle.

Erodium (Geranium, *Linné*) cicutarium, *L'Héritier*—Storksbill—indigenous to the Levant and Southern Europe, is sparingly naturalized in the Eastern United States, but is common in Utah and west of the Rocky Mountains, where it is known as *alfilaria*, *pinclover*, and *pingrass*. It has a low spreading stem, pinnate leaves with the leaflets sessile and pinnatifid, and pale-reddish flowers. The odor of the bruised plant resembles that of carrot.

Erodium moschatum, *Aiton*, is found near the Mediterranean and in Southern Africa, and resembles the preceding, but has a rather strong musk-like odor.

Rhizoma tormentillæ; Tormentil, *E.;* Tormentille, *Fr.;* Tormentillwurzel, *G.*—Potentilla Tormentilla, *Schrank* (Tormentilla erecta, *Linné*), *order* Rosaceæ, Potentilleæ, is indigenous to Europe and Northern Asia, and resembles our cinquefoil. The rhizome, which is recognized by the pharmacopœias of Southern and Western Europe, is about 5 Cm. (2 inches) long, of the thickness of a finger, dark gray-brown, with numerous irregular protuberances, internally light brownish-red; fracture short, somewhat resinous, showing a thin bark, one or two circles of

Fig. 137.



Tormentilla: rhizome and transverse section.

small yellowish wood-wedges, broad medullary rays, and a large pith. The faint rose-like odor of fresh tormentil disappears on drying; the taste is strongly astringent.

According to Meissner (1822), tormentil contains 17.5 per cent. (24 to 30 per cent., Bowman, 1869) of tannin, 18 tormentil-red, also some wax, resin, etc. Rembold (1867) found ellagic and kinovic acids; the tannin yields tormentil-red, and this, with potassium hydrate, gives protocatechuic acid and phloroglucin. The presence of calcium oxalate was proven by Scheele.

Potentilla anserina, *Linné.*—Silverweed, *E.;* Argentine, Anserine, *Fr.;* Gänserich, Silberkraut, *G.*—This plant has solitary, long-peduncled flowers, and radical, interruptedly pinnate leaves, composed of nine to nineteen oblong, deeply serrate leaflets, which are silvery white and downy underneath.

Pot. argentea, *Linné, Silvery cinquefoil*, has an ascending stem, palmately five-foliate leaves,

and wedge-oblong, incised, and beneath silvery canescent leaflets. This and the preceding species are recognized by the French Codex.

Pot. fruticosa, *Linné*, *Shrubby cinquefoil*, is shrubby, about 0.9 M. (3 feet) high, has pinnate leaves, with five to seven linear or lance-oblong, entire, and silky leaflets, and numerous flowers.

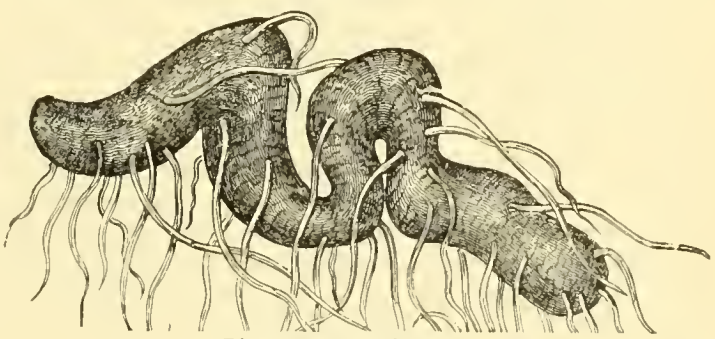
Pot. palustris, *Scopoli*, s. Comarum palustre, *Linné*, *Marsh cinquefoil*, has the leaves with five or seven lance-oblong underneath-whitish leaflets and purple-colored flowers. Like the three preceding species, it is indigenous to Europe and North America.

Pot. reptans, *Linné*.—Creeping cinquefoil, *E.*; Potentille rampante, Quintefeuille, *Fr.*; Fünffingerkraut, *G.*—It grows in moist fields in Europe and Asia; has slender, creeping stems, long-petiolate, palmately five-foliate leaves, oblong-obovate, deeply serrate leaflets, and single, axillary, long-stalked flowers. It resembles the indigenous Pot. canadensis, *Linné*, which has been employed in its stead.

With the exception noted, all the above species of Potentilla have yellow flowers; they are inodorous, and their roots and herbaceous portions have a slightly astringent and bitterish taste. They contain some tannin, a small quantity of bitter principle, mucilage, and other common constituents.

Bistorta, Bistort, Snakeweed, *E.*; Bistorte, Couleuvrine, *Fr.*; Wiesenknöterich, Natterwurz, *G.*—Polygonum Bistorta, *Linné*, *order* Polygonaceæ, grows in the northern hemisphere, in swampy meadows, in the United States from Colorado northward. The rhizome, which is recognized by the pharmacopœias of Western Europe, is about 12 M. (½ inch) broad, S-shaped, somewhat annulate from the leaf-scars, blackish-brown, internally reddish; fracture nearly smooth, showing a moderately thick bark, numerous small wood-bundles in one circle, and a large pith; it is inodorous, and has a strongly astringent taste. Bistort contains starch, calcium oxalate, phlobaphen, tannin (21 per cent., according to Bowman, 1869), and probably gallic acid.

Fig. 138.



Bistorta, natural size.

Extractum Bistortæ, *Fr. Cod.*, is prepared with cold water.

The herbs of most species of Polygonum have a slight astringent and more or less saline or acidulous taste, and have been occasionally employed as mild astringents. Pol. Persicaria, *Linné*, the *spotted knotweed* or *lady's thumb*, has the lanceolate leaves usually marked near the middle with a brown semilunar or triangular spot. Pol. amphibium, *Linné*, or *water-knotweed*, grows in ponds, swamps, and in damp sandy soil, is variable in appearance, and has the rose-red flowers in dense spikes. Pol. aviculare, *Linné*, known as *knot-grass*, *birdweed*, or *goose-grass*, is occasionally erect, but usually has the slender branches prostrate or ascending, and bears two to four inconspicuous greenish and reddish flowers in the axils of the small leaves. Pol. hydropiperoides, *Michaux*, or *mild water-pepper*, has narrow lanceolate leaves and slender spikes of whitish flowers; it is indigenous to North America, while the three preceding species are common in both hemispheres.

Medical Action and Uses.—Geranium is a pure astringent, and may be profitably used in the treatment of subacute and chronic *diarrhœa*. A decoction of it in milk is employed in *cholera infantum*. A decoction, made with an ounce of the root in 1½ pints of water boiled to a pint, is sometimes used in *aphthæ* of the mouth and fauces, in relaxed conditions of the *throat*, *vagina*, and *rectum*, to restrain internal *hæmorrhages*, and to cure *leucorrhœa*, *gleet*, *prolapsus ani*, *p. uteri*, *fissures of the rectum*, etc. The *dose* may be stated at from Gm. 1.30 to 2.60 (grs. xx–xl) of the powdered rhizome or from Gm. 32 to 64 (f℥i–ij) of the decoction. The fluid extract is to be preferred.

Geranium Robertianum, like the officinal plant, has been much valued in Europe for its astringent and cleansing virtues, and employed in the treatment of *sore throat*, superficial inflammations and eruptions of the *skin*, in engorgement of *glands*, *ophthalmia*, etc. Internally, it was given as a diuretic for the relief of *gravel*, also for *hæmorrhages*, etc.

Erodium moschatum was used as a diaphoretic.

Erodium cicutarium attracted some attention in 1859 as a diuretic in *dropsy*, and in 1863 similar reports of its efficacy were published. A decoction was made with 2 ounces of the whole plant in 3 pints of water reduced to 2 pints, and it was prescribed in doses of 4 or 5 fluidounces three times a day.

Bistorta, Potentilla, and Tormentilla are used for the same purposes as geranium. Other species of Polygonum (*e. g.* hydropiper) have a decidedly stimulant quality.

GEUM.—Water-Avens.

Radix caryophyllatæ aquaticæ, Radix benedictæ sylvestris.—Racine de bénoite aquatique (de bénoite des ruisseaux), Fr.; *Sumpfnelkenwurzel, Wasser-Benedikten-Wurzel*, G.

The rhizome, with the rootlets, of Geum rivale, *Linné.*

Nat. Ord.—Rosaceæ, Dryadeæ.

Origin.—This perennial plant grows in wet meadows and moist woods in hilly localities of North America from Pennsylvania northward, and is likewise indigenous to Central and Northern Europe and Northern Asia. It has a stem 30–60 Cm. (1 to 2 feet) high, with lyrate or interruptedly pinnate root-leaves and trifoliate or three-lobed stem-leaves, the leaflets or lobes being obovate or cuneate-oblong; the bell-shaped calyx is purplish-brown; the five petals are clawed, purplish-yellow, and veined.

Description.—The rhizome is nearly horizontal, 5–7 Cm. (2 to 3 inches) long, about 6 Mm. (¼ inch) thick, somewhat branched, tuberculate above from the bases of the stems, and there densely beset with red-brown hairy leaf-sheaths. It is externally blackish-brown, breaks with a rather short and waxy fracture, and has a thin purplish-brown bark, brown-gray pith, and small distant light-colored wood-wedges. It has a very faint somewhat clove-like odor and a bitterish-astringent taste.

Water-avens has not been analyzed; its constituents are probably similar to those of the yellow-flowered Geum urbanum, *Linné*, or *avens*, which grows in Europe in woods and shady places, and has an oblique or perpendicular rhizome 25–50 Mm. (1 or 2 inches) in length, abrupt below, or passing into the main or tap-root; it is hard, dark-brown, tuberculate, and beset with dark-brown membranous scales; the numerous thin fibres are pale-brown, and 7–10 Cm. (3 to 4 inches) long; the wood is in five or six broad and rounded wedges and encloses a large purplish pith. It has a distinct clove-like odor and a bitter astringent taste. It is known in Europe as *radix caryophyllatæ*. Geum japonicum, *Thunberg*, resembles it in appearance and properties, but has a brown horny centre.

Constituents.—Avens, according to Buchner (1844), contains a small quantity of a volatile oil possessing acid properties, about 3 per cent. of tannin, and a bitter principle which appears likewise to possess acid properties. The remaining constituents, sugar, fat, resin, etc., are not of medicinal importance.

Action and Uses.—Water-avens is in its action very like avens, G. urbanum. Both are very astringent and more or less tonic. Like other agents with these qualities, it is apt to derange the digestion and cause vomiting if too freely given. It has been employed in all forms of diseases of the mucous membranes depending upon relaxation and attended with excessive and altered secretions, including atonic *dyspepsia, diarrhœa, bronchorrhœa, leucorrhœa*, etc. It has also been used in chronic *rheumatism, scrofula*, slight *intermittent fever*, and in *menstrual derangements* depending on debility. The *dose* is represented by about Gm. 2 (gr. xxx) of the powdered root, but it is best administered in a decoction made by boiling Gm. 32 (an ounce) of the root in a pint of water, which may be given in *doses* of 1 or 2 fluidounces.

GILLENIA.—Gillenia,

Indian physic, Indian hippo, American ipecac, Bowman's root, E.; *Gillénie*, Fr.; *Gillenie*, G.

The rhizome, with the rootlets, of Gillenia (Spiræa, *Linné*) trifoliata, *Moench*, and of Gillenia stipulacea, *Nuttall* (Spir. stipulata, *Willdenow*).

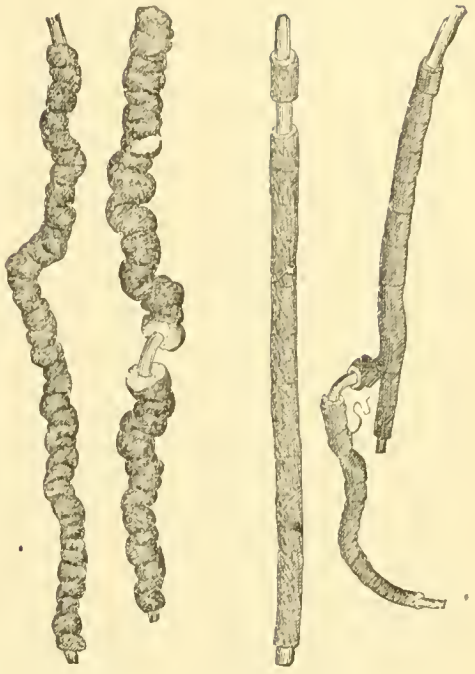
Nat. Ord.—Rosaceæ, Spiræeæ.

Origin.—Both species are perennial herbs indigenous to the United States, the first being found almost exclusively east of the Alleghanies from New York south to Georgia; the other is found from New York westward and southward to Alabama. The plants are 60 to 90 Cm. (2 to 3 feet) high, branched, with nearly sessile, trifoliate, doubly serrate, or incised leaves, and loose corymbs of pale rose-colored or white flowers, the calyx of which is tubular and constricted at the throat, the five unequal petals being long linear-lanceolate. The two plants are readily distinguished by their stipules, which in G. trifoliata are awl-shaped and entire, and in G. stipulacea are large, leaf-like, ovate, and incised. The rhizome and rootlets are employed.

Description.—The rhizome of G. stipulacea, which is usually found in commerce,

is nearly horizontal, about 25 Mm. (1 inch) thick, very knotty from the numerous branches and remnants of stems. The larger rootlets are 9 Mm. ($\frac{3}{8}$ inch) thick near the base, tortuous, irregularly branched; the smaller rootlets are undulated, and have a knotty or annulated appearance from the semicircular constrictions and the transverse fissure of the bark on one side and the depressions on the opposite side. The rhizome and rootlets of G. trifoliata are smaller and less knotty, the rootlets often smooth or indistinctly annulated, and with few or no transverse fissures. Both have a reddish- or grayish-brown color externally, and are hard and very woody, breaking with some difficulty except through the brittle bark. The bark of the rhizome is thin, the wood, about eight times thicker, of a whitish color, with several annual rings enclosing a thin pith and traversed by fine medullary rays. The bark of the root is of uneven thickness, in its outer layer brownish-red, the inner layer reddish-white, with numerous minute red resinous dots. The odor is very slight; the taste of the bark is bitter, not unpleasant, exciting the flow of saliva; the wood is tasteless.

Fig. 139. Fig. 140.



G. stipulacea. G. trifoliata.
Rootlets, natural size.

Constituents.—The various analyses made of Gillenia have established the presence of starch, tannin, gum, albumen, fat, resin, etc. The bitter principle, *gillenin*, not quite pure yet, has been obtained by W. B. Stanhope (1856) in the form of a whitish powder having a slight odor and a very bitter taste, neutral to test-paper, soluble in water, alcohol, ether, and dilute acids, and colored blood-red by nitric acid. Its watery solution is stated to be precipitated by lead subacetate, tartar emetic, and potassa, but not by tannin; $\frac{1}{2}$ grain caused much nausea. It was prepared by washing the alcoholic extract with water, treating the residue with very dilute sulphuric acid, adding magnesia, evaporating and exhausting the dry mass with alcohol.

Action and Uses.—The popular title of "American ipecacuanha" sufficiently indicates the prominent virtue of this medicine. It is a mild emetic. The *dose* is Gm. 1.30–2.00 (gr. xx–xxx). The allied species, G. stipulacea, has identical qualities. Its dust, like that of ipecacuanha, irritates the nostrils, throat, and larynx. Gillenin, when pure, will produce nausea and vomiting in *doses* of Gm. 0.03–0.06 (gr. ss–j). Injected into the femoral vein of a dog, it excited vomiting.

GLECHOMA.—Ground-Ivy.

Herba hederæ terrestris.—Lierre terrestre, Fr.; *Gundermann, Gundelrebe*, G.; *Hiedra terrestre*, Sp.

Glechoma hederacea, *Linné*, s. Nepeta Glechoma, *Bentham*.

Nat. Ord.—Labiatæ, Nepeteæ.

Description.—Ground-ivy is a creeping and trailing perennial which is common in Europe and naturalized in various parts of North America. The ascending branches are from 15–25 Cm. (6 to 10 inches) long, quadrangular, and have opposite petiolate leaves, which are 25–38 Mm. (1 or $1\frac{1}{2}$ inches) long, round-reniform, deeply crenate, green, and underneath often purplish. The blue or purplish flowers are in small axillary clusters, from two to five in number. The plant has a slight balsamic odor and a bitter somewhat acrid taste.

Constituents.—Like other plants of the same natural order, ground-ivy contains volatile oil, resin, fat, gum, sugar, and tannin; the bitter and acrid principle has not been investigated.

Action and Uses.—Ground-ivy is said to act poisonously upon horses and sheep. It has been chiefly used in medicine in the treatment of *chronic bronchitis*, and its virtues in this affection are attested by medical evidence as well as by popular faith. It was at one time reputed to be a cure for consumption, by which was meant not the incurable disease which depends upon tuberculosis, but chronic bronchitis with muco-purulent

sputa. It had also some reputation in catarrhal affections of the *urinary* organs and in atonic *dyspepsia*. Externally the bruised herb has been applied in poultices or alone to indolent *ulcers*. An infusion may be made with Gm. 32 (℥j) of the herb to Gm. 500 (Oj) of boiling water and given in wineglassful doses.

GLYCERINUM, *U. S., Br., P. G.*—Glycerin.

Glycerina, U. S., 1870.—*Glycerine*, E.; *Glycérine*, Fr.; *Glycerin*, *Oelsüss*, G.
Formula $C_3H_5(OH)_3$. Molecular weight 91.79.

A liquid sweet principle obtained from fat and fixed oils, and containing not less than 95 per cent. of absolute glycerin.

Origin.—Glycerin, which is not found in the free state except in some rancid fats, exists in combination with the so-called fatty acids, forming compound ethers, which constitute most of the animal and vegetable solid and liquid fats. It is formed in small quantities (about 3 per cent. of the glucose present) during the fermentation of saccharine liquids. Scheele, who discovered it in 1779, called it *sweet principle of oils*. In the United States it was first manufactured in Philadelphia by Robert Shoemaker in 1846; at present it is extensively obtained by distillation in several cities, and in addition over 6,000,000 pounds are now annually imported, against about 2,000,000 pounds in 1878.

Preparation.—To obtain glycerin, fat must be decomposed into its proximate constituents, either by a caustic alkali, as in the manufacture of soap, or by lead oxide, as in the preparation of lead plaster, or by the action of water at an elevated temperature under high pressure. The latter process, which was patented in 1854 by R. A. Tilghman, yields the acids of the fat and an aqueous solution of glycerin. Water which has been agitated with recently-prepared lead plaster is likewise such a solution, and the liquid from which soap has been separated contains glycerin, saline matters, and various organic impurities, which may be removed by treatment with the necessary precipitants and with charcoal, the solutions being finally evaporated and distilled with steam under pressure. By fractional condensation most of the glycerin is obtained in a nearly anhydrous state.

Large quantities of crude glycerin are obtained by treating fats with concentrated sulphuric acid, adding boiling water, and afterward removing the acid by means of barium or calcium carbonate; the glycerin remains in aqueous solution, is always highly colored, and constitutes the impurest variety of crude glycerin.

The best results in the manufacture of glycerin are those obtained by what is known as "aqueous saponification." This process consists in mixing the fats with certain proportions of water in closed boilers provided with stirrers, and then treating the mixture with superheated steam at a pressure of 15 atmospheres (225 pounds); the temperature is maintained at about 200° C. (392° F.), and the mixture kept in constant motion. This treatment decomposes the fat into glycerin and free fatty acids, which latter float on the surface, and may be removed mechanically, while the glycerin enters into solution in the water, and is subsequently purified and concentrated. The purest glycerin is that obtained by distillation of the concentrated crude product in specially constructed stills, where the liquid is first heated to 100° or 110° C. to remove all volatile fatty acids; when the distillate ceases to show an acid reaction the temperature is raised to 170° or 180° C., and glycerin will distil over with aqueous vapor into a series of condensers. Repeated distillations may be necessary.

Synthetic or artificial glycerin has been prepared from tribromopropane, $C_3H_5Br_3$, and also trichloropropane, $C_3H_5Cl_3$; the former compound is treated with silver acetate, and the resulting glyceryl acetate or triacetin is decomposed by potassium hydroxide, yielding glycerin and potassium acetate; thus, $C_3H_5Br_3 + 3AgC_2H_3O_2 = C_3H_5(C_2H_3O_2)_3 + 3AgBr$—$C_3H_5(C_2H_3O_2)_3 + 3KOH = C_3H_5(OH)_3 + 3KC_2H_3O_2$. When trichloropropane is heated with water to 180° C. it also yields glycerin.

In subjecting soap-liquors to dialysis the glycerin passes quite freely with the salts through parchment-paper, but not through "gutta-percha paper," which has been (1882) recommended for the purification of such impure glycerin. The purification of glycerin by distillation was patented by Wilson and Payne in 1854.

Properties.—Glycerin is a syrupy liquid having the specific gravity 1.28 at 15° C. (59° F.) (Pelouze). The following table, furnished by Dr. A. B. Lyons (1888) shows the percentage of absolute glycerin contained in aqueous solutions of different densities at 15°C. (59° F.); the figures differ but slightly in the third and fourth decimal places from

those obtained by W. Lenz (1880) in determining the carbon in various dilutions of glycerin.

100	per ct.,	1.26596	sp. gr.	75	per ct.,	1.19857	sp. gr.	50	per. ct.,	1.12990	sp. gr.
95	"	1.25285	"	70	"	1.18487	"	45	"	1.11618	"
90	"	1.23945	"	65	"	1.17113	"	40	"	1.10253	"
85	"	1.22583	"	60	"	1.15737	"	35	"	1.08908	"
80	"	1.21221	"	55	"	1.14362	"	30	"	1.07564	"

25	per ct.,	1.06236	sp. gr.								
20	"	1.04930	"								
15	"	1.03652	"								
10	"	1.02409	"								
5	"	1.01189	"								

The pharmacopœias require glycerin to have the density 1.250, *U. S. Br.*, 1.225–1.235, *P. G.*, which, according to the above table, corresponds to about 95 and to 85–90 per cent. of absolute glycerin. It is transparent, colorless, inodorous, very sweet and somewhat warm to the taste, owing to its affinity for water, oily to the touch, without action upon litmus, and soluble in all proportions in water and alcohol; also in spirit of ether, but not in ether, chloroform, benzene, fixed oils, or volatile oils. Its great affinity for water has been long known; W. Willmott (1879) ascertained that this continues in a moist atmosphere until about twice its bulk of water has been absorbed. Heintz, Berthelot (1854), and others observed that at about 100° C. (212° F.) glycerin volatilizes in appreciable quantity, more readily, it seems, with the vapors of water; in a current of superheated steam it distils readily between 170° and 200° C (338° and 392° F.). In contact with the air it distils only partially unchanged, the greater portion being destroyed, with the production of very acrid *acrolein* among the empyreumatic liquids. Its boiling-point is 290° C. (554° F.). When anhydrous, it takes fire at 150° C. (302° F.) and burns quietly with a blue non-luminous flame, without giving off any disagreeable odor and without leaving any residue. It dissolves all deliquescent salts, increases the solubility of many organic and inorganic compounds which are soluble in water or alcohol, and prevents the precipitation of some salts by alkalies and other reagents. By cooling glycerin to—40° C. (—40° F.) Berthelot could obtain it only as a nearly solid gummy mass. In 1867, Crooks saw it crystallized, after it had been exposed to cold weather while being transported, and Sarg obtained it in crystals by long-continued exposure to cold. The crystallization takes place slowly, but is greatly promoted even between 0° and 5° C. (32 and 41° F.) by the addition of a solid crystal to the cold glycerin. This behavior has been utilized for the purification of glycerin. The crystals are very deliquescent and melt at 22° C. (71.6° F.). Glycerin remains unfrozen at—35° C. (—31° F.), and even if it contained 28 per cent. of water it can be cooled to—31° C. (—23.8° F.) without freezing.

Chemically, glycerin is a triatomic alcohol and known as propenyl alcohol; hence chemists often designate it *glycerol*, in analogy with other alcohols. It forms with acids three series of ethers, in which 1, 2, or 3 atoms of hydrogen are replaced by the corresponding number of univalent acidulous radicals. The so-called neutral fats are saturated ethers, like *tripalmitin*, $C_3H_5(C_{16}H_{31}O_2)_3$. A similar compound is *nitroglycerin* or *glonoin*, $C_3H_5(NO_2)_3O_3$ (which see).

When 1 part of glycerin is heated with 2 parts of acid potassium sulphate, 2 molecules of water are split off and the glycerin is converted into *acrolein* or *allyladdehyde*, thus, $C_3H_5(OH)_3—2H_2O = C_3H_4O$; the same effect is produced when glycerin is heated with an excess of phosphoric anhydride, or even rapidly heated by itself to a temperature of about 290° C. (554° F.). Acrolein is a light, very refractive, and volatile oily liquid, the vapors of which are extremely irritating to the eyes

Glycerin dissolved in water and kept, with yeast, at a temperature of about 25° C. (77° F.), is converted into *propionic acid*, and with chalk and old cheese at 40° C. (104° F.) it yields *alcohol* and *butyric acid*. When slightly diluted with water and heated to just above 100° C. (212° F.) in the presence of oxalic acid, the latter will be decomposed into *carbon dioxide* and *formic acids*. $C_2H_2O_4$ yields $CO_2 + CH_2O_2$; the formic acid may be afterward obtained by *repeatedly* diluting with water and distilling. Glycerin unites with the alkalies and alkaline earths to compounds soluble in water, the former also in alcohol; the latter are not precipitated by carbonic acid. It unites also with sulphuric and other acids. "If a fused bead of borax on a loop of platinum wire be moistened with glycerin and then held in a colorless flame, the latter will be transiently tinted deep-green."—*U. S.* This behavior was observed by Iles (1877), and recommended as a test for borates or for glycerin, but Klein (1878) showed that the reaction with borax takes place not only with glycerin, but with other polyhydric alcohols; and the conditions for these reactions have been elaborately investigated by Dunstan (1883), proving that sodium pyroborate is decomposed, with the formation of sodium metaborate and a boric ether, or, if water be present, free boric acid, the alcohol being regenerated.

Tests.—Glycerin is now rarely adulterated, but much being prepared for uses in the arts, where purity is not necessary, impure glycerin may at all times be met with in the market. Water, mucilage, dextrin, glucose, and perhaps cane-sugar syrup, would be used as adulterants. The first is detected by the specific gravity of the sample, the others by the brown color produced on mixing the sample with twice its bulk of concentrated sulphuric acid. Since cane-sugar syrup which has been exposed to the light for some time contains appreciable quantities of glucose, glycerin adulterated with either kind of sugar will become brown on being heated with solution of potassa or soda, and will yield a red precipitate when heated to boiling with a drop of solution of copper sulphate and an excess of potassa. The impurities may consist of saline matters should the glycerin have not been distilled, or of odorous compounds if insufficiently purified by distillation. The odor becomes apparent on warming the glycerin or rubbing it well upon the hand. Most of these compounds reduce nitrate of silver, and produce a more or less deep color when glycerin is diluted with a little distilled water and after the addition of a few drops of nitrate of silver heated to boiling. The same reagent will detect chlorides by the white precipitate produced. Diluted glycerin should not be colored or rendered turbid on being tested with hydrogen sulphide or ammonium sulphide (metallic salts), ammonium oxalate (calcium), or barium chloride (sulphuric or oxalic acid). The presence of butyric acid is readily determined by warming a mixture of glycerin with one-fourth its measure each of alcohol and sulphuric acid, when butyric ether, recognized by its odor of pineapple, will be given off. The most important tests for practical purposes are those with sulphuric acid and silver nitrate. Goddefroy (1874) recommended the heating of glycerin in an open crucible to boiling, and then igniting it, when it should burn without diffusing the least smell or leaving the least residue. From these reactions the following tests have been formulated: "Glycerin should be neutral to litmus-paper. Upon warming a portion of 5 or 6 Gm. with half its weight of diluted sulphuric acid no butyric or other acidulous odor should be developed. A portion of 2 or 3 Gm., gently warmed with an equal volume of sulphuric acid in a test-tube, should not become dark colored (absence of cane-sugar). A portion of about 2 Gm., heated in a small open porcelain or platinum capsule upon a sand-bath until it boils, and then ignited, should burn and vaporize, so as to leave not more than a dark stain (absence of sugars and dextrin, which leave a porous coal). A portion heated to about 85° C. (185° F.) with test solution of potassio-cupric tartrate should not give a decided yellowish-brown precipitate, and the same result should be obtained if, before applying this test, another portion be boiled with a little diluted hydrochloric acid for half an hour (absence of sugars). After full combustion no residue should be left (metallic salts). Diluted with ten times its volume of distilled water, portions should give no precipitates or colors when treated with test solutions of silver nitrate, barium chloride, calcium chloride, ammonium sulphide or ammonium oxalate, (acrylic, hydrochloric, sulphuric, or oxalic acids, iron, and calcium salts.) If a mixture of 2 Cc. of glycerin with 10 Cc. of water, contained in a perfectly clean, glass-stoppered cylinder, be heated for five minutes in a water-bath at a temperature of 60°–65° C. (140°–149° F.), then mixed with 10 drops of silver nitrate test-solution, and the cylinder set aside, well stoppered, in diffused daylight, no change of transparency or color should occur in the mixture within five minutes (absence of chlorides, and limit of impurities having reducing properties.)."—*U. S.* 1 Cc. of glycerin mixed with 3 Cc. of stannous chloride solution should not become colored within one hour (absence of arsenic).—*P. G.*

Pharmaceutical Uses.—Glycerin forms the base of the official *glycerita* (*glycerina*) and glycerin suppositories, and is a constituent of a number of official fluid extracts; also of Linimentum potassii iodidi cum sapone, *Br.*, and of Mucilago tragacanthæ, *U. S.* It is used for preserving pill-masses and certain extracts in a plastic condition, and for preventing fermentation and other changes in aqueous liquids containing organic matter in solution.

Action and Uses.—The purest glycerin is irritating, on account of the avidity with which it abstracts moisture from the tissues, but commercial glycerin has sometimes a similar defect from containing nitric, sulphuric, or organic acids and other impurities. It is alleged that glycerin mixed with the food of animals tends to fatten them, while it diminishes the proportion of urea excreted. Catillon has shown that it sometimes augments and sometimes diminishes this excretion (*Bull. et Mém., etc.*, 1883, p. 133), but that, on the whole, the latter action prevails, and that during the use of the medicine the weight of the body increases. On the other hand the careful experiments of Munk led him to the conclusion that glycerin is not in the least degree nutritious

(*Virchow's Archiv*, lxxvi. 119). If given in larger doses than can be digested, it may be detected in the urine, but it cannot be recognized in the fæces (?) or the sweat. In excessive doses (such as f℥ss for every 2½ pounds of the animal's weight) its effects resembles those of alcoholic poisoning, including the gastric lesions found after death. Injected hypodermically, the same symptoms and lesions are produced. Similarly administered to frogs or injected into the veins of rabbits, it induces tetanic rigidity (*Archives of Medicine*, Oct. 1881).

Its richness in carbon suggested its use as a medicinal food, and especially as a substitute for cod-liver oil in *phthisis*, but, as in so many other instances, a little clinical experience showed the so-called scientific induction to be untrue. On theoretical grounds also it has been employed in the treatment of *diabetes*, but without striking advantage, although when the amount of sugar excreted is very small the use of glycerin may cause it to disappear from the urine, at least in its usual form. It may be used in this disease as a substitute for sugar, and has been thought to retard emaciation. (Compare Ransom, *Journal of Physiology*, viii. No. 2.) Prof. Semmola of Naples, inveighing against both the stimulant and the antipyretic treatment of *typhoid fever*, urgently advises in their stead the repeated administration of small doses of glycerin in water acidulated with citric or tartaric acid (*Bull. de Thérap.*, civ. 481), apparently not perceiving that this method is essentially an expectant treatment. Glycerin is an eligible adjunct to castor oil. It is said that a teaspoonful of both mixed together will act as a laxative. In 1887 a proprietary medicine for *constipation* was found to consist chiefly of glycerin (*Amer. Jour. of Med. Sci.*, Aug. 1888, p. 175). Numberless clinical observations have been made leading to substantially identical conclusions. These have been distinctly formulated by Ullmann (*Centralbl. f. Ther.*, v. 449), and by Polübinsky (*Med. News*, liv. 463). The most important of them are these: Glycerin enemas or suppositories are more efficient in habitual than in occasional *constipation*, and when the fæcal mass is in the rectum rather than at the sigmoid flexure or above it. It is more generally applicable to females than to males. It rarely gives rise to pain in the abdomen or burning in the healthy rectum, but it aggravates lesions of this and the adjacent parts. The enema generally acts in from five to ten minutes, causing a semiliquid or hard stool. The quantity which has been generally administered in this manner has been from ♏30 to ♏60. It may be given with a syringe or in hollow suppositories of cocoa butter. A pledget of cotton saturated with glycerin has been found equally efficient. If a syringe is used, its contents may be injected through a slender catheter passed, if possible, between the fæcal mass and the rectum. Similar enemas have been found efficient in destroying rectal *ascarides*. Its medicinal virtues depend mainly upon its having no tendency to evaporate and to its undergoing no change by exposure to the air. Hence it may be advantageously used where oil has from time immemorial been employed, and, owing to its solubility in water, with more effect. Thus it has been applied with good results to the rectum in *dysentery*, to the pharynx, to the larynx, trachea, and bronchia (by atomization and vaporization) in various diseases of these parts exciting *cough* and spasm or causing their obstruction. The vapor given off by glycerin heated to the boiling-point of water is very perceptible, and at 266° F. is very abundant, almost odorless, and of a sweetish taste. In a woman suffering from *hæmorrhoids* it was observed that while she was taking glycerin for diabetes she obtained great relief from the hæmorrhoidal affection. In other cases a complete cure of the rectal disease was accomplished by the continued use of glycerin in the dose of Gm. 8–12 (2 or 4 drachms), taken morning and evening (Young). Several subsequent reports are equally favorable to the efficiency of this treatment, which is applicable to both blind and bleeding piles. Possibly the slight digestibility of the glycerin permits it to reach the rectum and act as an emollient and protective. Mixed with water or pure, according to circumstances, it forms the best solvent for hardened *cerumen* and concreted epithelial scales, and is much used for keeping the *tympanum* moist. It has been applied to the treatment of recent *wounds*, but with far less satisfactory results than are obtained by dry dressings that exclude the air. When these cannot be employed, glycerin may be profitably substituted. Its affinity for moisture tends in certain cases to limit the secretion of pus by drying and constringing the secreting surface. This is strikingly the case in *leucorrhœa*. The addition of an astringent—tannic acid, for example—increases the efficiency of the glycerin, which should be applied upon a tampon of charpie. A similar application may be used for *fissure of the anus* and for fissured *nipples*. For the latter, however, a mixture of compound tincture of benzoin and glycerin is preferable. *Fissured tongue* is curable by a solution of 40 grains of borax in about an ounce of glycerin and 4 ounces

of water. Absorbent cotton, squeezed out of hot water and then saturated with glycerin, has been strongly recommended by Gordon as an efficient dressing for *wounds*, under which they heal by the first intention (*Boston Med. and Surg. Jour.*, Dec. 1885, p. 642). Later on, Fleming (*British Med. Jour.*, Sept. 22, 1888) used in the same manner a mixture of glycerin and starch, which prevents adhesion of the dressings and allows the free discharge of the secretions of the part. Pure glycerin applied to *carbuncles*, *boils*, and *abscesses* is said to promote their cure, but it is unsuited for application over a large surface, owing to its affinity for the moisture of the air. This affinity for moisture renders glycerin available for reducing *œdema of the prepuce* and similar parts. It should be applied on absorbent cotton or charpie. Also to lessen catarrhal secretion, as in *coryza*, *pharyngitis*, *otarrhœa*, etc. It allays *itching* in most affections of the skin attended with this symptom, and hence it is an appropriate ingredient of ointments and washes used in their treatment. To prevent the *laryngeal mirror* from becoming obscured by the condensation of vapor upon its surface, it has been recommended to pass lightly over it a cloth wet with glycerin. *Dryness of the mouth* from fever or any other cause may be lessened by a mixture of glycerin and water far better than by water alone.

The solvent powers of glycerin have suggested the glycerites as officinal forms of certain medicines, but many others are prescribed extemporaneously. One part of alum dissolved in 5 parts of glycerin by means of gentle heat is a powerful local astringent. Diluted, it can be used as a gargle, injection, or lotion. A solution of iodide of potassium in 2 parts of glycerin, with the addition of 1 part of iodine, makes an almost caustic preparation. A solution of 1 part of iodine in 5 parts of glycerin is used as a resolvent of enlarged and indurated glands, and as a revulsive over inflamed joints, abscesses, etc. 1 part of glycerin and 8 parts of sulphate of zinc forms an energetic caustic. Vaccine lymph may be preserved from decomposition by mixing it with glycerin.

GLYCERITA, *U. S.*,—GLYCERITES, GLYCERINA, *Br.*—Glycerines.

Glycerata, *Glycerolata*.—*Glycerols*, E.; *Glycérés*, *Glycérats*, *Glycérolés*, Fr.; *Glycerite*, *Glycerolate*, G.

This class of preparations consists mostly of solutions of 1 part of a chemical compound in 4 or 5 parts by weight of undiluted glycerin, which are readily made by trituration in the mortar. Two of the official glycerites require different manipulations, which will be noticed in the proper place. These preparations were suggested in 1854 by Cap and Garot, and soon after became favorably known and have become much used.

GLYCERITUM ACIDI CARBOLICI, *U. S.*—Glycerite of Carbolic Acid.

Glycerinum acidi carbolici, Br.; *Glycerin of carbolic acid*, E.; *Glycéré d'acide phenique*, *Glycérine pheniquée*, Fr.; *Phenol- (Phenyl-) Glycerit*, G.

Preparation.—Carbolic Acid, 20 Gm.; Glycerin, 80 Gm.; to make 100 Gm. Weigh the carbolic acid and glycerin, successively, into a tared capsule, and stir them together until the acid is dissolved.—*U. S.* (480 grains of carbolic acid may be dissolved in 27 fluidrachms of glycerin.)

Take of Carbolic Acid 1 ounce; Glycerin 4 fluidounces. Rub them together in a mortar until the acid is dissolved.—*Br.*

Action and Uses.—This is a convenient form of application of carbolic acid in certain *eruptions of the skin*, such as scabies, prurigo, etc., in which the itching is tormenting.

GLYCERITUM ACIDI GALLICI.—Glycerite of Gallic Acid.

Glycerinum acidi gallici, Br.—*Glycerin of gallic acid*, E.; *Glycéré d'acide gallique*, Fr.; *Gallussäure-Glycerit*, G.

Preparation.—Take of Gallic Acid 1 ounce; Glycerin 4 fluidounces. Rub them together in a mortar; then transfer the mixture to a porcelain dish and apply a gentle heat until complete solution is effected.—*Br.*

Action and Uses.—This preparation, taken internally, has the advantage over gallic acid in substance of being more readily absorbable. The *dose* is Gm. 1.30–4.0 (ℳ xx–lx).

GLYCERITUM ACIDI TANNICI, *U. S.*—Glycerite of Tannic Acid.

Glycerinum acidi tannici, Br.; *Glycerin of tannic acid* (*of tannin*), E.; *Glycéré de tannin*, *Glycérin tannique*, Fr.; *Tannin-Glycerit*, G.

Preparation.—Tannic Acid, 20 Gm.; Glycerin, 80 Gm; to make 100 Gm. Weigh the tannic acid and glycerin, successively, into a tared porcelain capsule, avoiding contact with metallic utensils, and apply the heat of a water-bath, until the acid is completely dissolved.—*U. S.* (480 grains of tannic acid may be dissolved in 27 fluidrachms of glycerin.)

Take of Tannic Acid 1 ounce; Glycerin 4 fluidounces. Rub them together in a mortar; then transfer the mixture to a porcelain dish and apply a gentle heat until complete solution is effected.—*Br.*

Action and Uses.—This glycerite is not so often used internally as that of gallic acid, but as a local application to *suppurating surfaces* of limited extent is more efficient —*e. g.* to the nostrils in chronic *coryza* and *ozæna*, to the *ear* in chronic catarrh, to the *throat* in chronic relaxation of the mucous membrane, etc. It is a useful dressing for certain chronic but irritable cutaneous eruptions, such as *eczema*, *impetigo*, *intertrigo*, etc. *Dose*, Gm. 1–4 (gr. xv–lx).

GLYCERITUM ALUMINIS.—Glycerite of Alum.

Glycerinum Aluminis, Br.—*Glycerin of alum*, E.; *Glycéré d'alun*, Fr.; *Alaun-Glycerit*, G.

Preparation.—Take of Alum 1 ounce; Glycerin 5 fluidounces. Stir them together in a porcelain dish, gently applying heat until solution is effected. Set aside, and pour off the clear fluid from any deposited matter.—*Br.*

Action and Uses.—Like all solutions of astringents in glycerin, this one is of inferior value to that of a watery solution of alum. It is, however, used, like other astringent glycerins, to check mucous secretions and slight passive hæmorrhages, to constringe soft granulations, relaxed membranes, etc.

GLYCERITUM AMYLI, *U. S.*—Glycerite of Starch.

Glycerinum amyli, Br.; *Unguentum glycerini*, P. G.—*Glycerin of starch*, *Glycamyl*, *Plasma*, E.; *Glycéré d'amidon*, *Glycérat simple* (*d'amidon*), Fr.; *Stärke-Glycerit*, G.

Preparation.—Starch, 10 Gm.; Water, 10 Cc.; Glycerin, 80 Gm. To the starch, contained in a porcelain capsule add the water and glycerin, and stir until a homogeneous mixture is produced. Then apply a heat gradually raised to 140° C. (284° F.) and not exceeding 144° C. (291° F.), stirring constantly until the starch-granules are completely dissolved and a translucent jelly is formed.—*U. S.*

Starch, 1 ounce; glycerin, 5 fluidounces; distilled water, 3 fluidounces. Stir and heat.—*Br.* Starch, 1 part; glycerin, 14 parts. Heat carefully.—*F. Cod.*

This preparation was introduced into British pharmacy by G. F. Schacht in 1858, and soon after became known in the United States. To obtain a uniform jelly-like mass, the starch should be first rubbed into a fine powder free from lumps, then intimately mixed with the glycerin and water, which may be done in the porcelain capsule, thus avoiding the unavoidable loss when done in a mortar; and finally the mixture is heated until all starch-granules are ruptured and the liquid is thickened to a translucent mass free from white spots. Prepared in this manner, the glycerite must be preserved in well-stoppered bottles, for in contact with the air it attracts moisture and gradually becomes soft. This tendency is entirely removed, according to W. Willmott (1879), by substituting for one-third of the glycerin an equal measure of water.

For the same purpose T. B. Groves (1867) introduced a preparation under the name of *glyceleum*, which, besides glycerin, contains fixed oil; it is made by triturating ½ ounce of fine almond meal with 1 ounce of glycerin, and then incorporating with it 3 ounces of olive oil, gradually added. The oil may wholly or in part be replaced by volatile oil or oleoresins. The preparation is a soft semi-gelatinous paste, which admits of the further addition of powders, and when mixed gradually with water forms readily an emulsion.

Zulkowsky (1880) has shown that on heating starch to 130° C. (266° F.) the starch-granules are ruptured and the mixture becomes thick and translucent, and at a higher temperature again thinner; at 170° C. (339° F.) it is quite limpid, and at 190° C. (374° F.) the starch is converted into the soluble modification—quite readily if potato starch had been used, but more slowly with wheat or rice starch. If now cooled, the mixture becomes thicker, but not gelatinous; on being poured into water the insoluble starch will precipitate, and the soluble starch may afterward be thrown down on the addition of alcohol.

The corresponding preparation of the German Pharmacopœia contains tragacanth in addition to starch, and is made by triturating 10 parts of wheat starch with 15 parts of water and 100 parts of glycerin, adding 2 parts of powdered tragacanth and 5 parts of alcohol and heating in a steam-bath until the odor of alcohol has disappeared and a translucent jelly-like mass results.

Action and Uses.—This preparation forms a transparent, unchangeable, and unirritating compound. It has been much used in ophthalmic surgery, especially when medicinal agents were to be applied to the *conjunctiva*. Ordinary ointments are still to be preferred in affections of the eyelids. It answers the purpose of a light poultice in *burns*, *erythema*, *erysipelas*, *furuncle*, *intertrigo*, and various other local inflammations of the skin.

GLYCERITUM BELLADONNÆ.—Glycerite of Belladonna.

Glycerinum belladonnæ, Br. Ph. Conf.—*Glycerin of Belladonna*, E.; *Belladonna-Glycerit*, G.

Preparation.—Rub 1 ounce of Extract of Belladonna into a smooth paste with 1 fluidrachm of boiling Distilled Water, and add enough Glycerin to produce 2 fluidounces. (The extract of belladonna prescribed is the inspissated juice prepared according to the British Pharmacopœia.)

Glycéré d'extrait de belladone, *F. Cod.* Soften extract of belladonna 1 part with a little glycerin, and mix with glycerite of starch 9 parts. Other narcotic extracts are used in the same proportion.

GLYCERITUM BORACIS.—Glycerite of Borax.

Glycerinum boracis, Br.—*Glycerin of borax*, E.; *Glycéré de borax*, Fr.; *Borax-Glycerit*, G.

Preparation.—Rub together Borax, in powder, 1 ounce, Glycerin 4 fluidounces, and Distilled Water 2 fluidounces, until the Borax is dissolved; or heat gently until solution is effected.—*Br.*

From the investigations of W. R. Dunstan, it appears that this preparation will contain some free boric acid.

Action and Uses.—In this preparation the glycerin forms a convenient but imperfect substitute for the honey usually employed along with borax in *aphthous* and other ulcerative affections of the *mouth*, *nipples*, *vulva*, etc., but is probably less efficient. It is more suitable for *pityriasis* of the scalp.

GLYCERITUM BOROGLYCERINI, *U. S.*—Glycerite of Boroglycerin.

Glycerite of glyceryl borate, *Solution of boroglyceride*, E.; *Liqueur* (*Soluté*) *de boroglyceride*, Fr.; *Boroglyceridlösung*, G.

Preparation.—Boric acid, in powder, 310 Gm.; Glycerin, a sufficient quantity, to make 1000 Gm. Heat 460 Gm. of glycerin in a tared porcelain capsule to a temperature not exceeding 150° C. (302° F.), and add the boric acid in portions, constantly stirring. When all is added and dissolved, continue the heat at the same temperature, frequently stirring and breaking up the film which forms on the surface. When the mixture has been reduced to the weight of 500 Gm., add to it 500 Gm. of glycerin, mix thoroughly, and transfer it to suitable vessels.—*U. S.*

1 pint of this solution, containing 50 per cent. by weight of boroglycerin, weighs about 23 av. ozs. (22.7544), and hence may be prepared by heating 4600 grains of glycerin with 3100 grains of boric acid at the above-mentioned temperature until the mixture weighs 5000 grains, and then adding an equal weight of glycerin. (10,000 grains = 22.85

av. ozs.) When glycerin and boric acid are heated together for some time, chemical union takes place, with the elimination of aqueous vapor, and, according to Dr. James, the reaction may be illustrated as follows: $C_3H_5(OH)_3$ (glycerin) + H_3BO_3 (boric acid) = $C_3H_5BO_3$ (boroglycerin) + $3H_2O$ (water). Care must be observed not to exceed the prescribed temperature, lest the product become discolored (yellowish or even darker). Attention was first called to boroglyceride and its remarkable preservative properties by F. S. Barff in 1881.

GLYCERITUM HYDRASTIS, *U. S.*—Glycerite of Hydrastis.

Glycéré d'hydrastis du Canada, Fr.; *Gilbwurzel-Glycerit*, G.

Preparation.—Hydrastis, in No. 60 powder, 1000 Gm.; Glycerin, 500 Cc.; Alcohol, Water, each a sufficient quantity, to make 1000 Cc. Moisten the hydrastis with 350 Cc. of alcohol, pack it firmly in a percolator, and percolate with alcohol until the hydrastis is practically exhausted. To the percolate add 250 Cc. of water, and then remove the alcohol by evaporation or distillation. After the alcohol is driven off, add enough water to the residue to make it measure 500 Cc., and set it aside for twenty-four hours. Then filter, pass enough water through the filter to make the filtrate measure 500 Cc., add the glycerin, and mix thoroughly.

25 av. ozs. of hydrastis should be moistened with about 9 fluidounces of alcohol, and percolated to exhaustion with the same menstruum; after addition of 6 fluidounces of water to the percolate, the alcohol is distilled off and enough water added to bring the volume up to 12 fluidounces. The mixture should be filtered after twenty-four hours, the filter washed with enough water to restore the volume to 12 fluidounces; finally 12 fluidounces of glycerin are added and the whole thoroughly mixed.

The filtration of the aqueous mixture is by no means as simple as it appears, and we would suggest the addition of ½ av. oz. of calcium phosphate and some paper pulp or finely shredded filtering-paper.

GLYCERITUM PLUMBI SUBACETATIS.—Glycerite of Lead Subacetate.

Glycerinum plumbi subacetatis, Br.—*Glycerin of lead subacetate*, E.; *Glycéré de sous-acétate de plomb*, Fr.; *Bleiglycerit*, G.

Preparation.—Take of Lead Acetate 5 ounces; Lead Oxide, in powder, 3½ ounces; Glycerin 20 fluidounces; Distilled Water, 12 fluidounces. Mix together and boil for fifteen minutes; then filter and evaporate until the water is dissipated.—*Br.*

Action and Uses.—It is said to be preferable to the simple solution of subacetate of lead in that it does not form a dry crust when it is applied to *ulcers*, *eczema*, etc.

GLYCERITUM SAPONIS.—Glycerite of Soap.

Glycerinum saponatum.—Glycéré de savon, Fr.; *Seifen-Glycerit*, G.

Preparation.—Dissolve 1 part of perfectly neutral cocoanut oil-soda soap or tallow-soda soap, dried at 100° C. (212° F.), in four parts of glycerin, sp. gr. 1.250, by means of a water-bath, and filter the solution while hot; after cooling it forms a pale-yellow, odorless, elastic mass, melting at the temperature of the body, and completely soluble in water. It is hygroscopic.

Action and Uses.—Glycerite of soap has been recommended by Dr. Hebra as a new base for ointments, and may be medicated as desired. (See *Proc. A. P. A.*, 1891.)

GLYCERITUM TRAGACANTHÆ.—Glycerite of Tragacanth.

Glycerinum tragacanthæ, Br.—*Glycerin of tragacanth*, E.; *Glycéré de gomme adragante*, Fr.; *Traganth-Glycerit*, G.

Preparation.—Take of Tragacanth, in powder, 110 grains; Glycerin 1 fluidounce; Distilled Water 74 fluidgrains. Mix the tragacanth with the glycerin in a mortar, add the water, and rub until a translucent, homogenous jelly is produced.—*Br.*

This preparation is useful as an excipient for many pill-masses.

GLYCERITUM VITELLI, *U. S.*—Glycerite of Yolk of Egg.

Glyconinum.—Glyconin, E., G.; *Glyconine*, Fr.

Preparation.—Fresh Yolk of Egg, 45 Gm.; Glycerin, 55 Gm.; to make 100 Gm. Rub the yolk of egg with the glycerin, gradually added, until they are thoroughly mixed—*U. S.*

If 720 grains of yolk of egg be triturated with 880 grains of glycerin, the resulting mixture will measure about 2½ fluidounces, dependent, of course, upon the density of the glycerin used.

This glycerite was introduced by E. Sichel (1866), who recommended 4 parts of yolk to 5 parts of glycerin. It has the consistence of honey, and keeps unaltered for a long time if kept in stoppered bottles to prevent absorption of moisture. G. C. Close (1874) recommended it as an excellent agent for emulsionizing cod-liver oil and other fats.

Action and Uses.—This preparation is a protective, and, although less emollient than glycerite of starch, is adapted to many of the same purposes, and is useful in *burns*, *erythema*, *erysipelas*, *intertrigo*, and other local irritations.

GLYCYRRHIZA, *U. S.*—Glycyrrhiza.

Glycyrrhizæ radix, Br.; *Radix liquiritiæ*, P. G.; *Radix glycyrrhizæ hispanicæ.—Liquorice- or Licorice-root, Spanish liquorice-root*, E.; *Réglisse, Bois de réglisse, Bois doux, Racine douce*, Fr.; *Spanisches Süssholz*, G.; *Orozuz, Regaliz, Palo dulce*, Sp.

The root (and underground stem) of Glycyrrhiza glabra, *Linné*, (Liquiritia officinalis, *Moench*), and of the variety glandulifera (*Waldstein et Kittaibel*) *Regel et Herder.* Bentley and Trimen, *Med. Plants*, 74.

Nat. Ord.—Leguminosæ, Papilionaceæ.

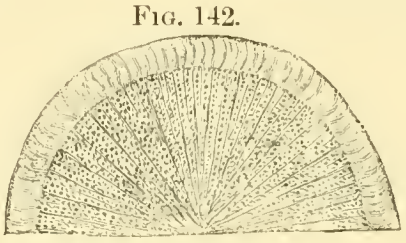
Origin.—This perennial in several well-marked varieties is indigenous to the countries on the northern and southern shores of the Mediterranean and farther east, through the Caucasus, Northern Persia, Afghanistan, and Southern Siberia, to China. The typical form, var. typica, *Regel et Herder*, grows wild as far east as Persia, and is cultivated in England, France, and Germany, and also to a limited extent in the United States. The stout roots penetrate deeply into the ground, while long horizontal rhizomes or runners are produced near the surface. The herbaceous overground stems are 1.2–1.8 M. (4 to 6 feet) high, and have imparipinnate leaves with oval-oblong mucronate leaflets, which are glutinous beneath, and racemes of white and purplish flowers producing brown legumes containing about four seeds. The variety glandulifera (Gl. glandulifera, *Waldstein et Kittaibel*, Gl. hirsuta, *Pallas*) has the leaves glandular-hairy beneath, and the legumes more or less glandular-prickly; it grows wild and is cultivated from Turkey and Hungary eastward to Turkestan. The roots and rhizomes are collected together and assorted before being brought into commerce.

Description.—Liquorice-root consists of long cylindrical pieces varying in thickness from 6–25 Mm. (¼ to 1 inch). It is longitudinally wrinkled, covered with a grayish-brown warty cork, pliable, tough, and breaks with a coarsely fibrous fracture. The transverse section shows a bark about one-sixth the diameter of the root in thickness, underneath the cork of the dull or bright grayish-yellow color of the wood, and in its inner layer radiately striate from the long, narrow, and somewhat wavy bast-wedges. The woody medullium consists of tough fibro-vascular tissue, appearing porous from the large vessels, and forming narrow wedges separated from one another by still narrower medullary rays. The rhizome has the same appearance and structure, and, in addition, a thin central pith. Liquorice-root has a peculiar odor and a strongly sweet somewhat acrid taste.

Fig. 141.

Spanish root (rhizome).

Fig. 142.



Russian root.

Glycyrrhiza glabra: transverse section of rhizome and main root.

Radix liquiritiæ (*P. G.*), s. russica, *Russian liquorice-root*, is mainly, if not entirely, derived from the var. glandulifera. It consists chiefly of the main root and its branches, with few rhizomes, and is about 30 Cm. (a foot) long and 2–10 Cm. (1 to 4 inches) thick, often hollow above, usually deprived of the brown corky layer, and furnished with a light grayish-yellow, thin bark covering a more porous wood, which is often fissured in the direction of the medullary rays, is softer, and breaks with a more fibrous fracture, than the preceding. It has a very sweet and somewhat bitterish taste, and yields a lighter-

colored powder than the former kind. Underneath the thin corky layer is the thin, small-celled primary bark; the cells of the medullary rays are larger and radially elongated; the long, tough, and somewhat wavy bast-fibres are surrounded by cells containing a crystal of calcium oxalate and accompanied by horn-like sieve-tubes; the ducts of the wood-tissue are usually in small groups, and are large, rather thick-walled, and dotted. The parenchyma of both the meditullium and bark contains much starch.

Constituents.—Robiquet (1809), Plisson (1828), and others obtained from liquorice-root starch, asparagin, albumen, a resinous oily matter, to which the slight acrid taste of the root is due, coloring matter, sugar, and *glycyrrhizin*. Roussin (1875) found the latter to be present in the root as *ammonium glycyrrhizate*, which he obtained pure from the cold infusion, after removing the albumen by heat, by precipitating with sulphuric acid, washing the precipitate well with water, dissolving it in strong alcohol, and adding ether, whereby a blackish mass is precipitated; the clear liquid is then carefully mixed with small quantities of alcoholic solution of ammonia. The precipitate is yellowish, very light, and its hot aqueous solution on cooling forms a jelly-like mass, and on evaporation leaves glycyrrhizin in brittle, translucent, shining scales. Prepared by the same process, with the exception of the final treatment with ammonia, it was found by Gorup-Besanez (1861) to have the composition $C_{24}H_{36}O_9$; to be soluble in alcohol, ether, and hot water, and on boiling with dilute acids, to be split into glucose and a bitter resinous substance named *glycyrretin*. Habermann (1880) gives to glycyrrhizin or *glycyrrhizic acid* the formula $C_{44}H_{63}NO_{18}$, and states that by heating with diluted sulphuric acid it is decomposed into glycyrretin, $C_{32}H_{47}NO_4$, and parasaccharic acid, $C_6H_{10}O_8$, the latter yielding amorphous salts, and the former being a white crystalline powder insoluble in water, alkalies, and ether, easily soluble in alcohol, glacial acetic acid, and strong sulphuric acid, fusible at 200° C., and not yielding any paraoxybenzoic acid with fusing potassa, as had been stated by Weselski and Benedict (1876). In purifying ammoniacal glycyrrhizin the amorphous bitter principle *glycyramarin*, $C_{36}H_{57}NO_{13}$, was obtained, soluble in ether-alcohol, and a resin soluble in glacial acetic acid and yielding paraoxybenzoic acid, $C_7H_6O_3$, on melting it together with potassa.

Allied Drugs.—Ononis spinosa, *Linné*, Radix ononidis, *P. G.*—Rest-harrow, *E.*; Bugrane, Bougrane, *Fr.*; Hauhechel, *G.*—This is a perennial herb common in sandy soil in Europe. The root, which is the part employed, is about 60 Cm. (2 feet) long, 1–2 Cm. ($\frac{2}{5}$ to $\frac{4}{5}$ inch) thick, slightly branched, many headed, tough-woody, and mostly curved and of a flattened and twisted appearance. It has a deeply-wrinkled, dark gray-brown, thin bark and an irregular whitish, tough, fibrous meditullium with numerous medullary rays. It has a faint odor resembling that of liquorice-root, and a mucilaginous, sweetish afterward bitterish, and disagreeable taste. It was analyzed by Reinsch (1842) and Hlasiwetz (1855). *Ononin*, $C_{30}H_{34}O_{13}$, is a crystalline, colorless, and tasteless glucoside slightly soluble in boiling water, more so in alcohol. *Onocerin*, $C_{12}H_{20}O$, is crystalline, fusible, colorless, and tasteless. Reinsch's *ononid* is considered by Hlasiwetz to be altered glycyrrhizin; like the latter, it is precipitated by acids from its aqueous solutions.

Pharmaceutical Preparations.—Syrupus glycyrrhizæ, Syr. liquiritiæ, *P. G.*—Syrup of liquorice-root, *E.*—Macerate for 12 hours 20 parts of peeled liquorice-root with ammonia-water 10 parts and water 100 parts, express, heat to boiling, evaporate to 10 parts, and add alcohol 10 parts, filter after 12 hours, and add sufficient simple syrup to make 100 parts.—*P. G.* A syrup of the same strength will be obtained by mixing 2 parts of fluid extract of liquorice-root with 8 parts of simple syrup.

Pasta glycyrrhizæ (s. liquiritiæ). Macerate 1 part of cut liquorice-root in 20 parts of water for 12 hours, strain and filter; add 10 parts of water, 15 of gum-arabic, and 9 of sugar; dissolve, strain, and heat, removing the scum; then evaporate until on cooling it will form a translucent mass, which is cut into suitable pieces. The French Codex recognizes a *Pâte de réglisse noire* made with extract of liquorice and sugar each 5 parts, gum-arabic 10 parts, and water 33 parts; and a *Pâte de réglisse brune*, made with 100 parts of extract of liquorice, 1500 parts of gum-arabic, 1000 of sugar, 2500 of water, and 1 part extract of opium. The finished paste will weigh 3000 parts.

Action and Uses.—Liquorice-root is demulcent and laxative, and locally is slightly stimulant; it is supposed to promote the secretions of the congested mucous membrane of the air-passages. The infusion is a useful drink in *febrile catarrhal affections*, especially those attended with much thirst, and in febrile and irritative disorders of the *bowels* and *urinary organs*. In these cases it it usually prepared with flaxseed-, rice-, barley-, or gum-water. It is said that an infusion of liquorice-root may be used by diabetic patients without aggravating their disease. Liquorice-root is an ingredient of the very excellent laxative which is now officinal as the compound powder of glycyrrhiza. It is also used to correct the acrid or bitter flavor of certain medicines, such as quinine,

colocynth, aloes, quassia, senega, mezereon, guaiacum, and sal-ammoniac, but for this purpose the extracts are more convenient.

It is recorded that some children who chewed the roots of "glycine" in mistake for Spanish liquorice-root presented symptoms of gastric inflammation, general collapse, and somnolence (*Med. News and Abstract*, May, 1881, p. 308).

Abrus precatorius furnishes the seeds which are treated of elsewhere (page 1); its "root has been used in the place of liquorice, for which, in our opinion, it is a very bad substitute" (Flückiger and Hanbury).

Ononis spinosa, or rest-harrow ("aratro-inimicus," Plinius), so called from its tangled roots impeding the harrow, was much esteemed until quite recent times as a diuretic and lithontriptic in decoctions made with vinegar or water; also as a stimulant for unhealthy *ulcers* and as a mouth-wash in *toothache*. More recently it was used to "remove obstructions" of the liver and spleen in *jaundice* and *dropsy*, and externally in the treatment of *hæmorrhoids*, *hydrocele*, and *eruptions* of the scalp. It was credited with the cure of *goitre* and of *hydrocele*, but, on the whole, has been most esteemed as a diuretic in dropsy, although less frequently prescribed alone than associated with squill, juniper, parsley, etc. Its glucoside, ononin, given by Schroff in doses of Gm. 0.2–0.3 (gr. iij–v), occasioned a persistent feeling of irritation and rawness in the throat and mouth, but no other effects.

Rest-harrow continues to be employed, by country physicians especially and in domestic practice in Germany and France, for the cure of *dropsy*, and, we are assured (Cazin), sometimes successfully when more accredited diuretics fail. But usually it forms only one of the ingredients of a compound infusion, the others consisting of the articles before mentioned, with the addition of cream of tartar or acetate of potassium. A decoction of the root is administered internally in chronic *gout* and *rheumatism*, especially where the local lesions are slight, and is also applied in poultices to *enlarged glands*. The decoction is prepared with Gm. 32–64 to Gm. 500 (1 or 2 ounces of the root in a pint of water), of which a wineglassful or more may be taken every two or three hours.

GLYCYRRHIZINUM AMMONIATUM, *U. S.*—Ammoniated Glycyrrhizin.

Glycyrrhizinum ammoniacale, *Glycyrrhizine ammoniacale*, Fr.; *Ammoniak-Glycyrrhizin*, G.

Preparation.—Glycyrrhiza, in No. 20 powder, 500 Gm.; Water, Ammonia-water, Sulphuric Acid, each a sufficient quantity. Mix 475 Cc. of water with 25 Cc. of ammonia-water, and, having moistened the powder with the mixture, macerate for twenty-four hours. Then pack it moderately in a conical glass percolator, and gradually pour water upon it until 500 Cc. of percolate are obtained. Add sulphuric acid slowly to the percolate, with constant stirring, so long as a precipitate is produced. Collect this on a strainer, wash it with cold water until the washings no longer have an acid reaction, redissolve it in water with the aid of ammonia-water, filter if necessary, and again add sulphuric acid so long as a precipitate is produced. Collect this, wash it, dissolve it in sufficient ammonia-water previously diluted with an equal volume of water, and spread the clear solution upon plates of glass, so that when dry the product may be obtained in scales.—*U. S.*

Using 20 oz. av. of glycyrrhiza and 1 fluidounce of ammonia-water would preserve the proportion of the Pharmacopœia.

This is Roussin's process (see Glycyrrhiza), as modified by Appenzeller (1876), who noticed that a considerably larger quantity, somewhat darker in color, is obtained by exhausting the root with ammonia-water, and that the scales have a more pleasant taste if liquorice-root deprived of the brown corky layer be used. Commercial extract of liquorice yields a still darker and less pleasant product. The cold percolate, if not too strongly alkaline, when heated to boiling deposits most of the albumen; this and other impurities are removed by again dissolving the precipitated glycyrrhizic acid in ammonia and reprecipitating it by an acid before its ammoniacal solution is finally evaporated and scaled. The yield is about 10 per cent.

Properties.—Ammoniated glycyrrhizin is in transparent "dark-brown or brownish-red scales, inodorous, of a very sweet taste, and readily soluble in water and in alcohol. The aqueous solution, when heated with potassa or soda, evolves vapor of ammonia. On supersaturating the aqueous solution with an acid, a substance (glycyrrhizin) is precipi-

tated which, when dissolved in hot water, forms a jelly on cooling. This substance, when washed with diluted alcohol and dried, appears as an amorphous yellow powder of a strong, bitter-sweet taste and an acid reaction. On ignition glycyrrhizin should leave not more than a trace of ash."—*U. S.* The scales consist mainly of ammonium glycyrrhizate, $(NH_4)C_{44}H_{62}NO_{18}$ (Habermann), with a variable quantity of glycyramarin. They are insoluble in ether, sparingly soluble in strong alcohol, become darker colored at 100° C. (212° F.), and at a higher heat melt, being decomposed at the same time. Glycyrrhizic acid is tribasic; the taste of its alkali salts is very sweet, and in the pure state free from the characteristic after-taste of liquorice; their solutions in water foam strongly on agitation and produce voluminous precipitates with most salts of the heavy metals.

Action and Uses.—The superiority of this preparation over pure extract of liquorice is not apparent. Possibly it may be more useful in the dry stage of inflammation of the respiratory mucous membrane.

GNAPHALIUM.—Life-Everlasting.

Pied de chat, *Immortelle*, Fr.; *Katzenpfötchen*, *Immerschön*, G.; *Gordolobo*, Sp.

The flowers and flowering herb of different species of Gnaphalium and allied genera.

Nat. Ord.—Compositæ, Senecionideæ.

Description.—Gnaphalium polycephalum, *Linné*, grows in woods and fields of North America. It is a woolly annual, with lanceolate nearly entire leaves, and with the numerous ovate and obovate flower-heads in dense corymbose clusters terminating the branches; the involucral scales are dry, scarious, and whitish, the tubular florets yellowish. The plant is quite fragrant, and has a bitterish and aromatic taste. On drying, the loss in weight of the flowering-tops amounts to about 65 per cent.

Gnaph. margaritaceum, *Linné*, s. Antennaria margaritacea, *R. Brown*, grows in similar localities with the preceding, chiefly northward, and has larger, roundish-ovate heads, which are of a pearly whiteness and slight odor.

Gnaph. (Helichrysum, *Dc Candolle*) arenarium, *Linné*, grows in Europe and Asia. The heads are globular-oblong, of a lemon- or orange-yellow color and agreeable odor.

Gnaph. dioicum, *Linné*, s. Antennaria dioica, *Gaertner*, is indigenous to Europe. The barren flower-heads are hemispherical and whitish, the fertile ones more top-shaped and reddish or purplish. The species is very closely related to Antennaria plantaginifolia, *Hooker*, which is common in North America, where it is known as *mouse-ear*.

Constituents.—These plants appear to contain a little volatile oil and bitter principle.

Action and Uses.—In Europe an infusion of the leaves and flowers of several species of Gnaphalium, which have, when chewed, an agreeable aromatic and slightly bitter and astringent taste, is used in chronic *bronchitis* and *diarrhœa* and in poultices to unhealthy *ulcers*. All the species are employed under similar circumstances. They may be given in an infusion made with half an ounce of the plant to a pint of water—Gm. 16 in Gm. 500.

GOSSYPII RADICIS CORTEX, *U. S.*—Cottonroot-bark.

Écorce de la racine de cotonnier, Fr.; *Baumwoll-Wurzelrinde*, G.; *Corteza de la raíz d'algodon*, Sp.

The bark of the root of Gossypium herbaceum, *Linné*, and of other species of Gossypium. Bentley and Trimen, *Med. Plants*, 37.

Nat. Ord.—Malvaceæ.

Origin.—The different species of Gossypium are indigenous to the tropical and subtropical countries of Asia and Africa, and have been cultivated from a very early period, whereby many characteristic varieties have been produced. They are herbaceous or shrubby plants or small trees, with three- to five-lobed leaves and showy axillary flowers, having a three-leaved involucre, a cup-shaped calyx, five petals, numerous stamens, and producing a three- to five-celled capsule, which opens by as many valves; the numerous seeds are densely covered with long woolly hairs. Bentley and Trimen refer the Sea Island cotton to Goss. barbadense, *Linné*, and to this the following as synonyms: G. vitifolium, *Lamarck*, G. peruvianum, *De Candolle*, G. punctatum, *Schumacher et Thonning*, G. acuminatum, *Roxburgh*, G. religiosum, *Parlatore*, non *Linné*. According to A. W. Chapman, the long-staple or Sea Island cotton cultivated in the United States is referred to Goss. nigrum, *Haworth*, and the short-staple or upland cotton to Goss. album, *Haw.* The seeds of Goss. religiosum, *Linné*, are invested with a yellow wool. Cottonroot is

conical, nearly simple or little branched, hard and woody, and covered with a thin bark, which is official. Goss. arboreum, *Linné*, is cultivated in some tropical countries for cotton.

Description.—Cottonroot-bark is in thin, flexible bands or quilled pieces covered with a brownish-yellow, satiny, very thin cork, by the abrasion of which irregular dull brownish-orange patches appear. The cork forms slight longitudinal ridges which are often confluent into elongated meshes and marked with black circular dots or short transverse lines. The inner surface is whitish or reddish-white, of a nearly silky lustre, and finely striate in a longitudinal direction by the thin medullary rays. The bast-fibres are long and tough, arranged in tangential rows, and are separated without difficulty in very thin layers. The bark breaks with difficulty in a transverse direction, but is readily torn longitudinally. It is without odor and without taste, with the exception of a very slight acridity and faint astringency. It bears a pretty close resemblance to mezereon-bark, except in color and taste.

Constituents.—The bark contains *starch*, and when fresh, according to W. A. Taylor (1876), a *chromogene* which dissolves in alcohol with a pale-yellow color, gradually changing to a bright brownish-red. The same change takes place on keeping the bark for some time, which then yields a red tincture with alcohol. This substance was examined by Prof. Wayne (1872) and W. C. Staehle (1875), who regard it as of a resinous nature. The latter obtained about 8 per cent. of this substance, which is soluble in 14 parts of alcohol, 15 of chloroform, 23 of ether, and 122 of benzene; also in alkalies, from which solutions it is again precipitated by acids. The potassa solution diluted with water is of a sage-green tint. *Glucose* was likewise observed, and the aqueous solution of the alcoholic extract contained a principle which gave a purplish-black precipitate with ferric chloride. C. C. Drueding (1877) obtained also a yellow resin soluble in petroleum benzin, fixed oil, little tannin, and 6 per cent. of ash.

Substitutions.—In 1875 a false cottonroot-bark, evidently obtained from the root of a tree, was found in the market; it was 3 to 6 Mm. ($\frac{1}{8}$ to $\frac{1}{4}$ inch) thick, pale-brown to rust-brown in color, covered with a soft fissured cork, inodorous, and of a slight astringent afterward bitterish and acrid taste, and yielded with alcohol a brown tincture. Its origin has not been ascertained.

Action and Uses.—The only virtue of cottonroot-bark consists in its action upon the uterine system. It is reputed to have long been used by the female negroes of the Southern States for producing abortion. There appears to be little doubt that it acts like ergot upon the uterus, and that it displays its virtues in *dysmenorrhœa* and scanty menstruation, and particularly in *suppression of the menses* produced by cold. According to Prochawnick, it is less efficient during labor than ergot, but more so in the treatment of *uterine tumors* and in *subinvolution* of the uterus. Garrigues claims that its action is identical with that of ergot in nature, but is inferior in certainty of action (*Med. News*, l. 185). It is generally used in a decoction, prepared by boiling Gm. 128 (4 ounces) of the bark in 2 pints of water, to the reduction of one-half. Of this a wineglassful is given every twenty or thirty minutes as *an oxytocic*. The fluid extract, which is officinal, is a more convenient but apparently a less active form of the medicine, and may be prescribed in the *dose* of Gm. 2–4 (♏xxx–lx). A tea made from the fresh leaves of the cotton-plant is used in Jamaica as a *galactagogue* (*Med. Times and Gaz.*, Feb. 1880, p. 194). It is true that experiments performed on frogs and rabbits by Dr. Martin (*Amer. Jour. of Med. Sci.*, Jan. 1882, p. 82), so far from indicating any action that would explain the facts just mentioned, only denote a narcotic and paralyzing operation. It is sufficient to remark that the results of such physiological experiments by no means invalidate those of clinical experience. Cotton-seed tea is a mucilaginous liquid which forms an appropriate drink in *dysentery*. The seeds have also been recommended as galactagogue, but the evidence of their value in this respect is insufficient.

GOSSYPIUM PURIFICATUM, *U. S.*—Purified Cotton.

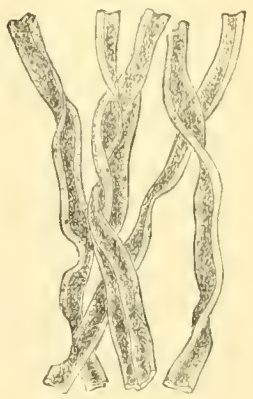
Gossypium, Br.; *G. depuratum*, P. G.; *Bombyx*, *Lana* (*Lanugo*, *s. Pili*) *gossypii*.—*Absorbent cotton*, E.; *Coton absorbant*, Fr.; *Gereinigte Baumwolle*, G.; *Algodon*, Sp.

The hairs of the seed of Gossypium herbaceum, *Linné*, and other species of Gossypium, freed from adhering impurities and deprived of fatty matter.

Description.—Cotton consists of soft, narrow-filiform, thin-walled, simple cells, which are about 12 to 38 Mm. ($\frac{1}{2}$ to $1\frac{1}{2}$ inches) long, and appear under the microscope as flattened hollow and twisted bands, which are slightly thickened at the edges, finely and spirally striate, and nearly cylindrical at the apex. Its specific gravity was by

Schuhmeister (1877) ascertained to be 1.707, while Kopp had previously determined it 1.27, and Grasi 1.979. It is without odor or taste, insoluble in the ordinary solvents, but soluble in ammoniacal solution of oxide of copper, and is colored blue by solution of zinc chloride and iodine, but not by solution of iodine. It consists of nearly pure cellulose, and yields with nitric acid an explosive nitro-compound (see PYROXYLIN) which is used in preparing collodion.

FIG. 143.



Cotton fibres.

The cotton-hairs are so thoroughly impregnated with fat that this cannot be removed by simple solvents. F. L. Slocum (1881) found the following process effectual: Boil carded cotton for half an hour with a 5 per cent. solution of caustic potassa or soda; wash thoroughly to remove all soap; express and immerse the cotton in a 5 per cent. solution of chlorinated lime for fifteen or twenty minutes; again wash, first with water; then dip into water acidulated with hydrochloric acid, and thoroughly wash with water; express, and again boil for fifteen or twenty minutes in a 5 per cent. solution of alkali, wash well with water, acidulated water, and water; express and dry quickly. By boiling once with alkali the cotton becomes somewhat absorbent, but the whole of the fat is not removed until it has been boiled a second time with alkali. The loss by this process is about 7 per cent., and represents mainly fat.

"Purified cotton should be perfectly free from all visible impurities, and on combustion should not leave more than 0.8 per cent. of ash. When thrown upon water it should immediately absorb the latter and sink, and the water should not acquire either an acid or an alkaline reaction."—*U. S.* By the absorption of water the hairs of the purified cotton distend and become more cylindrical, losing their band-like appearance. The untwisting of the flattened tubes of cotton filaments by caustic soda was noticed by Mr. Mercer (1867).

Pharmaceutical Preparations.—SALICYLIC (*Salicylated*) COTTON. According to Bruns (1878), cotton should be impregnated with 5 and with 10 per cent. of salicylic acid. 50 or 100 Gms. of salicylic acid and 10 or 20 Gms. each of castor oil and resin are dissolved in 4 liters of alcohol, and 1 Kgm. of clean absorbent cotton is immersed in the solution and dried.

BENZOIC COTTON is made by the same processes, substituting benzoic acid for salicylic acid; the addition of a small quantity of glycerin to the alcohol serves to fix these acids more permanently to the cotton.

IODOFORM COTTON is made in a similar manner, using an ethereal solution of iodoform.

HÆMOSTATIC COTTON is absorbent cotton impregnated with Monsel's solution or with a mixture of ferric chloride and alum.

CHLORINATED COTTON is made by Pavesi (1880) by suspending cotton slightly dampened with glycerin over a mixture of chlorinated lime, water, and sulphuric acid.

Action and Uses.—Cotton has long been employed as a dressing for *burns*, *scalds*, *blisters*, *excoriations*, *erysipelas*, and similar inflammations. If the burn, scald, or blister is superficial, there is no better dressing for it. No other application more speedily and completely allays the pain of the injury. Even when the tissue of the skin is more deeply interested the dressing is unsurpassed. It should consist of very thin layers of carded or absorbent cotton, successively applied and secured by a bandage, and should not be removed until the cure is complete. Cotton impregnated with carbolic, boracic, salicylic, and benzoic acids, iodine, iodoform, etc., has sometimes been employed. (For details see Woakes, *Practitioner*, xxv. 47). The fibre has been used as a substitute for lint, and also for sponge, after being thoroughly freed from the unctuous matter which in its natural condition renders cotton inapt for absorbing the secretions. As a dressing for *surgical wounds* cotton is said to be one of the most perfect preventives of *purulent infection*, as well as of prolonged suppuration, if it is properly applied in the manner described above. Washed, or absorbent, cotton is especially applicable to this purpose, and is still more effieient if it has been washed in carbolic-acid water. Vaginal pessaries have been made of carded cotton, chiefly for cases of *uterine displacement* in which instruments or harder materials cannot be tolerated. They are so shaped as to fill the upper part of the vagina, and usually are rendered somewhat firmer by holding in their centre a bent rod of gutta-percha. They require, of course, daily or frequent removal; to obviate which difficulty they have sometimes been dipped into a solution of caout-

chouc, which gives them a thin, and for a time impermeable, coating. Absorbent cotton, medicated variously as above, is a convenient substance for introducing into the ears and nostrils.

Bahmeria nivea furnishes a fibre which is employed for many of the purposes of cotton, and has been recommended as a substitute for absorbent cotton, lint, etc. (*Annuaire de Thérap.*, 1889, p. 143).

GRANATUM, *U. S.*—Pomegranate.

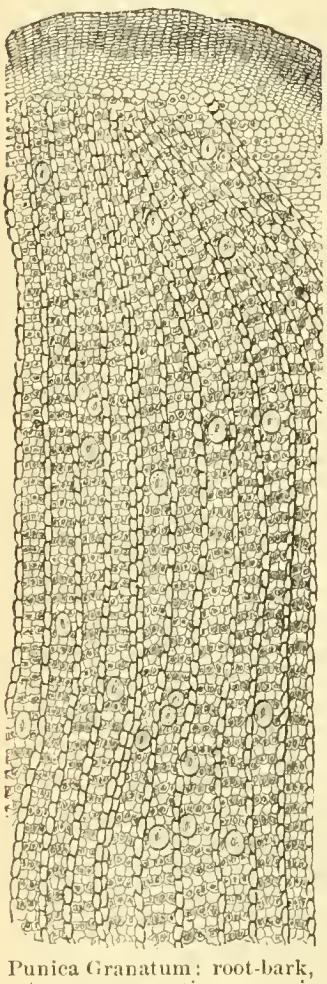
Granati radicis cortex, Br.; *Cortex granati*, P. A., P. G.—*Bark of pomegranate-root*, E.; *Grénadier*, F. Cod.; *Écorce de balaustier*, Fr.; *Granatrinde*, G.; *Corteza de granado*, Sp.

The bark of the root of Punica Granatum, *Linné*. Bentley and Trimen, *Med. Plants*, 113. *Nat. Ord.*—Lythrarceæ.

Origin.—The pomegranate is indigenous to South-western Asia from Northern India to Palestine; it has been cultivated from remote antiquity, and is now met with in all subtropical countries. It is a shrub or small tree about 6 M. (20 feet) high, with lanceolate or oblong, pointed, entire, and shining leaves, and producing a depressed globose fruit of the size of an orange, irregularly divided by a transverse dissepiment into two unequal parts, the lower and smaller of which is about three-celled and the upper five- to nine-celled. The numerous seeds are oblong, irregularly angular from pressure, each invested with a fleshy pink-colored translucent coating. The bark of the root is alone recognized by the British and French Pharmacopœias, but the other pharmacopœias admit also the stem-bark, which was shown by Nagelvoort (1878) to be equally effective. The flowers (*Balaustia*, *Balanote*, Fr.; *Balaustrias*, Sp.), the sweet acidulous seed-coating, and the rind of the fruit are likewise used.

Description.—The bark of pomegranate-root is met with in commerce in curved pieces or quills 5–10 Cm. (2 to 4 inches) long and 1–2 Mm. ($\frac{1}{12}$ inch) thick, which are externally of a yellowish gray color, marked with longitudinal or reticulate corky ridges, or irregular warts, and conchoidal depressions; the inner surface is smooth, finely striate, of a grayish or reddish-yellow color, frequently with fragments of the whitish wood adhering. It breaks with a short, granular fracture, which is of a greenish-yellow hue and indistinctly radiate in the inner layer; it has no odor and a purely astringent scarcely bitter taste. The trunk-bark, which is usually found in the commercial article, and is admitted by the German Pharmacopœia, is externally of a more yellowish-gray hue, is more regularly marked with corky ridges, has no conchoidal depressions upon the outer surface, and is frequently covered with blackish lichens, which are wanting on the root-bark. Both barks consist mainly of the bast-layer, and this is destitute of bast-fibres, but contains a number of scattered, thick-walled stone-cells, and consists of tangential rows of parenchyma-cells, which contain starch and tannin, and alternate with rows of crystal-cells containing calcium oxalate; the medullary rays are very numerous and delicate; the layer of primary bark is thin, and is covered with a thin layer of cork.

Fig. 144.



Punica Granatum: root-bark, transverse section, magnified 40 diameters.

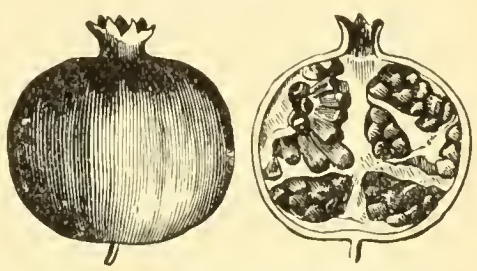
Constituents.—The principal constituent is tannin, of which Wackenroder (1824) found about 22 per cent., and which was recognized as peculiar by Stenhouse (1843). By fractional precipitation of the decoction with lead acetate, Ramdohr (1867) obtained some gallotannic acid, which could be converted into gallic acid, and *punico-tannic acid*, $C_{20}H_{16}O_{13}$, which is insoluble in alcohol and ether, reduces silver and alkaline copper solutions, and precipitates gelatin, tartar emetic, and ferric salts, the latter black. When boiled with dilute acids it is split into sugar and *ellagic acid*, $C_{14}H_6O_8$. Stenhouse did not succeed in obtaining indications of the presence of gallic acid. Boutron-Charlard and Guillemette (1835) isolated *mannit*, which Latour de Trie (1830) had named *granatin*, and Guiart (1831) *granato-mannit*. Cenedella (1835) obtained also sugar and mucilaginous and pectin compounds. Tanret (1878) announced the discovery in the root-bark and stem-bark of an

alkaloid, which, in honor of Pelletier, he proposed to call *pelletierine;* it is obtained by mixing the bark with milk of lime, displacing with water, and exhausting the percolate with chloroform. Thus obtained, it is colorless, oily, aromatic, and very soluble in water, alcohol, ether, and chloroform; it precipitates the salts of most metals, and unites with acids to form crystallizable salts. 4 parts of the alkaloid were obtained from 1000 parts of the bark. Shortly afterward Tanret proved that it was a mixture of three liquid and one solid alkaloid, which may be separated by fractional treatment with sodium bicarbonate. Pelletierine, $C_8H_{15}NO$, has the spec. grav. .988 at 0° C. (32° F.), boils at 125° C. (257° F.), dissolves its own weight of water, is soluble in 20 parts of water, and shows a left rotation to polarized light. *Isopelletierine* has the same composition and properties, but is optically inactive, and its sulphate is deliquescent. *Methylpelletierine* requires 25 parts of water for solution, boils at 215° C. (419° F.), is dextrogyre, and its salts are very hygroscopic. *Pseudopelletierine*, $C_9H_{15}NO$, crystallizes from ether or chloroform in long prisms, melts at 46° C. (114°.8 F.), boils at 246° C. (475° F.), and is easily soluble.

Adulterations and Substitutions.—*The bark of boxwood* has an exfoliating corky layer, a yellowish-brown color, and a sweetish-bitter taste; its infusion is not affected by ferric salts. *Barberry-bark* is readily distinguished by the bright yellow color of its tissue. (See BERBERIS, p. 314.) Both these barks are free from tannin. The infusion of pomegranate-bark in 100 parts of cold water has a yellowish color, and yields with lime-water a red flocculent precipitate, and with ferric chloride a dark-blue or blue-black color.

Allied Drug.—GRANATI FRUCTUS CORTEX; Cortex grenatorum (s. malicorii), Pericarpium granati.—Pomegranate-rind, Pomegranate-bark, *E.;* Écorce de grenade, Cuir de pomme de grenadier, *Fr.;* Granatenschalen, *G.*—Pomegranate-rind forms irregular curved fragments, which are about 2 Mm. ($\frac{1}{12}$ inch) thick, externally somewhat tubercular and rough, of a brownish color with a yellowish or reddish tint, internally of a lighter color, marked with meshes indicating the depressions caused by the seeds. Some of the pieces are crowned by the thick, tubular, six- to nine-toothed persistent calyx, enclosing the remains of the style and numerous stamens. They break with a short granular fracture, are nearly devoid of odor, and possess a strongly astringent taste. Examined by Reuss, pomegranate-rind was found to contain about 25 per cent. tannin, 21 extractive, and 34 gummy matter. Bowman (1869) obtained 23.8 per cent. of tannin, which gives with ferric salts a blue-black precipitate. Flücker obtained 5.9 per cent. of ash, calculated for the rind dried at 100° C. (212° F.), also some sugar.

FIG. 145.



Fruit of Punica Granatum and longitudinal section.

Action and Uses.—The bark of the root was known by the ancients to be anthelmintic, and since the beginning of the present century it has been distinguished as an efficient *tæniafuge* and *tæniacide*. Its specific operation upon the system is manifested by giddiness, dimness of vision, drowsiness, faintness, numbness of the limbs, and even convulsions. The bark is most efficient when fresh. It is best administered in a decoction prepared as follows: Take Gm. 64 (2 ounces) of the fresh bark, hashed, and let it soak over night in Gm. 750 (1½ pints) of water, and then by gently boiling reduce it to a pint. Strain off the liquor, expressing the grounds, and give it lukewarm in three doses, at intervals of an hour, before the patient has broken his fast. If the first dose is vomited, the others should still be administered, and will generally be retained. No purgative or other treatment need precede or follow: it is, however, more prudent to administer an ounce of castor oil as soon as the gurgling and colic provoked by the decoction begin to appear. Bettelheim used a strong decoction made with 10 ounces of the root-bark and 2 pints of water, of which from ½ pint to a pint was injected through an œsophageal tube into the patient's stomach. This method, which is claimed to be very prompt and efficient in its action, is certainly as barbarous as it is superfluous. The bark of the trunk and of the branches of medium size has recently been shown to equal the bark of the root in medicinal virtues. Indeed, according to some reports (Berenger-Féraud), it is more efficient than the bark of the root in expelling the unarmed tænia. It may be administered it the same manner as the latter.

It has been suggested that the superiority of fresh over dried pomegranate-bark is due to the evaporation from the latter of a portion of its pelletierine; but if such were the reason, it would be difficult to understand why the most efficient preparation of the bark is that which has been subjected to prolonged boiling.

Pelletierine was first used in the form of a sulphate as a tæniacide in 1878, but soon afterward the tannate was employed in the dose of about Gm. 0.40 (gr. vij). This quantity was given originally in divided doses, but later in a single dose, preceded and followed by a draught of water at short intervals, the patient remaining quiet and recumbent to repress nausea. At the end of about two hours a purgative was administered. Dujardin-Beaumetz prescribed a mixture of Gm. 0.33 (gr. v) of the sulphate in a solution containing Gm. 0.90 (14 grains) of tannin. It was given on an empty stomach, and followed by Gm. 32 (an ounce) of compound tincture of jalap. After comparing the results furnished by the sulphate and the tannate of pelletierine, the superiority of the latter became manifest. Moreover, it is tasteless, and incites neither repugnance, nausea, nor vomiting. Berenger-Féraud, who made a comparative study of various tænia medicines, concluded that pomegranate is the surest and best, and that it is most efficient under the form of pelletierine; and this last, it may be added, is to be preferred as a tannate, and should always be followed by a purgative dose of castor oil. Owing to the slowness of its action, which allowed the tæniæ to recover if not killed, brisker cathartics were by some preferred, as the sulphates of sodium or magnesium or jalap, or the infusion of senna with the addition of the saline or jalap. The "black draught," or compound infusion of senna, is very suitable for this purpose. It is desirable that the patient should diet very strictly for a day, taking only a moderate amount of milk in the evening, and on the following morning the medicine should be administered as above indicated. His stools should be received in a vessel filled with warm water, to facilitate the passage of the worm without breaking. Generally, it is discharged in the form of a knotted mass.

Pomegranate-rind is an astringent, and, although possessed of some anthelmintic virtues, is chiefly employed in a gargle for relaxed states of the *fauces* and in the treatment of chronic *diarrhœa*, *leucorrhœa*, passive *hæmorrhages*, and cancerous and other *ulcers* of the uterus and rectum. The *dose* in powder is Gm. 1.30–2.00 (gr. xx–xxx); a decoction prepared with Gm. 32 to 500 (℥j to Oj) may be given in the dose of a fluidounce.

GRATIOLA.—Hedge-Hyssop.

Herba gratiolæ.—Gratiole, Fr.; *Gnadenkraut, Gottesgnadenkraut*, G.; *Graciola*, Sp.

Gratiola officinalis, *Linné.*

Nat. Ord.—Scrophulariaceæ.

Description.—The stem grows from a creeping scaly rhizome to the height of 15 to 30 Cm. (6 to 12 inches), has opposite, sessile, lanceolate, finely serrate, three-nerved, smooth, pale-green leaves, and solitary axillary whitish or reddish two-lipped flowers, with yellow hairs in the tube. The plant is inodorous and has a very bitter somewhat acrid taste.

Constituents.—E. Marchand (1845) obtained the white crystalline bitter principle *gratiolin*, which is little soluble in water and ether. Walz afterward (1852, etc.) proved it to be a glucoside, splitting under the influence of acids into sugar, amorphous *gratiolaretin*, and scaly *gratioletin*. Walz also isolated the reddish amorphous bitter principle *gratiosolin*, which is soluble in water and alcohol, and is likewise a glucoside. *Gratioloic acid* crystallizes in white scales of a fatty odor.

Pharmaceutical Preparation.—Extractum gratiolæ is the inspissated juice of the plant freed from mucilaginous matter by mixing with alcohol.

Physiological Action.—Experiments upon animals and observations upon man show that gratiola is a powerful local irritant, and that when taken internally it causes retching, vomiting, colic, purging, even bloody stools, and inflammation of the stomach and bowels, especially of the rectum. Given by enema, it has occasioned so much pelvic irritation as to excite nymphomania, probably in predisposed persons. In one such case it is reported to have been fatal. In smaller (not purgative) doses it is said to be diuretic.

Action and Uses.—The chief, if not the only, use to which gratiola is applied in medicine is the treatment of *dropsy* by hydragogue purgation, as jalap, colocynth, and elaterium are employed. As it tends only to remove the dropsical effusion, and not its organic causes in the kidneys, heart, liver, etc., the main point to be regarded is that the effects of the medicine should not be so violent as to cause the patient's collapse. Like other drastics, gratiola has been used in the treatment of insane *melancholy* and *mania*, and also to expel *intestinal worms*, remove *jaundice*, cure *amenorrhœa*, etc. To expel ascarides the infusion has been given as an enema, prepared with Gm. 2 in Gm. 250

(ʒss to Oss). As a drastic purgative the *dose* of the root may be stated at Gm. 0.60–2.00 (gr. x–xxx).

GRINDELIA, *U. S.*— Grindelia.

Grindélia, Fr.; *Grindelie*, G.

The leaves and flowering tops of Grindelia robusta, *Nuttall*, and of Grindelia squarrosa, *Dunal*.

Nat. Ord.—Compositæ, Asteroideæ.

Description.—The genus Grindelia consists of herbaceous or suffruticose perennials which are indigenous to the western part of North America and to Mexico. They are characterized by their heads being many-flowered; the ray-florets yellow, ligulate, and pistillate; the disk-florets yellow, tubular, five-toothed, and perfect; the involucre hemispherical, with the scales imbricated in many rows, often with squarrose tips; the receptacle flat alveolate; and the akenes smooth and crowned with a pappus consisting of a few rigid deciduous awns of the length of the disk florets.

The leaves are 50 Mm. (2 inches) or less long, brittle when dry, vary from broadly spatulate or oblong to lanceolate, are sessile, the upper ones often clasping, with a heart-shaped base; obtuse at the apex, more or less sharply serrate on the margin, often spinosely toothed or even laciniate pinnatifid, nearly smooth or bearing scattered glandular hairs of a pale-green color, finely dotted, and the upper surface sometimes covered with patches of a glossy resin. The involucre is about 12 Mm. (½ inch) broad, and near the tips of the scales beset with short, flattish, many-celled glands. The akenes are from one- to three-toothed at the apex, and have two or three, rarely five, awns for the pappus. The odor is balsamic, the taste pungently aromatic and bitter. The variety latifolia is the robust and broad-leaved form, the leaves being often 7 to 10 Cm. (3 to 4 inches) long. The variety angustifolia has rather fleshy and narrower leaves, the upper ones being nearly entire, and all narrowed at the base. The variety (?) rigida is more glutinous, the leaves rigid and coriaceous, some of them sharply serrate. All these plants have the tips of the involucral scales at length rigidly spreading. The plant is common along the Pacific coast and inland on the mountains.

Allied Species.—Gr. hirsutula, *Hooker et Arnott*, is pubescent or tomentose, the stem often reddish or purplish, the leaves varying between spatulate, oblong, and lanceolate, the upper ones clasping. It is met with along the coast northward to Puget Sound.

Gr. glutinosa, *Dunal*, has been introduced near the coast of California. It is glabrous, has the leaves rounded at the apex, the involucral scales with short tips, and the pappus of five to eight rigid awns, with thin serrulate edges. It is the *calancapatle de Pueblo* of Mexico.

These plants resemble the former in odor and taste, and appear to be indiscriminately collected, particularly the last one.

Constituents.—As far as may be judged from the sensible properties, these species contain volatile oil, a bitter principle, and resin, the latter not unfrequently coating the involucre and leaves, rendering them glutinous; hence the name *gum-plant* commonly applied to them. The principles mentioned seem to be deserving of a thorough investigation. Fischer (1888) isolated a fixed oil, volatile oil, *robustic acid*, *grindeline*; the latter is crystalline, bitter, soluble in ether, alcohol, and water, and yields precipitates with tannin, potassium iodohydrargyrate, picric acid, potassium dichromate, iodopotassium iodide, platinum chloride, and gold chloride.

Action and Uses.—Grindelia has a persistent acrid and bitter taste, and excites the secretion of saliva. It is said to reduce the respiration-rate, to stimulate the brain and the spinal cord, and subsequently to produce a tendency to repose or sleep, with impaired power of the legs. In experiments on frogs it appeared to arrest breathing and to cause engorgement of the heart. It increases the secretion of urine and irritates the kidneys. The herb of this plant is reported to be useful in *whooping cough* and *bronchitis*, and of singular efficacy in *asthma*. We have been informed of several cases of asthma occurring in aged persons in which half a teaspoonful of the fluid extract afforded almost instantaneous relief. It does not, however, prevent the return of the paroxysms. It has been used with alleged advantage in *catarrh* of the *bladder* and of the *uterus*, as a dressing for *burns* and *blisters*, and to allay the pain of *herpes zoster*. The *dose* for a child two years old is stated to be Gm. 0.60 (gtt. x) of the fluid extract every two hours. It is added that no unpleasant symptoms have been observed after large doses. It is alleged that the tincture or fluid extract of G. squarrosa has been used topically with advantage in cases of *poisoning* by Rhus toxicodendron.

Hysterionica Baylahuen owes its medicinal qualities to the resin and volatile oil it contains, the former acting chiefly on the bowels and the urinary passages, and the latter like the terebinthinates and their products upon the lungs. It is said to possess an advantage over these medicines that it does not disorder the stomach and bowels. It has been found useful in chronic *diarrhœa*, and especially of the tuberculous variety, and in chronic *cystitis*. The tincture by its stimulant and protective action has served (like tincture of benzoin) as a dressing for *wounds* and *ulcers*. An infusion of the leaves and twigs (1 : 150) has been advised, and also a tincture (100 : 500) in the dose of 15–25 drops (Baillé, *Bull. de Thérap.*, cxvi. 160).

GUAIACI LIGNUM, *U. S., Br.*—Guaiacum-Wood.

Lignum guajaci, P. G.; *Lignum sanctum* (*vel benedictum*, *vel vitæ*).—*Lignum vitæ*, E.; *Gayac*, Fr. Cod.; *Bois de gaïac*, Fr.; *Guajakholz*, *Pockholz*, *Franzosenholz*, G.; *Guayaco*, *Palo santo*, Sp.

The heart-wood of Guaiacum officinale, *Linné*, and of Guaiacum sanctum, *Linné*. Steph. and Church, *Med. Bot.*, plate 90; Bentley and Trimen, *Med. Plants*, 41.

Nat. Ord.—Zygophyllaceæ.

Origin.—These species are indigenous to the West Indian islands and to the northern coast of South America; the second extends also to Southern Florida. The former is about 12 M. (40 feet) high, has evergreen pinnate leaves, with two, rarely three, pairs of smooth oval and obtuse leaflets, blue flowers, and two-celled obcordate capsules, each cell containing one black seed. G. sanctum is smaller, has leaves with four or five pairs of oblong mucronulate leaflets, and a winged four- or five-celled fruit with red seeds. The wood of both species consists of heavy dark-colored heart-wood, surrounded by a yellowish zone of sap-wood, which is generally relatively broader in the second species. Guaiac-wood became known in Europe early in the sixteenth century.

Description.—The heart-wood is of a brown color, turning olive-green on exposure, and is composed of alternately darker and lighter zones, which form incomplete circles and resemble annual rings, the tissue being well filled with resin. The central pith is quite indistinct; the medullary rays are very fine, the vessels scattered. The wood is very heavy, of specific gravity 1.3, hard, tenacious, and splitting very irregularly, caused by the much-interwoven wood-bundles. In the shops it is usually seen in the form of raspings and shavings, which should be free or nearly so from the lighter sap-wood. Guaiacum-wood has a slight aromatic odor, which is more apparent on warming or rubbing it, and a somewhat acrid taste. The shavings acquire a dark blue-green color on being moistened with nitric acid or other oxidizing agents.

Constituents.—The wood contains from 20 to 25 per cent. of resin, which is the most important constituent, and yields about 3 to 4 per cent. of aqueous extract. Frémy and Urbain (1881) found in the wood, besides 21 per cent. of cellulose, also 36 per cent. of *vasculose*, which is not soluble in ammoniacal copper solution, even after treatment with sulphuric acid.

Allied Species.—Guaiacum angustifolium, *Englemann*, s. Porliera angustifolia, *Gray*, is a small tree of Southern Texas and Mexico, with a hard, heavy, and irregularly splitting wood of a yellowish-brown color, and used like the preceding.

Pharmaceutical Preparations.—Species lignorum, P. G.; Species ad decoctum lignorum.—Wood tea, *E.*; Espèces (Bois) sudorifiques, *Fr.*; Holzthee, *G.*—Guaiacum-wood 5 parts; rest-harrow-root (ononis), 3 parts; peeled liquorice-root, sassafras-root, each 1 part; cut and mix.—*P. G.* Guaiac-wood, sassafras-root, sarsaparilla, and china-root, of each equal parts.—*F. Cod.*

GUAIACI RESINA, *U. S., Br.*—Guaiac.

Resina guajaci, *Guaiacum*.—*Guaiacum resin*, E.; *Résine de gayac*, Fr. Cod.; *Guajakharz*, G.; *Resina de guayaco*, Sp.

The resin of the wood of Guaiacum officinale, *Linné*. (See Guaiaci Lignum.)

Origin.—The resin is obtained partly as a natural exudation or from incisions, partly by setting fire to a billet of the wood which has been grooved or pierced lengthwise on the side, the resin as it melts running from the opening.

Description.—The resin is in separate or agglutinate tears, varying in size from 6 to 25 Mm. (¼ to 1 inch) in diameter, or more generally in irregular masses, intermixed

with fragments of wood and bark. It is of a greenish- or reddish-brown color, brittle, breaks with a somewhat conchoidal fracture having a glassy lustre, and is transparent in thin splinters. It yields a whitish powder which turns rapidly green on exposure to the air, has the specific gravity 1.2, fuses at about 85° C. (185° F.), emitting an agreeable odor, suggesting that of vanilla, and at a higher temperature gives off irritating vapors. Its taste is not strong, but distinctly acrid. The resin is soluble in caustic potassa and in nearly all the ordinary solvents for resins, except carbon disulphide, benzene, and oil of turpentine; it is nearly insoluble in benzin and fats. The solutions, as well as the powder, are colored green or blue by nitric acid, chlorine, ferric chloride, and other oxidizing agents; the same color is produced by ozone and upon the inner surface of the paring of a raw potato. Guaiacum resin should be soluble in alcohol, leaving but a slight residue; sometimes it is very impure, containing as much as 16 per cent. of wood and bark. Its alcoholic solution has a slight acid reaction, and when dissolved in solution of potassa or soda it is reprecipitated on the addition of an acid.

Constituents.—On boiling guaiac resin with milk of lime *guaiacic acid* and *guaiac-yellow* are dissolved. If the residue is treated with hot alcohol, the tincture evaporated, and this residue dissolved in hot solution of caustic soda specific gravity 1.3, the sodium salt of *guaiarctic acid* will crystallize on cooling, and the mother-liquor contains *guaiaconic acid* and *beta resin*, which after the removal of the alkali are separated by ether, in which the former only is soluble.

Guaiacic acid, $C_{12}H_{16}O_6$, was discovered in guaiac-wood by Thierry (1841), and is present in very minute quantity; it crystallizes in white needles and is sublimable and soluble in water, alcohol, and ether. *Guaiaretic acid*, $C_{20}H_{26}O_4$, discovered by Hlasiwetz (1859), crystallizes in warts and scales, is of a faint vanilla odor, and is soluble in alcohol, ether, chloroform, benzene, etc., and sparingly soluble in cold water and ammonia. *Guaiaconic acid*, $C_{38}H_{40}O_{10}$, discovered by Hadelich (1862), is light-brown, amorphous, insoluble in water, benzene, and carbon disulphide, easily soluble in alcohol, ether, chloroform, and acetic acid; it acquires a transient blue color with oxidizing agents. Hadelich's *guaiac-beta resin* is a red-brown powder; his *guaiac-yellow*, which was first noticed by Pelletier, has a bitter taste, forms pale-yellow octahedra, and dissolves in oil of vitriol with a handsome blue color and in alkaline liquids with a deep-yellow color. Hadelich obtained about 70 per cent. of guaiaconic acid, 10 per cent. each of guaiaretic acid and beta resin, and nearly 4 per cent. of gum, the remainder being the other constituents, including some impurities and 0.8 per cent. of ash.

On subjecting guaiaretic acid to dry distillation, a thick yellow oil is obtained, consisting of *guaiacol*, $C_7H_8O_2$, the methylic ether of pyrocatechin, which is a colorless oil of agreeable odor, and forms with alkalies crystallizable salts; *guaiacene*, C_5H_8O, which is thin, oily, of a bitter almond odor and hot aromatic taste; and *pyroguaiacin* (*pyroguaiacol*), $C_{19}H_{22}O_3$, which crystallizes in inodorous and tasteless scales. H. Wiesner (1880) gives to the last-named compound the formula $C_{18}H_{18}O_3$, and states that while it dissolves in sulphuric acid with a dark-blue color, its alcoholic solution gives no reaction with ferric chloride, contrary to the observation of Hlasiwetz, who found it to be colored green by ferric chloride, and regarded the similar reaction of the official resin to be probably due to this compound. By dry distillation guaiac resin yields *creosol*, $C_8H_{10}O_2$, in addition to the decomposition product mentioned; it and the allied guaiacol are colored green by caustic alkalies and blue by alkaline earths; both have been observed in creosote. See page 547.) On distilling pyroguaiacin with zinc-dust, Wiesner obtained *guaiene*, $C_{12}H_{12}$, in bluish fluorescing scales. Boetsch (1880) observed this to melt near 98° C. (208.4° F.), and to dissolve in sulphuric acid with a green color. He obtained this compound also from the resin by treatment with zinc-dust, and in addition thereto 50 per cent. of creosol and 30 per cent. of toluene, xylene, and pseudocumene. Hirschsohn (1877) found guaiacum resin to be free from cinnamic acid, umbelliferon, sulphur, and nitrogenated compounds.

Tests.—In addition to the properties mentioned above, Hirschsohn states that guaiacum resin should yield to petroleum benzin not more than 2 to 4 per cent. of its weight; colophony and damar dissolve to the extent of 77 to 90 per cent. The so-called *Peruvian guaiac resin*, of undetermined origin, has an odor resembling a mixture of rue and anise, and about 42 per cent of it is soluble in benzin. The alcoholic solution of guaiacum resin is precipitated by lead acetate (difference from carana resin), and with potassa solution gives a precipitate easily soluble in excess of the alkali (difference from colophony).

Action and Uses.—Guaiac is most renowned for the cure of constitutional *syphilis*,

and the records of its use during nearly three hundred years were accepted as true until the scepticism of the nineteenth century condemned it. The vain and frivolous methods of employing it which prevailed among modern physicians fully account for its want of success in their hands. While it was in vogue the treatment by it was serious. The patient was obliged to observe a very strict regimen, to drink enormous quantities of a stronger and of a weaker decoction of the wood, to live upon a very sparing and simple diet, and in every manner to promote perspiration. The question of its efficiency has, however, possessed a very subordinate interest since the introduction of iodide of potassium. Like other vascular stimulants, guaiac resin has been found efficient in promoting menstruation in all atonic conditions of the uterine system, and hence in *dysmenorrhœa* as well as in *amenorrhœa* of that origin. For the same reason, doubtless, it is a valuable remedy for chronic muscular *rheumatism*. For these purposes the ammoniated tincture is to be preferred. In simple *tonsillitis* and in *diphtheria* it is alleged to be very efficacious, but the former disease often gets well spontaneously, and the evidence of the value of guaiac in the latter is inconclusive. *Rheumatic pharyngitis*, which is often confounded with tonsillitis, may very possibly be palliated by guaiac.

Guaiacum-wood is prescribed only in decoction (*Pharm.* 1870), simple or compound, of which the latter is the more efficient. The resin may be given in doses of Gm. 0.60–2.00 (gr. x–xxx). The guaiac mixture (*Br. P.*) is a convenient form for its administration.

When the red coloring matter of the blood is brought into contact first with tincture of guaiac, and then with peroxide of hydrogen, the guaiac is instantly turned blue. On testing suspected stains in this manner "it will be safe to say that if there is no bluing of the guaiac resin in the presence of the peroxide, the mark or stain is not owing to blood" (Taylor).

Guaiacol has been used as a substitute for creasote in the treatment of *phthisis* by Schüller, Sahli (*Centralbl. f. Therap.*, v. 691), Horner (*ibid.*, vi. 338), Schetelig (*ibid.*, vii. 539; *Therap. Monatshefte*, iii. 400), and some others, who claim for it virtues which are also attributed to creasote in this disease—*i. e.* of lessening the fever, cough, sputa, and, in general, the progress of decline, and also of correcting the diarrhœal tendency. Sahli used it as follows: ℞ Guaiacol, Gm. 1–2; water, Gm. 180; spirit of wine, Gm. 20. M. S.–fʒj–fʒiv in a glass of water after meals. Schetelig used guaiacol hypodermically, in the daily dose of Gm. 0.5–1 (grs. 7–15). Others have preferred, as less irritating, benzoate or carbonate of guaiacol in the dose of Gm. 0.20–0.40 (gr. iij–vj). (Compare Jacobi, *Proceedings of Amer. Climatolog. Assoc.*, 1892.)

GUAIACOLUM.—Guaiacol.

Methyl-pyrocatechin (*catechol monomethyl ether*).

Formula $C_7H_8O_2=C_6H_4OHOCH_3$, Molecular weight, 123.71.

Source.—Beechwood creosote consists chiefly of guaiacol, creosol, and cresols, as stated elsewhere, and of these guaiacol is present to the extent of from 60 to 90 per cent.

Preparation.—Crude guaiacol is obtained by fractional distillation of beechwood-tar creosote, that portion passing over between 200° and 205° C. (392°—401° F.) being collected; this is treated with ammonia to remove acid compounds, and then again fractionated. The lower boiling fraction is dissolved in ether and treated with a concentrated alcoholic solution of potassa, which causes the separation of potassium-guaiacol, the latter being insoluble in ether. After thorough washing with ether the salt is crystallized from alcohol, and decomposed by treatment with dilute sulphuric acid; the guaiacol thus set free is again rectified.

Guaiacol is rarely met with absolutely pure; the latter is obtained from benzoylguaiacol (which has been repeatedly recrystallized) by saponification with alcoholic potassa, subsequent washing, drying, and rectifying. The so-called "absolute guaiacol" of commerce frequently contains notable quantities of cresols.

Properties and Tests.—Pure guaiacol is a colorless, slightly refractive liquid of strongly aromatic odor. Its specific gravity at 15° C. (59° F.) is 1.117 (Fischer), (1.133, Helbing), and its boiling point at 200°–202° C. (392°–395.6° F.) (Fischer), (206°–207° C. Helbing); it requires 200 parts of water (Fischer) (85 parts, Helbing) for solution, but is readily soluble in alcohol and ether. Guaiacol is soluble in solutions of sodium and potassium hydroxides, forming compounds known as sodium- and potassium-guaiacol ($C_6H_4OCH_3Na$ and $C_6H_4OCH_3K$), which, however, are unstable and decomposed, even upon addition of much water. If a trace of ferric chloride is added to an alcoholic

solution of guaiacol, a blue color is developed, which changes to emerald-green upon the addition of more ferric chloride; this is a characteristic reaction. Shaken with twice its volume of benzene at 20° C. (68° F.), pure guaiacol will separate rapidly and completely, whereas the impure article forms a clear solution. If 2 Cc. of guaiacol be added to 2 Cc. of sodium hydroxide solution of 1.30 sp. grav., the mixture becomes heated, and when cooled to normal temperature congeals to a white crystalline mass in case the guaiacol is pure, but remains fluid if it is impure (important test). With concentrated sulphuric acid perfectly pure guaiacol produces a yellow coloration which changes to cherry-red upon addition of a very small quantity of acetone; this same red color is produced without acetone if only a trace of creosote is present (Bougartz).

The following derivatives of guaiacol have been introduced:

Guaiacol benzoate, Benzosol, Benzoyl-guaiacol. $C_6H_4OHC_6H_5CO_2$. When potassium-guaiacol, prepared by adding to an alcoholic solution of guaiacol the necessary quantity of potassium hydroxide, is heated on a water-bath with benzoyl-chloride, benzoyl-guaiacol is formed, together with potassium chloride; the former is purified by recrystallization from alcohol. It is a colorless, odorless, and tasteless crystalline powder, almost insoluble in water, but readily soluble in ether, chloroform and hot alcohol. It melts at 56° C. (Fischer), 45° C. (Helbing), sulphuric acid colors the salt lemon-yellow, but ferric chloride does not produce the characteristic color reaction in an alcoholic solution. The dose is 1–10 Gm. (15–150 grains) daily.

Guaiacol carbonate. $(C_6H_4OCH_3)_2CO_2$. This compound is prepared by slowly passing 1 molecule of phosgene gas, $COCl_2$ (carbonyl chloride), into 2 molecules of guaiacol previously dissolved in soda solution, when sodium chloride and guaiacol carbonate will be formed: the latter is washed with soda solution and crystallized from alcohol. It is a white neutral crystalline powder, nearly void of odor and taste, insoluble in water, slightly soluble in cold, but readily in hot alcohol, also in ether, chloroform, and benzene, and sparingly soluble in glycerin and fixed oils. Its melting-point is 78°–84° C. (Fischer), 86°–90° C. (Helbing). The dose of guaiacol carbonate is gradually increased from 0.2–0.5 Gm. (3–7½ grains) daily to 2–4 Gm. (30–60 grains).

Guaiacol cinnamate, Styracol, Cinnamyl-guaiacol. $C_6H_5.CH:CH.CO_2C_6H_4OCH_3$. If equal molecular weights of guaiacol and cinnamyl-chloride are brought together at ordinary temperature, and after two hours heated for some time on the water-bath, hydrochloric acid is formed and also cinnamyl-guaiacol. The salt is crystallized from boiling alcohol. It occurs as colorless needle-shaped crystals which melt at 130° C. and are practically insoluble in water.

Guaiacol di-iodide was first proposed by Vicario (1892) as a pulmonary antiseptic. It is obtained when a solution of iodine in potassium iodide is added to an aqueous solution of sodium-guaiacol as long as precipitation continues; it is of a reddish-brown color, possessing the odor of iodine, melts on the water-bath, is soluble in alcohol and fixed oils, and is readily decomposable.

Guaiacol salicylate, Guaiacol-salol, Salicyl-guaiacol. $C_6H_4OHCO_2.C_6H_4OCH_3$. This compound is analogous to salol, and is the result of the action of phosphorus oxychloride on a mixture of sodium-guaiacol and salicylate, when guaiacol salicylate, sodium chloride, and sodium phosphite are formed. It is a white crystalline odorless and tasteless powder, insoluble in water, but soluble in alcohol, ether, and chloroform. It melts at 65° C. An alcoholic solution of the salt is colored wine-red by ferric chloride. The dose is the same as that of the benzoate (see above).

Guaiacolcarbonic acid, Methoxysalicylic acid. $C_6H_3OHOCH_3.CO_2H+2H_2O$. It is prepared by a patented process in a manner somewhat similar to that of the salicylic-acid manufacture; carbon dioxide is made to act on sodium-guaiacol previously heated, whereby guaiacol-sodium carbonate is formed; continued heating converts this into sodium guaiacol-carbonate, from which the free acid is obtained by acidifying with hydrochloric acid, and finally recrystallizing from hot water or diluted alcohol. It is a white, odorless crystalline powder of a bitter taste, difficultly soluble in cold, but readily in hot water, also in alcohol and ether, and likewise in a solution of sodium bicarbonate. The anhydrous acid melts at 148°–150° C. A cold aqueous solution of the acid is colored by ferric chloride solution.

Action and Uses.—Guaiacol and the compounds into which it enters, including the *carbonate*, *iodide*, *salicylate*, and *cinnamate* (styracol), and *benzosol*, have, since 1891, been a good deal employed in the treatment of pulmonary *phthisis* and other wasting forms of *tuberculosis*. Its effects have been mainly such as were long attributed to the preparations of tar—*i. e.* a diminution of the bronchitic and intestinal disorders proper to con-

sumption of the lungs—viz. cough, expectoration, sweating, and diarrhœa. *Styracol* has been especially employed in the treatment of *gleet*, *vesical catarrh*, and chronic *diarrhœa*. Some have dared to inject these compounds into pulmonary cavities through the chest-walls. Guaiacol carbonate has been given in gradually increasing doses from Gm. 0.2 (gr. $\frac{1}{3}$) until Gm. 2 (gr. xxx), and then Gm. 7 (gr. xc), a day were reached.

GUANO.—Guano.

Origin.—Guano consists of the partially-decomposed excrements of the penguin and other sea-birds, which congregate in large numbers on the barren and uninhabited islands on the western coast of South America, in Western Africa, and Australia. It is principally exported from the islands off the coast of Peru and Bolivia.

Description.—It is in the form of crystalline or amorphous masses, or more frequently of an irregular powder, having a grayish or pale-brown color and an offensive, usually ammoniacal, odor. Its spec. grav. is about 1.64; its reaction is mostly alkaline, though occasionally acid. It contains hygroscopic water varying between 6 and 20 per cent., which is expelled by the heat of a water-bath; when exposed to a higher temperature it blackens and burns, leaving a white ash varying in amount between 25 and 38 per cent.

Constituents.—Guano contains, besides the moisture, 25 to 52 per cent. of organic matter and ammonium salts, 19 to 42 per cent. of tricalcic phosphate, and 5 to 15 per cent. of alkaline salts; the nitrogen varies in amount from 7 to 15 per cent. The organic constituents of guano are chiefly *uric acid*, *ammonium urate*, and various oxalates. The chief inorganic constituents are phosphates of calcium, magnesium, and the alkalies, some sulphates, chlorides, and a very little sand; occasionally also ammonium carbonate. B. Unger (1845) discovered in guano the alkaloid *guanine*, $C_5H_5N_5O$, which has since been proved to exist also in the pancreatic juice of mammals; it forms a white crystalline powder which is insoluble in water, alcohol, ether, and ammonia, but soluble in acids and in potassa solution.

In estimating the value of guano as a manure the amount of the following constituents, besides moisture and ash, is determined: ready-formed ammonia (present as ammonium salts), latent ammonia (generated in the soil from nitrogenous compounds), uric acid, and phosphates.

Action and Uses.—Under the singular delusion that the ammonia in guano possesses some special mode of action different from that of officinal ammonium compounds, this substance, mixed with potter's clay, was used as a dressing for several *diseases of the skin*, and afterward in baths and lotions. But it speedily exhibited the irritating effects proper to the salts of ammonia in common use, and is now quite abandoned. It will hardly be believed that this bird-dung should have been introduced into a syrup and administered internally.

GUARANA, *U. S.*—Guarana.

Pasta guarang.—Guarana, Fr.; G., Sp.

A dried paste chiefly consisting of the crushed and pounded seeds of Paullinia cupana, *Kunth*, s. P. sorbilis *Martius*. Bentley and Trimen, *Med. Plants*, 67.

Nat. Ord.—Sapindaceæ.

Origin.—Paullinia cupana is a climbing shrub with pinnate leaves composed of five oval-oblong toothed leaflets, small flowers in narrow spicate panicles, and pyriform beaked capsules containing one to three shiny blackish-brown subglobular seeds. It is indigenous to the northern and western provinces of Brazil.

Preparation.—The dry seeds are powdered, moistened by water or by exposure to the dew, and then kneaded into a kind of stiff paste, which is formed into globular or cylindrical masses; these are well dried near a fire or by exposure to the sun.

Description.—Guarana is met with in subglobular, cylindrical, or elliptic cakes which have an uneven surface, are hard, of a reddish-brown color, somewhat lighter internally, and breaking with an uneven, slightly glossy fracture, showing angular fragments of seeds with a brittle, blackish-brown tegument and with thickish white cotyledons. It has a peculiar slight chocolate-like odor and an astringent and bitter taste. It is partly soluble in water and in alcohol.

Constituents.—Martius found guarana to contain starch, gum, a greenish fat, tannin which precipitates iron salts dark-green, and a crystalline substance, *guaranine*, which

was afterward proved to be identical with *caffeine* (p. 342) by Martius and by Berthemot and Dechastelus (1840). The latter obtained 4 per cent., Stenhouse 5.07 per cent., and Feemster (1882) between 3.9 and 5 per cent., of caffeine. Saponin and volatile oil are likewise present in guarana. The alkaloid is best obtained, according to Dr. F. V. Greene (1877), by Prof. Wayne's process, by prolonged boiling with litharge; and Mr. Feemster found it of advantage to add near the end of the process a few drops of lead subacetate, which facilitates the settling of the insoluble matter. The tannin, *paullinitannic acid*, was shown by Dr. Greene to give precipitates with ferric salts (green, brown), gelatin, most alkaloidal salts, and barium salts, to give no precipitate with tartar emetic or copper sulphate, and to reduce salts of silver and gold.

Action and Uses.—The curative powers of guarana at first appeared to be not less wonderful than those of many other new remedies. It was a specific for diarrhœa (*Amer. Jour. Phar.*, lxii. 69) and dysentery, gonorrhœa, leucorrhœa, and passive hæmorrhages, was lauded as a stomachic tonic, and was even put forward as remarkably efficacious in lumbago. Of all these virtues of the drug none survive, and the only affection in which it continues to be found useful is one which its congeners, tea (and especially green tea) and coffee, have never lost the reputation of relieving—*headache*. The particular forms of headache in which it is useful are the nervous sick headache which recurs frequently in the same person, and especially in females at the menstrual periods, and that which follows a debauch, when the head throbs and the eyes are bloodshot. Like the other more popular remedies, guarana gradually loses its power over such attacks, and even appears to render them more frequent and severe. It may be administered in substance in the *dose* of from Gm. 1–4 (gr. xv–lx) in powder, but in this form it is repulsive, and the doses mentioned are better given in infusion. The most efficient preparation is, however, the alcoholic extract dissolved in alcohol to form a tincture in the proportion of 1 part to 30. From Gm. 0.10–0.30 (gr. ij–v) of the extract may be given at a dose. A fluid extract, which is officinal, and a syrup, have been made, and are convenient forms for administration.

GUTTA-PERCHA, *Br., P. G.*—Gutta-Percha.

Gutta-percha depurata, *Gutta-taban*, *Gummi plasticum*.—*Gutta-percha*, Fr., G.

The concrete exudation, obtained by incisions, of Isonandra (Dichopsis, *Bentley*) Gutta, *Hooker*. Bentley and Trimen, *Med. Plants*, 167.

Nat. Ord.—Sapotaceæ.

Origin and Preparation.—The taban is a stately tree, 12–18 M. (40 to 60 feet) high, with few branches, with evergreen oblong or obovate, entire, glossy, and underneath brownish-yellow scaly leaves, and small white flowers aggregated in little clusters near the top of the branches. It is common in jungles of the Malay peninsula and of the Malayan Archipelago; it is now extinct in Singapore, having been destroyed in the collection of the juice. To obtain the gutta-percha the tree is felled and circular incisions are made through the bark at distances of 15–30 Cm. (6 to 12 inches) along the whole trunk, from which the milky juice slowly exudes and hardens on exposure. The yield from one tree is stated to be from 6 to 10 pounds; others claim a yield of over 20 pounds. Several other sapotaceous trees of the genera Dichopsis, Payena, and Ceratophorus yield similar products.

Description.—Gutta-percha is grayish or yellowish, frequently with red-brown streaks from fragments of bark and other impurities. It is hard and rather leathery or horny, in thin pieces somewhat flexible, is readily cut with the knife, between 45° and 60° C. (113° to 140° F.) sufficiently soft to be rolled into sheets, quite plastic at 65° C. (149° F.), and very soft at the temperature of boiling water. Its specific gravity is about 0.98, but it is heavier than water after the removal of all air-cavities (Payen). It is insoluble in water, alcohol, acids, alkalies, and fixed oils, dissolves in boiling ether, chloroform, benzene, coal-tar oils, carbon disulphide, and oil of turpentine; on evaporating these solutions it is left behind with its original properties. It is purified for dental and other purposes by agitating its solution with gypsum. If purified by treatment with water and hydrochloric acid, and then repeatedly dissolved in boiling ether and washed with cold ether and alcohol, a fine white powder is obtained of the composition $C_{20}H_{32}$, which is probably the composition of the recent juice (Baumhauer, 1859). It absorbs and combines with oxygen from the air, yielding white crystalline resin, Payen's *albane*, $C_{20}H_{32}O$, and yellow amorphous *fluavil*, $C_{20}H_{32}O_2$, which are contained in commercial gutta-percha sometimes to the amount of 20 per cent. Subjected to dry distillation, various

gases, water, and volatile acids are obtained, and two oils, one yellow, the other red-brown, both of the composition $C_{10}H_{16}$.

Pure gutta-percha is inodorous and tasteless; ignited, it burns with a bright flame. Its mixture with caoutchouc is readily vulcanized, and after the incorporation of insoluble earthy or metallic compounds is largely used in the preparation of various instruments.

Percha lamellata, *P. G.—Gutta-percha paper*—is in thin, brown, translucent sheets, which are prepared by softening gutta-percha in hot water and pressing it between rollers.

Allied Products.—Murton (1878) describes four additional guttas:

Gutta-soosoo of Perak is firmer than gutta-taban, and contains a little oil, but gutta-soosoo of Borneo is a caoutchouc.

Gutta-rambong of Perak is reddish-brown, closely resembles caoutchouc, and is probably obtained from the milk-juice of the roots of Ficus elastica.

Gutta-singgarip seems to be produced from a woody apocynaceous climber, and enters commerce as a soft, spongy, and wet mass.

Gutta-putih or Gutta-sundek comes from a species of Dichopsis, having shorter and broader leaves than the taban tree, and is whiter and more spongy than gutta-percha.

Other similar products from different species of Ficus and Isonandra are used in the Malayan islands for adulterating gutta-percha.

Balata—in Central America called *chicle*, *tuno gum*, and *leche de popa*—is the milky exudation of Mimusops globosa, *Guertner* (Mimusops Balata, *Crueger;* Achras Balata, *Aublet:* Sapota Muelleri, Belkrode), a tree called *bully tree*, growing on the banks of the Orinoco and Amazon Rivers. It resembles gutta-percha, becomes soft at 50° C. (122° F.), melts at 150° C. (302° F.), is soluble in benzene, carbon disulphide, and hot oil of turpentine, and partly soluble in absolute alcohol and ether. It is not acted on by alkalies or hydrochloric acid, but is decomposed by strong nitric and sulphuric acids. It has been used as an addition to plasters.

Action and Uses.—The qualities which render this substance of value in the surgical and mechanical treatment of diseases are—its flexibility when warm, its firmness at ordinary temperatures, and its solubility in menstrua which do not alter its essential qualities. The facility with which it is bent and moulded when warm adapts it to making splints, whose size, shape, and weight can readily be changed. It has in a great degree supplanted the old and costly carved splint, to which, indeed, it is in all respects superior. Its lightness, firmness, smoothness, and unalterable character render it admirably adapted for the manufacture of syringes, specula, bougies, pessaries, stethoscopes, etc. Like collodion, the solution of gutta-percha in bisulphide of carbon or in chloroform may be used to retain the edges of incised *wounds* in apposition, and also as a protective of the *abraded skin* against mechanical injury or the *absorption of poisons.* In this manner it has been used as a coating for *sore nipples.* The solution in chloroform, which is officinal, is a very convenient agent for protecting portions of the skin from the air, while it exerts a slight degree of compression which is modified by the flexibility of the film formed by the dried solution. It has been used with more or less advantage in the treatment of *lepra* and *psoriasis*, *herpes tonsurans*, *eczema marginatum*, and *prurigo*, to prevent pitting in *small-pox*, and to limit the efflorescence in *erysipelas.* This method has been recommended by numerous dermatologists, and among them Auspitz in Germany and Morrow in this country (*Wiener med. Wochenschrift*, 1883; *Med. News*, xliv. 257). The solution generally used by the former is one part of gutta percha to ten of chloroform, which corresponds nearly to Liquor gutta-percha U. S. P. (1880) Its advantages are stated to be that it excludes air from the diseased skin, prevents crusts from forming, which hinder medicinal applications, lessens the secretions, and limits to the affected part the action of the agent employed. It is not easily removed by the friction of clothing or by muscular action. It is, also, unirritating and easily prepared for use. It seems to be the best agent for concentrating and limiting the action of chrysarobin. Gutta-percha is also found to be a convenient vehicle with which to incorporate certain caustics, as potassa and chloride of zinc, for the purpose of limiting and mitigating their action.

GYNOCARDIA.—Chaulmugra.

The seed of Gynocardia (Chaulmoogra, *Roxburgh*, Hydnocarpus, *Lindley*) odorata, *R. Brown.* Bentley and Trimen, *Med. Plants*, 28.

Nat. Ord.—Bixaceae.

Origin.—The chaulmugra is a large tree of the Malayan peninsula, growing northward to Assam and westward to Sikkim. It has alternate oblong and acuminate leaves

and diœcious yellowish flowers, each petal having a dark-yellow spreading scale at the base. The fruit is globular, gray, one-celled, pulpy, and many-seeded.

Description.—The seeds are irregular ovoid, about an inch (25 Mm.) long, somewhat angular, dull-gray, have a brittle testa, and contain a large embryo with a thick radicle and a pair of leafy cordate cotyledons imbedded in a brown oily albumen. The kernel has a faint, peculiar, somewhat unpleasant odor and taste.

Constituents.—By subjecting the seeds to pressure or by boiling them in water *chaulmugra oil* is obtained, which, when pure, is of a pale or golden-sherry color, melts at about 40° C. (104° F.), and on keeping frequently deposits a granular fat; that obtained by boiling is said to remain clear, and, according to Dymock, does not form a green tenacious mass on stirring 20 minims of it with 1 minim of sulphuric acid. On the contrary, when the expressed oil is thus treated a reddish-brown resin-like mass is formed around the acid. John Moss (1879) ascertained that the acid reaction of the oil is due to palmitic and gynocardic acids, and that the oil consists of glycerides of palmitic and about 11.7 per cent. of gynocardic acid, with small proportions of hypogæic and cocinic acids. *Gynocardic acid* has a yellowish color, crystallizes readily in plates, melts at 29.5° C. (85° F.), has an acrid burning taste, is probably of the formula $C_{14}H_{24}O_2$, and gives a green color with sulphuric acid; a similar color is also produced by the same reagent with palm oil.

Allied Species.—Hydnocarpus venenata, *Gaertner*, a large tree of Western India, has a tomentose fruit containing longitudinally striate, and on the edges rugose, seeds.

Hydnocarpus Wightiana, *Blume*, a large tree, a native of Ceylon, has a fruit of the size of a small apple and obtusely-angular seeds. The seeds of both species yield a fatty oil which is used like chaulmugra oil.

Action and Uses.—Chaulmugra oil has from time immemorial been held in great esteem by the native races of India as a potent medicine in the treatment of *leprosy*, *scrofula*, *phthisis*, *syphilis*, *rheumatism*, *itch*, and various *diseases of the skin*. For the first named of these diseases it is held in the Mauritius to be a specific remedy. Of its mode of action nothing is known beyond the fact that when given in excessive doses it causes vomiting. Of its utility in leprosy we have the report of Dr. Young, who treated fifty-three cases, of which four belonged to the macular, twenty-three to the anæsthetic, fifteen to the tubercular, and eleven to mixed forms of the disease. He concluded that in the macular and in the early stage of the anæsthetic forms of leprosy chaulmugra appears to be of decided value. Several of the cases treated were complicated with bronchial affections, which were quite relieved during the treatment. The oil was given in gradually increasing doses, beginning with 5 drops three times a day, but the good effects of the treatment were seen earlier in cases treated with the powdered seeds. A liberal milk diet seemed to be a valuable auxiliary. These results have, on the whole, been confirmed by the later experience of competent judges. Thus, Dr. Liveing draws attention to the fact that leprosy (E. græcorum), like many other fatal diseases, is liable to long periods of comparative rest or subsidence quite apart from any special treatment. After a study of twenty cases he concludes that neither gurjun oil nor chaulmugra oil can be regarded as a specific for the disease; some cases improved under the latter, but he adds, "I have never met with one well-authenticated case of complete cure under its influence" (*Times and Gazette*, Aug. 1879, p. 205). Mr. C. T. Peters found this oil useful in relieving the dyspeptic symptoms of lepers and in promoting the absorption of the leprous tubercles (*Edin. Med. Jour.*, xxviii. 214). It seems to form a convenient and useful local application, for its unctuous smoothness has been compared to that of goose-grease. It was employed in England (1879) in the treatment of pulmonary *phthisis*. The patients showed an unusual degree of objection to taking it on account of its nauseous odor and taste, and when mixed with cod-liver oil it became particularly repugnant to them. The result of the trial was altogether unfavorable (Yeo). These adverse results have been confirmed by the subsequent observations of Murrell. "The oil has a deserved reputation in cases of *itch* and parasitic *pediculi*." In skin diseases, except, perhaps, in chronic *psoriasis* and *eczema*, it has proved irritating. Rheumatism and gout have been alleged (Cottle) to improve rapidly under the use of chaulmugra oil, but confirmatory evidence is wanting. It may be administered in the *dose* of Gm. 0.30 (♏v) enclosed in gelatin capsules, or in an emulsion with milk, glycerin, or almond oil. The seeds, coarsely powdered, are given in pills in the dose of Gm. 0.30–0.40 (gr. v–vj). The ointment is officinal in India.

HÆMATOXYLON, *U. S.*—Logwood.

Hæmatoxyli lignum, Br.; *Lignum Campechianum, Lignum cæruleum.—Bois de Campêche, Bois d' Inde, Bois de sang*, Fr.; *Blauholz, Blutholz, Campecheholz*, G.; *Palo de Campeche*, Sp.

The heart-wood of Hæmatoxylon campechianum, *Linné*. Woodville, *Med. Bot.*, plate 17; Bentley and Trimen, *Med. Plants*, 86.

Nat. Ord.—Leguminosæ, Cæsalpineæ.

Origin.—The logwood tree is indigenous to the shores of the Gulf of Campeachy and to other parts of Central America, and has been introduced into, and perfectly naturalized in, Jamaica, St. Domingo, and other West Indian islands. It is 9–12 M. (30 to 40 feet) high, has many spreading and crooked branches, alternate leaves with four pairs of obcordate leaflets, small yellow flowers in lax racemes, and two-seeded legumes. The tree is felled when about ten years old; the bark and light-colored sap-wood are removed, the red heart-wood alone entering commerce.

Description.—Logwood is met with in logs about 90 Cm. (3 feet) long, which consist of the heart-wood, and, from exposure, are externally of a blackish-purple darkened by chlorine, internally of a brown-red color. Irregular concentric circles of darker and lighter red color, resembling annual rings, are observed upon cross-section; the vessels are distinct to the naked eye, the medullary rays very fine. The wood is heavier than water, specific gravity about 1.06, splits irregularly, has a slight agreeable odor and a sweetish and astringent taste, and imparts a dark pink color to the saliva. In the shops it is found in the form of chips and ground into a coarse powder, upon both of which a greenish lustre (*hæmatein*) is often observed. Under the microscope the cell-walls are seen to have a red color, and the ducts and wood-fibres to be filled with a red resin-like mass, occasionally forming in the ducts crystals of a green metallic lustre.

Constituents.—Analyzed by Chevreul (1812), it was found to contain a little volatile oil, brown extractive containing tannin, fatty or resinous and glutinous matter, and a crystalline substance which he named *hæmatin*, but which is now more properly called *hæmatoxylin*. According to Erdmann (1842), it is best obtained from powdered extract of logwood by mixing it with much sand and exhausting with ether; the ether is mostly recovered by distillation, and the residue mixed with some water and crystallized, a little sulphurous acid or solution of a sulphite being added to prevent oxidation; the yield is about 12 per cent. When pure, hæmatoxylin is $C_{16}H_{14}O_6$, and crystallizes with 1 or $3H_2O$ in colorless or pale yellow prisms which have a strongly sweet taste of liquorice, acquire a red color on exposure to the light, are freely soluble in hot water, in alcohol, and ether, and, fused with potassa, yield pyrogallol. The aqueous solution is slightly precipitated by solution of isinglass, and produces with baryta solution, lead acetate, and with copper salts white or grayish precipitates which rapidly turn blue. Ammonia dissolves hæmatoxylin, the solution being rose-red, then purple, and finally blackish-red; the fixed alkalies produce similar solutions, and the color ultimately becomes yellowish-brown. The blackish ammonia solution contains *hæmatein-ammonia*, from which acetic acid separates *hæmatein*, $C_{16}H_{12}O_6$; this is soluble in alcohol and hot water, slightly so in ether, and forms a blackish-violet crystalline powder having a green metallic lustre. Hæmatein-ammonia causes, in a warm solution of a small amount of alum and with ferric chloride, deep-violet precipitates; with lead acetate, a brown one.

Action and Uses.—Logwood is mildly astringent and has been reputed to possess tonic virtues. Its preparations darken the fæces, and sometimes turn the urine blood-red and give it a sweetish taste. They constipate less than the pure astringents. They are used to check *diarrhœa, hæmorrhage*, and *sweat;* their mildness renders them appropriate for infantile diarrhœa. Externally, logwood is said to display antiseptic and healing qualities in the treatment of *gangrenous* and *ill-conditioned sores*.

HAMAMELIS, *U. S.*—Hamamelis.

Witch-hazel, E.; *Hamamélis*, Fr.; *Hamamelis, Zauberhasel*, G.

The leaves of Hamamelis virginica, *Linné*, collected in autumn.

Nat. Ord.—Hamamelaceæ.

Origin.—The witch-hazel is a shrub from 1.8–3 M. (6 to 10 feet) high, growing in damp woods and thickets in Canada and the United States. It has a rather crooked stem, with a close white wood and with flexuose branches, which are covered with a

smooth brown bark, the older bark being brown-gray and somewhat fissured, and internally whitish and smooth. The flowers are in clusters of three or four with an involucre of three ovate leaflets, have a four-cleft calyx and four long linear, greenish-yellow petals, and appear in September and October, the nut-like two-celled and two-beaked capsule, containing two black oily edible seeds, not ripening until September of the next year. The bark, which has been medicinally employed, has a bitter, astringent, and somewhat pungent taste.

Description.—The leaves are alternate, short-petiolate, thickish, 10–15 Cm. (4 to 6 inches) long, oval or obovate, feathered-veined, wavy-toothed on the margin, slightly heart-shaped and oblique at the base, stellate-pubescent when young and nearly smooth when old; they are inodorous, and have an astringent and bitter taste.

Constituents.—H. K. Bowman (1869) ascertained the bark to contain 8.10 per cent. of tannin, which was determined by means of gelatin. The leaves have not been analyzed; they contain tannin and a bitter principle.

Pharmaceutical Uses.—Tinctura Hamamelidis, *Br. Add.*—Tincture of Hamamelis, *E.*; Hamamelisrinden-Tinktur, *G.*—Take of hamamelis bark, in No. 20 powder, 2 ounces, proof spirit a sufficiency. Moisten the powder with a suitable quantity of the menstruum, and macerate for twenty-four hours; pack in a percolator, and gradually add proof spirit until one pint of tincture is obtained.

Action and Uses.—The accounts published of the remedial virtues of witch-hazel seem to be as hard to accept as the popular faith in it as an infallible divining-rod. Yet through the extravagant statements concerning it there runs a thread of truth, for all the conditions it is said to relieve are those of morbid excitement, such as *inflammations*, *congestions*, *hæmorrhages*, and even the action of the gravid uterus in threatened *miscarriage*. To the tannin and essential oil it contains, and to a peculiar bitter principle, some of its alleged sedative virtues may be attributed. In America it was very early used as a medicine. Coxe (*Amer. Dispensatory*, 1814) quotes from Thacher, who, in his turn, borrows from Cutler the following: "The Indians applied the bark, which is sedative and discutient, to painful *tumors* and internal *inflammations*. A cataplasm of the inner rind of the bark is found to be very efficacious in removing painful inflammations of the *eyes*. The bark chewed in the mouth is, at first, somewhat bitter, very sensibly astringent, and then leaves a pungent sweetish taste, which will remain for a considerable time." Mérat and De Lens (1831) quoted from Coxe the substance of the preceding passage. In 1868, Dr. Lee declared witch-hazel to contain a larger proportion of tannin than geranium or sumach. Dr. Hector Guy (*Boston Med. and Surg. Jour.*, April, 1885, p. 361) found in it only "tannin, an essential oil, waxy matter, and extractive." Of these constituents, tannin is evidently the most important, and necessarily is not contained in the distillate which is popularly known as extract of witch-hazel. Experiments on animals and man by Guy prove that the preparations of this plant are totally devoid of poisonous properties, and that there is no evidence that they can exert any physiological action at all. These results were fully confirmed by the investigations made by Drs. H. C. Wood and John Marshall, who also concluded that whatever virtues the medicine may possess depend upon "the very large percentage of tannic or gallic acid in the fluid extract" (*Therap. Gaz.*, x. 295). When the negro slaves endeavored to produce abortion by means of cotton-root, miscarriage is said to have been prevented by the use of hamamelis (Porcher, *Resources of the Southern Fields, etc.*, 1869, p. 62). Recent observations (1882) appear to justify the use of witch-hazel to check hæmorrhage, relieve tender and painful piles, and promote the healing of unhealthy wounds and irritable and varicose ulcers. But they do not demonstrate its possession of other qualities than such as belong to tannin and the plants containing it. The published reports often exhibit more faith in the physician than virtue in the medicine. They overlook the natural tendency of hæmorrhage to cease, which has led into error the advocates of many hæmostatics, and their statements are mutually destructive. For while one reporter states that he cured "bleeding piles, menorrhagia, and continued oozing from the uterus four weeks after confinement" by giving "two drops of the fluid extract hourly," another arrested hæmoptisis by "40 to 60 drops of the extract repeated three times a day," and a third boasts of arresting hæmorrhage from the bladder by this medicine, when in fact he employed "1 drachm of tincture of hamamelis and ½ *drachm of carbolic acid*." There can be little doubt that *hæmorrhoidal* swellings and hæmorrhage have been palliated by hamamelis as they are by preparations of gallic or of tannic acid; but when we are assured that varicose veins and ulcers are curable by this agent applied locally, and we are disposed to accept the assurance, we hesitate on being

told of the efficacy in *varicose veins* of 1 grain twice a day of its extract, internally administered (*Therap. Gaz.*, ix. 336). Hamamelis may be used in a decoction made with Gm. 32 to Gm. 500 (℥j in Oj), and given in wineglassful *doses* every three or four hours, or oftener, according to the urgency of the case. We have known a decoction or infusion of it to be applied as a lotion with apparent benefit in *crusta lactea*. The fluid extract is officinal, and an ointment may be made with this extract evaporated to dryness or with the fresh bruised bark boiled in lard. The last is used for *hæmorrhoids*.

HEDEOMA, *U. S.*—Hedeoma.

American pennyroyal, E.; *Pouliot américain*, Fr.; *Amerikanischer Polei*, G.

The leaves and tops of Hedeoma (Melissa, *Linné*, Cunila, *Willdenow*, Ziziphora, *Desfontaines*) pulegioides, *Persoon*. Barton, *Med. Bot.*, t. 41; Bentley and Trimen, *Med. Plants*, 200.

Nat. Ord.—Labiatæ, Satureieæ.

Origin.—Pennyroyal is an annual herb indigenous to North America, from Canada south through the United States. It grows in barren and sandy fields, on hills, and along the open border of woods, always in dry places.

Description.—It has an erect, obscurely quadrangular, branched, and hairy stem about 15–30 Cm. (6 to 12 inches) high; opposite, shortly-petioled, oblong-ovate, and obscurely serrate leaves, which are about 12 Mm. (½ inch) long and glandular dotted on the lower side, and axillary cymules of about three flowers. The calyx is tubular-ovoid, hairy in the throat, and somewhat two-lipped, the upper lip divided into three lanceolate teeth, the two lower teeth subulate. The corolla is small, the tube scarcely exceeding the calyx, pale-blue with purplish spots, two-lipped, the upper lip erect and emarginate, the lower lip spreading and nearly equally three-lobed. It has two sterile and two fertile somewhat exserted stamens, a bifid style, and produces four small smooth akenes at the base of the persistent calyx. It has a strong aromatic mint-like odor and a warm and pungent taste.

Fig. 146.

Hedeoma pulegioides, *Persoon*: flower and corolla, cut open; magnified.

Constituents.—Its virtues depend upon the volatile oil. (See Oleum Hedeomæ.) Its other constituents are probably those generally found in plants of this natural order.

Allied Plants.—Mentha Pulegium, *Linné* (s. Pulegium vulgare, *Miller*) is the European pennyroyal, Menthe pouliot, Pouliot commun, *Fr.*; Polei, *G.*; Poleo, *Sp.* It grows in moist sandy localities in Central and Southern Europe, has oval-obtuse and crenately-serrate leaves, many-flowered axillary cymes forming globular whorls, and a purplish-colored four-lobed corolla. It resembles the former in odor, while the taste is somewhat bitter and acrid.

Hedeoma thymoides, *Gray*, of Texas, possesses similar properties, but has a more agreeable odor.

Action and Uses.—Hedeoma is an aromatic stimulant. It may be prescribed, like other medicines of its class, to relieve flatulent *colic* or *painful digestion*, to correct the nauseating or griping operation of certain purgatives, etc. For these purposes it is less eligible than mint, anise, etc. In the form of hot infusion it is much used to dissipate the congestions tending to *diarrhœa* and to inflammation of the *throat* or *bronchia*, also in muscular *rheumatism*, etc., and, in conjunction with the hot hip- and foot-baths, to bring on retarded or suspended *menstruation*. An infusion made with Gm. 16 (℥ss) of the plant to Gm. 500 (Oj) of water may be given in the *dose* of 2 fluidounces or more every hour. Mentha pulegium possesses similar virtues, and in Europe its oil is a popular medicine for bringing on the menses and even for producing abortion.

HELENIUM.—Sneezeweed.

Helenium autumnale, *Linné*. Meehan, *Native Flowers*, ii. 113.

Nat. Ord.—Compositæ, Senecionideæ.

Description.—The sneezeweed or *sneezewort* is an herbaceous perennial which is common in damp places in the United States, in British Columbia, and in Mexico, where it is called Rosilla de Puebla. It is of a grayish-green color, nearly smooth, .9 to 1.5

M. (3 to 5 feet) high, has a branching quadrangular, winged stem, and lanceolate-serrate leaves which are pointed above and narrowed toward the base. The flower-heads are rather large, numerous, and have the involucral scales in two rows, the outer one foliaceous and reflexed; the ray-florets are ligulate, drooping, yellow, veined, and obtusely three-toothed at the apex. It flowers in August and September. The plant has scarcely any odor and possesses a very bitter taste.

Constituents.—It was analyzed by F. J. Koch (1874). Besides the principles common to herbs, it contains malic acid and traces of tannin; the bitter taste is due to a principle which was obtained in an amorphous condition, is soluble in ether, alcohol, and boiling water, and on being boiled with dilute sulphuric acid is resolved into sugar and an amorphous bitter substance having an acid reaction.

Allied Plants.—Hel. parviflorum, *Nuttall*, indigenous to Georgia, has lanceolate, nearly entire, scarcely decurrent leaves, and smaller flower-heads than the preceding.

Hel. tenuifolium, *Nuttall* (Meehan, *Nat. Flow.*, ii. 37), has numerous linear or filiform entire leaves and small flower-heads. It is found in the Southern United States from Georgia westward to Texas, Arkansas, and Southern Kansas. The properties of these two species appear to be similar to those of the first.

Action and Uses.—Common sneezewort is so called on account of the acrid quality of its flowers and leaves, which when dried and powdered have been used as an errhine for the purpose of dissipating incipient *coryza* and relieving *headache*. H. tennifolium is said to be very poisonous to animals, producing in them muscular twitchings, passing into violent convulsions, and terminating in death. In four negroes it produced spasms, with more or less delirium and loss of consciousness (Galloway).

HELIANTHEMUM.—Frostwort.

Herbe de heliantheme de Canada, Fr.; *Canadisches Sonnenröschen*, G.

The herb of Helianthemum canadense, *Michaux*, s. Cistus canadensis, *Linné*.

Nat. Ord.—Cistaceæ.

Frostwort or *rock-rose* is a perennial herb indigenous to dry and rocky hills and sandy or gravelly soil of Canada and of the United States south to Florida.

Description.—The rigid slender stem is about 30 Cm. (2 inches) high, has alternate elliptic or linear lanceolate entire leaves, which are nearly 25 Mm. (1 inch) long and woolly beneath. The flowers are of two kinds: the earlier ones, appearing in June, are solitary, stalked, with five unequal hairy sepals, and the same number of large yellow petals, which unfold in sunshine only once. Somewhat later smaller apetalous and nearly sessile flowers make their appearance in axillary hoary clusters. The fruit is a three-valved, one-celled capsule, which is shorter than the calyx and contains few brown seeds. The herb, which varies much in habit, is inodorous and has a bitterish-astringent taste. Hel. corymbosum, *Michaux*, is mainly distinguished by the petal-bearing and apetalous flowers being in crowded cymes near the top of the branches, the former being on elongated, filiform stalks. It grows from New Jersey southward near the coast, in similar localities with the former. It is called *frostwort* and *frostweed* from the crystals of ice which shoot from the cracked bark at the base of the stem during freezing weather in autumn. Hel. vulgare, *Gaertner*, Cistus helianthemum, *Linné*, indigenous to Europe, resembles the preceding and possesses similar properties. Frostwort has not been analyzed. It seems to contain tannin and a bitter principle.

Action and Uses.—The bitter, astringent, and slightly aromatic taste of this plant may explain its alleged utility in *scrofula*, *diarrhœa*, and secondary *syphilis*. A strong decoction of it is apt to produce vomiting, but is employed as a gargle in *sore throat*, especially as it occurs in *scarlatina*, and also as a wash for *prurigo*. An extract is prepared which may be given in the *dose* of Gm. 0.12 (gr. ij).

HELIANTHUS.—Sunflower.

Helianthe, *Grand Soleil*, Fr.; *Sonnenblume*, G.; *Elianto*, Sp.

Helianthus annuus, *Linné*.

Nat. Ord.—Compositæ, Senecionideæ.

Description.—The sunflower is indigenous to tropical America and cultivated in most civilized countries, in many of which it has become naturalized or grows spontaneously. It has a straight stem from 3–4.5 M. (10 to 15 feet) high, which contains a large white pith. The leaves are alternate, petiolate, 25 Cm. (10 inches) long, broadly ovate or heart-shaped, three-ribbed, serrate, and rough. The flower-heads are from 20–30 Cm.

(8 to 12 inches) in diameter, with bright-yellow ligulate ray-florets and a flat brownish disk. The akenes are obovate-oblong, somewhat quadrangular, flattened, vary in color between whitish and black or are striped, are at the base embraced by the chaff, and crowned with a very deciduous pappus of two chaffy scales. On being triturated with water the kernels yield a bland emulsion.

Constituents.—Wittstein (1876) obtained from the fresh plant, deprived of the fruit, 1.9 per cent. of ash, nearly two-thirds of which were potassium carbonate, and from the fruit between 16 and 28 per cent. of fixed oil. *Sunflower-oil* is pale-yellow, limpid, bland, has the sp. gr. 0.962, and dries slowly on exposure to air; under the influence of nitrous acid it forms a soft yellow mass; with strong sulphuric acid it turns red and brown, but is not altered by a weak acid. The kernels contain also, according to Ludwig and Kromayer, *helianthic acid*, $C_7H_9O_4$, which reacts dark-green with ferric salts, is soluble in water and alcohol, and not precipitated by gelatin or potassium ferrocyanide. The dried pith, according to John, contains 9 per cent. of potassium nitrate.

Allied Plants.—The numerous species of this genus have yellow flowers, rough and frequently opposite leaves, and generally possess little odor. The next is occasionally cultivated for culinary purposes:

Helianthus tuberosus, *Linné.*—Jerusalem artichoke, *E.;* Topinambour, *Fr.:* Erdartischocke, *G.*—Indigenous to Brazil. The tubers are thick, oblong, externally reddish, internally white, and resemble the artichoke in flavor, but are less pleasant. Examined by Braconnot, Payen, and others, they were found to contain 76 to 77 water, 14.7 sugar, mucilage, inulin, 1 to 3 per cent. albumen, etc.

Actinomeris squarrosa, *Nuttall*, is a coarse-looking herb, with a winged stem, and with alternate, or sometimes opposite, oblong-lanceolate, and tapering leaves. The involucre consists of two rows of spreading or reflexed scales; the receptacle is small, hemispherical; the ray-florets, about six, are short, yellow, and neutral; the flat, broadly-winged, and two-awned akenes are partly enclosed by chaff. The plant grows in moist ground in the Middle and Western United States.

Action and Uses.—Sunflower is scarcely a medicinal agent. Its oil was largely used by the aborigines of North America. It serves many of the purposes of olive oil; the seeds are employed in fattening poultry and, after expression of the oil, for cattle, the pith of the stalk for making moxas, and the growing plant for drying damp soils on account of its remarkable power of absorbing water. The preposterous assertion has been made that the dried stems infused in whiskey cure intermittent fever. Quite possibly the alcohol of the preparation may have some such effect. A similar statement regarding the leaves and the flowers is not proven (*Bull. de Thérap.*, cxvii. 333).

Actinomeris helianthoides, or gravel-weed, is said to be diuretic and to have been used with advantage in cases of gravel, and also in dropsy (*Therap. Gaz.*, Sept. 1881). The evidence in its favor is not, however, very conclusive.

HELLEBORUS.—Black Hellebore.

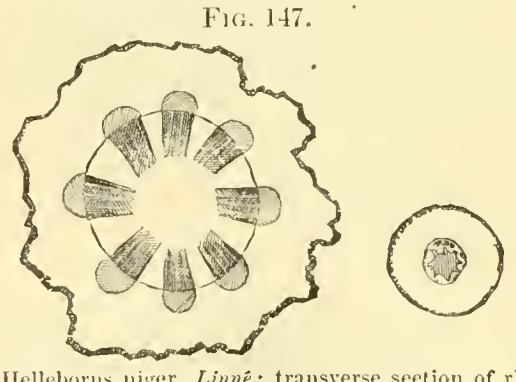
Radix hellebori nigri, Radix melampodii.—Hellébore noir, Fr. Cod.; *Schwarze Nieswurzel, Weinachtswurzel, Winterrose*, G.; *Eléboro negro*, Sp.

The rhizome, with the rootlets, of Helleborus niger, *Linné.* Woodville, *Med. Bot.*, 169; Bentley and Trimen, *Med. Plants*, 2.

Nat. Ord.—Ranunculaceæ, Helleboreæ.

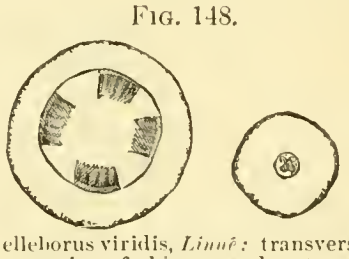
Origin.—Black hellebore, also called *Christmas rose*, is a native of Europe, and is met with in mountainous woods from Southern Germany and Central France southward

Fig. 147.



Helleborus niger, *Linné:* transverse section of rhizome and root.

Fig. 148.



Helleborus viridis, *Linné:* transverse section of rhizome and root.

to Italy and eastward to Greece. It flowers in winter, from December to March. The

plant is acaulescent, and has coriaceous, smooth, pedately seven- to nine-lobed leaves, and pale-green petioles and flower-stalks mottled with red; the single flowers have five large white or pinkish sepals and ten or more small greenish petals. The fruit consists of five to nine follicles, having the black shining seeds in two rows.

Description.—The rhizome, with branches, has an irregular knotty appearance, is 25–75 Mm. (1 to 3 inches) long, 6–12 Mm. ($\frac{1}{4}$ to $\frac{1}{2}$ inch) thick; the branches are annulate from leaf-sheaths and terminate with a concave (or when more recent with a convex) scar. The numerous rootlets are long, but, being very brittle, are always more or less broken off in the commercial article, about 2.5 Mm. ($\frac{1}{10}$ inch) thick, longitudinally wrinkled, and, like the rhizome, of a brown-black color. The transverse section of the rhizome shows a thick brownish-gray bark occupying about one-sixth of the diameter, a somewhat thicker whitish pith, and six to ten small wedge-shaped wood-bundles placed in a circle and separated by broad medullary rays. The rootlets have a thick bark and a central slightly pentagonal or hexagonal wood. In the dry state black hellebore has scarcely any odor; its taste is sweetish, then bitterish-acrid.

The rhizome and roots of Helleborus viridis, *Linné*, which are officially recognized in several European countries and considered to be more efficacious, are gathered, together with the radical leaves, in the autumn or in early spring, before flowering, the leaves being removed when used. The plant, which is indigenous to Central and Southern Europe and grows wild on Long Island, produces its greenish flowers in March and April, and has pedately seven-lobed radical leaves with the lobes lanceolate-acute and serrate. The rhizome is about 5 Cm. (2 inches) long and 6 Mm. ($\frac{1}{4}$ inch) thick, above knotty from the numerous stem-remnants, and annulate by the leaf-scars; the numerous nearly simple rootlets are 10 Cm. (4 inches) long, brittle, and usually broken off in the commercial article. In color, odor, and taste it resembles black hellebore. The transverse section of the rhizome shows a large pith with broad branches, and a woody ring consisting of four broad and short wedges, each composed of several smaller ones. The rootlets have a thick bark and a central obtusely four-branched ligneous cord. This drug is known in Europe, and prescribed as *Radix hellebori viridis*, or *green hellebore;* it should not be confounded with Veratrum viride, to which the same common name is sometimes given. It is not often met with in the American market.

Constituents.—The two rhizomes appear to have the same constituents. Aside from those more generally met with, like resin, gum, etc., they contain *helleborin*, $C_{36}H_{42}O_6$, discovered by Bastick (1852), and *helleborein*, $C_{26}H_{44}O_{15}$, discovered by Husemann and Marmé (1865); the latter principle is more abundant in black, the former in green, hellebore. On exhausting the concentrated tincture with hot water and filtering from the resin and oil, helleborin will crystallize; it is very poisonous, scarcely soluble in cold water, little so in ether and fixed oil, and freely soluble in alcohol and chloroform; its alcoholic solution has a burning taste, and it yields grayish amorphous and tasteless *helleboresin*, $C_{30}H_{38}O_4$, on being boiled with solution of zinc chloride. *Helleborein* is obtained from the decoction by precipitating with basic lead acetate, then with sodium sulphate, and finally with tannin; the latter precipitate is decomposed by lead oxide, the dry mass exhausted with alcohol, the tincture concentrated and mixed with ether. It forms colorless nodules of minute needles, is readily soluble in water, less so in alcohol, and insoluble in ether, and has a sweetish taste and a poisonous action. Boiling with dilute acids converts it into sugar and greenish amorphous and tasteless *helleboretin*, $C_{14}H_{20}O_3$.

Hellebore contains no tannin; an organic acid present is probably identical with aconitic acid.

Adulterations.—Black hellebore of commerce has been sometimes mixed with the rhizomes and roots of other, mainly ranunculaceous, plants, the most frequently occurring being Actæa spicata, *Linné*, which has a close resemblance to cimicifuga, but merely the dimensions of black hellebore. (See page 122.) The rhizome of Adonis vernalis, *Linné*, is subconical, almost simple, tufted above, not annulated, and has brittle rootlets with a cross-shaped wood. At one time we observed a black, forked, monocotyledonous rhizome of unknown origin offered as black hellebore.

Pharmaceutical Uses.—Extractum hellebori.—Extract of black hellebore, *E.;* Extrait d'ellébore noir, *Fr.;* Nieswurzextrakt, *G.*—The drug is exhausted with alcohol and diluted alcohol (*U. S. P.* 1870), or preferably with alcohol of 60–70 per cent.; the yield is about 14 per cent.

Tinctura hellebori.—Tincture of hellebore, *E.;* Teinture d'ellébore noir, *Fr.;*

Nieswurztinktur, *G.*—Black hellebore 2 troyounces; displace with diluted alcohol sufficient for obtaining 1 pint.—*U. S. P.* 1870.

Action and Uses.—Hellebore and helleborein are violent gastro-intestinal irritants, producing vomiting and purging, with copious bilious evacuations, and killing through exhaustion and convulsions. Vittorio and Elvidio have shown that even a very small quantity of helleborein applied to the eye produces local anæsthesia (*Centralbl. f. Therap.*, vi. 443), and Van der Heide states that in dogs its continued administration slows the pulse and finally arrests it (*Practitioner*, xxxvi. 298). It acts chiefly on the nervous system as a powerful depressant. In man small and repeated doses of hellebore produce liquid alvine evacuations and increase the menstrual and hæmorrhoidal flows. In larger doses it causes vomiting, colic, spasm of the throat, thirst with heat in the abdomen, exhaustion, failing pulse, dilated pupils, cold sweats, and collapse with spasms. In the fatal cases reported nothing is said of its having purged.

The reputation of this medicine rests chiefly upon the cures attributed to it of *mania* and *melancholy*, for which it was anciently held to be a specific. Possibly it may have been useful in cases of mental disorder connected with constipation and congestion of the liver and the abdominal organs generally. Yet the form of insanity which it seems most to have benefited in modern times is acute mania with febrile excitement. Like all drastic purgatives, black hellebore is sometimes curative of *amenorrhœa* either of the congestive or the atonic form, and is often a palliative of *ascites* by removing more or less of the dropsical fluid through the bowels. For this purpose it is inferior to jalap. The *dose* of the powdered root as a purgative is Gm. 0.30–1.30 (gr. v–xx). A decoction may be prepared by boiling Gm. 4 (60 grains) of the bruised root in Gm. 500 (a pint) of water, of which a fluidounce may be given every two or three hours until it operates. The antidotes to poisoning by black hellebore are diffusible stimulants, given after the evacuation of the poison.

Adonis vernalis acts upon the frog's heart very much like digitalis, producing a tonic contraction of the organ and a diminished pulse-rate (Bubnoff, 1880; Cervello, 1882; Huchard; Durand, 1885). Clinical observation leads to a similar conclusion, for the medicine restores its rhythm to the arhythmical heart, rendering the pulse slower, fuller, tenser, and stronger. It augments the urinary secretion by increasing the proportion of water in it while diminishing its solid ingredients. The observations of DaCosta (*Phila. Med. Times*, xvii. 551), Hermann (*Therap. Gaz.*, xi. 215), Albertoni (*Centralbl. f. Ther.*, v. 341), Huchard (*Jour. de Méd.*, Nos. 1 and 2, 1888), Borgiotti (*Therap. Gaz.*, xii. 854), and Oliver (*Lancet*, Nov. 24, 1888) agree substantially with these statements and with one another, but it would seem that, as in the case of digitalis and digitaline, there is a difference in the actions of the herb and the glucoside of adonis; that the former is a cardiac sedative and a diuretic, while the action of the latter on the kidneys appears to be less than that of the former. It seems also to differ from digitalis in exhibiting no cumulative action. Huchard pronounced it an energetic poison, requiring to be cautiously used, and considered it preferable to digitaline only where a prompt and vigorous action is required. On the other hand, Bubnoff, Lublinski, and others object to the glucoside and to adonis itself, that they are extremely bitter, and more apt than digitalis and digitaline to occasion vomiting and diarrhœa, while they admit that the former sometimes succeed in regulating an arhythmical heart when the latter has failed to do so (*Therap. Gaz.*, 1884, p. 47; *Med. Record*, xxvi. 192; *Bull. de Thérap.*, cx. 63). In cardiac *dropsy* it therefore palliates all the symptoms depending upon obstruction of the heart—viz. those due to the heart itself and those occasioned by the dropsy—and measurably it has analogous effects in renal dropsy, unless the effusion is very large and the kidney lesion very general. The same is true of it in hepatic and splenic dropsy. Adonis is useless in functional disease of the heart. The infusion is made with from Gm. 2–8 (gr. xxx–cxx) in Gm. 150 (6 fluidounces) of water. *Dose*, a tablespoonful every one, two, or three hours (Bubnoff, *Centralblatt f. Ther.*, i. 361). Adonidin is generally prescribed in divided doses, beginning with Gm. 0.01 (gr. $\frac{1}{6}$), and so as not to exceed in twenty-four hours Gm. 0.02–0.03 (gr. $\frac{1}{3}$–$\frac{1}{2}$), but some have found that in doses of Gm. 0.02 (gr. $\frac{1}{3}$) given four times a day it had an excellent effect upon the circulation and upon the action of the kidneys.

HEMIDESMI RADIX, *Br.*—Hemidesmus-Root.

Indian sarsaparilla, *Nunnari*, E.; *Hemidesmus*, Fr., G., It., Sp.

The root of Hemidesmus indicus, *R. Brown* (Periploca indica, *Willdenow*; P. emetica

Retzius; Asclepias pseudo-sarsa, *Roxburgh*). Wight, *Icon. Plant. Ind. Orient.*, ii. p. 594; Bentley and Trimen, *Med. Plants*, 174.

Nat. Ord.—Asclepiadaceæ, Periplocæ.

Origin.—This slender climbing shrub is a native of the Indian peninsula, growing in uncultivated places. It has opposite entire leaves, varying between linear-lanceolate and ovate, the broadest being on the upper branches, axillary clusters of small purple flowers, long linear follicles, and numerous seeds with tufts of slender hairs.

Description.—The root is met with in pieces about 15 Cm. (6 inches) long and 5 to 15 Mm. ($\frac{1}{5}$–$\frac{3}{5}$ inch) thick, cylindrical, tortuous, longitudinally wrinkled, and transversely fissured, forming annulations. It is covered with a thin dark-brown corky layer, followed by a whitish mealy thin bark containing in its inner layer scattered laticiferous ducts. The cambium-line is dark, wavy, and the wood yellowish, with narrow medullary rays, which are best observed in the thin roots. Hemidesmus-root has an agreeable odor, suggesting that of tonka, and a sweetish, slightly acrid, not unpleasant taste.

Constituents.—The root contains starch, and in the suberous layer some tannin. Scott (1843) obtained a stearopten by distillation with water. Its other constituents are unknown.

Allied Plant.—Gymnema sylvestre, *R. Brown* (Asclepias geminata, *Roxburgh*), a native of India and Africa, is a woody climber, bearing small yellow flowers. The root is of the thickness of a finger, has a spongy reddish-brown bark, and possesses a saline and acrid taste. The leaves are 4 to 7 Cm. ($1\frac{1}{2}$–3 inches) long, entire, elliptic or obovate, thin, coriaceous, and puberulent. Besides resins, carbohydrates, albuminous and coloring-matters, D. Hooper (1887) determined the presence of a neutral bitter principle, tartaric acid, and *gymnemic acid*, the latter somewhat resembling chrysophanic acid.

Action and Uses.—In India, whence it was introduced into England, this medicine has some reputation for efficacy in the constitutional disorders supposed to be benefited by sarsaparilla. But its syrup, which is also officinal, is, like the syrup of sarsaparilla, chiefly used as a flavoring ingredient of mixtures.

Gymnema sylvestre.—The powdered root has long been used in certain parts of Hindostan as a remedy for snake-bites. The leaves, when chewed, have the curious property of suspending for several hours the perception of sweet and bitter tastes. These properties are ascribed to the gymnemic acid of the plant (*Practitioner*, xxxviii. 457).

HEPATICA.—Liverwort.

Herbe de hépatique, Fr.; *Edelleberkraut*, G.; *Hepatica*, Sp.

The leaves of Hepatica triloba, *Chaix* (Hep. nobilis, *Moench;* Anemone Hepatica, *Linné*).

Nat. Ord.—Ranunculaceæ, Anemoideæ.

Origin.—A perennial acaulescent herb flowering in March and April, and indigenous to Europe and North America south to Georgia, growing in shady woods. The flowers are on villous scapes 10–15 Cm. (4 to 6 inches) long, and have a three-leaved involucre and six to nine petal-like blue or purplish, or sometimes white, sepals. The radical leaves are the portion used; the loss in drying amounts to from 70 to 75 per cent.

Description.—The leaves are subcoriaceous, smooth, dark-green, and shining above, paler beneath, broadly heart-shaped or somewhat kidney-shaped in outline, and divided into three lobes, which are obtuse or rounded (Hep. americana, *De Candolle*) or pointed (Hep. acutiloba, *De Candolle*). A similar distinction is also observed in the involucral leaves, the two forms being probably mere varieties of one species, the acute-lobed preferring a northern exposure. The leaves are inodorous and have an insipid, slightly astringent, and bitterish taste.

Constituents.—As far as may be judged from the sensible properties, liverwort does not appear to contain any important characteristic principle. Mucilage, sugar, and a small amount of tannin are present.

Action and Uses.—Liverwort passes for being tonic and deobstruent. It once had a transient vogue in the treatment of chronic *bronchitis* and *phthisis*. But its medicinal value is very small, and hardly entitles it to a place in the materia medica. It may be given freely in infusion.

HERACLEUM.—Cow-Parsnip.

Heracleum lanatum, *Linné.*

Nat. Ord.—Umbelliferæ, Orthospermæ.

Description.—The cow-parsnip, also called *masterwort*, is a woolly perennial herb growing from 1.5–3 M. (5 to 10 feet) high in most of the northern and middle parts of the United States westward to the Pacific. The root is many-headed, fleshy, nearly simple, or composed of many thinner branches, 12 Mm. (½ inch) or less, in diameter, brownish yellow externally, white internally, with a rather thick bark containing resin-cells. The leaves are large, ternately dissected, on very broad and sheathing petioles, the segments often 25 Cm. (10 inches) long, the middle one usually three-lobed. The umbels are from 30 to 38 Cm. (12–15 inches) broad, with an involucre of oblong lanceolate leaves and involucels composed of five or eight lanceolate, slender, acuminate leaves. The flowers are white. The fruit is 8 Mm. (⅓ inch) long, oval, flattened on the back broadly winged on the margin, each mericarp with five slender ribs, the lateral ones being close to the margin, and in the upper half with six clavate oil-tubes, two of which are on the commissure. All parts of it have a rank odor and a pungently acrid taste. The root, leaves, and fruit have been employed.

Heracleum sphondylium, *Linné*, the cow-parsnip of Europe and Northern Asia (Berce, Fausse acanthe, *Fr.;* Baerenklaue, *G.*), is a similar but smaller plant, and possesses similar properties.

Constituents.—These plants appear to contain volatile oil and resin; their acrid principles have not been investigated.

Action and Uses.—In their fresh state the leaves and also the root, applied to the skin, may produce vesication and have been used as counter-irritants. Some of the European species are still more irritant, and contain a juice which has been applied to *warts* as an escharotic. The American plant has been used with alleged curative effect in *epilepsy* apparently depending upon gastro-intestinal irritation. It is given both in substance and in infusion, and is thought to correct *dyspeptic* disorder. Gm. 4 (℥j) of the root or its equivalent in infusion may be taken several times a day.

HEUCHERA.—Alum-root.

The root of Heuchera americana, *Linné.*

Nat. Ord.—Saxifragaceæ.

Origin.—This is a perennial herbaceous plant, with a tuft of orbicular-heart-shaped, slightly lobed, and crenately-toothed hairy leaves and glandular hairy scapes about 60 Cm. (2 feet) high, bearing loose panicles of small flowers with short, white, narrow petals and exserted stamens and styles. It is common in rich woodlands of the United States from the New England States west to Wisconsin and the Mississippi and south to Georgia. It flowers in June, and the root is probably best collected in September.

Description.—The root is about 15 Cm. (6 inches) long and about 12 Mm. (½ inch) thick, with several short cylindrical heads terminating with a concave scar, tapering, and somewhat branched below, and beset with some thin radicles. In its fresh state it is fleshy; when dry, irregularly shrivelled, tuberculate, the brittle fibres usually broken off. It is externally of a purplish-brown color, has a thin bark and a thick, fleshy meditullium of a pale-reddish or brownish tint, and breaks with a short somewhat spongy or granular, not fibrous fracture, often showing internal cavities. It is inodorous, and has a strongly astringent, slightly bitterish taste. The rootlets agree with the main root in color and taste, but have a thick bark and thin, spongy centre. It has not been fully analyzed. H. K. Bowman (1869) found it to contain from 18 to 20 per cent. of tannin.

The root of Heuchera villosa, *Michaux*, and probably other species may possess virtues similar to those of the above.

Action and Uses.—Alum-root, as its name implies, is astringent. It is sometimes used in domestic medicine as a remedy for *diarrhœa* and *menorrhagia*, as a mouth-wash for *aphthæ*, and as an application to *ulcers*, *hæmorrhoids*, etc. It may be used in decoction.

HIERACIUM.—Hawkweed.

Epervière, Fr.; *Habichtskraut*, G.

Nat. Ord.—Compositæ, Cichoraceæ.

Description.—The following species have been used:

Hieracium venosum, *Linné.*—Rattlesnake-weed.—It is a perennial herb, common in dry woods and plains of North America, with oblong-obovate, purple-veined, entire, and scarcely petiolate radical leaves, and with a naked or one-leaved smooth scape bearing a loose paniculate corymb of yellow flower-heads, which have slender peduncles, a nearly cylindrical involucre, and linear akenes with a tawny, fragile, bristly pappus. The plant is inodorous, and has a bitter and somewhat acrid taste.

Hier. gronovii, *Linné*, likewise a North American species and growing in similar localities, has a wand-like simple stem which is leafy and hairy below. The leaves are petiolate, lance- or obovate-oblong, the peduncles slender, and, like the involucre, glandular-pilose. The akenes are tapering at the summit. This and the next species are sometimes used for toothache.

Hier. scabrum, *Linné.*—It is stouter than the preceding, rough-hairy, more branched, the involucre glandular-hirsute and the akenes not taper-pointed.

Hier. pilosella, *Linné.*—Piloselle, Oreille de souris, *Fr.;* Mäuseöhrchen, *G.*—A European plant, with white hairy leaves and a hairy, naked, or one-leaved scape. Its taste is bitter and astringent.

Hier. murorum, *Linné.*—Pulmonaire des Français, *Fr.;* Gelbes Lungenkraut, *G.*—It has ovate, pale-green, sometimes spotted radical leaves, and a hairy, few-leaved stem, bearing several yellow flower-heads. Its taste is slightly bitter and astringent. It has been used as a vulnerary and in pectoral complaints.

Prenanthes (Harpalyce, *Don*) alba, *Linné*, s. Nabalus albus, *Hooker.*—Rattlesnake-root.—Lion's-foot, White lettuce, Cancer-weed, Gall of the earth; this North American perennial has a purplish and glaucous stem, branched above, and growing from a tuberous, spindle-shaped root. The leaves are petiolate, angular, hastate, the radical ones palmately five- or seven-lobed, those of the stem ovate roundish and sinuate-toothed; the flower-heads are in loose, racemose cymes, drooping, have a cylindrical involucre, with the linear, purplish, and white scales in a single row, and a few bractlets at the base, and contain from eight to twelve ochroleucous or purplish florets, with linear-oblong, striate, and unbeaked akenes, and a pale-brownish pappus composed of several rows of rough hairs. All parts of the plant contain a milky juice and have a bitter taste. No analysis of its constituents has been made.

Action and Uses.—Although hawkweed has been used in several diseases, such as scrofula and chronic catarrh, its chief claim to notice rests on its reputed power of curing the *bites of venomous snakes.* The late Dr. Griffith of Philadelphia, in his *Medical Botany*, relates the following: "Some years ago a person brought a collection of rattlesnakes to this city, and professed to be in possession of a certain cure for the symptoms arising from their bite, which he offered to divulge for a moderate compensation. This being paid him, he suffered himself to be bitten several times, and after the poisonous effects had displayed themselves was completely relieved by taking a few ounces of the decoction of a plant which was identified as Hieracium venosum. The same snake was suffered to bite a small puppy, which died from the poison in about five hours. These experiments were made in the presence of a number of distinguished medical and scientific persons." It appears that H. Gronovii has been employed with like results (*Ther. Gaz.*, xl. 566).

HIPPOCASTANUM.—Horse-Chestnut.

Marronnier (*chataignier*) *d'Inde*, Fr.; *Rosskastanie*, G.; *Castagno d'India*, It.; *Castaño de Indias*, Sp.

Æsculus Hippocastanum, *Linné*, s. Hippocastanum vulgare, *Gærtner.*

Nat. Ord.—Sapindaceæ, Hippocastaneæ.

Origin.—The horse-chestnut is a well-known stately tree which is a native of Persia and Northern India, became known in Europe in the latter half of the sixteenth century, and is at present cultivated as an ornamental tree and grows spontaneously in many countries of the temperate and subtropical zones. The bark of the smaller branches and the seeds have been employed.

Description.—The bark (*cortex hippocastani*, *cortex castaneæ equinæ*) is thin, externally of a brown-gray color, has some small scattered warts, and shows opposite leaf-scars, which have the lower rounded margin marked with five or seven small warts. The inner surface is smooth and whitish, the internal color brownish. The inner bark is rather tough, breaks with a fibrous fracture, has a slight odor, and a bitter, astringent taste.

The seeds are subglobular, smooth, glossy, reddish-brown; the hilum marked by a large grayish spot; the leathery testa enclosing a white embryo with two hemispherical cotyledons, having a sweetish and bitter acrid taste. By prolonged washing the starch may be obtained pure.

Constituents.—The tannin of horse-chestnut bark colors iron salts green. Besides some fat, chlorophyll, and other common compounds, the bark contains *æsculin*, $C_{15}H_{16}O_9$, and *fraxin* (*paviin*), $C_{16}H_{18}O_{10}$, both principles being inodorous, of a slightly bitter taste, and showing a blue fluorescence when dissolved in water, particularly in the presence of some alkali. Æsculin is obtained by precipitating the decoction with lead acetate, treating the filtrate with H_2S, evaporating, and recrystallizing. It forms small white needles containing $1\frac{1}{2}H_2O$, which are insoluble in ether and have a slight acid reaction upon litmus. On boiling with dilute acids it is split into glucose and *æsculetin*. Baryta solution produces the same decomposition, and then yields *glucinic*, *apoglucinic*, and *æsculetinic acids*. Æsculetin, $C_9H_6O_4.H_2O$, crystallizes in colorless needles, is with difficulty soluble in cold water and alcohol, the solutions coloring ferric salts dark-green, dissolves in alkalies with a golden-yellow color, and on boiling with potassa is decomposed into oxalic, formic, and protocatechuic acids. Fraxin is obtained by precipitating the alcoholic tincture with an alcoholic solution of lead acetate, diffusing the precipitate in water, decomposing by hydrogen sulphide evaporating over sulphuric acid to dryness, and removing the tannin by washing with ice-cold water; it dissolves in alkalies with a yellow color, colors ferric chloride green, and then produces a lemon-yellow precipitate.

The integuments of the seeds contain some æsculin and *quercitrin*, which are likewise present in the flowers, but the leaves contain yellow *quercæscitrin*. The cotyledons contain, besides starch and gummy matter, 2 to 4 per cent. of fixed oil, *oleum hippocastani*, which is greenish-brown or yellow, has a turnip-like odor, a somewhat bitter taste, and the specific gravity .927, and congeals near the freezing-point of water. *Argyræscin* and *aphrodæscin* are two amorphous acrid bodies discovered by Rochleder (1862), which are insoluble in ether, soluble in alcohol, and yield with water solutions foaming like a soap solution; the latter is precipitated by baryta-water, and boiled with alkalies yields butyric and amorphous *æscinic acids;* the former is a glucoside.

Æsculus Pavia, *Linné*.—Red buckeye.—B. C. Batchelor (1873) obtained from the testa tannin, 3 per cent. of resin, a tasteless crystalline principle, and coloring matter. The cotyledons were found to contain 5 per cent. of greenish-brown fixed oil, $2\frac{1}{2}$ per cent. cane-sugar and syrup, and a brownish, bitter, and acrid glucoside different from argyræscin, and apparently poisonous.

Medical Uses.—In 1787 Murray (*Apparat. Med.*, iv. 62) gave a detailed account of the utility of the flowers, leaves, bark, and fruit; spoke of the virtues of the last in epilepsy, of its powder as a sternutatory and as a preventative of fermentation and putrefaction, and of the bark for intermittent fever. According to him, its decoction with lime-water allays inflammation, heals ulcers, and arrests gangrene. Much more recently it was asserted that the bark of the branches, and also the æsculin obtained from it, have cured *periodical fevers* in which even quinine failed. The same statement is made respecting numberless bitter vegetable products. It is also alleged that æsculin will cure *neuralgia*. Oil of horse-chestnut has been used as an embrocation for joints affected with chronic *gout* or *rheumatism*, with the same effect, probably, as any other bland oil, and a decoction of the leaves has had some reputation as a remedy for *whooping cough*. It is said to be still employed as a popular remedy for this disease (*Amer. Jour. Pharm.*, lix. 152). These medicines are of little value—as little, probably, as the entire horse-chestnut, to which, if constantly worn in the pocket, a vulgar superstition ascribes the power of curing hæmorrhoids. This is evidently a survival of the doctrine of signatures. A decoction may be prepared with Gm. 32–64 in water Gm. 500 (℥i–ij in Oj), boiled for 10 minutes. *Dose*, a wine-glassful. Æsculin may be given in doses of Gm. 0.30 (gr. v).

HIRUDO, *Br.*—Leech.

Hirudines, P. A., P. G.—*Sangsue médicinale*, Fr. Cod.; *Blutegel*, G.; *Sanguisuga*, *Mignatta*, F. It.; *Sanguijuela*, Sp.

Sanguisuga medicinalis, *Savigny*, and Sang. officinalis, *Savigny*.

Class Vermes; Ord. Annulata; Sub-ord. Apoda; Family Hirudineæ.

Description.—Leeches are invertebrate animals with an elongated, roundish, or somewhat flattened body, which has numerous transverse wrinkles, and is generally attenuate toward both ends; the posterior one always terminates by a broad and muscular disk, by means of which the animal fastens itself upon objects. The blood-sucking

leeches have their anterior end or head likewise terminated by a narrower disk, in the centre of which is placed the mouth containing three jaws, which are provided with two rows of numerous pointed teeth, and are mutually inclined at an acute angle, so as to make a triangular incision through the skin. Respiration is carried on through small apertures or *stigmata* arranged in two rows on the abdominal surface and found at every fifth ring. Leeches are hermaphrodites, but mutually impregnate each other. Several pairs of testicles are located in the fore and middle part of the body; the filiform penis is projected from an abdominal orifice about one-third distant from the head, and the female organs with two ovaries have their aperture or vagina five rings below the penis. The ova are deposited near the edge of the water, invested with a kind of a jelly or mucus, which contracts into a capsular or cocoon-like body having a spongy appearance and containing about ten or more eggs. Leeches are aquatic animals, and swim with a vertical undulating motion. For medicinal use their weight should be between 1 and 5 Gm. (15 and 75 grains). The two species named have a soft smooth body, 5 Cm. (2 inches) or more in length, and have the back of an olive-green color, with six rusty-red longitudinal stripes, which are sometimes spotted with black.

Sang. (Hirudo, *Linné*) medicinalis, *Savigny*, has the belly greenish-yellow, more or less spotted with black, occasionally to such an extent that the prevailing color is black. The animal is indigenous to Central and Northern Europe, and is known in commerce as the *speckled*, *Swedish*, or *German leech*.

Sang. officinalis, *Savigny* (Hirudo provincialis, *Carena*). The belly is light olive-green, unspotted, but marked with a black stripe on each side; the dorsal stripes are somewhat variable in width. This leech is indigenous to the southern part of Europe, and is known in commerce as the *green* or *Hungarian leech*.

Several other species of Sanguisuga of Southern Europe are occasionally employed, but are not an article of commerce. Leeches are generally kept in ponds by the wholesale dealer, and even cultivated in this manner. They are usually transported imbedded in moist turf.

The *American leech*, Hirudo decora, *Say*, which draws less blood, is sometimes employed. Its back is of a dark-green color and marked with one row of orange-brown and two lateral rows of black spots; the belly is of a light orange-brown color spotted with black.

Preservation.—Leeches require some attention to keep them healthy and in good condition. They are kept in clean river-water in a glass jar covered with a linen cloth and put in a shady place which is free from ammoniacal and other noxious vapors. The temperature is best kept between about 10° and 20° C. (50° and 68° F.), sudden changes being carefully prevented. As soon as the water begins to get turbid or colored the leeches should be placed in clean water of the same temperature and the jar well cleaned from the slimy deposit, which is caused by the transparent epidermis being thrown off every four or five days. To facilitate this removal some material is often put into the jar through which the leech may draw itself, and which, by retaining this slime, will tend to keep the water clean; charcoal, pebbles, clay free from lime, moss, and Irish moss have been recommended and found advantageous for the purpose, and apparatuses have been constructed in which leeches may be kept on a bed of material which permits of a frequent renewal of the water without handling the leeches. If they are kept in moist earth, turf, or clay, this should be examined from time to time and dead animals removed. The water should be changed at least once a week, and oftener in warm weather. It will be observed that the conditions for the preservation of leeches are pure air, pure water, and a pretty uniform temperature. Leeches are subject to several diseases which may become epidemic, and which are recognized by an excessive separation of mucus, ulcerations, tumors, or a flaccid appearance of the body; those thus attacked should be at once removed from the healthy ones, and placed in a separate vessel in clean water upon a layer of washed charcoal.

Medical History.—Leeches have been used from time immemorial in Asia, but particularly in Bengal, where they are considered the best means of local depletion. They are especially preferred for rayahs, for women and timid persons, and for the very young and very old (Wise). In Greek medicine they were apparently not known until a late date, the first mention of them being made by Themison, who lived in the century preceding the Christian era. They are scarcely alluded to by Pliny, who flourished a century later in Rome, but subsequently their uses were described by all the Latin and Arabian medical writers, as well as the mode of applying and preserving them and the accidents that may occur from their getting into the throat or stomach.

Action and Uses.—Depletion by leeches is by no means identical with taking

blood by venesection, even in its action upon the general system, for the rapidity of the loss in the one case and the slowness in the other produce quite different effects; in the former the impression is direct and sudden, in the other indirect and gradual. In their local action the difference is still more evident, for while in the one case the whole of the blood is despoiled to make a limited and local impression, in the other the object is attained by a very small loss of blood. It must be remembered that the circulatory apparatus is not a mere hydraulic machine, but that the blood-vessels, and especially the capillaries, are endowed with a vital contractility which may be modified within a limited area and excited by a local irritation. All active congestions and inflammations are, in their origin, local diseases, and are therefore more or less amenable to local treatment, of which one of the most powerful forms is the abstraction of blood, the essential pabulum of all inflammatory processes. Hence the utility of leeches in inflammations in whose immediate neighborhood these animals can be applied; it is not so intelligible when they operate upon the surface of the body immediately over inflamed organs which have no direct communication with the skin, as in pneumonia, metritis, gastritis, enteritis, meningitis, etc. The mere loss of so small a quantity of blood as they abstract from the general circulation does not appear to be a satisfactory explanation. The superiority of leeches over cups as a means of local depletion consists not only in the advantages referred to above, but also in their being applicable to various parts to which cups could not be applied, as the eye, the mouth, the anus, vagina, etc.

Large leeches should be used only when blood is to be freely abstracted and when the part is not very sensitive or exposed. The wounds they make are apt to become ecchymosed and leave visible scars. Small leeches are always preferable for application to the face and neck, for the reasons just given, and also because the bleeding from their wounds is more easily controlled. The number to be used will depend upon the size of the leeches, the quantity of blood to be abstracted, and the vascularity of the part. The part to which leeches are to be applied should be thoroughly washed with warm water, and even with hot water, if it is not sufficiently vascular. Sometimes a hot-water fomentation is applied to stimulate the skin. In order to induce the animals to bite it is customary to moisten the part with sugared water or milk or to rub it with a piece of raw meat, or the leecher pricks the part with a fine needle and smears the blood over the skin, or he draws from his own finger a drop of blood for this purpose. A common method of applying leeches to a free surface is to put them in a small tumbler or wine-glass and invert it over the part. Others place the creatures in a cup and direct them, as they crawl over its edge, to the part where they should bite. For application to the nostril, throat, or vagina the leech may be enclosed in a tube open at both ends.

A healthy leech of medium size will draw from 1 to 2 fluidrachms of blood, and as much more will usually flow after the animal has fallen. When a strong and rapid impression is to be made by leeches the number applied at once should be considerable, but when a slow though continuous action is desired a succession of them may be used. This is often the case in traumatic and other inflammations within the cranium. It is an ancient custom, instead of applying many leeches, to apply one or two or a comparatively small number, and when they are nearly gorged to puncture their bodies near the tail with a needle or fine lancet, when they will often continue to draw blood indefinitely. In any case the punctures will not soon cease bleeding if they are kept sponged with warm water. Sometimes there is a difficulty in stopping the flow of blood, particularly if the wound is in the epigastrium, on the neck, or on some other part where firm pressure cannot readily be made. The various hæmostatics may here be applied, several of them being of common use in domestic medicine, such as scraped lint, burned rag, agaric, cobweb, powdered rosin, India-rubber softened by heat, vinegar and water, etc. If these fail, or in their stead, a saturated solution of alum in hot water may be applied on lint while the liquid is hot, or lint saturated with a solution of perchloride of iron or of tannic acid, or the lunar-caustic pencil reduced to a fine point, may be inserted in the wound, or, finally, the point of a red-hot knitting-needle may be used in the same way. In all these cases the action of the hæmostatic should be aided by pressure with the hand or with a small clamp or pincers made for the purpose, or by passing a needle through the skin, including the wound, and surrounding it with a ligature in the form of a figure-of-eight. The continued flow from leech-bites has been variously explained. The investigations of Haycraft show that the blood sucked by the leech remains liquid, because the animal secretes a ferment that prevents its coagulation without impairing its cell-organization (*Archiv f. exp. Pathol., etc.*, xviii. 209).

Small leeches are sometimes taken in drinking-water, and attach themselves to the

fauces or pharynx (*Times and Gaz.*, Apr., 1884, p. 463), and have even penetrated into the larynx and fatally obstructed it. A strong gargle of salt and water usually suffices to make them quit their hold, and vinegar will have the same effect. These liquids have been used, and also wine, when leeches have been swallowed, but the creatures would probably be unable to live under the action of the gastric juice. In some cases, and especially when the leech has entered the larynx, its presence has been discovered by the laryngeal mirror, and in several cases laryngotomy has been performed for its removal (*Times and Gaz.*, Apr., 1884, p. 463; *Therap. Gaz.*, xii. 419). The case is recorded of a leech that entered the urethra and caused hæmorrhage (*Jour. Amer. Med. Assoc.*, iv. 375).

When leeches have been gorged with blood they are not, if left to themselves, fit to be used again for several months. But by placing them in a weak solution of salt and water or of vinegar and water they may be made to disgorge the blood they have swallowed, and they soon regain their vigor if they are then placed in fresh water. They may also be emptied of their blood by stripping them. Such leeches are more subject to disease, and they should be kept separate from the fresh ones.

HORDEUM DECORTICATUM, *Br.*—Pearl Barley.

Hordeum perlatum.—Orge perlé, Fr. Cod.; *Perlgerste, Perlgraupen*, G.; *Orzo perlado*, F. It.; *Cebada perla*, Sp.

The husked seeds of Hordeum distichon, *Linné*. Bentley and Trimen, *Med. Plants*, 293.

Nat. Ord.—Graminaceæ, Hordeæ.

Origin.—Barley is probably indigenous to Western Asia, and has been cultivated from a very early period. It is now raised in most parts of the temperate zones, and in Europe within the Arctic Circle. Besides the two-rowed or long-eared barley, Hord. vulgare, *Linné*, the four-rowed or spring barley, and H. hexastichon, *Linné*, or six-rowed barley, are the principal species cultivated. The fruit of these species is used indiscriminately in the preparation of malt, and, when deprived in suitable mills of the integuments and rounded at the ends, constitutes the officinal pearl barley.

Description.—Pearl barley is nearly globular, of a white color and mealy appearance, with the exception of a groove in which fragments of the integuments are present. The larger pearls still contain externally a layer of gluten; the smaller ones consist altogether of the mealy albumen, and are formed of a cellular tissue filled with starch-granules, which resemble wheat starch, and are made up of small and large grains with few intermediate ones. They are irregularly circular or elliptical in shape, with the nucleus or hilum rarely perceptible and the layers indistinct. Pearl barley is inodorous and has an insipid taste.

Fig. 149.

Barley starch-granules.

Constituents.—The average of the various analyses made by different chemists gives to barley 60 to 68 per cent. *starch*, 12 to 16 per cent. of *protein compounds* consisting of gluten and albumen, 2 to 3 per cent. of *oil*, the same of *ash*, 10 to 14 per cent. of *moisture*, and 8 to 12 per cent. of *cellulose*. Lermer (1863) found also traces of tannin and bitter principle, and Lintner (1868) a little cholesterin. Kühnemann (1875) showed the absence of dextrin and the presence of *sinistrin* and crystallizable sugar, the latter being, in heated or germinating barley, converted into uncrystallizable sugar, reducing Fehling's solution. O'Sullivan (1882) showed the presence of several carbohydrates; and Mills and Pettigrew (1882) observed that water containing calcium carbonate or sulphate dissolves from barley an increased amount of extractive matter, while the albuminoids are decreased. Proust's *hordein* was proven by Braconnot and Guibourt to be a mixture of cellular tissue, starch, and gluten. The fat contained in barley, according to Hanemann, consists of glycerides of palmitic and lauric acids, the latter being Beckmann's (1855) *hordeic acid*.

Pharmaceutical Preparations.—Farina hordei præparata is prepared by heating barley flour in a well-closed vessel in a steam-bath for thirty hours. It is a yellowish or pale-reddish powder, having a sweetish and mucilaginous taste, and contains dextrin and other derivatives of starch and of gluten.

Action and Uses.—From the earliest times barley has been used not only as food, but to prepare drinks for the sick, especially in febrile diseases and in pulmonary and

urinary disorders. Jacobi recommends the addition of barley mucilage to all the milk used by children who are brought up by hand. Barley is now seldom employed externally, but continues to be given internally and for the same purposes as of old. The addition of honey makes barley-water more efficient in *bronchial affections* and *sore throat*. Formulæ for preparing it are given under DECOCTUM HORDEI.

HUMULUS, *U. S.*—HOPS.

Lupulus, Br.; *Strobili humuli, s. lupuli.—Hop*, E.; *Houblon*, Fr. Cod.; *Hopfen*, G.; *Lupulo, Hombrecillos*, Sp.

The strobiles of Humulus Lupulus, *Linné*. Steph. and Church, *Med. Bot.*, plate 41; Bentley and Trimen, *Med. Plants*, 230.

Nat. Ord.—Urticaceæ, Cannabineæ.

Origin.—The hop is distributed over a great portion of the northern temperate zone, and has been introduced into Brazil and Australia. It grows in hedges and thickets, and is indigenous to North America, where it is particularly common in the northern and western regions, and is found in the Sierra Madre range of Colorado at an altitude of 10,000 feet; it is met with also in Middle and Southern Siberia and throughout the greater portion of Europe. It is perennial, producing rough, long, and twining stems, which have the leaves mostly opposite, heart-shaped, and three- to five-lobed. The staminate flowers are in short racemes, and the pistillate flowers in densely-leafy, cone-like spikes upon different plants; the spikes or strobiles are the parts used.

Description.—The strobiles are ovate in shape 25–38 Mm. (1 to 1½ inches) long, and consist of a grayish, hairy, zigzag-shaped, somewhat glandular axis, to the angles of which the enlarged leafy bracts and scales are attached; these are obliquely ovate, membranous, parallel-veined below, reticulately veined above, and at the base glandular and surrounding a subglobular akene, which is likewise covered with numerous yellow and shining glands (*lupulin*). Hops are of a yellowish-green color, of an agreeable aromatic odor, and of a bitter, aromatic, slightly astringent taste. When kept for some time hops acquire a brownish color, and an unpleasant odor from the formation of some valerianic acid; these changes are prevented, or at least retarded, by exposure to sulphurous acid gas, and the color of brown hops is to some extent restored by the same means.

(For an account of the culture of hops in the United States consult papers by W. H. Ramsey in *Amer. Jour. Phar.*, 1875, p. 241, and E. G. Bissell, 1877, p. 538.) In the fiscal year 1876–77, 20,177 pounds of hops were imported into the United States, and 874,559 pounds in 1882.

Constituents.—Besides the principles contained in the yellow glands (see LUPULINUM), hops contain about 4 per cent. of *tannin*, which, according to R. Wagner, resembles moritannic acid. Bissell (1877), however, found its behavior to mineral acids entirely distinct, and noticed that only a small portion of it is precipitated by gelatin. Bowman (1869) obtained by means of this reagent 3.67 per cent. of tannin. Hops, entirely freed from lupulin, gave to Bissell, with water, a neutral distillate having an odor distinct from that of hops, and containing mere traces of organic matter; the extract was but slightly bitter. Hops contain 0.8 per cent. of volatile oil (R. Wagner, 1853), between 9 and 18 per cent. of resin (Siewert, 1870), some trimethylamine, and a volatile alkaloid, *lupuline* (Griessmayer, 1874); this alkaloid is liquid, has a strong coniine-like odor and an alkaline not bitter taste, and gives with phosphomolybdic acid a white or yellow precipitate which dissolves with a blue color in an excess of ammonia. Sace (1876) asserted that hops contain a peculiar fermentative principle, which was disproven by Soxhlet and Pasteur (1876). C. G. Wheeler (1865) found hops to contain 1.7 per cent. of nitrogen, and to yield 7 to 10 per cent. of ash, in which potassa, lime, phosphoric acid, and silica predominate.

Action and Uses.—The association in hops of a bitter tonic with a direct sedative of abnormal nervous action renders them peculiarly fitted to relieve those numerous cases of *dyspepsia* which are due to an abuse of the stomach which both irritates and exhausts it. Hence at one time they were celebrated in the treatment of atonic *gout*, a disease in which such conditions are prominent. These qualities also explain their reputation in the treatment of the forms of constitutional derangement which exists in *scrofula* and *rickets* when anæmia, glandular swellings, cutaneous eruptions, and dropsy, especially of the abdomen, are present. Hop-tea is one of the best remedies for *delirium tremens*, tending to restore its tone to the irritated and exhausted stomach, and directly to allay the characteristic nervous excitement of the attack. In various affections

attended with genito-urinary irritation, as *priapism*, *seminal emissions*, *nocturnal incontinence of urine*, and *irritable bladder*, hops are often salutary. As an external application to relieve the pain of *muscular rheumatism*, *abscesses*, *spasms*, *toothache*, *colic*, *bruises*, etc., hops form an excellent application. They may be incorporated in a poultice, or the strobiles, enclosed in a bag, may be moistened with hot water, vinegar, or alcohol, and applied to the painful part. In this way hops are often associated with chamomile, thyme, lavender, mint, etc. The infusion of hops is the best preparation for internal use, although so much more bulky than the tincture or the fluid extract of lupulin. Its *dose* is Gm. 32–64 (f℥j–ij). A pure and strongly hopped beer contains all the virtues of this agent, but ordinary malt liquors are too often fraudulently adulterated to deserve such praise.

A drug called "hopine," and which was alleged to be the alkaloid of American wild hops, proved to be an artificial product whose chief ingredient was morphine.

HURA.—Sand Boxtree.

Sablier, Fr.; *Sandbüchsenbaum*, G.

Nat. Ord.—Euphorbiaceæ.

Description.—The following species have attracted some attention:

Hura crepitans, *Linné*, indigenous to the West Indies and Central and some portions of South America, and known there as *ajuapar*. It is a straight tree, about 21 M. (70 feet), high, with long petiolate, cordate-ovate, and serrate smooth leaves, pendulous ovate staminate catkins, erect dark-red or purple pistillate flowers, and depressed globular twelve- to eighteen-celled capsules, which when ripe break with some violence, scattering the roundish flattened seeds, which have an agreeable sweetish taste. The tree contains a very acrid milk-juice. The leaves, steeped in oil, are used in rheumatic complaints. In Mexico the seeds are known as *habilla* (*pepita*) *de San Ignacio*, and are used for their drastic properties.

Hura brasiliensis, *Willdenow*, known in Brazil as *assacou* or *ussacu*, resembles the preceding in appearance and properties, but has oblong catkins. The thick, hard, grayish, inodorous, and slightly acrid bark, *casca de assacou*, is employed in South America.

Constituents.—Boussingault and Rivero (1825) ascertained that one of the acrid principles of the milk-juice is oily and volatile—the other, *hurin*, is crystallizable; the other constituents found were malates, nitrates, etc. Bonastre found in the integuments of the seeds much coloring matter, tannin, and gallic acid, and in the kernel 51 per cent. of fixed oil soluble in alcohol, solid fat, albumen, and salts. The oil is purgative.

Allied Plant.—Hippomane mancinella, *Linné*.—Manchineel, *E.*—A large West Indian tree, with ovate, acute, finely serrate leaves. The fruit resembles a small apple in size and color, is internally white and soft-fleshy, and contains from three to seven woody cells, each with a roundish-triangular silvery seed. All parts contain an acrid poisonous milk-juice; the poisonous principle appears to be volatile. Ricord-Madianna (1827) found, in addition to this *mancinellin*, volatile oil, fat, resin, caoutchouc, and gummy matter.

Action and Uses.—Like several other Euphorbiaceæ, hura is a powerful irritant, and taken internally in large doses occasions violent vomiting and purging. For these reasons, probably, it has been used as an *anthelmintic*. Applied to the skin in decoction, it causes irritation and even vesication. In Brazil, where it is native, it is much used in the treatment of *leprosy*, but there is no evidence of its having cured the disease. It is given in the form of a decoction, made by boiling half an ounce of the bark in a pint of water to half a pint (Gm. 16 in Gm. 500). Baths made with a saturated infusion of the bark are also employed. It is almost unnecessary to add that neither this medicine nor any other ever cured leprosy, and that the use of a drastic medicine like hura cannot fail to hasten the inevitable progress of the disease.

Manchineel was early described as a fatal poison. If, say the authors of the *History of the Antilles*, (2d ed., 1665, p. 257), the fruit falls into the water and is eaten by fish, they invariably die. Land-crabs are rendered poisonous by eating it. The juice of the tree blisters the skin, and a single drop of it in the eye occasions a violent inflammation. Dew or rain dripping from the leaves produces a similar effect. Sleeping under the tree will cause the whole body to swell. The aborigines used the juice to poison their arrows. Later observations and experiments have for the most part confirmed these statements, and shown that the fruit, and also the juice of the tree, when taken internally, are emeto-cathartic and inflame the alimentary canal (Wibmer, *Die Wirkung*, etc., 1837, iii. 20). More recently a writer has corroborated the original accounts of the poisonous qualities of manchineel (*XIX Century*, May, 1888, p. 683).

HYDRANGEA.—Hydrangea.

The root of Hydrangea arboreseens, *Linné.*

Nat. Ord.—Saxifragaceæ, Hydrangeæ.

Origin and Description.—The wild hydrangea grows near the banks of rivers, preferring rocky places, from Pennsylvania westward to Illinois and southward. It has a pale-brown, internally whitish, woody, and much-branching root, which is of a sweetish and pungent taste. The stem has a grayish, or on the branches a light reddish-brown, bark, which is detached in thin concentric layers, from which circumstance the shrub is known as *seven barks.* The leaves are opposite, nearly smooth, ovate, pointed, rounded or slightly heart-shaped at the base and serrate on the margin. The flowers, which appear in July, are in flat cymes, whitish, the marginal ones often sterile and radiant, with four or five petals, and stamens twice that number. The fruit is a two-celled and two-beaked capsule, containing numerous seeds.

Constituents.—Nothing is known about the principles to which the medicinal properties of the root might be due. Laidley's analysis (1850) merely proves the presence of the common vegetable principles—gum, starch, resin, etc.

Action and Uses.—We are told that hydrangea-root was employed by the Cherokee Indians for the relief of calculous complaints, and that when duly administered to persons suffering from *urinary concretions* in the kidneys and bladder it provokes their discharge. We are also informed that in over-doses it occasions vertigo, oppression of the chest, etc. (*U. S. Dispensatory*, 12th ed.). If these qualities really belong to the medicine, it presents the singular case of being at once diuretic and narcotic. However this may be, there seems to be good reason to believe that hydrangea has been found useful in *gravel* and its associate disorders. In 1880 it was reported that the fluid extract had "a solvent effect on lithate of ammonia," and in the following year that it put an end to attacks of renal colic which had beset a patient for years (Edson). A little later several aggravated cases of this affection were reported by N. F. Brown, in which the medicine seemed to be perfectly successful (*Med. Record*, xvii. 471; xx. 652; xxi. 39). The best form in which it can be administered is a fluid extract, which may be given in teaspoonful doses.

HYDRARGYRI CHLORIDUM CORROSIVUM, *U. S.*—Corrosive Mercuric Chloride.

Hydrargyri perchloridum, Br.; *Hydrargyrum bichloratum*, P. G.; *Hydrargyrum muriaticum corrosivum, Hydrargyrum corrosivum sublimatum, Hydrargyri bichloridum, Sublimatus corrosivus, Sublimatum corrosivum, Mercurius sublimatus corrosivus, Chloruretum (Chloretum) hydrargyricum.—Mercuric chloride, Perchloride of mercury, Corrosive sublimate, Bichloride of mercury*, E.; *Deutochlorure de mercure, Sublimé corrosif, Chlorure mercurique*, Fr.; *Quecksilberchlorid Ætzendes Quecksilbersublimat*, G.

Formula $HgCl_2$. Molecular weight 270.54.

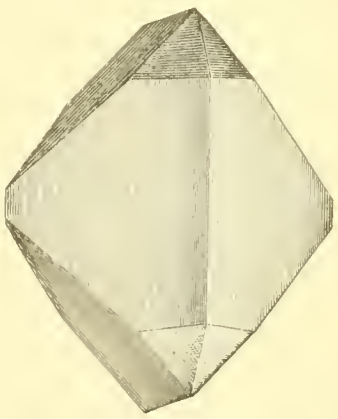
Preparation.—Take of Mercuric Sulphate 20 ounces; Sodium Chloride dried, 16 ounces; Black Manganese Oxide in fine powder, 1 ounce. Reduce the mercuric sulphate and the sodium chloride each to fine powder, and, having mixed them and the manganese oxide thoroughly by trituration in a mortar, put the mixture into an apparatus adapted for sublimation, and apply sufficient heat to cause vapors of perchloride of mercury to rise into the less heated part of the apparatus, which has been arranged for their condensation.—*Br.*

Mercuric chloride is formed by the mutual decomposition of mercuric sulphate and sodium chloride; $HgSO_4+2NaCl$ yields $HgCl_2+Na_2SO_4$. By heat, mercuric sulphate is partly decomposed (see Hydrargyri Sulphas), and the product of the above process is thereby apt to become contaminated with mercurous chloride or calomel; to prevent such a result, the British Pharmacopœia directs the addition of a little manganese dioxide, which, reacting with some of the sodium salt, generates chlorine sufficient to reconvert any mercurous into mercuric salt. On conducting the vapors into a large chamber they are condensed in the form of a heavy white crystalline powder.

Properties.—Corrosive sublimate forms colorless rhombic prismatic crystals, or, more generally heavy white crystalline masses. It has the density 5.4, and when heated to about 265° C. (509° F.) fuses to a colorless liquid, and at a higher temperature sublimes without leaving any residue. It is permanent in the air, is inodorous, has a dis-

agreeable acrid metallic taste, and dissolves in about 2 parts of boiling water and 16 parts of water at 15° C. (59° F.); also in 3 parts (2.3 parts, Simon) of alcohol, in 4 parts of ether, freely in volatile oils, in 1.2 parts of boiling alcohol and about 14 parts of glycerin (U. S.). In the presence of camphor the solubility is increased, so that 4 parts of ether and 16 parts of camphor will dissolve 8 parts of corrosive sublimate, and 4 parts of alcohol, with 25 parts of camphor, will dissolve 16.5 parts of corrosive sublimate (Karls, 1827; Simon, 1836). The aqueous solution has an acid reaction, becomes neutral on the addition of sodium chloride, and when exposed to the light is partly decomposed, with the precipitation of calomel and the liberation of hydrochloric acid; the decomposition is prevented by the presence of free hydrochloric acid or of ammonium chloride. The aqueous solution yields yellow precipitates of mercuric oxide with an excess of lime-water (see LOTIO HYDRARGYRI FLAVA) or potassa solution, a white precipitate of ammoniated mercury with ammonia, and on the addition of silver nitrate a white curdy precipitate of silver chloride, insoluble in nitric acid, but soluble in ammonia. Phosphorous and sulphurous acids separate calomel from the solutions; hypophosphorous acid and stannous chloride produce the same change, but when in excess and heated liberate metallic mercury. The salt is soluble without decomposition in sulphuric, hydrochloric, or nitric acid, and crystallizes again on cooling. Solutions of albumen or of tannin, forming insoluble compounds, are used as antidotes to corrosive sublimate.

FIG. 150.



Crystal of Corrosive Sublimate.

Tests.—Corrosive sublimate should volatilize when heated without leaving any residue (absence of fixed impurities), and should be completely soluble in water or alcohol (absence of calomel). It often contains traces of arsenic, which are probably derived from the sulphuric acid with which the sulphate was prepared; this may be readily detected by mixing the solution with an excess of potassa solution, adding some zinc, and heating, the test-tube being covered with filtering-paper moistened with a drop of solution of silver nitrate; the appearance of a black spot indicates arsenic. "If a saturated, aqueous solution of the salt be heated nearly to boiling, then completely saturated with hydrogen sulphide, and allowed to stand in a well-corked flask for several hours, it should afford a colorless filtrate which, on evaporation, should leave no residue (absence of many *foreign salts*.) If the precipitated mercuric sulphide obtained in the last-mentioned test be washed with water, then shaken for a few minutes with ammonia-water, and filtered, the colorless filtrate, on the addition of a slight excess of hydrochloric acid, should afford neither a yellow color, nor a yellow precipitate (absence of *arsenic*)."—*U. S., P. G.* This test for arsenic depends upon the solubility of arsenic sulphide in ammonia-water, and its subsequent precipitation by hydrochloric acid, mercuric sulphide being insoluble in ammonia.

Action and Uses.—A solution of 1 part of this salt in 1000 of water prevents the germination of seeds and the communicability of the vaccine virus, and destroys the life of plants, leeches, and fish immersed in it. Marcy's experiments led him to conclude that no other agent possesses a germicide power equal to that of corrosive sublimate. "To-day," he remarks, "it clearly ranks first of all the known agents as a disinfectant" (*Jour. Am. Med. Assoc.*, i. 199). Investigation by experiment has proved that the continued use of all mercurials induces diuresis (Rosenheim, *Zeitschrift f. klin. Med.*, xiv. 170), and this result has been confirmed clinically (*e. g. Centralb. f. Ther.*, v. 476; vi. 716). In the connective tissue corrosive sublimate is absorbed, and occasions the same symptoms and lesions of gastro-intestinal inflammation as if it had been given by the mouth. The symptoms include gastric pain, thirst, vomiting of mucus and blood, and death by convulsion or exhaustion. The lesions vary from slight redness to complete softening of the mucous membrane of the stomach; similar ones, with the addition of eschars, ecchymoses, and ulcers, may be found in the intestine, and especially in the rectum.

Poisoning by corrosive sublimate may be produced by its external application as well as by its being taken internally. A solution of it applied to the unbroken skin has repeatedly caused symptoms of poisoning, such as an acrid taste in the mouth, irritation of the œsophagus, vomiting, epigastric pain, constriction of the chest, and a small and irregular pulse. We have known a strong solution of corrosive sublimate applied for many weeks and extensively to the sound skin occasion a copious diuresis, (which only

ceased with the suspension of the lotion), and at the same time a looseness of the bowels which recurred at intervals for years. Hospital nurses have been salivated and otherwise poisoned by applying the solution used to disinfect wounds, etc. (*e. g. Phila. Med. Times*, xiv. 952). When the skin is not whole the same and more aggravated effects arise, including those of severe local irritation of an eczematous nature, and the absorption of mercury is sometimes proved by the salivation that ensues, and sometimes by a deposit of mercury upon articles of gold worn next the skin.

The use of corrosive sublimate as a disinfectant in surgery and obstetrics has occasioned many grave and fatal accidents. In 1884, Mikulicz recorded cases of poisonous effects produced in physicians, patients, and nurses by irrigating solutions of 1 : 1000 and 1 : 2000. Often albuminuria was developed. Fränkel collected fourteen cases of death from this cause. In all of them inflammation, ulceration, or gangrene of the large intestine was found (*Virchow's Archiv*, xcix. 2). Demme, Belfield, and others have reported like cases (*Centralbl. f. Ther.*, iv. 330; *Jour. Amer. Med. Assoc.*, vii. 273). Peabody reported eleven cases, of which seven were fatal (*Med. Record*, xxvii. 291), and Garrigues stated that he had collected 22 cases of death from this cause in obstetrical practice (*Boston Med. and Surg. Jour.*, Oct. 1889, p. 434. Compare also Keller, *Med. Record*, xxviii. 516; Stadtfeld, *Boston Med. and Surg. Jour.*, July, 1884, p. 93; Winter, *Therap. Gaz.*, viii. 555; Fleischmann, *ibid.*, xi. 126; Clark, *Med. Record*, xxx. 345; Virchow, *Practitioner*, xl. 288; A. J. Pepper, *Boston Jour.*, Nov. 1887, p. 516; Steffeck, *Amer. Jour. Med. Sci.*, Apr. 1888, p. 427; Legrand, *Med. Record*, xxxvi. 517). In 1887, Butte showed that corrosive sublimate, used in sufficient quantities, for dressing wounds and washing cavities is liable to occasion watery and bloody diarrhœa, nausea and vomiting, colic, tenesmus, etc., and occasionally salivation and stomatitis. Sometimes the urine is albuminous. After death, which takes place in collapse, the chief lesion is diphtherial inflammation of the large intestine. These effects occur whether the poison be introduced by the mouth, the rectum, vagina, peritoneum, or skin (*Med. Record*, xxxi. 520). A solution of 1 : 6000 injected into the peritoneum has caused fatal poisoning (*Practitioner*, xxxix. 46). An enema composed of about f℥v of water and an equal quantity of a 5 per cent. solution of the bichloride was, by mistake, given to an adult female, producing diarrhœa, vomiting, collapse, and death in five days (Haber, *Zeitsch. klin. Med.*, xiv. 459). Repeated small doses taken internally may involve danger. A. H. Smith (*Med. Record*, xxvi. 312) relates that in eleven cases the bichloride was given, at intervals of one or two hours, in doses varying from $\frac{1}{25}$ to $\frac{1}{16}$ grain. In five cases no disturbance ensued, but in six griping occurred, with bloody diarrhœa or ptyalism, and in three cases there was diuresis.

Corrosive sublimate has never lost the pre-eminence which it shared with calomel of being one of the best internal remedies for *syphilis*. In general, it is found not to salivate unless given in doses of at least Gm. 0.03 ($\frac{1}{2}$ grain) twice a day, but even in smaller doses its tendency to irritate should be guarded by its being associated with some syrup, bitter extract, or opium, and taken directly after meals. To prevent its decomposition in solution, it should be given along with muriate of ammonia, in the proportion of Gm. 0.06 to Gm. 0.33 (1 grain of the bichloride to 5 grains of the latter salt). To this solution alcohol should be added in the proportion of 1 part to 10. It is preferable to prescribe as many daily doses of the medicine as the patient takes meals, in order to lessen the chances of gastro-intestinal irritation. In appropriate quantities this preparation is undoubtedly the best in infantile syphilis. In it about Gm. 0.003 ($\frac{1}{20}$ grain) should be given in solution three times a day, and generally prescribed in a syrup or mixed with one when administered. If diarrhœa occurs, it should be corrected by diminishing the frequency or the size of the dose and by adding to it a minute proportion of laudanum. Baths of the bichloride have been used to cure syphilis, and with very great success; they are not apt to salivate, but the irritation of the skin they occasion renders them objectionable. The salt has also been employed hypodermically. Some believe that the subcutaneous injection of mercury will supersede all other methods of treating syphilis, because it enables the physician to graduate the dose of the medicine—because, also, it dispenses with baths and frequent changes of linen, does not hinder the patient from pursuing his usual calling, and shortens the duration of the treatment. On the other hand, it is not demonstrated that this method of cure is as certain as the internal use of mercury, unless the duration of the treatment is prolonged beyond the disappearance of the symptoms for which it was administered. And it certainly has been fruitful in painful and often extensive abscesses even when it was cautiously used. Köbner lays great stress on the efficacy of hypodermic mercurial injections in curing local manifestations of syphilis, such as *condylomata* and *papular syphilides*, engorged *glands*, etc. He holds that

in this manner the antidote is brought into contact with the poison more immediately than when it is otherwise administered (*Jour. of Cutan. and Venereal Dis.*, May, 1885). While hypodermic injections were employed superficially they were found to occasion much local irritation and even abscess. But it is now agreed that they should be deep and intramuscular, and that the most eligible region for making them is the buttocks. The needle of the syringe is liable to become corroded, and should therefore from time to time be renewed. It is recommended that the injections should be repeated about once a week, and should each contain about Gm. 0.02 (one-third of a grain) of the salt on an average, and that they should be continued for about a year (Bloxam; Schadeck). Or a solution of 1 : 100 may be used, of which from 10 to 20 minims may be injected daily for about a month, or until the mouth becomes sore. The quantity employed during the treatment is usually from Gm. 0.20–0.40 (3 to 6 grains) (Wolff, *Therap. Gaz.*, xiii. 729; Kaposi, *Boston Med. and Surg. Jour.*, May, 1890, p. 499). The salt preferred by Letnik was "chloride of mercury with sodium chloride," but he did not make any experiments with mercurial albuminate (*Edinb. Med. Jour.*, xxviii. 370). The peptonated bichloride was claimed by Terillon in 1880, and was still maintained by Martineau in 1882, to possess all the advantages hitherto attributed to it, including a rapid improvement in the general nutrition and the constitution of the blood; but it has been alleged, on the other hand, that its use hypodermically is very painful and irritating, and that its cures are not more radical than those obtained by inunction or by the internal administration of mercury (*Bull. de Thérap.*, xcix. 150; *Med. Record*, xx. 684; *Bull. et Mémoires de la Soc. de Thérap.*, Oct. 1882, p. 188). In 1881 the albuminate was introduced, and its efficacy was stated to have been equal, if not superior, to that of the peptonate, while it was free from the objections urged against that preparation (Gourgues, *Bull. de Thérap.*, cii. 49). Another preparation of the same order is the gluten-peptonate, which is claimed to be unirritating and efficient (*Therap. Monatsch.*, iv. 437). On the whole, the soluble mercurials are preferable for hypodermic use, and among these the bichloride is the best. (Compare Lesser, *Centralbl. f. Ther.*, viii. 47; Horovitz, *ibid.*, p. 193; editorial, *Univ. Med. Mag.*, ii. 382.)

It is claimed that a solution of Gm. 0.016 (¼ gr.) of the bichloride in Gm. 32 (an ounce) of water is of great efficacy, both topically and internally, in the treatment of *diphtheria*. The dose used internally varied from ¼ of a grain to 1 grain in twenty-four hours, given in divided doses at short intervals. In this disease and in *pseudo-membranous laryngitis* Jacobi advocates the same treatment (*Med. Record*, xxv. 573), and more emphatically in 1888 (*Med. News*, lii. 662). It was used by Stumpf (*Centralb. f. Med.*, 1887, v. 598), who sprayed in the fauces about 1 fluiddrachm of a sublimate solution ½–1 per mill. strong, and cured twenty-nine out of thirty-one cases. Arrest of the deposit and subsidence of the fever promptly followed. The injection was at first made five times an hour, and its frequency was then gradually reduced. In every case salivation took place. These results have been confirmed by others, and notably by Rennert (*Med. News*, lv. 348), who limited the application of 1 part sublimate, 5 parts tartaric acid, and 1000 parts water to the existing and accessible false membranes. The solution was applied every six to twelve hours on fresh wads of cotton, and so as to remove, if possible, the exudation and to saturate it if it could not be removed. No poisonous effects occurred, probably on account of the weakness of the solution. Lunin of St. Petersburg made comparative trials of various remedies in the treatment of the fibrinous and septic phlegmonous forms of diphtheria, and found as a general result that the percentage of deaths was less under the use of corrosive sublimate than under that of other agents employed, except turpentine (*Jour. Am. Med. Assoc.*, x. 127). Led by the bacillar doctrine of *phthisis* and the antizymotic properties of corrosive sublimate, some have made claims for the efficacy of this agent as an internal medicine that have not been substantiated. But others who used it in atomized solutions have found that, like many other local stimulants applied in this manner, it only diminished the bronchial secretion, and therefore the sputa and the cough; and others, again, that it was not tolerated (Csátáry, *Centralbl. f. Ther.*, viii. 542). In all the forms of *chronic bronchitis*, and especially in *fœtid bronchitis*, whether or not associated with pulmonary tubercle, this method should not be overlooked. Solutions for this purpose should contain about Gm. 0.01 in Gm. 100 (gr. ⅙ in f℥iij) of distilled water, of which 4 or 5 fluidrachms may be inhaled twice a day. It has been proposed to treat acute *pneumonia* by perenchymatous injections of this salt (*Practitioner*, xxxv. 377). Fortunately, the proposition did not commend itself to the judgment of physicians.

In various diseases of the *skin* solutions of corrosive sublimate are useful topical

applications, but the strength of the preparation should be carefully regulated, and none should be employed if the skin is broken. *Psoriasis*, when inveterate, has been successfully treated by baths containing corrosive sublimate, the patients taking from 30 to 40 baths, kept at a lukewarm temperature, and remaining immersed from a half to three-quarters of an hour (Voss and Sperk, *Med. News and Abs.*, June, 1881, p. 356). A solution of Gm. 1 (15 grains) of the salt in a pint of water, or, still better, in 2 fluidounces of dilute alcohol and 14 fluidounces of water, forms a very efficacious lotion in many cases of *acne*, especially in the form which affects the noses of certain women at their menstrual periods; in *chloasma;* in lentigo and the discolorations of the skin which go under the general name of *freckles;* in *prurigo pudendi* as a palliative, and in *pityriasis*, it usually serves as a cure. In various forms of *ophthalmia* Chabret states that irrigation of the eye with a solution of 1 part of the bichloride to 2000 of water promptly secures a reduction or an arrest of the inflammation (*Practitioner*, xxxv. 55). Similar statements have been made by Below (*Med. News*, xlviii. 38), and Arnauts recommends that in *granular conjunctivitis* a collyrium of the strength of 1 : 500 or 1 : 400 should be instilled into the eye three times a day, while twice a week the conjunctiva should be brushed over with a solution of 1 : 120 or 1 : 100. Essentially the same method was advocated by Staderini (*Univ. Med. Mag.*, i. 702). Progressive *suppuration of the cornea* has been treated successfully by Hotz with solutions of the bichloride, 1 : 5000 (*Journ. Amer. Med. Assoc.*, ix. 773). The efficiency of corrosive sublimate in the treatment of *lupus* has been proven by Doutrelepont, Unna, Payne, White, and others, either as an exclusive or as an associated agent. It is claimed to destroy the morbid growth without injuring the surrounding tissues. It has been used in watery solution, in an ointment, with collodion, etc., and of the strength of from half a grain up to four grains to the ounce. It is usually applied twice a day, or less frequently or in a mitigated form if signs arise of mercurial poisoning. *Warts* may be destroyed by a solution of 15 grains of corrosive sublimate in an ounce of collodion. A solution containing from 10 to 20 grains of the salt to the ounce of water is claimed to be a specific remedy for the inflammation caused by *Rhus radicans*, or poison ivy. A solution of 2 grains in an ounce of water is one of the best agents for destroying *pediculi pubis*, and is most efficiently applied with a fine-tooth comb. *Malignant pustule* is said to be treated more efficiently than by any other method with corrosive sublimate applied to the raw surface of a crucial incision made through the hardened tissues. *Ozæna*, especially of syphilitic origin, is benefited by the injection into the nostrils of weak solutions of the bichloride containing Gm. 0.06–0.12 (1 or 2 grains) to Gm. 32 (1 ounce) of water, or by a weaker solution applied with the nasal douche. The nasal injection is objectionable, owing to the danger of the medicine being swallowed. More than half a century ago injections of corrosive sublimate were used in the treatment of *leucorrhœa* and *gonorrhœa*, both simple and syphilitic. Richter (*Ausfürliche Arzneimittellehre*, 1830, v. 636) especially advised that they should not be stronger than about one grain in six ounces, and refers to their employment by Plisson, Swediaur, and others in these affections and in *balanitis*. Others afterward employed the same treatment occasionally, but in 1884 it was revived for its supposed specific action on the gonococcus or germ of gonorrhœa. Injections were used containing the bichloride in the proportion of 1 : 20,000. Paul employed Van Swieten's solution, 1 part, and water 190 parts. From comparative trials made by Firth (*Therap. Gaz.*, x. 331) it appears that injections of corrosive sublimate (gr. $\frac{1}{16}$ to f℥j) cured gonorrhœa sooner than any others except solutions of permanganate of potassium, and that such injections were more efficient when warmed than when cold. But under either agent the average duration of the disease was from seventeen to twenty days. (Compare Rand, *New York Med. Jour.*, Dec. 2, 1887). Theorists have ventured to treat *typhoid fever* with repeated small doses of the bichloride, and even to proclaim its success, but experience has altogether condemned the method and refuted its supporters. (Compare Gläser, *Practitioner*, xxxviii. 455.) On similar grounds solution of perchloride of mercury (Br. P.) has been used in *dysentery* (*Lancet*, Nov. 1889, p. 901) and *cholera* (*Therap. Gaz.*, xiii. 753), and calomel as well as corrosive sublimate internally for the same disease (*Bull. de Thérap.*, cxviii. 49). A solution of the salt (1 : 1000) has been used in the operation for the radical cure of *hydrocele* (*Bull. de Thérap.*, cxii. 179). Syphilitic *condylomata* have been successfully treated by washing them with a solution of common salt, and then sprinkling calomel powder over them. This method is said to be less painful than the direct application of corrosive sublimate (Nussbaum), especially in the form of Plenck's solution. This preparation has occasioned grave effects (*Therap. Monatsh.*, iv. 371).

In the subacute and chronic forms of muscular and also of articular *rheumatism* a very

gentle but sustained mercurial action will sometimes put an end to the lingering stiffness of the joints. For this purpose minute doses of the bichloride in compound syrup of sarsaparilla will be found appropriate. In chronic rheumatic *arthritis* it is said that baths of the bichloride and compresses wet with solution of the salt have sometimes produced cures of this intractable disease. It is recommended that a full bath should contain from Gm. 12–32 (3 to 8 drachms) of the salt. The many possible dangers from so large a quantity of a poisonous liquid should condemn its use for a disease in which its utility is so questionable.

The most striking among the recent applications of corrosive sublimate is its use as a dressing for *wounds*. No doubt can be entertained that it greatly diminished the mortality from surgical as well as accidental wounds, especially in hospital practice and when the sublimate solution was applied, to the injured part itself, and to the surgeon's hands, his instruments, and his dressings, so that not only was the specific action of the solution utilized, but the utmost and most scrupulous cleanliness was enjoined. The latter element is of capital importance in estimating the value of the method. Its leading advantages were that the dressings need not be frequently changed; there were no discharges, offensive or otherwise; the pain and fever were reduced to a minimum; and a rapid and perfect union of the several parts was secured. The solution never was stronger than 1 part of the salt in 1000 of the water, and one of half this strength was found best during operations; while a solution of 1 : 10,000 was held to be sufficient for ordinary dressings that were to remain in place. Naturally also the strength of the solution had to be less when it was frequently removed than when a single and permanent application was made. The repeated use of the stronger liquid sometimes (as has already been stated) occasioned poisonous and even fatal effects, including vomiting, ptyalism, tenesmus, diarrhœa, and collapse, as well as local signs of irritation, such as erythema, eczema, etc.

It was claimed that in the ordinary manœuvres required in *obstetrics*, and also in obstetrical operations, the same method greatly reduced the mortality of lying-in hospitals. Especially was it found that irrigations of the vagina and uterus after delivery with a solution varying in strength from 1 : 12,000 to 1 : 1500 were very efficient. But they were not free from danger. Richardson relates (*Boston Med. and Surg. Jour.*, April, 1885, p. 413) five cases in which the uterine injection of solutions of 1 : 2000 and 1 : 2500 occasioned sore mouth. In a previous paragraph of this present article the dangers of using this solution have been pointed out. They have also been dwelt upon by Braun (*Centralbl. f. Therap.*, v. 589), and in this country by Davis (*Med. News*, l. 309), though Winternitz maintains (*ibid.*, liv. 545) that solutions of 1 : 2000 are not dangerous if immediately after their injection they are allowed to escape from the vagina. A mercurial sublimate prepared with an ounce of fatty acids has been found of especial service in the treatment of *parasitic* skin affections, *anthrax*, etc., and a mixture of 3 parts of bichloride of mercury and 20 parts of collodion has been applied to flat *vascular tumors* of the skin.

The combination of corrosive sublimate with chloride of ammonium, which was formerly known as *sal alembroth*, has been used by Lister in a 1 per cent. solution to prepare surgical *antiseptic* dressings, but was found practically objectionable.

Administration.—The dose of corrosive sublimate internally is from Gm. 0.004–0.008 ($\frac{1}{16}$ to $\frac{1}{8}$ grain). It should not be given when the stomach is empty unless in a very weak solution. It is recommended that for hypodermic use a 90 per cent. solution should be prepared, with the addition of 6 per cent. of common salt, and the equivalent of Gm. 0.06 (gr. $\frac{1}{6}$) employed as a single dose (*Med. News*, lv. 521). Sigmund used Gm. 0.25 and Gm. 2 in Gm. 32 (4 grs. of sublimate and 30 grs. of salt) in an ounce of water, of which one dose was Gm. 1.30–2.00 (20–30 minims). It is claimed, though not admitted, that *ammoniated peptonate* of mercury deeply injected into a muscular part is superior to other modes of administration.

HYDRARGYRI CHLORIDUM MITE, *U. S.*—Mild Mercurous Chloride.

Hydrargyri subchloridum, Br.; *Hydrargyrum chloratum*, P. G.; *Hydrargyri chloridum*, *Hydrargyrum chloratum* (*muriaticum*) *dulce*, *Mercurius dulcis*, *Calomelas*, *Chloruretum* (*Chloretum*) *hydrargyrosum*.—*Calomel*, E.; Fr.; G.; *Mercurous chloride*, *Subchloride* (*Protochloride*) *of mercury*, E.; *Protochlorure* (*Sous-muriate*) *de mercure*, *Mercure doux*, Fr.; *Quecksilberchlorür*, G.

Formula HgCl or Hg_2Cl_2. Molecular weight 235.17 or 470.34.

Preparation.—Take of Mercuric Sulphate 10 ounces; Mercury 7 ounces; Sodium Chloride, dried, 5 ounces; Boiling Distilled Water a sufficiency. Moisten the mercuric sulphate with some of the water, and rub it and the mercury together until globules are no longer visible; add the sodium chloride and thoroughly mix the whole by continued trituration. Sublime by a suitable apparatus into a chamber of such size that the calomel, instead of adhering to its sides as a crystalline crust, shall fall as a fine powder on its floor. Wash this powder with boiling distilled water until the washings cease to be darkened by a drop of ammonium sulphide. Finally, dry at a heat not exceeding 212° F., and preserve in a jar or bottle impervious to light.—*Br.*

Mercuric sulphate is first mixed with the requisite quantity of mercury to form mercurous sulphate, Hg_2SO_4, and afterward with sodium chloride. On heating the mixture reaction takes place between the two salts, resulting in the production of mercurous chloride, which sublimes, and sodium sulphate, which remains behind; $Hg_2SO_4 + 2NaCl$ yields $Hg_2Cl_2 + Na_2SO_4$. If these vapors are cooled and condensed in a small space, white or yellowish-white crystalline masses are obtained, which should be finely powdered. To avoid this operation, the condensation is directed to be effected in a large chamber, whereby a fine crystalline powder is obtained; it is condensed in a similar form, but still finer and as a still softer powder, by injecting steam into the condensing-chamber while the sublimation is in progress. Calomel prepared in this way is designated in the German Pharmacopœia as *Hydrargyrum chloratum vapore paratum*, and is known in France as *Calomel à la vapeur*. Water being at the same time condensed, it will hold any corrosive sublimate in solution which may have sublimed with the vapors of calomel. It is for the purpose of removing the same impurity that the ordinarily-condensed calomel requires to be washed with water as long as mercuric chloride is dissolved, which is indicated by the filtrate producing a white turbidity with ammonia or a black one with ammonium sulphide. A current of cold air injected into the condensing-chamber will precipitate the calomel vapors as a soft powder in a manner similar to that produced by steam.

Very finely-divided calomel, *Hydrargyri chloridum mite præcipitatione paratum*, known in France as *Précipité blanc* (which should not be confounded with ammoniated mercury), is obtained by gradually adding a not too concentrated solution of mercurous nitrate to a solution containing an excess of sodium chloride, digesting the mixture for a short time, and washing the precipitate thoroughly with water. Wöhler (1854) proposed the reduction of corrosive sublimate in solution by sulphurous acid and by warming the mixture. Good results and nearly the theoretical quantity of calomel are obtained, according to Sartorius (1855), if the corrosive sublimate has been dissolved in 80 parts, or, according to Stein (1857), in 45 parts, of water. Concentrated solutions yield only one-half the mercury as calomel.

Besides calomel manufactured in the United States, 2400 pounds were imported in 1875, and 8177 pounds in 1881.

Properties.—Calomel is a heavy, fine, smooth, and impalpable white powder, which under the microscope is observed to consist of minute needle-shaped crystals, but when prepared by levigating the crystallized mass it forms irregular fragments of crystals. These two varieties are usually met with in commerce. Calomel obtained by precipitation is in very minute particles, either crystalline or amorphous, but on account of its more energetic action is rarely used. The salt is without action on test-paper, is entirely inodorous and tasteless, and is not altered in the dark on exposure to the air; but if kept in the light it gradually acquires a gray or blackish color, indicating decomposition. Its density is about 7.0, but varies somewhat as prepared by different processes. When heated it sublimes completely without previous fusion. It is insoluble in water and other simple solvents, but boiled with water it is slowly decomposed into metallic mercury and mercuric chloride. Solutions of the fixed alkalies and alkaline earths decompose it, with the formation of soluble chlorides and black mercurous oxide Hg_2O (see LOTIO HYDRARGYRI NIGRA); ammonia-water also colors it black, but the resulting compound has the composition NH_2Hg_2Cl. When mixed with a dry caustic alkali, alkaline earth, or an alkali carbonate, and heated, decomposition takes place, metallic mercury being produced. Moist calomel is reduced to the metallic state by many metals either in the cold or on being warmed, soluble chlorides and metallic mercury being formed. Boiling nitric or sulphuric acid dissolves calomel, with disengagement of nitric oxide or sulphurous acid vapors and the production of mercuric chloride and nitrate or sulphate. Boiling concentrated hydrochloric acid dissolves mercuric chloride and leaves mercury; in the diluted state, and heated in contact with the air, mercuric chloride is slowly dissolved without

separation of mercury. Calomel left in contact with solution of ammonium chloride is gradually converted into mercuric chloride, which dissolves; the decomposition occurs more rapidly with a concentrated solution and at a somewhat elevated temperature. Potassium and sodium chlorides have a similar effect, but react more slowly. According to Jolly's observations (1878), corrosive sublimate is also formed from calomel in the presence of hydrochloric acid, citric acid, alkalies, their carbonates, and alkaline earths, but not with calcium carbonate or with sugar which is absolutely free from lime. Chlorine-water converts calomel into corrosive sublimate. With potassium iodide a green powder is produced containing mercurous iodide. When triturated with impure sugar some corrosive sublimate is formed.

Tests.—Calomel should volatilize when heated, without leaving any residue (absence of fixed impurities). Heated with potassa solution, it should turn black, without evolving the odor of ammonia (absence of ammonium compounds). Agitated with warm distilled water or alcohol, the filtrate should not be colored by hydrogen sulphide or yield a white precipitate with silver nitrate (absence of mercuric chloride), nor should it on evaporation leave any residue (absence of fixed soluble impurities). Agitated with diluted acetic acid, the filtrate should not be affected by hydrogen sulphide or silver nitrate (absence of ammoniated mercury).

Action and Uses.—The action of calomel does not materially differ from that of uncombined mercury (see HYDRARGYRUM); it is, however, rather more irritating, and in excessive doses may cause active vomiting and purging. But some alleged instances of its irritating action may be attributed to the calomel having been partially converted into corrosive sublimate; but as Trasbot (*Bull. etc. Soc. Thérap.*, 1890, p. 121) and others have shown, such a change must be very slight if it occurs at all. Among the anomalous effects of calomel is a cutaneous erythema.

The experiments of Wassilieff led him to conclude that calomel in the stomach does not hinder the digestive process, while it tends to prevent putrefactive changes in the food. The cholagogue action ascribed to mercury, and especially to calomel, was an invention of the British physicians in India, who long accepted the doctrine that large doses of calomel diminish the vascularity of the gastro-duodenal mucous membrane, and dissolve the inspissated mucus investing it and obstructing the gall-ducts, and that small doses of the medicine are absorbed and through the blood promote the secretion of bile. But a careful repetition of their experiments proved that *large doses of calomel, as well as small doses, lessen the biliary secretion*, and that *among purgative medicines mercury in every form is the one that tends least to augment the discharge of bile.* The experiments of Prevost and Binet in 1888 confirmed the conclusion here stated (*Boston Med. and Surg. Jour.*, Nov. 1888, p. 439). Like other mercurials, calomel is diuretic (Jendrássik, *University Med. Mag.*, iii. 330).

When the cure of *syphilis* was believed to depend upon profuse mercurial salivation, calomel was generally employed to produce that effect. But at the present day this action of calomel, along with its tendency to purge, has caused it to be less frequently used than formerly. If prescribed at all, it should be in very small and repeated doses, and the frequency of its administration determined by its effects upon the mouth, the bowels, and the course of the disease. These remarks apply to indurated chancres as well as to secondary symptoms. Of late years (for the history of the method, see Guelpa, *Bull. de Thérap.*, cxii. 289; Zeissl, *Centralb. f. Ther.*, v. 288) calomel has been administered for the cure of constitutional syphilis by deep muscular injections. One formula was as follows: calomel, common salt, of each 5 parts, distilled water 50 parts, gum arabic mucilage 2.5 parts; each injection contained about one grain of calomel. Another was calomel 1 part, olive oil 10 parts; and a third calomel and lanolin, of each three parts, olive oil 4 parts; glycerin has been used as a vehicle. Albuminate of mercury has been recommended for this purpose. The injections have usually been made in the gluteal region behind the great trochanter, on the two buttocks alternately, and at intervals of from one to three weeks (*Centralb. f. Ther.*, iv. 37). The advantages claimed for this method are that the patient's disease is less apt to be known than it is under other treatment; that less mercury is required for a cure; that the cure is more speedy; that relapses after it are not more frequent; that salivation and ulceration following it are rare and slight; that it is adapted to primary as well as constitutional syphilis; that it permits an accurate estimate of the amount of mercury used; and that it does not derange the digestive organs. On the other hand, it is accused of being extremely painful and liable to occasion abscess or purulent infiltration, pyæmia, and stomatitis (Schopf; Bender; Besnier), and that relapses are more frequent and graver

than after other mercurial modes of treatment. (Compare Leloir and Tavernier, *Therap. Gaz.* xiv. 617.) Two cases of death caused by the hypodermic use of calomel are on record (*Archiv. gén.*, Juin, 1889, p. 732); and the like issue occurred after a similar use of *oleum cinereum* (*Therap. Monatshefte.*, iii, 436). Other and similar results have been noted by Kaposi (*Amer. Jour. Med. Sci.*, March, 1870, p. 305). The latter preparation, or "gray oil," is composed of mercury and lanolin, each 3 parts, and olive oil 4 parts. Calomel 1 part and olive oil 10 parts form a similar preparation which is claimed to be comparatively unirritating in quantities containing one grain of the chloride.

Much has been written both for and against the use of calomel in *typhoid fever*, but a careful study of its history seems to show—1, that it is most useful when given in the forming stage of the disease and in purgative doses; and 2, that it is peculiarly mischievous in all cases which tend to assume an ataxic or an adynamic type. In other words, it is to be placed, in relation to typhoid fever, in the same category as other purgatives, among which the salines have been proved to be eminently useful in the first period of the disease. It is very probable that calomel, acting as a purgative, assists in removing the poisonous material from the bowel, and possibly tends to destroy it if it be a ferment, while, owing to its imperfect solubility, the medicine may serve as a protective to the mucous glands of the small intestine. It has been recommended to administer calomel in small and repeated doses, and so as slightly to affect the gums, about the height of the disease, when the tongue grows dry, the abdomen tympanitic, and the mind dull; but if we know anything about the nature of these symptoms, it is that they are signs of increased exhaustion of the nervous system and poisoning of the blood, and therefore the very last to be treated by a medicine which tends directly to aggravate such conditions. The period at which these phenomena appear, only to subside again in three or four days in the natural course of the disease when it tends to recovery, is the one in which the medicine is supposed to be indicated, and the reason assigned for its use probably results, therefore, from an error of observation. Dr. J. C. Wilson has used calomel hypodermically in this disease (*Therap. Gaz.*, xii. 729), 1 or 2 grains every four or five days suspended in glycerin and water.

At one time calomel was held to be a specific in *yellow fever*—according to some, if prescribed in large doses; according to others, if given in small doses intended to produce its constitutional effects. Experience has condemned both methods as not only useless, but injurious. The same may be said, but not so absolutely, in regard to *remittent fever;* the necessity of "unloading the portal circulation," which purgative doses of calomel were supposed to effect, does not now appear so imperative as it did to the theorists of thirty or forty years ago; but the gastro-duodenal inflammation and the engorged state of the liver are undoubtedly allayed by alvine evacuants, among which calomel is one of the best, because it is one of the least irritating, particularly if followed by copious but weak saline draughts in divided portions. The constitutional action of calomel in this disease is no longer sought by judicious physicians.

During the last century, and indeed until within a few years, calomel was used by English and American physicians in all *inflammatory* diseases with complete faith in its efficacy. Borrowed originally from the treatment of acute hepatitis in hot climates, it was applied in England to a totally different order of diseases (plastic inflammations), and gradually came to be regarded as a specific in most of them. Subsequently, this empirical practice was supposed to find a rational justification when it appeared that mercury diminished the coagulability of the blood by lessening the proportion of its fibrin, and still later, when it appeared that the medicine directly diminished the proportion of red globules in the blood. The former effect was probably, indeed, only a consequence of the latter. But, although it seemed to be proved that mercury thus restricted inflammatory action and its consequences, it was not proved that their restriction by this means was necessary to cure the disease, and it was even rendered probable that the antiphlogistic use of calomel involved more danger than advantages. Extensive observation has now demonstrated that, with one or two possible exceptions, inflammatory affections may be cured quite as rapidly, and much more safely and agreeably, without mercury than with it, while the dangers involved in the antiphlogistic use of the medicine are so serious as to condemn it whenever a safer remedy can be substituted for it.

Of acute inflammations, for whose treatment calomel has long been supposed essential, may be mentioned *pericarditis*, *endocarditis*, *pleurisy*, *pneumonia*, *meningitis*, and *hepatitis*. It is now apparently determined that none of these diseases, as a rule, require calomel for their cure, and that most of them are aggravated by it. In regard to *peritonitis*, it may be added that as the disease is never idiopathic, at least in adults, and never primary

unless traumatic, pathology confirms what clinical observation demonstrates—that mercury is unsuited to its cure. Acute *hepatitis* is not now, as formerly, indiscriminately treated by calomel in tropical climates, where alone the disease is frequently observed. The use of mercurial and other purgatives appears to be beneficial in the early stages of the disease, but not through any specific operation. There are good grounds for suspecting that in hot climates the repeated administration of calomel in divided doses leads to the formation of abscesses of the liver. *Meningitis*, like peritonitis, is always a secondary disease when not traumatic, depending upon a specific poison in epidemic cerebro-spinal meningitis, upon the rheumatic poison in another class of cases, upon tubercle in a third, etc. In no form of meningitis is calomel of any avail, unless it may be so in certain exceptional cases of the tubercular variety; and, although it must be confessed that diagnostic difficulties obscure the subject, still, in the present state of our knowledge, mercury stands next to iodine in the promise of doing good. In regard to pleurisy, pneumonia, pericarditis, and endocarditis the case is somewhat different. In their acute forms mercury is probably unnecessary, and, considering its liability to abuse, should not be employed except as a purgative; but when their acute stage has passed and the products of inflammation show no tendency to be absorbed, mercury sometimes hastens this consummation in a remarkable degree, even when all other medicines have failed to abate the hectic or asthenic symptoms or diminish the physical evidences of the causes that produce them. Especially is this the case when the local lesion is engrafted upon a syphilitic constitution. When under this dyscrasia alone the lung becomes solidified, simulating tubercular infiltration, a carefully-conducted course of mercury will often dissipate the local signs of disease and restore the general health.

Formerly calomel formed part of the established treatment of *dropsy*, and only fell into disuse when clinical were supplanted by so-called rational therapeutics. Richter in his Materia Medica (1830) declared that "in dropsy calomel is of almost inestimable value," especially when neither diuretics, emetics, nor cathartics avail. He advised it to be given in divided doses amounting to 4–6 grains a day, or in still smaller doses, associated with squill and digitalis. This method was the usual one during many years, and was familiar to the present writer between 1833 and 1840, but it seems to have been forgotten until it was, in 1885–86, revived by Jendrássik. He found it most beneficial in cardiac dropsy, but not useless in others of like mechanical origin; and observed that there was no uniform relation between the mercurial sore mouth and the occurrence of diuresis, and that it was not necessary to continue the medicine after the diuretic action began. The urine discharged was always watery and contained a large proportion of cylindroid cells. In healthy persons no diuresis was occasioned by calomel administered as above. It also failed in chronic pleurisy and in Bright's disease, and even in some cases of aortic stenosis and mitral insufficiency (*Centralbl. f. d. g. Therap.*, iv. 74; viii. 549). These conclusions have been in the main confirmed by Korányi (*ibid.*, iv. 197), by Stiller and by Mendelsohn (*Archives gén.*, 7 ème, sér. xix. 738), by Meyjes (*Therap. Gaz.*, xi. 751), Biró (*Centralbl. f. Med.*, v. 184), Rosenheim (*ibid.*, p. 366), Leyden (*ibid.*, p. 476), Weinstein (*ibid.*, p. 560), Meyes (*ibid.*, p. 635), who insisted that salivation was not necessary to the success of the treatment, and is also unsuited to renal dropsies; Stintzing (*ibid.*, vi. 85), who advocated the combination of calomel and digitalis, as did also Schwass (*Amer. Jour. of Med Sci.*, March, 1889, p. 294), Snyers (*Bull. de Thérap.*, cxvi. 189), Ignatiew (*Centralbl. f. Therap.*, vii. 14), who considered the medicine of little avail in all dropsies that were not of cardiac origin—a statement made also by Huchard (*ibid.*, vii. 408), and more recently by Pal (*ibid.*, vii. 65). When formerly employed in dropsy, calomel was, as before mentioned, usually associated with digitalis and squill; and a hospital physician of the day was in the habit of prescribing the combination "to gently touch the mouth." The above results have been more recently confirmed by Fachler (*Jour. Amer. Med. Assoc.*, xv. 233), and by Garvens (*Therap. Monatsh.*, iv. 180). All observers agree that the method requires caution, partly to limit salivation, and partly to guard against cardiac failure.

Calomel is worse than useless in acute articular *rheumatism;* it neither mitigates the disease nor prevents its complications. In certain cases of subacute and chronic rheumatism involving the ligaments of the joints and rendering the latter stiff and painful on motion, a course of very small doses of calomel will sometimes act beneficially, but more advantage will be derived from iodide of potassium. Several cases published by Dr. Ormsby illustrate the advantages of calomel in membranous *dysmenorrhœa* when given so as lightly to affect the gums (*Med. Record*, xx. 597). Simpson formerly attained the same end by means of pessaries medicated with mercurial ointment (*Clinical*

Lectures, Amer. ed., 1863, p. 109). In *metritis*, both acute and chronic, calomel and opium are generally administered with supposed advantage. In diseases of the *kidney*, whether acute or chronic, mercury is a mischievous medicine. *Iritis*, although it may, in its simple form, recover without mercury, is more readily cured by calomel and opium internally, and mercurial ointment, with extract of belladonna or the instillation of atropine, topically. Syphilitic iritis should always be treated by the internal use of calomel, if not by mercurial inunctions.

In *jaundice* depending upon engorgement of the liver or upon obstruction of its ducts with thick bile saline purgatives are the appropriate remedies, but the English custom of first administering calomel or blue pill prevails in this country. It is by no means certain that the mercurial renders the purgative treatment more efficient. It can do no harm as an occasional remedy, but is very mischievous if habitually taken.

Among mucous inflammations, *pseudo-membranous laryngitis*, or true croup (and not diphtheria, which we hold to be a totally different affection, *vid.* HYDRARGYRUM), is treated by calomel internally and by mercurial inunctions, in the belief that under its operation exudation-matter will form less densely and adhere less tenaciously, and hence be rejected by coughing or by vomiting more readily. The question of their efficacy is difficult to solve, for the cases of the disease differ widely among themselves in the thickness and tenacity of the membrane and in the extent of its deposit. But in a disease with such fatal tendencies even a doubtful remedy should not be rejected. But that cannot be truly called a "doubtful" remedy of which we read that it was given to a child twenty-eight months old in a primary dose of 20 grains, which was followed every hour by 10-grain doses until during three days 720 grains had been taken. The child recovered from the treatment (*Med. Record*, xxvi. 36: compare *Med. News*, xlvi. 672). In *syphilitic laryngitis*, which is generally ulcerative, calomel or mercury in some form is indispensable. In acute *bronchitis*, which shows no tendency to decline at the usual period of subsidence, small doses of calomel repeated until the mouth begins to feel its effects will often promote the cure; and in the chronic form of the same disease, with dyspnœa and bronchorrhœa depending upon thickening of the bronchial mucous membrane, the same method is often very efficient. In acute *dysentery* calomel has been used as a purgative and in small or so-called alterative doses. There appears to be no doubt that in the asthenic form of the disease purgative doses of calomel, if given in the forming stage, will modify the course of the disease, just as salines, rhubarb, and ipecacuanha will. There is no reason to attach any special importance to calomel as such. Its virtue resides chiefly in its mild evacuant and protective action. In this disease calomel in small or fractional doses is most useful when associated with ipecacuanha, and least so when combined with opium. The advantage of the latter combination consists mainly in its negative virtue of protecting the patient from perturbative measures. It is most suitable when the acute stage has begun to decline, and after a judicious evacuant treatment has mitigated the severity of the attack. A similar remark is perhaps justifiable in regard to the calomel treatment of epidemic *cholera*. The huge doses of the drug which were originally used by the British East India surgeons have long ago been condemned, as well as the other elements of their crude therapeutics. Nevertheless, they have been from time to time revived by persons unacquainted with their history. If calomel has shown any special virtues in epidemic cholera, it has only been when it was administered in doses of 1 or 2 grains every five or ten minutes, with 1 or 2 drops of laudanum in each of the first few doses. Knowing, as we do, the stomach's complete loss of its absorbing functions in this disease, the method in question really amounts to a negative treatment, and this, it is pretty well settled, is more efficient than any of the active methods which have prevailed. No doubt that calomel has been, and will again be, employed in cholera as a specific destroyer of microbes, but the validity or invalidity of the theory cannot alter the clinical results. The hostile influence of mercury upon the lower forms of animal life explains the propriety of using calomel purges in some cases of *lumbricoid worms*. But the possibility of its poisonous action on the system renders it less eligible for this purpose than other direct vermicides.

It is perhaps even truer of calomel than of other mercurials, that it should be very cautiously exhibited to persons suffering under a scrofulous, tuberculous, or cancerous cachexia, or to those who have begun to exhibit the infirmities of old age or who are known to be morbidly susceptible to its poisonous influence.

In an ointment—calomel Gm. 4 to Gm. 32 (℥j, lard ℥j)—calomel is sometimes applied to *condylomata* and to limited *scaly eruptions*, and in powder it has been used to destroy *maggots* infesting wounds in hot weather. In the latter form also it has been applied to

ulcers of the cornea, but is not strongly to be recommended for this purpose. Schlaefke warns against the application of calomel to the conjunctiva of patients taking iodide of potassium. This salt is then abundantly contained in the tears, and converts the calomel into iodate and iodide of mercury, which in solution exert a caustic action (*Med. News and Abst.*, April, 1880, p. 211). Calomel alone, or mixed with starch, has been applied to the face in the forming stage of *small-pox* pustules to prevent pitting.

Calomel is most conveniently given mixed with a little syrup or enclosed in wafers. As a purgative *dose*, from Gm. 0.30–1.30 (gr. v–xx) may be administered. Children require larger doses, in proportion to their age, than adults. To produce its constitutional action, of which the first sign is usually a metallic taste in the mouth or soreness of the gums, Gm. 0.05–0.10 (gr. j–ij) may be given three times a day, with $\frac{1}{8}$ grain of opium; but still smaller doses, more frequently repeated, as Gm. 0.005–0.006 ($\frac{1}{10}$ or $\frac{1}{12}$ grain) every hour, will affect the system more promptly. Hypodermically, 1 grain is the average dose. It is recommended that calomel should not be applied to the glans penis for balanitis if the patient is taking potassium iodide.

HYDRARGYRI CYANIDUM, *U. S.*—Mercuric Cyanide.

Hydrargyrum cyanatum, P. G.; *Hydrargyrum borussicum*, *Mercurius cyanatus s. borussicus*, *Cyanuretum hydrargyricum*.—*Mercuric cyanide*, *Cyanuret of mercury*, E.; *Cyanure (Bicyanure, Prussiate) de mercure*, Fr.; *Cyanquecksilber*, *Quecksilber-Cyanid*, G.

Formula $HgCy_2$ or $Hg(CN)_2$. Molecular weight 251.76.

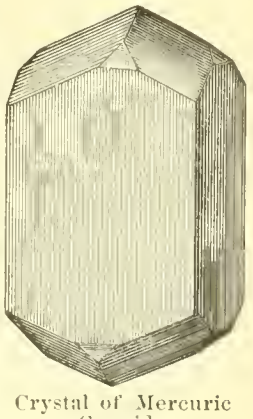
Mercuric cyanide should be kept in well-stoppered bottles, protected from light.

Preparation.—The process recommended by the U. S. P. 1870 consists in dissolving mercuric oxide in hydrocyanic acid, the latter being prepared as the first step by acting upon potassium ferrocyanide with sulphuric acid. (See Acid. Hydrocyanicum, page 63.) On agitating it with mercuric oxide a combination is effected, resulting in the production of mercuric cyanide and water; $2HCy + HgO$ yields $HgCy_2 + H_2O$. Should an excess of mercuric oxide be present, it will combine with the cyanide to mercuric oxycyanide, $HgO.HgCy_2$, which is converted into cyanide by the addition of a reserved portion of hydrocyanic acid; an excess of the latter does not change the nature of the product, and is volatilized on evaporating the liquid. When the clear liquid has been sufficiently concentrated it is set aside in a cool and dark place to crystallize, and the crystals are dried, protected from the light.

This is not the only process, but the most convenient one, by which mercuric cyanide may be obtained. On boiling pure ferrocyanide of iron with mercuric oxide, mercuric cyanide enters into solution; should the filtrate contain iron, it must be evaporated to dryness, the residue again taken up with water, and the solution evaporated to crystallization. On boiling potassium ferrocyanide with a proper quantity of mercuric sulphate, a complex reaction will take place, resulting finally in the production of metallic mercury and of a solution containing mercuric cyanide, potassium sulphate, and ferric sulphate, to be separated by crystallization from diluted alcohol. $7HgSO_4 + 2K_4FeCy_6 = Hg + 6HgCy_2 + 4K_2SO_4 + Fe_2 3SO_4$.

Properties.—Mercuric cyanide is in colorless or white quadrangular prisms, which are inodorous, have a bitter metallic taste, and are permanent in the air if the light be excluded. The salt is soluble at 15° C. (59° F.) in 12.8 parts of water (*U. S.*, *P. G.*) and in 14.5 (*P. G.*) or 15 (*U. S.*) parts of alcohol, also in 3 parts of boiling water and in 6 parts of boiling alcohol, but is very sparingly soluble in ether. The solutions have a neutral reaction to test-paper. The aqueous solution is not decomposed by nitric or dilute sulphuric acid, but hydrochloric acid liberates hydrocyanic acid, recognizable by its odor, and mercuric chloride remains in solution; it yields a black precipitate with hydrogen sulphide, but does not give the ordinary reactions for mercuric salt or cyanide when tested with alkalies, potassium iodide, or silver nitrate, double compounds, mostly crystalline, being formed, which are more or less freely soluble in water. The salt is blackened by exposure to the light, and when carefully dried and heated is decomposed into mercury and cyanogen, which is inflammable, burning with a purplish flame; but when rapidly and strongly heated the crystals decrepitate violently, and black paracyanogen is first produced before the whole is finally dissipated, and in the presence of moisture carbon dioxide, ammonia, and hydro-

Fig. 151.



Crystal of Mercuric Cyanide.

cyanic acid are evolved. When mixed with an equal weight of iodine, and heated in a dry test-tube, two crystalline sublimates are obtained, the lower one consisting of mercurie iodide, being yellow and becoming red on cooling, while the upper one, consisting of cyanogen iodide, is white and has a penetrating acrid odor.

Tests.—Mercurie cyanide dissolved in water should not impart a brown color to turmerie-paper (absence of mercurie oxycyanide). "A 5 per cent. aqueous solution of the salt, when mixed with a dilute aqueous solution of potassium iodide, should not yield a red or reddish precipitate soluble in excess of the precipitant (absence of mercuric chloride)."—*U. S.* In the presence of a *little* chloride this test is apt to fail unless the potassium iodide solution be very cautiously added. A much better test is the following: The solution of the salt in twenty parts of water slightly acidulated with nitric acid, should not produce a white precipitate on the addition of test-solution of silver nitrate. The absence of salts of other metals is shown by the complete volatility by heat.

Action and Uses.—Mercury cyanide is a violent irritant poison, producing also extreme prostration and partial cyanosis, and death by exhaustion. In other words, its action includes that of hydrocyanic acid as well as that of the irritant mercurial salts. It has been used in the treatment of constitutional syphilis, and is strongly recommended by Dr. Maenaughton Jones in doses of $\frac{1}{12}$ grain three times a day, but not to the exclusion of arsenic and *iodine* (*Practitioner*, xxxiv. 410). A German physician claims that, when all the usual remedies for *diphtheria* had failed, he succeeded in curing nearly all his cases by administering every hour $\frac{1}{28}$ grain of cyanide of mercury (*Times and Gaz.*, Jan. 1881, p. 101). A similar claim is made by Bree, who used a solution of Gm. 0.01 to Gm. 10 (gr. $\frac{1}{6}$ in f℥iiss) of diluted alcohol, of which 2 or 3 drops were given at first every quarter of an hour (*Centralb. f. Ther.*, v. 403). The share of the medicine in the alleged result is more than problematical. No sufficient reason appears for retaining so dangerous a preparation among officinal medicines. Gm. 1.30 (20 grains) of it caused death in ten days, and Gm. 0.10 (2 grains) a severe illness which lasted for three weeks.

"Cyanide of mercury" ($HgOHgCn_2$) was proposed by Chibret as being less poisonous and more antiseptic than the bichloride. Boer claims that when administered hypodermically it does not coagulate albumen, that its solution is neutral, that it is neither poisonous nor corrosive, that it does not attack surgical instruments as much as corrosive sublimate, and that it is not decomposed by light (*Therap. Monatsh.*, iv. 332).

The double cyanide of mercury and zinc was proposed by Sir Joseph Lister in 1889 as an antiseptic dressing superior to all others (*Lancet*, Nov. 1889, p. 945; White (*Med. News*, lv. 608; lvi. 130), but it was soon declared to show no superiority to the previously used mixture of corrosive sublimate and sal ammoniac (sal alembroth), and, indeed, was alleged to consist essentially of cyanide of zinc (Dott, *Lancet*, Nov. 1889, p. 1133).

HYDRARGYRI IODIDUM FLAVUM, *U. S.*—Yellow Mercurous Iodide.

Hydrargyri Iodidum Viride, U. S. 1880.—*Hydrargyrum iodatum flavum*, *Hydrargyrii proto-ioduretum*, *Ioduretum hydrargyrosum*.—*Protoiodide of mercury*, *yellow* (*or green*), *iodide of mercury*, E.; *Proto-iodure de mercure*, *Iodure mercureux*, Fr.; *Quecksilberjodür*, *Gelbes Iodquecksilber*, G.

Formula HgI or Hg_2I_2. Molecular weight 326.33 or 652.66.

Preparation.—Mercury, 50 Gm.; Nitric Acid, Potassium Iodide, Distilled Water, Alcohol, each, a sufficient quantity. Mix 20 Cc. each of nitric acid and distilled water, and, when the liquid is cold, pour it upon the mercury contained in a small glass flask. Set the mixture aside in a cool and dark place, and agitate it occasionally until the reaction ceases and a little mercury still remains undissolved. Separate the crystals of mercurous nitrate, which will have formed from the mother-liquid, allow them to drain in a glass funnel, and dry them on bibulous paper in a dark place. When the salt is dry, weigh off 40 Gm. of it, and dissolve it in 1000 Cc. of distilled water to which 10 Cc. of nitric acid had previously been added. Having prepared a solution of 24 Gm. of potassium iodide in 1000 Cc. of distilled water, slowly pour the solution of potassium iodide into that of the mercurous nitrate, under constant stirring; allow the precipitate to subside, decant the supernatant liquid, and transfer the precipitate, together with the remainder of the liquid, to a filter. When the precipitate has drained, wash it with distilled water until the washings no longer have an acid reaction upon litmus paper, and after-

ward wash it with alcohol as long as the clear, colorless washings afford any color with hydrogen sulphide test-solution. Lastly, dry the product in a dark place, between sheets of bibulous paper, at a temperature not exceeding 40° C. (104° F.). Keep it in dark amber-colored vials, and expose it to light as little as possible. Instead of weighing off 40 Gm. of the mercurous nitrate as above directed, the whole of the crystallized salt may be taken and the amount of potassium iodide, etc., adjusted on the proportions given above.—*U. S.*

When solutions of a mercurous salt and potassium iodide are brought together, mutual decomposition results, and mercurous iodide is formed, together with a salt of the alkali, as shown by the following reaction: $Hg_2(NO_3)_2 + 2KI = 2(HgI)$ or $Hg_2I_2 + 2KNO_3$.

The object of adding the potassium iodide to the mercurous nitrate in the official process is to avoid the formation of mercuric salt, which is apt to occur if the process were reversed; it is well known that solutions of alkali iodides and also ferrous iodide will decompose mercurous iodide into mercuric iodide and mercury, the mercuric salt being held in solution by the alkali iodide as the so-called iodohydrargyrate of the alkali, while the mercury is precipitated in a finely-divided state. The decomposition is readily understood from the equation, $2HgI + 2KI = HgI_2.2KI + Hg$.

The former U. S., Br., and G. Pharmacopœias all directed the preparation of mercurous iodide by triturating iodine and mercury together in proper proportions in the presence of a little alcohol; any mercuric iodide formed was removed by washing with alcohol. The Br. P. and P. G. have dismissed this compound entirely in their recent issues, 1885 and 1890. When prepared by direct union mercurous iodide is much more green in color, and this is also the case if appreciable quantities of mercuric iodide are present, as may be seen from the change of color caused by exposure of the yellow iodide to sunlight, which causes decomposition into mercuric iodide and metallic mercury.

Properties.—Mercurous iodide (official) is a bright-yellow, amorphous powder, odorless and tasteless, and becoming darker by exposure to light, in proportion as it undergoes decomposition into mercuric iodide and mercury. It is wholly insoluble in alcohol or ether, and almost insoluble in water. When slowly heated it assumes at first an orange, and then a red or red-brown color, becoming yellow again on cooling; but when quickly and strongly heated, it is at first partially decomposed into mercury and mercuric iodide, and is finally completely volatilized. Mercurous iodide dissolves in ammonia-water, leaving a gray residue, and in sodium thiosulphate solution, leaving mercury, and yielding a colorless liquid, which on heating deposits dark-red mercuric sulphide. When it is heated with sulphuric acid and a little manganese dioxide, vapors of iodine are evolved.

Tests.—"If 0.5 Gm. of the salt be shaken with 10 Cc. of alcohol, and filtered, a portion of the filtrate should be scarcely affected by hydrogen sulphide test-solution, nor should it produce more than a very faint, transient opalescence when dropped into water; and if 5 Cc. of the filtrate be evaporated from a white porcelain surface, not more than a very faint red stain should remain (absence of more than traces of *mercuric iodide.*)"—*U. S.* Fixed impurities, if present, remain behind if a portion is heated to redness in a porcelain crucible.

Action and Uses.—Green iodide or protiodide of mercury is chiefly used in the treatment of constitutional *syphilis*, and is preferred above other preparations by several eminent syphilographers. It should be given in doses of from Gm. 0.04–0.06 (gr. $\frac{3}{4}$–1) three times a day, and gradually increased until these doses are trebled or more, provided that neither salivation nor diarrhœa occurs. It is less apt than calomel to produce such effects. The following formula is much employed: R. Protiodide of mercury, extract of lettuce, each Gm. 3 (45 grains); extract of opium Gm. 1 (15 grains); confection of roses Gm. 6 (90 grains). Mix, and divide into sixty pills, one, two, or three to be taken daily.

HYDRARGYRI IODIDUM RUBRUM, *U. S., Br.*—Red Mercuric Iodide.

Hydrargyrum biiodatum, P. G.; *Deutoioduretum (Biniodidum) hydrargyri*, *Mercurius iodatus ruber*, *Ioduretum hydrargyricum.*—*Biniodide of mercury*, *Mercuric iodide*, E.; *Deuto-iodure (Bi-iodure) de mercure*, *Iodure mercurique*, Fr.; *Rothes Jodqueeksilber*, *Queeksilberjodid*, G.

Formula HgI_2. Molecular weight 452.86.

Preparation.—Corrosive Mercuric Chloride, 40 Gm.; Potassium Iodide, 50 Gm.;

Distilled Water, a sufficient quantity. Dissolve the corrosive mercuric chloride and the potassium iodide each in 800 Cc. of distilled water, and filter the solutions separately. Pour both solutions simultaneously and in a thin stream, under constant stirring, into 2000 Cc. of distilled water. When the precipitate has subsided, decant the supernatant liquid, collect the precipitate on a filter, and wash it with cold distilled water, until the washings give not more than a slight opalescence with silver nitrate test-solution. Finally, dry it in a dark place, between sheets of bibulous paper, at a temperature not exceeding 40° C. (104° F.). Keep the product in well-stoppered bottles, protected from light.—*U. S.*

Take of perchloride of mercury 4 ounces; potassium iodide 5 ounces; boiling distilled water 4 pints. Dissolve the perchloride of mercury in 3 pints, and the potassium iodide in the remainder of the water, and mix the two solutions. When the temperature of the mixture has fallen to that of the atmosphere, decant the supernatant liquor from the precipitate, and, having collected the latter on a filter, wash it twice with cold distilled water and dry it at a temperature not exceeding 212° F.—*Br.*

Mercuric chloride and potassium iodide, when mixed in the proportion of the weight of 1 molecule of the former to 2 of the latter salt, decompose each other into mercuric iodide, which precipitates, and potassium chloride, which remains in solution: $HgCl_2 + 2KI$ yields $HgI_2 + 2KCl$. The U. S. and British Pharmacopœias use the two salts in the proportion of 4 to 5, which is a slight excess of the potassium salt over the theoretical quantity, but is generally necessary in practice, owing to the small percentage of impurities always present in commercial potassium iodide. By calculation it is found that 4 parts of mercuric chloride require for complete decomposition 4.898 parts of potassium iodide, or 9 parts of the former require 11.02 parts of the latter salt. By mixing the two solutions cold the red iodide is separated in the form of powder, but when the hot solutions are mixed and slowly cooled beautiful crystals are obtained. In either case the yield should be about 60 per cent. over the weight of the corrosive sublimate used.

Properties.—Mercuric iodide is a scarlet-red amorphous or crystalline powder or is in brilliant crystals. It is permanent in the air if kept in the dark or in diffused daylight, but acquires a brownish tint in the sunlight. It is inodorous and nearly tasteless, a metallic taste being slowly developed when kept upon the tongue. On being heated, to above 150° C. (302° F.), it turns yellow, but on cooling readily resumes its red color under various influences. It fuses near 240° C. (464° F.) to an amber-colored liquid, and at a higher heat sublimes to bright-yellow tabular crystals which after cooling are again converted into the prismatic or octahedral red crystals. The salt is very sparingly soluble in cold or hot water, little so in ether and diluted nitric acid, but more freely soluble in hydriodic or hydrochloric acid, in potassium iodide or chloride, in many ammonium salts, in solutions of mercuric salts, in chloroform, fixed oils, hot carbon disulphide, etc. It dissolves in 130 parts of cold and in 15 (*U. S.*) or 20 (*P. G.*) parts of hot alcohol, crystallizing on cooling; on pouring the alcoholic solution into cold water the salt separates as a fine yellow powder, remaining suspended in the liquid and gradually turning red. The solutions are colorless, and are partly decomposed by potassa solution, a portion of the mercury being deposited as mercuric oxide, the remainder forming a soluble iodide of potassium and mercury. On heating the salt with solution of soda and glucose or sugar of milk, metallic mercury will be precipitated, and on heating it with sulphuric acid and black manganese oxide, vapors of iodine will be given off. When a hot solution of potassium iodide is saturated with mercuric iodide and then allowed to cool, one-third of the latter salt crystallizes on cooling; the remainder is obtained, on further concentration, as yellow prisms, which are soluble in alcohol and ether, but are partly decomposed by water. The crystals are *mercuric potassium iodide* $(2KI.HgI_2)3H_2O$, more generally known as *potassium iodohydrargyrate*, and are likewise formed on adding mercuric chloride to an excess of potassium iodide.

Tests.—Impurities, if present, are readily detected by the residue left on subliming the salt (red oxide of lead and other non-volatile compounds) and on dissolving it in hot alcohol (vermillion, etc.). The cold alcoholic solution should be colorless and without acid reaction (mercuric chloride), and on the addition of ammonia should merely acquire a brown color, but not be precipitated (mercuric chloride). "If about 0.5 Gm. of the salt be shaken with 10 Cc. of water, the filtered liquid should not become more than very slightly colored by hydrogen sulphide test-solution, nor afford more than a slight opalescence with silver nitrate test-solution (limit of *soluble chlorides* or *iodides*)." *U. S.*

Pharmaceutical Uses.—The observation of Nessler (1856) of the effect of

ammonia upon solutions of mercuric iodide has resulted in the discovery of a very delicate reagent for minute quantities of ammonia or ammonia salts, known as the

Nessler Reagent.—It is made by dissolving 50 Gm. of potassium iodide in a little boiling distilled water, and adding to it, carefully, sufficient boiling hot concentrated solution of mercuric chloride until the red precipitate formed is no longer redissolved on agitation; the liquid is decanted and filtered, and the filtrate mixed with 200 Gm. of potassa dissolved in a small quantity of water; when cold the mixture is diluted to the measure of 1 liter by the addition of distilled water. The addition of 5 Cc. of cold saturated solution of corrosive sublimate is recommended by some, but is not necessary. (See also AQUA AMMONIÆ, p. 250.) It will be observed that this is a solution of mercuric potassium iodide in caustic potassa. On the addition of ammonium salt this is decomposed by the potassa, ammonia is liberated, and reacts now with the double iodide and another portion of the potassa, resulting in the formation of brown insoluble dimercur-ammonium (NHg_2) iodide, potassium iodide, and water, as will be seen from the equation $NH_3 + 2(HgI_2.2KI) + 3KOH = NHg_2I + 7KI + 3H_2O$. If the ammonia is present in minute quantity, the color is best observed by looking through the column of the liquid contained in a tall test-tube and placed on white paper.

Winckler (1830), Von Planta (1846), and Groves (1858) observed the behavior of solutions of the double iodide upon solutions of vegetable alkaloids, which led F. F. Mayer (1862) to the adoption of a tenth normal solution, now known as

Mayer's Solution.—It is prepared by dissolving 13.546 Gm. of mercuric chloride and 49.8 potassium iodide in sufficient distilled water to obtain 1 liter of liquid. The present test-solution of mercuric potassium iodide (see *List of Reagents*) is identical with this. The test is applied in acidulated aqueous solutions, since ammonia would also be precipitated if an alkaline liquid were used. 1 Cc. of this test liquid precipitates of

Aconitine,	0.0267 Gm.	Coniine,	0.00416 Gm.	Quinine,	0.0108 Gm.
Atropine,	0.0145 "	Morphine,	0.020 "	Quinidine,	0.0120 "
Brucine,	0.0233 "	Narcotine,	0.0213 "	Strychnine,	0.0167 "
Cinchonine,	0.0102 "	Nicotine,	0.00405 "	Veratrine,	0.0269 "

The end of the precipitation is determined by filtering a few drops of the liquid tested upon a watch-crystal, and by placing a small drop of the test solution alongside, allowing the two to run together. For colorless solutions which are free from chlorides, etc. an excess of the test liquid may be used, and the excess determined in the filtrate by a standard solution of silver nitrate.

Delffs' Reagent (1854) is a solution of potassium iodide saturated with mercuric iodide; its behavior to alkaloids appears to differ to a certain extent from the preceding.

Action and Uses.—Biniodide of mercury is a powerful irritant poison; Gm. 0.12 (gr. ij) of it taken with Gm. 4 (ʒj) of iodide of potassium caused violent gastric pain, coma, stertor, opisthotonos, and convulsions. As an internal remedy it is superfluous, and dangerous unless very cautiously used. It may, however, be given in constitutional *syphilis* in a solution of iodide of potassium, and in the *dose* of Gm. 0.004 ($\frac{1}{16}$ grain), cautiously increased. As a caustic it has been applied to the treatment of *lupus*, but is inferior to other preparations used for this purpose. It has also been employed in ointments in the proportion of 1 : 20, and from that to 1 : 5, as a stimulant or almost caustic application to *syphilitic diseases of the skin*, *goitres*, (vid. *Ung. Hydrargyri Iodidi Rubri*), chronic *glandular* indurations, fistulous *ulcers*, and chronic inflammation of the *joints*; in the proportion of 1 : 100 for *granular eyelids*, etc. A solution of biniodide of mercury one part in absolute alcohol 400 parts and water 20,000 parts is recommended as preferable to a solution of the bichloride in *iridectomies*, *cataract extractions*, etc. (*Med. News*, liii. 720). It has been administered subcutaneously. Yvon claimed for the solution made according to the following formula that it does not irritate and that it is readily absorbed: Biniodide of mercury 1 Gm.; iodide of potassium 1 Gm.; neutral phosphate of soda 2 Gm.; distilled water 50 Ccm. (*Practitioner*, xxvii. 207). It has been used as an *obstetrical* and *surgical* disinfectant in solutions of from 1 : 12,000 to 1 : 4000. Levis pronounced it "four or five times more powerful as a disinfectant or germicide than mercuric chloride." This estimate is sustained by various clinicians, and among them Bernardy (*Trans. Phila. Co. Med. Soc.*, Jan. 23, 1889), who also claims for the compound a controlling action in acute and chronic *bronchitis* when applied to the chest or inhaled in a spray, and as a disinfectant or deodorizer of *typhoid-fever* stools.

HYDRARGYRI OXIDUM FLAVUM, *U. S., Br.*—Yellow Mercuric Oxide.

Hydrargyrum oxydatum via humida paratum, P. G.; *Hydrargyrum oxydatum præcipitatum (vel flavum).—Precipitated oxide of mercury, or Mercuric oxide*, E.; *Oxyde mercurique jaune (précipité), Deutoxyde jaune de mercure*, Fr.; *Präcipitirtes (Gelbes) Queeksilberoxyd*, G.

Formula HgO. Molecular weight 215.76.

Preparation.—Corrosive Mercuric Chloride, 100 Gm.; Soda, 40 Gm.; Distilled Water, a sufficient quantity. Dissolve the corrosive mercuric chloride in 1000 Cc. of warm distilled water, and filter the solution. Dissolve the soda (which should contain 90 per cent. of sodium hydroxide) in 1000 Cc. of cold distilled water, and into this solution pour gradually, and with constant stirring, the solution of corrosive mercuric chloride. Allow the mixture to stand for an hour at a temperature of about 30° C. (86° F.), stirring frequently. Then decant the supernatant, clear liquid from the precipitate, and wash the latter repeatedly by the affusion and decantation of distilled water, using 1000 Cc. of water each time. Collect the precipitate on a strainer, and continue the washing with warm distilled water, until a small portion of the washings, when poured on a little mercuric chloride test-solution, no longer affords a yellowish turbidity at the line of contact of the two liquids. Then allow the precipitate to drain, and dry it between sheets of bibulous paper, in a dark place, at a temperature not exceeding 30° C. (86° F.). Keep the product in well-stoppered bottles, protected from light.—*U. S.*

Take of perchloride of mercury 4 ounces; solution of soda 2 pints; distilled water a sufficiency. Dissolve the perchloride of mercury in 4 pints of distilled water, aiding the solution by the application of heat, and add this to the solution of soda. Stir them together; allow the yellow precipitate to subside; remove the supernatant liquor by decantation; thoroughly wash the precipitated oxide on a calico filter with distilled water, and finally dry it by the heat of a water-bath.—*Br.*

On mixing solutions of mercuric chloride and soda, sodium chloride, water, and mercuric oxide are formed, the latter being precipitated; $HgCl_2 + 2NaOH$ yields $2NaCl + H_2O + HgO$. The alkali must be in excess, lest some mercuric oxychloride be precipitated with the oxide, and it is essential to pour the mercuric solution into the alkali.

The foregoing equation shows that 270.54 parts of mercuric chloride require 79.92 parts of sodium hydroxide for complete decomposition and as the Pharmacopœia orders for 100 parts of mercuric chloride, 40 parts of soda containing at least 90 per cent. of NaOH, the necessary excess is assured, for 40 @. 90 = 36, and 100 parts $HgCl_2$ require only 29.5 parts of NaOH. If the soda is contaminated with carbonate brown mercuric carbonate will also be precipitated and it is therefore essential that pure alkali be used.

Of great importance for the appearance of the oxide is the temperature at which it is prepared; the lower it be kept the brighter will be the yellow color, while with an elevation of temperature the red tint will become more decided. The yield is nearly 80 per cent.

Properties and Tests.—Yellow mercuric oxide is a heavy, smooth, impalpable, amorphous, yellow or reddish-yellow powder, which is not altered in the air, but on exposure to light becomes dark, in consequence of partial reduction to mercurous oxide; when heated it assumes a red color, and at a sufficiently strong heat is decomposed and volatilized like red mercuric oxide. It has the specific gravity 11.0, is without odor or taste, and is insoluble in water and other simple solvents, but dissolves readily and completely without effervescence in diluted hydrochloric or nitric acid. When digested or agitated with a solution of oxalic acid it forms white mercuric oxalate (difference from red oxide). Heated with an alcoholic solution of mercuric chloride, it speedily turns black from the formation of an oxychloride; red mercuric oxide slowly undergoes a similar change (Roncher). It should be completely volatilized by heat, and its solution in diluted nitric acid should become merely opalescent on the addition of test solution of silver nitrate (limit of chloride).

Action and Uses.—This preparation is used chiefly as an external remedy to stimulate indolent *ulcers*, especially of venereal origin, and as an application in granular and ulcerated conditions of the *eyes*. It is applied in an ointment, which is officinal. It has also been given internally in doses of Gm. 0.001 (gr. $\frac{1}{60}$) twice a day in certain ill-defined *dyspeptic* derangements. In 1887, Rosenthal employed in treating syphilis hypodermic injections of 1 part of the yellow oxide in 20 parts of oil, of which about 15 grains

were used for an average injection. No abscesses followed its use, and he concluded that it was quite as efficient as calomel (*Centralbl. f. Med.*, vi. 170) Kuhn, on the other hand, found it less so (*Med. News*, liii. 300). Chernoguboff considered Gm. 0.12 (gr. ij) doses more efficient than smaller ones (*Lancet*, Oct. 1889, p. 757).

HYDRARGYRI OXIDUM RUBRUM, *U. S.*, *Br.*—Red Mercuric Oxide.

Hydrargyrum oxydatum, P. G.; *Hydrargyri nitrico-oxidum*, *mercurius corrosivus* (*præcipitatus*) *ruber*, *Oxydum hydrargyricum*—*Peroxide of mercury*, *Red precipitate*, E.; *Deutoxide* (*Peroxyde*) *rouge de mercure*, *Oxyde mercurique*, *Précipité rouge*, *Poudre de Jean de Vigo*, Fr.; *Rothes Quecksilberoxyd*, *Rother Präcipitat* (*Quecksilber-Präcipitat*), G.

Formula HgO. Molecular weight 215.76.

Preparation.—Take of Mercury, by weight, 8 ounces; Nitric Acid 4½ fluidounces; Water, 2 fluidounces. Dissolve half the mercury in the nitric acid diluted with the water, evaporate the solution to dryness, and with the dry salt thus obtained triturate the remainder of the mercury until the two are uniformly blended together. Heat the mixture in a porcelain dish, with repeated stirring, until acid vapors cease to be evolved, and when cold enclose the product in a bottle.—*Br.*

In this process mercuric nitrate is formed at the first step; this may be directly decomposed by heat, or, as directed above, it is previously mixed with an additional quantity of mercury, which, during the subsequent heating is oxidized at the expense of the nitrate. In both cases the color changes to yellow and then to red, red fumes of nitric peroxide being given off. Occasionally a minute quantity of nitrate remains undecomposed. The decomposition is as follows: $2Hg(NO_3)_2 + Hg_2 = 4HgO + 2N_2O_4$. Should the nitric acid employed be contaminated with hydrochloric acid, a corresponding quantity of mercuric chloride, and finally oxychloride, would be formed, the latter remaining with the mercuric oxide as an impurity. The last traces of acid may be removed by boiling with diluted soda solution.

Properties.—When made on a small scale it is a finely granular powder of a yellowish-red color without lustre, but made in larger quantities it is obtained in the form of bright brownish-red shining crystalline scales, which on trituration yield a fine orange-red powder, the yellow tint increasing with the fineness of the powder. It is inodorous, and at first tasteless, but slowly develops a metallic taste. It is insoluble in water and other simple solvents, but completely soluble in diluted hydrochloric and nitric acids. It is permanent in the air if kept in the dark, but on exposure to light it becomes superficially black—however, much more slowly than the yellow oxide. When heated its color is changed to dark-red, brown, and near 400° C. (750° F.) to black, the original color reappearing on cooling; but at a red heat it is completely decomposed into metal and oxygen.

Tests.—When strongly heated, mercuric oxide should not give off red nitrous vapors (absence of nitrate), and when heated to full redness it should be decomposed and volatilized, without leaving any residue (absence of non-volatile impurities). On being agitated or digested with a solution of oxalic acid in 10 parts of water, the red color should not be changed (difference from yellow mercuric oxide). Treated with diluted nitric acid in excess, it should yield a colorless solution. A red-colored residue would indicate the presence of brick-dust or of vermilion, the latter being volatilizable by heat; a brown residue (of puce-colored oxide of lead) would prove an adulteration with red lead, and the nitric acid solution would contain lead, recognizable by the white precipitate appearing on the addition of a little sulphuric acid. The nitric acid solution should remain undisturbed or merely become slightly opalescent on the addition of test solution of silver nitrate (limit of chloride)—*U. S.* If to 1 Gm. of red mercuric oxide 5 Cc. of water be added, followed by 5 Cc. of sulphuric acid, and after cooling 1 Cc. of concentrated solution of ferrous sulphate be carefully poured upon the acid mixture, a brown color should not be produced between the two liquids (absence of nitrate).

The preparation formerly official in various pharmacopœias as *Mercurius præcipitatus per se* or *Mercurius calcinatus* was red oxide of mercury in the form of crystalline scales, which are obtained by keeping metallic mercury in a loosely-covered flask or retort at a temperature near its boiling-point. The process required several weeks for its completion.

Action and Uses.—Red precipitate is a powerful irritant, and taken internally may act as a corrosive poison. Its application to ulcers, wounds, etc. has been frequently

followed by its constitutional operation, including salivation. The last-named effect is said to be unusual when the medicine is administered internally, as it sometimes has been in the treatment of *syphilis*, in the *dose* of Gm. 0.006 ($\frac{1}{10}$ of a grain) twice a day and gradually increased. Notwithstanding its irritant action and its tendency to salivate when applied to ulcers, this preparation has been used hypodermically by Watraszewski in the treatment of *syphilis*. He alleges that in doses of one grain, so administered, it causes neither local irritation nor constitutional derangement. He uses from two to five injections at intervals of six or eight days (*Therap. Gaz.*, x. 186). Externally it is generally, used in the form of an ointment, but sometimes it is also applied as a fine powder, mixed with sugar, to indolent *syphilitic ulcers*, *condylomata*, etc., and even to *granular eyelids*, *pannus*, *ulcers*, and *opacities of the cornea*. But for the latter purposes the officinal ointment of red precipitate diluted one-half, or more, is generally preferable. A mixture of 1 part of red oxide of mercury with 50 parts of finely-powdered white sugar was much used by Trousseau as a snuff in cases of *ozæna*, especially when of syphilitic origin. Before it is applied the nostrils should be cleansed by the nasal douche.

HYDRARGYRI SUBSULPHAS FLAVUS, *U. S.*—Yellow Mercuric Subsulphate.

Hydrargyri sulphas flava, U. S. 1870; *Hydrargyri subsulphas*, *Hydrargyrum sulphuricum flavum*, *Mercurius emeticus flavus*, *Sulphas hydrargyricus flavus*, *Turpethum minerale*.—*Basic mercuric sulphate*, *Oxymercuric sulphate*, *Subsulphate of mercury*, *Turpeth mineral*, E.; *Sulfate trimercurique*, *Sulfate jaune de mercure*, *Turbith minéral*, Fr.; *Basisches Quecksilberoxydsulfat*, *Mercurioxydsulfat*, *Mineralischer Turpeth*, G.

Formula $Hg(HgO)_2SO_4$, Molecular weight 727.14.

Preparation.—Mercury 100 Gm.; Sulphuric Acid, 30 Cc.; Nitric Acid, 25 Cc.; Distilled Water a sufficient quantity. Upon the mercury, contained in a capacious flask, pour the sulphuric acid, previously mixed with 15 Cc. of distilled water, then gradually add the nitric acid previously mixed with 25 Cc. of distilled water, and digest at a gentle heat until reddish fumes are no longer given off. Transfer the mixture to a porcelain capsule, and heat it on a sand-bath, frequently stirring, until a dry, white mass remains. Reduce this to a fine powder, and throw it, in small portions at a time and constantly stirring, into 2000 Cc. of boiling distilled water. When all has been added continue the boiling for 10 minutes, then allow the mixture to settle, decant the supernatant liquid, transfer the precipitate to a strainer, wash it with warm distilled water until the washings no longer have an acid reaction, and dry it in a moderately warm place.—*U. S.*

Mercuric sulphate is formed by the action of hot sulphuric acid upon metallic mercury, the combination being effected with decomposition of a portion of the sulphuric acid (see Hydrargyri Sulphas), or, as in the above process, with decomposition of nitric acid; $Hg_3 + 3H_2SO_4 + 2HNO_3$ yields $3HgSO_4 + 4H_2O + 2NO$. On adding this normal sulphate to boiling water it is converted into basic sulphate, while an acid sulphate remains in solution. The result varies somewhat, depending upon the amount and the temperature of the water. Using boiling water in the above proportions, the yield will be about 75 per cent. of the weight of the dry mercuric sulphate used. The same compound is also formed by slowly pouring a solution of mercuric nitrate into an excess of a boiling solution of sodium sulphate.

Properties.—Yellow mercuric subsulphate is a heavy bright lemon-yellow powder which has the specific gravity 6.44, is permanent in the air, inodorous, has a slight metallic taste, on heating becomes red, and yellow again on cooling; at a red heat it is completely volatilized, being at the same time decomposed into metallic mercury, oxygen, and sulphurous acid. It is insoluble in alcohol and ether, requires 2000 parts of cold and 600 parts of boiling water for solution, is decomposed by potassa solution, yellow mercuric oxide being formed, and dissolves completely in sulphuric, nitric, or hydrochloric acid, the latter solution, according to Mohr, containing corrosive sublimate and free sulphuric acid.

Tests.—"The salt should be soluble in 10 parts of hydrochloric acid without residue (absence of mercurous salt or of lead)."—*U. S.* The presence of nitrate is detected by sulphuric acid and ferrous sulphate in the same manner as stated for red mercuric oxide. Non-volatile impurities are left behind on heating to bright redness.

Action and Uses.—Turpeth mineral is a powerful irritant, and in sufficient doses may act as a corrosive poison, causing active erosion of the fauces, œsophagus, and

stomach, and even sloughing of the first-named parts, as well as salivation. In spite of its grave effects, turpeth mineral has been used as an emetic in "croup," by which was probably meant *spasmodic laryngitis*. The employment of so dangerous a remedy in a disease which involves no danger to life is inexcusable. The emetic action of this preparation is the first stage of its poisonous operation. The *dose* fitted to produce that effect is Gm. 0.13–0.20 (gr. ij–iij) for a child. Owing to its tendency to salivate, it should not be employed as an errhine. It seems to be a superfluous article of the materia medica.

HYDRARGYRI SULPHAS, *Br.*—Mercuric Sulphate.

Hydrargyrum sulphuricum, Mercurius vitriolatus, Sulfas mercuricus.—Persulphate of mercury, Normal mercuric sulphate, E.; *Deuto-sulfate (Persulfate) de mercure, Sulfate mercurique*, Fr.; *Schwefelsaures Queeksilberoxyd, Mercurisulfat*, G.

Formula $HgSO_4$. Molecular weight 295.62.

Preparation.—Take of mercury, by weight, 20 ounces; Sulphuric Acid 12 fluid-ounces. Heat the mercury with the sulphuric acid in a porcelain vessel, stirring constantly until the metal disappears, then continue the heat until a dry white salt remains. —*Br.*

Mercury does not dissolve in cold sulphuric acid, but on heating the mixture sulphur dioxide and watery vapors are disengaged, any excess of sulphuric acid is driven off, and the residue consists of mercuric sulphate; $Hg_2 + 4H_2SO_4$ yields $2SO_2 + 4H_2O + 2HgSO_4$. This is now named *Hydrargyri persulphas*, with the above title as synonym.

Properties and Tests.—Mercuric sulphate is a heavy white crystalline powder which, on being mixed with a small quantity of water, is at first colored yellow, but after some time is converted into colorless shining prisms or silvery scales of the hydrated salt, $HgSO_4.H_2O$. A larger quantity of water decomposes it permanently into yellow basic sulphate. When heated to redness it is decomposed into mercury, oxygen, sulphurous acid, and mercurous sulphate, and is finally completely volatilized.

Pharmaceutical Uses.—It is employed for the preparation of turpeth mineral, corrosive sublimate, and calomel.

It is not used in medicine.

HYDRARGYRI SULPHIDUM RUBRUM.—Red Mercuric Sulphide.

Hydrargyri sulphuretum rubrum, U. S. 1870.; *Hydrargyrum sulfuratum rubrum; Cinnabaris, Sulfuretum hydrargyricum —Red sulphuret of mercury, Cinnabar, Vermilion, Paris red*, E.; *Sulfure rouge de mercure, Cinnabre*, Fr.; *Rothes Schwefelquecksilber, Quecksilbersulfid, Zinnober*, G.

Formula HgS. Molecular weight 231.78.

Preparation.—Take of Mercury 40 troyounces; Sublimed Sulphur 8 troyounces. To the sulphur, previously melted, gradually add the mercury, with constant stirring, and continue the heat until the mass begins to swell. Then remove the vessel from the fire and cover it closely to prevent the contents from inflaming. When the mass is cold rub it into powder and sublime.—*U. S.* 1870.

The preparation of vermilion is carried on in large establishments, and will hardly ever be attempted by the pharmacist except as an experiment. It may be obtained in the dry or humid way. The above process belongs to the former class, but a large excess of sulphur is directed, 6½ troyounces being sufficient for the quantity of mercury; the excess is volatilized before the cinnabar is condensed. If the black mass obtained in the first part of this process is digested with solution of potassa and potassium sulphide at a temperature of about 45° C. (113° F.), it will be gradually converted into vermilion. This is also produced by digesting white precipitate with a solution of sulphur in ammonium sulphide or of sodium thiosulphate.

Cinnabar, native as well as artificially prepared, has been known from a remote period. Although in the early part of the eighteenth century it was stated to consist solely of mercury and sulphur, this was not conclusively proven until the beginning of the present century. Fuchs afterward showed that it has the same composition as the amorphous black mercuric sulphide, differing from it in being crystalline.

Properties.—Sublimed mercuric sulphide forms brilliant dark-red crystalline masses having a fibrous fracture; after levigation it is seen in commerce in the form of a bright scarlet-red, fine, inodorous, and tasteless powder. It has the spec. grav. 8.12, acquires

a darker color on exposure to the sunlight, but remains unaltered in the dark. When heated to above 250° C. (482° F.) it becomes brown, then black, and finally volatilizes, and assumes its red color again on cooling; heated in contact with the air, it burns with a blue flame, emitting the odor of sulphur dioxide. It is insoluble in water, alcohol, ether, hydrochloric or nitric or diluted sulphuric acid, cold concentrated sulphuric acid, or diluted alkaline solutions. Nitro-muriatic acid dissolves it without heat, with the separation of sulphur and the production of sulphuric acid and mercuric chloride. It dissolves in boiling sulphuric acid, forming mercuric sulphate and separating sulphur; also in alkali sulphides containing potassa or soda. Metallic mercury is separated by heating vermilion with soda to redness; by boiling with water and iron or zinc; by zinc and warm diluted sulphuric acid, etc.

Tests.—Its complete volatility by heat ensures the absence of red lead and basic lead chromate (American vermilion); and when it is treated with warm solution of potassa the colorless solution, on being acidulated, should not yield a yellow or orange precipitate (absence of arsenic or antimony), nor should it produce a colored precipitate with lead acetate (absence of chromates, iodides, or other sulphides). If agitated with warm diluted nitric acid, it should not turn brown (absence of red lead), nor should the filtrate be colored or become dark-colored on the addition of hydrogen sulphide (lead) or of ammonia and ammonium sulphide (iron).

HYDRARGYRI SULPHIDUM NIGRUM, *s. Æthiops mineralis.* This preparation has been very properly discarded by the United States and British Pharmacopœias, but is still employed on the continent of Europe. It is made by triturating equal weights of mercury and sulphur until all metallic globules have disappeared. It forms a fine black and heavy powder, which, when viewed with a lens, does not show any globules of uncombined mercury. When heated upon a plate it takes fire and burns with a blue flame, without leaving any residue; heated in a test-tube, it yields a red sublimate of vermilion. When digested with hydrochloric acid, the acid liquid does not yield a white precipitate on being diluted with water (absence of antimony). Ethiops mineral is a mixture of black amorphous mercuric sulphide, HgS, with a large excess of sulphur. Triturated with an equal weight of antimony sulphide *æthiops antimonialis* is obtained.

Action and Uses.—The red, like other metallic sulphides, is less irritating than the sulphates of the same metal. Indeed, there is much reason for believing that in its natural state it has no action at all. It is seldom used, and then only by fumigation, powdered cinnabar being strewn upon hot coals; the sulphuret is decomposed, and the fumes contain metallic mercury and sulphurous acid. The irritating action of the latter renders the method objectionable. As occasionally employed, the patient is enclosed in a wooden box with an aperture through which his head passes, so that he is not obliged to inhale the irritating fumes. This method is said to be a very efficient one, although not without the risk of salivating, causing congestion of the brain, etc.

Black sulphuret of mercury is no longer officinal in the German Pharmacopœia, and its activity as a mercurial has been doubted. It was considered to be especially adapted to persons of delicate constitution or feeble health, and was given in (relatively) very large doses, such as from Gm. 0.30–1.30 (gr. v–xx) several times a day.

HYDRARGYRUM, *U. S., Br., P. G.*—MERCURY.

Hydrargyrum vivum, Mercurius vivus, Argentum vivum.—*Quicksilver*, E.; *Mercure, Vif-argent*, Fr.; *Quecksilber*, G.

Symbol Hg. Atomicity bivalent. Atomic weight 199.8.

Origin.—Mercury became known before the Christian era, but long after silver and gold had been in use. It is principally obtained from New Almaden in California, from Peru, China, Idria in Austria, and Almaden in Spain. It is found to some extent in the metallic state in the form of minute or large globules, also in combination with oxygen, chlorine, selenium, etc.; but the principal ore for extracting it is *cinnabar*. 38,250 pounds of mercury were imported into the United States in 1877, and 597,898 pounds in 1882.

Preparation.—Most of the mercury is obtained by roasting the ore in a kiln. It is placed upon an arch of brickwork containing several openings, through which the flames pass, whereby the sulphur of the ore is ignited and burns, air being admitted at the same time; the heat thus produced volatilizes the mercury, the vapors of which, mingled with the smoke and sulphur dioxide gas, are passed through a series of condensing-chambers, where the metal is condensed, the incondensable gases finally escaping

through the flue. This is essentially the process as carried on at Idria and New Almaden; likewise at Almaden, except that the vapors are passed through the so-called *aludels*, consisting of cylinders adapted to each other, first in a descending and then in an ascending direction, where most of the mercury is condensed and collects in a gutter placed under the angle, the remainder being condensed in a large terminal chamber, from which the gases pass into the flue. In the Palatinate the cinnabar is mixed with lime, and in Bohemia with hammerslag, and then distilled, calcium sulphide remaining behind in the former, and sulphide of iron in the latter, case.

Mercury appears in commerce in cylindrical iron flasks containing 75 pounds each. In this condition it still contains small quantities of other metals, principally lead, which, however, do not interfere with its uses in the silvering of looking-glasses, in the amalgamation process for the extraction of gold and silver, nor in the preparation of some chemicals. For barometers and thermometers, as well as for some pharmaceutical preparations, a purification of the metal is required or advisable, and may be effected by distillation or by the following process directed in several European pharmacopœias:

HYDRARGYRUM DEPURATUM, S. PURIFICATUM. Take of Mercury 100 parts; Nitric Acid, Distilled Water, each 5 parts. Digest in a suitable vessel for 3 days, shaking frequently. Having poured off the acid liquid, wash well the mercury with distilled water, and dry it completely.

The operation is best conducted in a broad glass or porcelain vessel, so as to expose a very large surface of the metal to the action of the dilute acid; or, as proposed by L. Meyer, by allowing the mercury to run slowly in a fine stream into a long glass tube containing the diluted acid. Lead, iron, and other metals, being far more easily oxidized and dissolved than the mercury, are thereby removed, though a little of the latter likewise passes into solution. After washing, most of the water may be removed by bibulous paper. These metals may also be removed by agitating the crude mercury with concentrated sulphuric acid or with solution of ferric chloride, the latter process being preferable for operations on a small scale.

Properties.—Mercury is solid at a temperature of −39.44° C. (−39° F.), and crystallizes in octahedrons and needles, which are ductile and may be cut with a knife. At the ordinary temperature it forms a bright silvery, lustrous, inodorous, and tasteless liquid, which is very cohering, and not adhering to glass or paper unless it be impure, when small globules will *tail* or leave a streak upon it. When triturated with sugar, fat, various salts, oil of turpentine, etc., it is converted into a gray powder consisting of minute globules separated by the foreign substances and running together again on their removal; this finely-divided state is called the *extinction* or *killing* of mercury, and is accomplished in making mercurial ointment and several other official preparations. Mercury has at 4° C. (39.2° F.) the specific gravity 13.59, and at 15° C. (59° F.) 13.5584. It boils at about 357.2° C. (675° F.), giving a colorless vapor of 6.98 spec. grav., and leaving no residue; it volatilizes very slowly even at the ordinary temperature. It is permanent at the ordinary temperature, the whitish pellicle which forms upon the surface of commercial mercury being due to the presence of foreign metals (lead, zinc, etc.). It unites directly with chlorine, bromine, and iodine, and dissolves completely even in dilute nitric acid, with the evolution of nitric oxide. All simple solvents and boiling hydrochloric and dilute sulphuric acids are without action upon it, but hot concentrated sulphuric acid dissolves the metal, sulphur dioxide being given off. When heated to near its boiling-point in contact with the atmosphere it combines with oxygen, forming scales of red oxide.

Tests.—The purity of mercury is ascertained from its behavior and properties as described above. When mercury is agitated for a few minutes with the official solution of ferric chloride, which is free from ferrous chloride, the liquid should afterward not yield a blue precipitate on the addition of potassium ferricyanide, which would result through the solution of a foreign metal and the reduction of some ferric to ferrous chloride; nor should the liquid, if necessary, after being acidulated with hydrochloric acid yield more than a mere trace of a colored precipitate on the addition of hydrogen sulphide. Hager's test for distinguishing the purified from crude mercury has been adopted by the U. S. P., as follows: "On boiling 5 Gm. of distilled water with 5 Gm. of mercury, and 4.5 Gm. (1.5 Gm., Hager) of sodium thiosulphate in a test-tube for about 1 minute, the mercury should not lose its lustre, and should not acquire more than a slightly yellowish shade (absence of more than slight traces of foreign metals)."

Oxides and Salts.—Mercury unites with oxygen in two proportions, and forms two series of salts, the *mercurous* and *mercuric*. All soluble salts of mercury are poisonous, have a strong metallic taste, and mostly an acrid reaction upon test-paper. The normal

salts are usually white, and the basic salts yellow; treated with stannous chloride, phosphorous or sulphurous acid, or other deoxidizing agents, they are blackened, and finally reduced to metal. Their solutions deposit a silvery coating of metallic mercury upon a bright piece of metallic copper, and yield black precipitates with hydrogen sulphide and white ones with sodium phosphate. *Mercurous* salts yield black precipitates with potassa, ammonia, and, on boiling, also with alkali carbonates. Hydrochloric acid causes a white precipitate of calomel, and potassium iodide separates a greenish-yellow deposit. *Mercuric* salts yield with potassa or soda, if added in insufficient quantity, brown-red, and if added in excess yellow, precipitates—with ammonia and ammonium carbonate white, and with potassium or sodium carbonate red-brown, precipitates. Hydrochloric acid does not disturb the solutions; potassium iodide causes a scarlet-red precipitate, which is soluble in an excess of either solution. All compounds of mercury are either volatilized or decomposed by heat.

Besides the mercury compounds mentioned elsewhere, the following are in use:

Hydrargyrum formamidatum solutum. Solution of mercuric formamide, was first introduced by Liebreich for hypodermic use in the treatment of syphilis, in daily doses of 1 Cc. (about 16 minims) which corresponds to about 0.01 Gm. ($\frac{1}{6}$ grain) of mercuric chloride. It is prepared by dissolving the freshly precipitated oxide obtained from 10 Gm. of mercuric chloride in a sufficient quantity of formamide and adding enough distilled water to bring the volume up to 1000 Cc.

Hydrargyrum bichloratum carbamidatum solutum. Solution of mercuric chloride and urea, a similar preparation to the preceding, introduced for hypodermic use by Schütz and Doutrelepont. As the solution readily changes it should be prepared extemporaneously as follows: 1.0 Gm. of mercuric chloride is dissolved in 100 Cc. of hot water and when cold 5.0 Gm. of urea are added and the liquid filtered. The daily dose is 1 Cc. corresponding to 0.01 Gm. ($\frac{1}{6}$ grain) of mercuric chloride.

Hydrargyrum peptonatum solutum. Solution of mercuric peptonate. The mercury compound is first obtained by mixing a solution of 1.0 Gm. mercuric chloride in 20 Cc. of water with a solution of 3.0 Gm. dry peptone in 10 Cc. of water; after lapse of an hour the precipitate is collected on a filter, drained, and added to a solution of 3.0 Gm. of sodium chloride in 47 Cc. of water; solution is effected by agitation and enough water then added to bring the final volume up to 100 Cc. The solution should only be used when clear and free from sediment; the daily dose hypodermically is 1 Cc. corresponding to 0.01 Gm. ($\frac{1}{6}$ grain) of mercuric chloride.

Hydrargyrum phenylicum. Mercuric phenate (carbolate). Two preparations occur under this name, *Gamberini's* basic mercuric phenate, $HgOHOC_6H_5$ and *Merck's* normal mercuric phenate or mercuric diphenate, $Hg(OC_6H_5)_2$; the latter is a stable combination and should be dispensed whenever mercuric phenate is prescribed. It is prepared by dissolving 188 parts of liquefied carbolic acid and 56 parts of potassium hydroxide in just sufficient alcohol with the aid of heat and adding to this under constant stirring an alcoholic solution of 135 parts of mercuric chloride; a yellowish-colored precipitate is formed which becomes almost colorless as the mass is evaporated to dryness. After washing with hot water slightly acidulated with acetic acid the salt is crystallized from hot alcohol. It is usually given in pill form to adults in doses of 0.02–0.03 Gm. ($\frac{1}{3}$ to $\frac{1}{2}$ grain) twice daily.

Hydrargyri salicylas. Secondary mercuric salicylate. $HgC_7H_4O_3 = HgOC_6H_4CO_2$. This salt has been prepared by adding 15 parts of salicylic acid to the freshly precipitated and well washed oxide obtained from 27 parts of mercuric chloride, previously rubbed into a soft magma with water; the mixture is heated with frequent agitation, on a water-bath until the yellow color gradually disappears and snow-white salicylate results. The salt is washed with warm water to remove excess of acid, then drained and dried; it is amorphous, odorless and tasteless and insoluble in alcohol and water, but soluble in soda solution, forming a double salt, and also in sodium chloride solution. Mercuric salicylate is administered in pill form in doses of 0.01–0.03 Gm. ($\frac{1}{6}$–$\frac{1}{2}$ grain) three times a day, gradually increased to 0.06 or 0.075 Gm.(1 or $1\frac{1}{2}$ grains).

Hydrargyrum tannicum oxydulatum. Mercurous tannate has been proposed by Lustgarten as a substitute for the other mercurials in the treatment of syphilis, etc. In the dose of from 3 to 5 gr. (Gm. 0.25–0.30) a day it appears as mercury in the urine after the lapse of 24 hours. It does not salivate or disturb the stomach or bowels. In ten cases of various forms of constitutional *syphilis* its effects were quite as favorable as those of mercurial ointment (*Centralblatt f. d. ges. Ther.*, ii. 93).

It is prepared as follows: 50 parts of freshly prepared mercurous nitrate (free from

oxide) are triturated in a mortar to an impalpable powder; to this is added a carefully prepared mixture of 30 parts of tannin and 50 parts of distilled water. The whole is then triturated until a homogeneous mass is obtained, entirely free from grittiness. 3000 or 4000 parts of water are gradually added and the green precipitate repeatedly washed with cold water as long as a trace of nitric acid remains; finally the mass is drained and dried on porous tiles at a temperature not above 30° or 40° C. (86° or 104° F.). The compound contains about 50 per cent. of metallic mercury, is odorless and tasteless and insoluble in ordinary simple solvents; when treated with alcohol or water, it gives up tannin, however, to these liquids.

Metallic writing-pencils have been prepared by melting together bismuth 90 parts and lead 70 parts, then adding mercury 8 parts, and casting in suitable moulds. By increasing the proportion of lead and mercury softer pencils, producing darker marks, are obtained.

Action and Uses.—The mode of action of mercury may be regarded as the following: Being essentially non-nutritive, yet penetrating every tissue, it probably acts in small and transient doses as a stimulant of all organic processes, but in a little greater proportion and by continued use it impairs nutrition, hindering the formation of tissue on the one hand, and on the other hastening its destruction and elimination. At the same time it augments more or less the glandular secretions. It diminishes the proportion of fibrin, and, by its toxical action, the proportion and probably also the constitution of the red corpuscles in the blood. Thus, hindering nutrition at every step of the latter action, mercury causes the waste of all the tissues, and especially of those least organized, as cicatrices and callus, and favors the removal of all plastic exudations. These effects are essentially morbid and destructive, and only incidentally and within varying limits can they become salutary.

It is probable that as much injury has been inflicted by the use of mercury in primary *syphilis* as good has been accomplished by its administration in the constitutional forms of the disease. And when it is considered that every simple sore following a suspected coition was apt to be treated as syphilitic by mercurialization of the system, it may be a question whether, on the whole, the medicine has not been more mischievous than useful. In regard even to true chancres, although mercurials will sometimes hasten their cure by lessening their induration, and may thereby postpone constitutional infection, it does not in any case prevent that result, nor even the enlargement of the inguinal glands. Moreover, in certain states of the primary sore and of the patient's system mercury aggravates the disease. Such is the case when the skin around the sore is very red, swollen, tense, and painful, or shows a tendency to gangrene—when the patient is anæmic, scrofulous, tuberculous, or scorbutic, or has been an habitual drunkard. Opinions differ in regard to treating pregnant syphilitic women with mercury; the better opinion is in favor of the measure for the sake of the child as well as the mother. But this judgment refers to secondary, not to primary, syphilis.

Until comparatively recent times the treatment of constitutional syphilis consisted in the administration of mercury for the purpose of exciting profuse salivation, which was maintained for four or five weeks at a time. The disastrous consequences of this method, which had no other reason for its use than the hypothesis that the syphilitic poison was to be eliminated with the saliva, and which thus illustrated the folly and dangers of *a-priori* therapeutics, caused it at last to be abandoned, and it is now certain that mercury cures syphilis without salivation better than by means of it. The dose of mercury, however used, should at first always be small, and gradually increased until its effects on the disease begin to appear or slight soreness of the gums occurs; it should then be continued in a diminished quantity, or even temporarily suspended if the symptoms begin to decline, but it should never be abandoned as long as any trace of the disease remains. This often involves a course of six months', or even of several years', duration; but it is safe, while the method of treatment with large doses of mercury is always hazardous. (Compare Gougenheim, *Bull. et Mém. de la Soc. de Thérap.*, 1883, p. 97.) The idea that rules the modern use of mercury in syphilis is that the medicine is strictly antidotal to the morbid poison, and that the latter is not to be removed by heroic attacks, but by gradual and steady undermining. It is generally recognized as a fundamental precept that when the treatment is internal a course of mercurials lasting for at least six months is indispensable, and that even then the permanent cure of the disease can only be determined by watching the result of a temporary suspension of the medicine. Hypodermic treatment of much shorter duration is held to secure immunity.

The treatment by inunction with mercurial ointment may be referred to here. It is one of the oldest modes of employing mercury in this disease, and is still a favorite hospital method, but it is too filthy for private practice, and it necessarily betrays the nature of the patient's disease. It, moreover, ruins all the body- and bed-clothing that is used. The advantages attributed to it are that it is much less likely to disorder the bowels than mercury taken by the mouth; it cures, also, more quickly and with less risk of injuring the constitution. It is chiefly appropriate to the treatment of syphilitic affections of the skin, and, next to these, but far less efficiently, to ulcerated states of the mouth and throat, and still less to syphilitic disorders of the nervous system. Syphilis of the bones and their annexes is more successfully treated with iodide of potassium. Before commencing mercurial inunction the patient should live for some days on simple food, use laxative medicine, and cleanse the skin thoroughly by warm bathing. Immediately afterward, in bed or near a warm fire in winter, the ointment should be methodically rubbed into the skin with the hand protected by a caoutchouc glove or a piece of softened pig's bladder. The places selected for friction should be used alternately or in succession, as the thighs, the armpits, the legs, the arms, etc., and if the part is hairy it should be shaven and the friction made in the direction of the hairs. About Gm. 8 (2 drachms) should be rubbed in daily for five or six days, at the end of which time the patient should have a warm bath with soap and be allowed to quit his bed, but warmly clothed. After an interval of a week the same discipline should be renewed, and this generally suffices for a cure. The result is supposed to be quickened by the use of sudorific diet-drinks, such as the compound decoction of sarsaparilla. Mercurial inunction of syphilitic infants is conveniently performed by enveloping the trunk of the patient with a flannel band that has been smeared with mercurial ointment. The use of other mercurial compounds in syphilis is treated of in connection with the several preparations of the medicine, and also the hypodermic use of mercurial salts, which possesses all the advantages, with none of the special disadvantages, belonging to the method by inunction (*Centralbl. f. Ther.*, i. 355). These include a possibly fatal result. Two such cases occurred in 1887 (*Arch. gén.*, Sept. 1887, p. 364). Mercurial soap has been used in place of mercurial ointment, with alleged success. It has a great advantage over the ointment in cleanliness (Oberländer, *Centralbl. f. Ther.*, i. 150; Shuster, *Therap. Gaz.*, x. 47.)

In the greater number of *febrile* and *inflammatory* affections calomel is the form of mercury usually selected by those who believe mercurials appropriate to these diseases, but sometimes its action is supplemented by the use of mercurial ointment, as in acute *meningitis*, *pericarditis*, *hepatitis*, etc. In these cases it is generally applied upon a blistered surface. But mercurial ointment used by inunction of the abdomen has been claimed by Kalb to be an efficient remedy for *typhoid fever* (*Berlin. klin. Wochensch.*, Jan. 19, 1885). No other clinician appears to have adopted this unreasonable practice. Berthel and Moritz claim a great improvement in the mortality from *pneumonia*, which they ascribe to the use of inunctions of from one to three drachms of mercurial ointment daily into the abdomen, loins, and limbs of the patients. It caused but little if any salivation (*Centralbl. f. d. g. Therap.*, iv. 128). This filthy method with its very questionable results does not commend itself to acceptance. *Gray oil* (ol. cinereum = mercury, and lanolin, each 3 parts; olive oil, 4 parts) has been used subcutaneously in mild cases of syphilis, Gm. 0.25 (about 4 minims) weekly (Hartmann, *Therap. Monatsh.*, iv. 210; *Centralbl. f. Therap.*, viii. 313). In *acute dyspepsia*, often accompanied with jaundice and produced by excesses in eating and drinking and a constipated habit, a superstitious belief prevails among English physicians and their American copyists that the sovereign remedy is blue pill, followed by a saline cathartic. Other nations, it is true, relieve such symptoms by the saline alone or by rhubarb and aloes along with it. Whenever congestion of the liver is associated with enlargement of the spleen, the administration of blue pill or other mercurial is extremely apt to be followed by profuse salivation, and even by gangrene of the mouth. An apparent exception to this rule is the cure of malarial enlargement of the *spleen* by the external use of biniodide of mercury. Mercury in various forms and combinations has been used advantageously in the treatment of dropsy. Indeed, it is distinctly diuretic. According as the dropsy is of cardiac, hepatic, or splenic origin the mercury should be associated with digitalis, squill, salines, etc. In renal dropsy it is apt to salivate. Metallic mercury has been used to overcome *intestinal obstructions* supposed to be formed by invagination, and also to expel intestinal worms. A case of the former sort in which the expedient was successful occurred in 1879 (*Med. Record*, xvii. 121; another in 1884, *Jour. Amer. Med. Asso.*,

iii. 578). Bettelheim has reported seventy cases "of intestinal stenosis, of which fifty-seven were relieved" by this expedient alone, and in six it saved the lives of the patients (*Phila. Med. Times*, xiv. 174). Mercurial ointment is probably the best remedy for *ascarides of the rectum*. It is generally used as an application around the eye in the treatment of acute *iritis*, along with the internal use of calomel. It is a valuable auxiliary also in the treatment of true *croup* (pseudo-membranous laryngitis), when it should, from the commencement of the attack, but only in primary and sthenic cases, be rubbed into the axillæ and the groins. It is of all medicines the least to be advised in *diphtheria*, which is always an asthenic disease. And yet that it has been so is shown by the sharp and well-merited criticism of Jacobi, who says: "That it should be recommended as a panacea in all classes and forms of diphtheria shows that common sense and sound judgment do not always prevail in the treatment of a disease where individualizing is of the utmost importance" (*A Treatise on Diphtheria*, p. 188). The source of this deplorable error is in confounding epidemic diphtheria with true membranous croup. Mercurial ointment relieves the pain and is said to subdue inflammation in *paronychia;* it has an analogous effect in *erysipelas;* and there is reason to believe that it checks the development of *small-pox* pustules, and thereby tends to prevent their pitting. Metallic mercury has been successfully used to amalgamate with a *gold ring* which had become too tight for the finger, and to render it so brittle that it readily broke under pressure. The ring in such cases should first be cleansed with alcohol or ether.

Metallic mercury is seldom given internally, except as above mentioned and in the modified form of blue pill. (See PIL. HYDRARGYRI.)

CARBOLATE OF MERCURY, recommended by Gamberini and Shadek, has been found an efficient remedy for *syphilis* in doses of Gm. 0.008 (gr. $\frac{1}{8}$) three or four times a day (*Centralb. f. Therap.*, iv. 397; *Med. Record*, xxxii. 217).

FORMAMIDATE OF MERCURY has been recommended for treating *syphilis* hypodermically by Liebreich (1882). In solution it causes neither local irritation nor salivation, according to this authority; but others have not found it so innocuous, and, indeed, object to it on account of the inflammation it excites (*Therap. Gaz.*, ix. 557). It has been used in a solution of 1 : 100, of which the amount injected daily varied from Gm. 0.5–1, equal to Gm. 0.005–0.010, or gr. $\frac{1}{12}$ to $\frac{1}{4}$, of the salt.

IODOTANNATE OF MERCURY is claimed to be not only soluble, but also to have very little taste, and to occasion neither abscess nor induration when given hypodermically, and yet to act rapidly and powerfully on the system, occasioning, however, disorder of the stomach (*Bull. de Thérap.*, cxiv. 365).

OXYCYANIDE OF MERCURY is said to be superior to corrosive sublimate as an antiseptic, and to be especially adapted for operations on the *eye*.

SALICYLATE OF MERCURY has been examined by Dr. Caldwell (*Therap. Gaz.*, xii. 225), who obtained the following among other results: Three grains daily, for a week or two at least, usually will not affect the gastro-intestinal tract, though in one case $\frac{3}{8}$ of a grain three times daily produced salivation. It tends to arrest putrefaction in wounds and ulcers, besides acting as a mild stimulant; $\frac{1}{2000}$ prevents putrefaction nearly as completely as the bichloride, while $\frac{1}{60000}$ does not disturb digestion nearly as much as the bichloride. It irritates very slightly the gastro-intestinal mucous membrane. (Compare Müller, *Therap. Monatsh.*, iii. 577.) It has been applied by Plumert (*Centralbl. f. Therap.*, vii. 47, 693; *Therap. Monatsh.*, iii. 287; iv. 513) in a solution of 1–3 : 1000 in the treatment of *gonorrhœa*, but without shortening the attack; also in powder to *syphilitic ulcers*; and has been administered by intramuscular injection in doses of Gm. 0.01 (gr. $\frac{1}{6}$), repeated daily. It occasioned neither persistent swelling, nor inflammation, nor abscess, and, very rarely, stomatitis. The injections were given daily, and on an average about thirty in each case during the treatment. It was also administered internally in pills, each containing Gm. 0.025 (gr. $\frac{1}{3}$), of which from two to four are given daily. No gastro-intestinal disorder was produced, and once only a slight stomatitis. Similar results were obtained by Aranjo (*Med. News*, liv. 297) in *syphilis*, and by Schwimmer in *gonorrhœa* (*ibid.*, p. 603). Hahn confirmed previous results. He made use of Neisser's mixture, containing 1 part of the salicylate in 10 parts of liquid paraffin, for deep muscular injections. About Gm. 0.06 (1 grain) of the salt was injected every three days (*Therap., Monatshefte*, iii. 480). Confirmatory reports have been made by Epstein, Judassohn, Zeising, Neumann, and Schreus (*Therap. Gaz.*, xiii. 391), by Tchistiakoff (*Bull de Thérap.*, cxvi. 43) and Vacher (*Amer. Jour. Phar.*, lxiii. 129).

SUCCINAMIDE OF MERCURY has been proposed by Vollert as being a suitable preparation for hypodermic and intramuscular injection. Its solution is clear, and does not become

clouded nor precipitate on standing, nor does it coagulate albumen nor precipitate it from its solutions. It is said to rarely give rise to abscess. According to Wolff, the injections of a 2 per cent. solution should be made subcutaneously and obliquely in the buttock. Each injection, or Pravaz syringe-ful contains Gm. 0.01 (gr. $\frac{1}{6}$) of mercury. The abdomen has been suggested as preferable to the back or the thighs for this operation (*Bull. de Thérap.*, cxvi. 380). According to Julien, the treatment by this salt is well borne, but nothing denotes its superiority to other mercurials.

Tannate of the protoxide of mercury, was proposed by Lustgarten as a substitute for other mercurials in the treatment of syphilis, etc. In the dose of from Gm. 0.20–0.30 (3 to 5 gr.) a day it appears as mercury in the urine after the lapse of twenty-four hours. It does not salivate or disturb the stomach or bowels. In ten cases of various forms of constitutional *syphilis* its effects were quite as favorable as those of mercurial ointment (*Centralblatt f. Ther.*, ii. 93). These statements have been confirmed by Dorning (*Therap. Gaz.*, ix. 607), and in England by Parsons, who used the medicine in treating *chancres* as well as *syphilitic eruptions* (*Times and Gaz.*, Dec. 1885, p. 869). The dose given by the latter varied from $1\frac{1}{2}$ to 2 grains three times a day.

HYDRARGYRUM AMMONIATUM, *U. S.*, *Br.*—Ammoniated Mercury.

Hydrargyrum præcipitatum album, P. G.; *Hydrargyrum amidato-bichloratum* (*ammoniato-muriaticum*), *Hydrargyri ammonio-chloridum*, *Mercurius præcipitatus albus*.—*White precipitate*, *Mercur-ammonium chloride*, E.; *Chloramidure de mercure*, *Oxychlorure ammoniacal de mercure*, *Lait mercuriel*, *Mercure précipité blanc*, Fr.; *Weisser Quecksilberprücipitat*, *Quecksilber-Chloridamidid*, G.

Formula NH_2HgCl. Molecular weight, 251.18.

Preparation.—Corrosive Mercuric Chloride 100 Gm.; Ammonia-water, Distilled Water, each a sufficient quantity. Dissolve the corrosive mercuric chloride in 2000 Cc. of warm distilled water; filter the solution, and allow it to cool. Pour the filtrate gradually, and constantly stirring, into 150 Cc. of ammonia-water, taking care that the latter shall remain in slight excess. Collect the precipitate upon a filter, and when the liquid has drained from it as much as possible wash it twice with a mixture of 400 Cc. of distilled water and 20 Cc. of ammonia-water. Finally, dry the precipitate between sheets of bibulous paper in a dark place, at a temperature not exceeding 30° C. (86° F.)—*U. S.*

The process of the German Pharmacopœia is in all respects identical with the foregoing, except that the washing of the precipitate is accomplished with distilled water instead of diluted ammonia. The process of the British Pharmacopœia is like the last, but a somewhat smaller quantity of ammonia is directed, and the precipitate is dried at a temperature not exceeding 100° C. (212° F.). The French Codex no longer recognizes this preparation; it should, however, be remembered that the *précipité blanc* of French pharmacy is *calomel* prepared by precipitation (see page 826).

In following the above processes one-half of the ammonium has 2 atoms of the univalent hydrogen replaced by 1 atom of the bivalent mercury, producing the radical mercur-ammonium (NH_2Hg), which is a monad like ammonium, and combines with 1 atom of chlorine to form the white precipitate; the other half of the ammonium unites with the other atom of chlorine contained in the mercuric chloride to form ammonium chloride, which remains dissolved; water is likewise produced by the reaction, which is explained by the equation $HgCl_2 + 2NH_4OH = NH_2HgCl + NH_4Cl + 2H_2O$. The ammonium chloride requires to be washed out, for which purpose the Pharmacopœia very properly uses a very dilute ammonia to prevent decomposition. If water be used, it should be cold, and the washing should not be continued too long, to prevent the precipitate from acquiring a yellowish tint in consequence of the formation of oxidi-mercur-ammonium chloride, $NH_2(Hg_2O)Cl$. The above formula yields nearly 93 Gm. of ammoniated mercury.

Properties.—Ammoniated mercury is a white, amorphous, inodorous powder or is often in friable masses, permanent in the air and having an earthy afterward metallic taste. It is insoluble in ether, alcohol, and ammonia-water, but is slowly decomposed by cold water, and yields with boiling water a lemon-yellow basic compound, $NH_2(Hg_2O)Cl$, ammonium chloride being dissolved. When rapidly heated it turns yellow, and above 360° C. (680° F.) is decomposed and completely volatilized without fusion, yielding nitrogen, ammonia, and calomel; when slowly heated intermediate compounds are first formed. It is completely soluble in a cold solution of sodium thiosulphate, with evolution of

ammonia; on digesting this solution for a short time it separates red mercuric sulphide, or vermilion, which on protracted boiling turns black. Ammoniated mercury is decomposed by potassa solution or lime-water, ammonia being evolved and a yellow compound separated. It is soluble in hot solutions of ammonium salts and in hydrochloric as well as in nitric and acetic acids; these solutions yield white precipitates with potassa (ammoniated mercury) and silver nitrate (silver chloride). When ammoniated mercury is triturated with iodine the mixture will after some time puff up, from the spontaneous decomposition of nitrogen iodide or iodamine formed in it, but in the presence of alcohol the decomposition takes place suddenly and with violent explosion.

Tests.—Ammoniated mercury should dissolve in hydrochloric acid without effervescence (absence of carbonate), and without leaving any residue (absence of mercurous salt, calcium sulphate, starch, etc.). Its solution in acetic acid should not yield a precipitate with sulphuric acid (absence of lead), and, after treating it with an excess of hydrogen sulphide a colorless filtrate should be obtained, which, on being acidulated with hydrochloric acid, evaporated to dryness, and ignited, should not leave a fixed residue (absence of zinc, calcium, etc. salts).

Fusible white precipitate, which was formerly considered to be identical with the preceding, until Wöhler and Kane proved its difference, was prepared by dissolving ammonium and mercuric chlorides in water and precipitating with sodium carbonate. Thus obtained, it has the composition $(NH_3)_2HgCl_2$, or perhaps $NH_2Cl.NH_2HgCl$, and differs from the official ammoniated mercury in fusing, when heated, to a yellowish liquid, evolving nitrogen and ammonia and yielding a transparent and an opaque white sublimate.

Action and Uses.—The insolubility of ammoniated mercury in water, and even in the normal acid contents of the stomach, renders it a less active irritant than some other mercurial salts. Sometimes its harsh operation seems to be attributable to defects in its manufacture or to its exposure to light, whereby a portion of it is converted into corrosive sublimate. Certainly in several cases it has occasioned all the symptoms of an active poison, with the specific effects of mercury, and a fatal result at last. This preparation is not used internally as a medicine, but its ointment, which is officinal, is employed in *ophthalmia* and *skin diseases*.

HYDRARGYRUM CUM CRETA, *U. S., Br.*—Mercury with Chalk.

Æthiops cretaceus.—Mercure avec la craie, Poudre de mercure crayeux, Fr.; *Quecksilber mit Kreide*, G.

Preparation.—Mercury 38 Gm.; Clarified Honey 10 Gm.; Prepared Chalk 57 Gm.; Water a sufficient quantity, to make 100 Gm. Weigh the mercury and clarified honey successively into a strong vial of the capacity of 100 Cc. and add 3 Cc. of water. Cork the vial, and shake it for fifteen to thirty minutes at a time, until the aggregate time of shaking reaches six hours, or until the globules of mercury are no longer visible under a lens magnifying 4 diameters. Rub the precipitated chalk to a stiff paste, in a mortar, with water, and, having added the contents of the vial, washing the last portions in with a little water, triturate the whole to a uniform mixture. Finally, dry the mixture between ample layers of bibulous paper, at the ordinary temperature, until it weighs 100 Gm. Then reduce it to a uniform powder, and keep it in well-stoppered bottles, protected from light.—*U. S.*

Take of mercury, by weight, 1 ounce; prepared chalk 2 ounces. Rub the mercury and chalk in a porcelain mortar until metallic globules cease to be visible to the naked eye and the mixture acquires a uniform gray color.—*Br.*

When certain substances are triturated with metallic mercury they acquire a gray tint, and the metallic lustre of the mercury gradually disappears in consequence of its fine division. (See Hydrargyrum.) To effect this with chalk alone is a tedious operation, to shorten which Dr. Stewart (1843) proposed to triturate first with resin, then with chalk, and finally to remove the resin by alcohol; Dr. Mettauer suggested the use of a mixture of starch and chalk, kept damp by a little water during the trituration; and W. Hewson (1850) proposed to shake the metal with a portion of the chalk in a bottle until extinguished, and then to add the remaining powder. This process is followed on a large scale, a barrel or other suitable vessel containing the mixture being turned on its axis, or it is combined with trituration, a ball being also introduced into a vessel having a somewhat eccentric motion. Dr. Squibb (1857) constructed an apparatus in which the mercury is shaken with honey or syrup, and when completely extinguished mixed with the chalk,

most of the sugar being afterward washed out with cold water; this process yields a very pure product, but the globules are larger than in the products of the other processes, and the powder cannot be triturated with pressure without separating some metallic globules. This plan of succussion has been adopted by the Pharmacopœia; it is probably better adapted for large manufacturers than the retail pharmacist. W. E. Bibby (1876) suggested a method which enables the pharmacist to prepare this medicament without the expenditure of much time by substituting sugar of milk for about one-fifth of the chalk, which greatly facilitates the fine division of the metal; this was the process adopted by the last U. S. P., with the additional improvement to keep the material moist with alcohol and ether until the mercury has been finely divided.

Properties and Tests.—Mercury with chalk is a gray, uniform, non-gritty, inodorous, and nearly tasteless powder, from which the mercury may be volatilized by heat. When treated with an excess of diluted acetic acid the chalk dissolves with effervescence, finely divided metallic mercury being left behind; the solution thus obtained should not become more than slightly opalescent on the addition of a few drops of hydrochloric acid (limit of mercurous oxide).—*U. S.* The presence of this oxide is disregarded by the British Pharmacopœia, which requires the preparation to be partly dissolved by dilute hydrochloric acid; any mercurous oxide present would be converted into calomel and remain with the finely-divided, undissolved mercury; but it insists on the total absence of *mercuric oxide*, which is detected in the clear solution in hydrochloric acid by a white or gray precipitate with stannous chloride or by a black one with hydrogen sulphide. Arsenic may be detected in this solution in the same manner as in corrosive sublimate. Dr. Squibb (1857) determined in a sample the presence of 1.2 per cent. of mercurous and 1.44 per cent. of mercuric oxide; Joseph P. Remington (1869) found even 14.3 and 25.7 per cent. of the latter in two samples taken from dispensing-bottles. These results fully explain the violent action which has been occasionally observed. The preparation should be examined from time to time to ensure its fitness for medicinal use.

Action and Uses.—This preparation seems to be only metallic mercury maintained in a state of minute subdivision by chalk. The proportion of the latter ingredient is too small to be regarded as of any direct therapeutic value, for in 8 grains of the compound there are 3 of mercury and 5 of chalk; and in the dose of Gm. 0.13–0.20 (2 or 3 grains), in which it is generally administered, any immediate action except that which belongs to an unirritating insoluble powder can scarcely be admitted. Mercury with chalk is chiefly used in the *bowel complaints* of children, especially when the discharges are colorless and sour, and is very generally believed to cause a secretion of bile, and thus restore the normal action of the alimentary canal. Of this action, as elsewhere stated (see HYDRARGYRUM), no proof exists. The chief good it does is very probably to take the place of larger doses of more perturbative medicines. *Dose* (Gm. 0.15–0.50 (gr. iij–x). Mr. Jonathan Hutchinson recommends this preparation of mercury as the best in constitutional *syphilis*, and in the dose of one grain from three to six times in twenty-four hours for not less than six months (*British Med. Jour.*, Jan. 1886, p. 143).

HYDRASTININÆ HYDROCHLORAS, *U. S.*—HYDRASTININE HYDROCHLORATE.

The hydrochlorate of an artificial alkaloid derived from hydrastine, a colorless alkaloid obtained from hydrastis.

Formula $C_{11}H_{11}NO_2.HCl$. Molecular weight 224.97.

Preparation.—Schmidt and Wilhelm (1888) found that when they oxidized hydrastine, the colorless alkaloid of hydrastis canadensis, with manganese dioxide and sulphuric acid, platinum chloride, chromic acid, or potassium permanganate in acid solution they obtained *opianic acid* and *hydrastinine*.

Properties.—The hydrochlorate forms light yellow, amorphous granules, or a pale yellow crystalline powder. It is odorless and possesses a bitter saline taste and is deliquescent in moist air. At 15° C. (58° F.) it is soluble in 0.3 part of water, and in 3 parts of alcohol, and difficultly soluble in ether or chloroform. When heated to 173° C. (343.4° F.) the salt undergoes partial fusion but does not liquefy; on ignition it is wholly consumed. Towards litmus-paper the salt shows an acid reaction. A dilute aqueous solution shows a blue fluorescence even in a dilution of 1 to 100,000. Sulphuric acid dissolves the salt with effervescence and is colored yellowish-red thereby. An aqueous solution is not precipitated by ammonia-water, but yields a precipitate with

solution of silver nitrate which is insoluble in nitric acid but dissolves in ammonia-water. "On adding to 2 Cc. of an aqueous solution of the salt (1 to 100) an excess of bromine water, a yellow precipitate is produced, which dissolves in ammonia-water to a nearly colorless liquid (difference from hydrastine, with which the ammonia-water produces a brick-red precipitate)."—*U. S.*

Action and Uses.—Hydrastinine hydrochlorate is recommended for controling uterine hemorrhages. It is said to act with greater certainty than ergot. *Dose* is 0.025 Gm. ($\frac{3}{8}$ gr.), about three or four times a day, or exhibited as hypodermic injection in *doses* of $\frac{1}{2}$–1 Cc. of a 10-per-cent. solution.

HYDRASTIS, *U. S.*—Hydrastis.

Golden seal, Yellow-root, Yellow puccoon, Orange-root, Indian dye, Indian turmeric, E.; *Racine orange, Sceau d'or*, Fr.; *Canadische Gilbwurzel*, G.; *Raizamarilla sello de oro*, Sp.

The rhizome, with the rootlets, of Hydrastis canadensis, *Linné*, s. Warnera canadensis, *Miller*. Bentley and Trimen, *Med. Plants*, 1.

Nat. Ord.—Ranunculaceæ, Helleboreæ.

Origin.—This perennial is indigenous to Canada and the United States east of the Mississippi; it grows in rich woodlands, and in the Southern States is confined to the mountainous districts. It has a low stem, and at the summit two round heart-shaped, palmately-lobed leaves and a single greenish-white flower, and produces a crimson fruit composed of twelve or more one- or two-seeded berries.

Description.—The rhizome is 2 to 5 Cm. (1 to 2 inches) long, about 6 Mm. ($\frac{1}{4}$ inch) thick, oblique, with several short branches, terminated by a broad concave scar, somewhat flattened, annulate from the leaf-scars, longitudinally wrinkled, and below beset with many thin fragile rootlets 75–125 Mm. (3 to 5 inches) long, containing a thin triangular or quadrangular ligneous cord and a thick bright-yellow bark. The rhizome is externally brownish-gray with a yellow hue, hard, and breaks with a short waxy fracture of a bright reddish- or brownish-yellow color; the bark is about one-eighth the thickness of the rhizome; the central pith and medullary rays are broad, and the yellowish wood consists of eight to twelve narrow wedges, or, near the base of the branches, of a few linear and several larger irregular bundles. Golden seal has a slight odor, and a bitter taste free from any marked astringency.

Fig. 152.

Hydrastis.

Constituents.—Besides the common constituents, like starch, sugar, etc., A. B. Durand (1851) found in it a yellow coloring matter and a white alkaloid, *hydrastine*. The former was recognized by Mahla (1862) as *berberine*, the hydrochlorate of which has been used by eclectic practitioners under the incorrect name of *hydrastine*. Perrins (1862) obtained 4 per cent. of the crude hydrochlorate (see Berberis, p. 336) and 1.5 per cent. of hydrastine, which was analyzed by Mahla (1863). *Hydrastine*, $C_{22}NH_{23}O_6$, is contained in the mother-liquor from the preparation of berberine, and obtained by diluting the liquid with water, evaporating the alcohol, neutralizing carefully with ammonia, filtering from the precipitated resin, etc., and precipitating with ammonia; the fawn-colored deposit is purified by animal charcoal and recrystallization from hot alcohol. It is in white, shining quadrangular prisms which fuse at 135° C. (275° F.), are readily soluble in alcohol, ether, chloroform, and benzene, insoluble in water, colored red by nitric acid, brown-red by sulphuric acid and potassium chromate, and yield with acids soluble and very bitter salts. Oxidized in acid solution hydrastine yields *hydrastinine* and *opianic acid* and in alkaline solution, hemipinic acid, nicotinic acid, and methylamine. From the investigations of A. K. Hale (1873) and J. C. Burt (1875) it appears that the hydrastine of former investigators was not quite pure, but probably mixed with a third alkaloid, which Hale obtained, of a dark-yellow color, and Burt crystallized as sulphate in colorless needles; warmed with nitric acid, it turns red, with sulphuric acid reddish-brown, and the solution of its hydrochlorate is colored dark-brown to black by ferric chloride; it is present in smaller quantities than hydrastine. Lerchen (1878), who proposed to call it *xanthopuccine*, found it insoluble in ether and chloroform, but soluble in alcohol and hot water, and the hot alcoholic solution, treated with iodine in potassium iodide, avoiding an excess of iodine, to yield light brown-colored spangles. Schmidt and Wilhelm (1888) isolated a third alkaloid which they called *canadine;* it differs from

hydrastine by being more soluble in acetic ether and absolute alcohol. From the former it crystallizes in radiating crystals, and from the latter as flat, faintly yellow, warty crystals. It melts at 120° C. (248° F.). In the preparation of the alkaloids Dr. L. Wolff (1881) has found it of considerable advantage to deprive the powdered hydrastis of the fixed oil by means of gasolin, and thus lessen the trouble of purification.

Action and Uses.—The experiments of King, Bartholow, Slavatinski, Fellner, Heinrich, and others have been in the main confirmed by the elaborate and careful experiments of Cerna (*Therap. Gaz.*, xv. 289), but none of them have furnished the least *rational* explanation of the usefulness of this medicine in disease.

Hydrastis is one of the many medicines borrowed from the aborigines of this country. It was afterward long in use as a domestic remedy and by irregular practitioners before it became officinal in 1860. Various incongruous virtues were ascribed to it by the vulgar, such as being at once tonic, aperient, diuretic, and antiseptic, besides being of use in hæmorrhoids, jaundice, and chronic diarrhœa and all affections of the urinary tract, as well as for ophthalmia and cancer. Rutherford decided that it was "an hepatic stimulant of considerable power and a feeble intestinal stimulant." It is alleged to be "one of the best remedies for the gastric catarrh of chronic alcoholism, and probably the best substitute for alcoholic stimulants when their use has to be abandoned. For habitual constipation depending on inaction of the liver it is undoubtedly a valuable remedy" (*Practitioner*, xxvi. 121). The fluid extract has, indeed, been employed in various affections of the alimentary canal, but especially in those which are ranked under *dyspepsia* and atonic *diarrhœa*, and for which the vegetable bitters, and especially colombo, are habitually used. The physiological investigations made with hydrastis neither indicate nor explain its most conspicuous virtues. It has been applied as an infusion or tincture, or in solutions of hydrastine, to a variety of local affections. A solution of muriate of hydrastine (gr. ij–iij to f℥j) applied to the *conjunctiva* excites lachrymation, redness, and a moderate degree of pain, and has been used, like other local stimulants, to produce a substitutive and salutary irritation (Sattler, *Med. News*, xlvi. 119). This was one of its earliest applications (1864) by King, who also used it in the treatment of *gonorrhœa* and diseases of the *rectum*. Subsequently it was employed for *fissure of the nipples, stomatitis, otorrhœa, ozæna, leucorrhœa*, cancerous and other *ulcers*, *fissure of the anus, prolapse of the rectum*, and ulcers of the *throat*. Felsenberg found that the fluid extract was a useful application to the throat in chronic *pharyngitis* whether associated with *tonsillitis* or not (*Lancet*, Mar. 1889, p. 549). It has been claimed that this medicine controls *hæmoptysis* (*Ther. Gaz.*, xiii. 119), but the proof is wanting. The action of hydrastis upon the uterus, of late demonstrated experimentally, was long ago recognized clinically. In 1877, Gordon employed the tincture in *menorrhagia*, uterine *hæmorrhage*, and *dysmenorrhœa* (*Chicago Med. Jour. and Exam.*, Aug. 1877), and Dr. Bartholow published his observations in 1884. In 1886, Slavatinski (*loc. cit.*) confirmed the previous results, and used the medicine to bring on premature labor in a case of contracted pelvis, using hypodermic injections of one grain each of muriate of hydrastine. For other purposes he suggested as the maximum daily dose Gm. 0.3 (5 grains) hypodermically and Gm. 0.5 (8 grains) internally. Akuloff reported a case of profuse menorrhagia due to chronic uterine congestion, cured by the fluid extract given in the dose of 20 minims three times a day for three months (*Lond. Med. Record*, Feb. 1886, p. 71). In 1887, Givopiszew found that it stimulated the gravid uterus in the latter half of pregnancy, but less energetically than ergot (*Bull. de Thérap.*, cxiv. 189). Schatz, however (*Edinb. Jour.*, xxxiii. 861), maintained that it neither originated nor increased uterine contractions (see also Heinricus, *Med. News*, lv. 126), but that it acted on the vascular system of the organ so as to restrain hemorrhages from it due to various causes, but especially those which are independent of material disease of the uterus (compare Bataud, *Med. News*, lviii. 362.) Wilcox also (*Med. Record*, xxxi. 712) formed a similar judgment, adding, however, to the cases of hemorrhage controlled by the medicine those of fungous uterine growths producing hemorrhage, which the curette failed to control. The experience of Dr. A. Reeves Jackson, moreover, was not as satisfactory as that of some among the promoters of the medicine. He found it to act best where ergot had failed (*Med. News*, liv. 375). Yet the general result that hydrastine is a uterine stimulant of considerable value appears to be established by the evidence here given, to which might be added the testimony of Fuchs (*Therap. Gaz.*, xi. 863); Oliver (*ibid.*, xii. 388); Rutherford (*ibid.*, p. 647); Akuloff (*Philada. Med. Times*, xvi. 478); Mendes and others (*Repert. de Pharm.*, 1887, p. 93); Jordan (*Lancet*, Oct. 1889, p. 811); Falk (*Ther. Gaz.*, xiv. 86) and Marfori (*ibid.*, p. 483); Czempin

(*Amer. Jour. Med. Sci.*, Feb. 1892, p. 322); Faber (*University Med. Mag.*, iv. 840); Emmanuel (*Ther. Gaz.*, xvi. 188); Gottschalk (*ibid.*, p. 699). A decoction of hydrastis, made by boiling Gm. 32 (℥j) of the bruised rhizome in Gm. 500 (Oj) of water for fifteen minutes, may be given in doses of 1 or 2 fluidounces several times a day. Of the fluid extract the dose is about Gm. 4 (f℥j) several times a day, and of the tincture about the same. The dose of hydrastine (internally) is Gm. 0.13–0.40 (gr. ij–vj), and hypodermically Gm. 0.01–0.03 (gr. $\frac{1}{6}$–$\frac{1}{2}$), and of hydrochlorate of hydrastine, Gm. 0.008–0.016 (gr. $\frac{1}{8}$–$\frac{1}{4}$). Falk recommends the hypodermic use of hydrastinine muriate, Gm. 0.05 (gr. $\frac{3}{4}$) to Gm. 0.1 (gr. $1\frac{1}{2}$), or ℞ Hydrastinine muriate, Gm. 1 (15 gr.), Distilled water Gm. x (f℥iiss). S. One-half to one syringeful for an injection.

HYDROCOTYLE, *F. Cod.*—Water-Pennywort.

Indian pennywort, E.; *Bevilacqua*, Fr.; *Wassernabel*, G.; *Hidrocotila*, Sp.

Hydrocotyle asiatica, *Linné.* Bentley and Trimen, *Med. Plants*, 117.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Description.—A low, creeping perennial which is indigenous to the tropical and subtropical regions of Asia, Africa, and America. The leaves are smooth, situated in tufts on the nodes of the stem, have petioles with a sheathing base, are roundish-reniform in outline with a somewhat crenate margin, about 25 Mm. (1 inch) broad, rather thick, radiately veined, and dark-green. The pink-colored flowers are in small umbellate clusters of about three, and produce small, laterally flattened, suborbicular fruits without oil-tubes. The plant is inodorous, but in bruising the fresh leaves a peculiar odor is developed; the taste is bitterish and pungent.

Constituents.—Lépine (1855) isolated *vellarin*, which he regarded as the active principle. It is an oily liquid having a bitter taste, a strong, peculiar odor, becoming viscous on exposure, insoluble in potassa solution, and soluble in ammonia, diluted alcohol, and ether. He obtained from the dried leaves 13 per cent. of ash.

Allied Plants.—Most other species of this genus appear to possess somewhat similar sensible properties. The North American species, H. ranunculoides, *Linné*, and H. americana, *Linné*, have likewise reniform leaves, those of the former being three- to seven-cleft; those of the latter, thin, crenate-lobed, the lobes of both being crenate.

Peltate leaves, with doubly crenate margins, are met with in the European H. vulgaris, *Linné*, which has five-flowered umbellate clusters, and in the American H. umbellata, *Linné* which has the umbellate clusters about twenty-flowered, and in Mexico is called *ombligo de Venus*.

Action and Uses.—About 1852 this medicine, which had long been employed in India in the treatment of febrile diseases and as a diuretic, was incorrectly announced by a French physician in the Mauritius to have cured a case of *leprosy*. It, appears, however, to stimulate the skin, occasioning severe itching, and in large doses producing vertigo, headache, and stupor, as well as bloody stools. It has been said to be an efficient remedy in scaly and pruriginous *diseases of the skin*, including those of a syphilitic origin, in chronic *eczema*, *lichen*, *prurigo*, in scrofulous and other *ulcers*, and in chronic *rheumatism*. The powdered root has been prescribed in doses of Gm. 0.20 (3 grains) several times a day, and an alcoholic extract in doses of Gm. 0.03 ($\frac{1}{2}$ grain).

HYOSCINÆ HYDROBROMAS, *U. S.*—Hyoscine Hydrobromate.

Hyoscinum hydrobromicum.—Bromure d'hyoscine, Fr.; *Hyoscinbromid*, G.

Formula $C_{17}H_{21}NO_4.HBr + 3H_2O$. Molecular weight 436.98.

The hydrobromate of an alkaloid obtained from hyoscyamus.

Preparation.—Ladenburg (1880) found that hyoscyamus contained, besides hyoscyamine, another alkaloid, *hyoscine*, which he isolated from the mother-liquors of the former. It is separated by converting it into the gold double salt, as this is less soluble than the corresponding salt of hyoscyamine. This double salt differs furthermore from the other in that it has a duller lustre, forms better crystals, and has a higher melting-point.

Properties.—Hyoscine forms a thick syrupy liquid which, when heated with solution of barium hydroxide, is decomposed into tropic acid and *pseudotropine*. The Pharmacopœia characterizes the hydrobromate as follows: It forms "colorless, transparent, rhombic crystals, having an acrid, slightly bitter taste, and permanent in the air. Soluble, at 15° C. (59° F.), in 1.9 parts of water, and in 13 parts of alcohol; very little soluble in ether or chloroform. When heated to 100° C. (212° F.), the salt loses its water of crystallization, fusing to a thick, syrupy mass, which becomes quite fluid at

160° C. (320° F.). When ignited it is consumed without leaving a residue. The salt is neutral to litmus-paper. Addition of ammonia-water to the aqueous solution (1 in 60) of the salt produces no change, but sodium or potassium hydroxide test-solution causes a white turbidity. If 5 drops of fuming nitric acid be added to 0.01 Gm. of the salt, in a small porcelain capsule, and evaporated to dryness on a water-bath, a scarcely tinted residue will be left which, when treated, after cooling, with a few drops of an alcoholic solution of potassium hydroxide, will assume a violet color. Addition of silver nitrate test-solution to the aqueous solution produces a yellowish-white precipitate which is insoluble in nitric acid, but, when filtered off and washed, soluble in ammonia-water diluted with its own volume of water.—*U. S.*

Uses.—"It has been used in asthma, enteralgia, trigeminal neuralgia, colliquative sweats, insomnia, motor disorders of the insane, paralysis agitans, spasmodic torticollis, and hypochondriacal neurasthenia" (Erb). *Dose*, internally, 0.0005–0.0075 (gr. $\frac{1}{130}$–$\frac{1}{15}$).

HYOSCYAMINÆ HYDROBROMAS, *U. S.*—Hyoscyamine Hydrobromate.

Hyoscyaminum hydrobromicum.—Bromure d'hyoscyamine, Fr.; *Hyoscyaminbromid*, G.
Formula $C_{17}H_{23}NO_3HBr$. Molecular weight 369.14.

The hydrobromate of an alkaloid obtained from hyoscyamus.

Preparation.—It is equal to that of the sulphate given below, using hydrobromic acid in place of sulphuric acid.

Properties and Tests.—The requirements of the present Pharmacopœia are quite as stringent as with the sulphate. It is described as "a yellowish-white, amorphous, resin-like mass or prismatic crystals, having, particularly when damp, a tobacco-like odor and an acrid, nauseous, and bitter taste; deliquescent on exposure to air. Soluble, at 15° C. (59° F.), in about 0.3 parts of water, 2 parts of alcohol, 3000 parts of ether, or 250 parts of chloroform. At 78° C. (172.4° F.) the salt melts, forming a nearly colorless liquid. When ignited it is consumed without leaving a residue. The salt is neutral to litmus-paper. An aqueous solution of the salt is not precipitated by platinic chloride test-solution (difference from most other alkaloids). With gold chloride test-solution it yields a precipitate which, when recrystallized from a small quantity of boiling water acidulated with hydrochloric acid, is deposited, on cooling, in minute, lustrous, golden-yellow scales (difference from atropine). The aqueous solution of the salt yields, with silver nitrate test-solution, a yellowish-white precipitate which is insoluble in nitric acid, but, when filtered off and washed, soluble in ammonia-water diluted with its own volume of water."—*U. S.*

Uses.—This compound appears to have been used principally in the treatment of excited states of insanity. It has been regarded as less apt than hyoscine to produce mental excitement, as well as other accidents chargeable to the latter. The *dose* has been stated at Gm. 0.0005 ($\frac{1}{130}$ grain) and should never exceed twice that quantity.

HYOSCYAMINÆ SULPHAS, *U. S.*—Hyoscyamine Sulphate.

Hyoscyaminum sulfuricum.—Sulfate d'hyoscyamine, Fr.; *Hyoscyaminsulfat*, G.
Formula $(C_{17}H_{23}NO_3)_2.H_2SO_4$. Molecular weight 674.58.

The neutral sulphate of an alkaloid prepared from hyoscyamus.

Preparation.—Hyoscyamine is dissolved in alcohol, and the solution carefully neutralized with diluted sulphuric acid and evaporated at a low temperature; or the solution of the alkaloid in diluted sulphuric acid is concentrated under a bell-glass over sulphuric acid.

Properties and Tests.—Hyoscyamine sulphate is described by E. Rennard (1868) as forming bundles of microscopic crystals; by Thorey (1869) as crystallizing in long satiny prisms, united in bundles or sheaf-like groups; and by Höhn and Reichardt (1871) as radiating groups of white glossy needles. But, according to Ladenburg (*Annalen*, vol. ccvi.), the salts of hyoscyamine are uncrystallizable, while those of hyoscine, or amorphous hyoscine, are crystallizable; most of the salts of both alkaloids are colorless or white if pure, but as ordinarily obtained are usually more or less colored (see Hyoscyamus); and no method is known for separating the two alkaloids except by the recrystallization of their gold double salts. The pharmacopœial description of hyoscyamine sulphate (1880) admitted a mixture with hyoscine sulphate more or less contaminated with coloring matter; but in the present revision the requirements are more stringent, it being described as "white indistinct crystals, or a white powder, without odor, having a bitter, acrid taste, and deliquescent in damp air. Soluble, at 15° C. (59° F.), in 0.5

parts of water, and in 2.5 parts of alcohol. Very slightly soluble in ether or chloroform. At 140° to 160° C. (284° to 320° F.) the salt melts, and upon ignition it is consumed without leaving a residue. The salt is neutral to litmus-paper. An aqueous solution of the salt is not precipitated by platinic chloride test-solution (difference from most other alkaloids). With gold chloride test-solution it gives a precipitate which, when recrystallized from a small quantity of boiling water acidulated with hydrochloric acid, is deposited, on cooling, in minute, lustrous, golden-yellow scales (difference from atropine). The aqueous solution of the salt yields, with barium chloride test-solution, a white precipitate insoluble in hydrochloric acid."—*U. S.*

Action and Uses.—These are detailed in the following article on HYOSCYAMUS. The dose of the sulphate is about the same as that of the alkaloid, hyoscyamine, Gm. 0.001 ($\frac{1}{65}$ grain); but in urgent cases Gm. 0.016–0.06 ($\frac{1}{4}$ grain, and even a grain) has been given by the mouth, and Gm. 0.001 ($\frac{1}{65}$ grain) hypodermically. The *Brit. Pharm. Extra* states the dose as $\frac{1}{120}$ to $\frac{1}{40}$ grain increased, but that of hyoscine hydrobromate at $\frac{1}{300}$–$\frac{1}{100}$ gr.

HYOSCYAMUS, *U. S.*—HYOSCYAMUS.

Hyoscyami folia, Br.; *Herba hyoscyami*, P. G.; *Henbane*, E.; *Jusquiame noir*, Fr. Cod.; *Bilsenkraut*, G.; *Beleño negro*, Sp.

The leaves (and seeds) of Hyoscyamus niger, *Linné*, collected from plants of the second year's growth. Bentley and Trimen, *Med. Plants*, 194.

Nat. Ord.—Solanaceæ.

Origin.—The typical form of henbane is biennial, grows in sandy soil and waste places throughout the greater portion of Europe and eastward and southward to Siberia, Northern India, and Egypt, and has been naturalized in North America from the New England States to Michigan. It is 60–90 Cm. (2 to 3 feet) high, covered with long, jointed, glandular hairs, and has the numerous nearly sessile flowers in a long, leafy, one-sided spike-like raceme. The funnel-shaped five-lobed corolla is about 3 Cm. ($1\frac{1}{4}$ inches) long and wide, pale yellow, with purple veins and a similar colored base. The capsule (pyxis) is enclosed in the bell-shaped calyx, about 12 Mm. ($\frac{1}{2}$ inch) long, dehiscent near the top by a cap, two-celled, and contains numerous seeds. An annual variety, H. agrestis, *Kitiabel*, is not over 30 Cm. (1 foot) high, less villous, and has smaller leaves and fewer flowers; if the latter are veinless, the plant is H. pallidus, *Willdenow*.

H. albus, *Linné*, and H. aureus, *Linné*, of Southern Europe, are occasionally employed there, but are less active. H. physaloides, *Linné*, is used in Siberia.

Description.—Taken from different parts of the stem, the leaves vary from 5–25 Cm. (2 to 10 inches) in length and 2–10 Cm. (1 to 4 inches) in width, the lower leaves being stalked, the upper sessile and amplexicaul. They are ovate to ovate-oblong in shape, on each side with one (upper leaves) to five coarse, sinuate teeth or lobes, which are rather acute and oblong or triangular. In the dry state they are of a grayish-green color, glandular-hairy above, more densely so on the lower surface and upon the prominent broad midrib. Some of the characteristic flowers or capsules, or both, may usually be found with the drug, the heavy narcotic odor of which is diminished by drying, but becomes more prominent again when the leaves are moist. The taste is bitter and somewhat acrid. Being very hygroscopic, the leaves should be kept in a dry place. The German and British Pharmacopœias admit the leaves and flowering-tops.

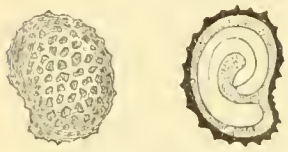
FIG. 153.

Hyoscyamus niger, *Linné*.

HYOSCYAMI SEMEN, *U. S.* 1870.—Hyoscyamus-seed, Henbane-seed, *E.*; Semences de jusquiame noir, *Fr.*; Bilsensamen, *G.*—The seeds are no longer recognized by the pharmacopœias, but are employed for preparing

the alkaloid. They are roundish-reniform, flattened; have a gray-brown, finely and densely rough-pitted testa, and contain a whitish oily albumen which encloses a curved embryo of the shape of the figure 9. The hilum is in the concave side of the seed. The seeds are without odor and have an oily, bitter, and acrid taste.

Fig. 154.



Hyoscyamus-seed and longitudinal section, magnified 7 diameters.

Constituents.—Brandes (1820) obtained from the seeds 25 per cent. of a bland, limpid, and colorless oil, of which absolute alcohol dissolves about 20 parts. Their most important constituent, like that of the leaves, is the alkaloid *hyoscyamine*, observed by Brandes, and again obtained by Geiger and Hesse (1833) and by Kemper (1866). Completer investigations were made by Höhn (1870 and 1871), and the composition of the alkaloid, its identity with duboisine, and its isomerism with atropine were determined by Ladenburg (1880). Thibault (1875) received it in silky crystals from the chloroformic solution. Thorey obtains the alkaloid at once pure by exhausting the powdered seeds deprived of oil with alcohol acidulated with hydrochloric acid. The dried seeds yield from 0.08 to 0.16 per cent., and the leaves 0.042 to 0.224 per cent.

Pure hyoscyamine, $C_{17}H_{23}NO_3$, crystallizes in colorless silky needles or is left as a white gelatinous mass; it is permanent in the air, melts at 108.5° C. (227.3° F.), is levogyre, and dissolves sparingly in cold water, but freely in alcohol, ether, and chloroform. The gold double salt forms lustrous golden-yellow scales which do not melt under boiling water, and in the dry state fuse at 160° C. (320° F.) (difference from atropine). Boiled with baryta-water, as was proven by Ladenburg, it yields tropine and tropic acid (see page 306).

Commercial hyoscyamine frequently contains a second alkaloid, which Ladenburg (1880) named *hyoscine*, and for which Buchheim (1876) proposed the name *sikeranine*. It is isomeric with hyoscyamine, is semi-liquid and uncrystallizable, but its double salt with chloride of gold is less lustrous, less freely soluble, and melts at 198° C. (388.4° F.); heated with baryta-water, the alkaloid yields tropic acid and *pseudotropine*, $C_8H_{15}NO$.

Höhn (1870) obtained from the seeds also a bitter glucoside, *hyoscypicrin*, $C_{27}H_{52}O_{14}$, which is neutral, soluble in alcohol and water, and precipitated by tannin; by boiling with diluted hydrochloric acid it is decomposed into fermentable sugar and a yellowish-white resin. In addition to this, a yellow, amorphous, somewhat bitter and slightly acid resin containing nitrogen was found, and on distilling the mother-liquors with soda some volatile bases were obtained—among them, probably, methylamine and ammonia.

Pharmaceutical Preparations.—Oleum hyoscyami infusum. Mix hyoscyamus 2 parts with alcohol 1 part; after absorption has taken place digest with olive oil 20 parts until the alcohol has evaporated; express and filter.—P. G. 1872.—Dieterich (1888) recommended moistening the powder with ammonia and spirit of ether, extracting it with ether, mixing this tincture with olive oil and distilling the ether. Thus prepared it contains all the alkaloids present in the leaves.

Baume tranquille of the French Codex is a similar preparation, made from the fresh leaves of hyoscyamus, belladonna, stramonium, black nightshade, tobacco, and poppy, of each 40 parts, and of 120 parts of dry aromatic herbs and flowers, comprising twelve kinds, with 1000 parts of olive oil.

Allied Drug.—Duboisia myoporoides, *R. Brown*, (*Nat. Ord.* Solanaceæ,) is a tree-like shrub. Its leaves are alternate, short-stalked, smooth, lanceolate, entire and slightly revolute on the margin, narrow toward the apex and base, inodorous and of a bitter taste. The prominent midrib is marked on the upper side by a slight ridge. The flowers are whitish or lilac-colored, bell-shaped, and have four didynamous stamens with reniform anthers; the fruit is a small roundish black berry, resting with its lower half in the five-toothed, persistent calyx, and containing in each of the two cells two to four oblong-reniform and reticulate brown seeds. It was examined by A. W. Gerrard and A. Petit (1878), who isolated the alkaloid *duboisine* as a yellow viscous mass, which is colored red by sulphuric acid, and on warming the mixture gives off an unpleasant odor, suggestive of butyric acid. Duquesnel subsequently obtained the alkaloid in crystals, and Ladenburg (1880) proved it to be identical with hyoscyamine, and that the commercial duboisine sulphate, which is brown, amorphous, and hygroscopic, is identical with hyoscyamine sulphate, but contaminated with a resin-like body. A volatile alkaloid contained in these leaves is probably identical with *piturine*.

Duboisia Hopwoodii, *F. von Müller*. This tree-like or shrubby plant is called *pituri* or *pedgery*; it is rare and its fruit is unknown. The leaves are short-petiolate, smooth, glossy, and rather thick, narrow and linear or somewhat lanceolate, narrowed at the base, and finely acuminate, with the end often bent.

Pituri-leaves, examined by Mueller and Rummel, Petit (1879), Liversidge (1881), and others, were found to contain a volatile alkaloid, *piturine*, C_6H_8N, which when pure is a colorless liquid,

but on exposure to light or air turns yellow and brown; it is very freely soluble in water, alcohol, and ether, has a nicotine-like odor, which changes to pyridine-like, and has an acrid and persistent pungent taste; its salts are bitter, mostly amorphous or with difficulty crystallizable, and readily part with a portion of the alkaloid. Sulphuric acid and potassium bichromate cause an orange color, changing to brown and green.

Action and Uses.—The following effects are produced by henbane and by hyoscyamine: In full medicinal dose the former occasions headache, pasty mouth, hoarse voice, dry throat, a warm skin, and a slower and then an accelerated pulse, while the pupil becomes dilated and vision indistinct, and the limbs give way under the body. The sense of touch is blunted, and the voluntary muscles are apt to be cramped or to be affected alternately with spasms and paralysis. No direct narcotic effect is produced in the greater number of cases, but rather a loquacious subdelirium, with hallucinations, which may merge into a restless and dreamy sleep. Only in large doses is henbane decidedly hypnotic. Its power to produce a peculiar talkative and pugnacious delirium was fully described by ancient writers, and some modern observers have witnessed similar effects (Stillé, *Therapeutics*, 4th ed., i. 891). A more recent illustration occurred in Algeria in 1883 (*Bull. de Thérap.*, cix. 336). It is curious that in certain cases, although the general sensibility is impaired, severe neuralgic pains may be felt in the limbs. Continued medicinal doses tend to produce a reddish efflorescence upon the skin, which is dry and itching. When poisonous doses, on the other hand, have been taken, the skin is sometimes cool and clammy, the face pale, and the lips bluish.

According to Gnauck, *hyoscine* is tenfold stronger than hyoscyamine, even a very minute dose (gr. $\frac{1}{600}$) invariably producing its characteristic effects, and subcutaneously acting twice as powerfully as by the mouth. He thinks that it tends directly to slow the pulse (*Phila. Med. News*, xl. 323).

At one time hyoscyamus was believed to be a valuable remedy for *epilepsy*, but experience has shown that the doses formerly given were quite inert, and that even in really operative doses its utility is limited to cases of emotional origin. Dr. Lawson in England found hyoscyamine very useful in controlling violent outbreaks of *mania*, especially of the recurrent acute and subacute forms, the monomania of suspicion, and the excitement of senile dementia. He regarded it as essential to the success of the treatment that the medicine should be given in a dose not less than 1 grain. If a smaller dose is taken, it is said cerebral excitement, without complete motor paralysis, is produced, and remains through the whole period of the operation of the medicine. Mr. Gill, physician to the Lunatic Hospital, York (Eng.), on the other hand, recommended a dose varying from $\frac{1}{8}$ to $\frac{3}{8}$ grain; and that in exceptional cases $\frac{3}{4}$ grain, or even a grain, might be given with safety. In some forms of *hypochondriasis* it seems to have been useful as a means of calming agitation. Prolonged experience has confirmed these statements. Thus we learn from Prideaux (*Practitioner*, xxiii. 446) that it produces sleep, sometimes of considerable duration, in excited conditions of the brain, as in *mania*, *delirium tremens*, *meningitis*, and where ordinary hypnotics, and especially opiates, are inadmissible. In such cases small doses ($\frac{1}{16}$ gr.) suffice, but in chronic mania large doses ($\frac{1}{2}$ grain, or even 1 grain) are necessary, and are very useful in cutting short exhibitions of temper and excitement of a violent and destructive character. It would appear to be particularly useful in delusional *insanity;* the illusions which it conjures up overlie and gradually obliterate those which belong to the disease. "In chronic *dementia*, associated with destructive tendencies, bad habits, and sleeplessness," the patients are said to be much improved by a course of small doses of the drug. Dr. Gray, when superintendent of the State Medical Asylum of New York, confirmed these observations by his own experience. but recommended a combination of hyoscyamine and morphine where there is a failure of cerebral energy; and, on the other hand, when violence predominated he associated the hypodermic use of hyoscyamine with the internal exhibition of the bromides (*Practitioner*, xxvi. 299). These results are confirmed by those of Bacon (*Practitioner*, xxvii. 367), Seguin (*Med. Record*, xvii. 354), Gnauck (*Amer. Jour. of Med. Sci.*, Oct. 1863, p. 556), by Ewart (*Lancet*, Aug. 18, 1884, p. 273), Schmidt (*Thérap. Gaz.*, ix. 808), and others (*ibid.*, xi. 51; *Med. Record*, xxxiii. 608); but on the whole, and the greater the knowledge of its effects gained by experience, the less reliance is placed upon it as a remedy, and the greater the distrust of it due to the serious and even fatal accidents attributed to it. Seguin particularly maintains the favorable action of the drug in delusional insanity with insomnia (*Med. Record*, xix. 712). In puerperal insanity the action of the medicine is most advantageous. In functional *palpitation* of the heart of a purely nervous nature it has been found beneficial, when used hypoder-

mically, in the dose of Gm. 0.001 ($\frac{1}{50}$ grain). The same means relieve cardiac and pulmonary *asthma* (*Lancet*, Aug. 20, 1887). Hyoscyamine has been used in trembling *palsy* and mercurial *trembling*, *epilepsy*, *chorea*, *locomotor ataxia*, and *tetanus*. In the first it exerts a marked power in moderating the tremulousness and in the second it is alleged to have effected cures. In the epileptic status in *epileptic mania* it diminishes the number, frequency, and severity of the attacks (Prideaux), and it is one of the most efficient means of procuring sleep in *delirium tremens* when the patient is at the same time properly fed. The hypodermic dose has varied from $\frac{1}{50}$ to $\frac{1}{20}$ gr. It seems to have cured a number of cases of *chorea*, of which several occurred in adults, but other preparations of hyoscyamus have but little influence on the disease; in *locomotor ataxia* it palliates the spasms and the neuralgic pains, and in *tetanus* it moderates the severity of the paroxysms. In these affections, and notably in chorea, its therapeutical action may be explained by its paralyzing influence upon the spinal cord, which seems to be of the same nature as that produced by conium. (Compare DaCosta, *Philada. Med. Times*, xvi. 312.) The *vomiting* of pregnancy, a symptom of reflex origin, has been controlled by it, It was prescribed in a solution containing 5 Mgs. (gr. $\frac{1}{12}$) of the alkaloid in 125 Gm. (f℥iv) of liquid, of which a teaspoonful was given every hour.

Hyoscine has been used in the same diseases as hyoscyamine, and with essentially the same results. At first it was alleged to aggravate *insanity* (*Med. Record*, xxviii. 309); then its hypnotic power in repressing excitement in mania and melancholy was demonstrated (*ibid.*, xxix. 376). The danger of its causing œdema of the lungs where renal obstruction exists was early pointed out (*Therap. Gaz.*, ix. 8). Some would use it only when less powerful hypnotics, such as chloral, the bromides, urethan, and hyoscyamine, had failed (Kobert); some would restrict its use to cases of excited or violent insanity, whether acute or chronic (Salgò, Pitcairn, Wetherill); while others repeat the original charge that it sometimes, instead of calming, excites, and in epilepsy particularly it is apt to bring on hallucinations and maniacal violence (Konrad, Klenche, Malfilate, and Lemoine). On the whole, hyoscine seems to be little more than a substitute for the various sedatives and methods of physical restraint that have been long employed in treating insanity, and to have only an indirect and incidental influence on the essential cause and nature of the disease. It prevents more or less the waste of strength in the insane, and lessens the noisy and destructive habits of many among them. (Compare Kobert, *Centralbl. f. Therapie*, x. 340; Erb, *ibid.*, vi. 23; Salgò, *ibid.*, p. 325; Pitcairn, *British Med. Jour.*, July, 1888, p. 75; Konrad, *Centralbl. f. Therap.*, viii. 660; Wetherill, *Jour. Nerv. and Ment. Dis.*, 1887; Thompson, *Lancet*, Feb. 4, 1888; Colman and Taylor, *ibid.*, Oct. 1889, p. 736; Lloyd, *Therap. Gaz.*, xii. 101; Erb, *ibid.*, p. 173; Malfilate, *ibid.*, p. 743; Dornbluth, *Med. News*, liv. 518; *Therap. Monatsheft.*, iii. 282, 361.) Hyoscine has been found useful as a palliative of the dominant symptoms in *paralysis agitans*, spasmodic *torticollis*, *tetany*, *chorea*, *asthma*, *whooping cough*, *epilepsy*, *insomnia*, *mania a potu*, *delirium tremens*, *neuralgia*, and the *morphine habit*. It is said to moderate the *sweats* of phthisis, and in several cases of *spermatorrhœa* it was used with advantage by Dr. H. C. Wood (*Therap. Gaz.*, ix. 594).

There is no doubt that hyoscyamus is anodyne, and apparently by its operation upon the sensitive nerves and ganglia, and not upon the cerebral organs of perception. The crushed leaves of fresh henbane are popularly applied where the plant abounds for the relief of local pains, and internally its preparations are of common use to allay *neuralgic* and other pains that hinder sleep. It is also used to lessen the tendency to gripe of certain cathartics given in a pilular form, for it has the advantage of relaxing rather than confining the bowels. Like the other mydriatics, henbane (hyoscyamine, hyoscine) is used to dilate the *pupil*. *Poisoning* by ether should be treated by evacuating the stomach, applying warmth to the extremities and cold to the head, and administering stimulants, particularly coffee, and morphine hypodermically in small and repeated doses. In a case of poisoning by hyoscine recovery followed repeated doses of chloral. It is recommended not to give hyoscyamine or hyoscine to patients with degenerate arteries or chronic cardiac disease, or to very old people.

The *dose* of powdered henbane is stated at Gm. 0.30–0.60 (gr. v–x), but this form of the medicine is rarely used. Hyoscyamine may be given in the dose of 1 Mgm. ($\frac{1}{65}$ gr.), repeated at intervals of several hours, or, if not for a temporary purpose, the dose should be prescribed twice a day, and gradually increased until its characteristic effects are observed in the pupils and in the throat. But in cases of great functional excitement or disorder from Gm. 0.016–0.06 ($\frac{1}{4}$ grain to 1 grain) may be given by the mouth. But in every case it should be administered tentatively. Hypodermically, its action is

relatively far more powerful than when it is given by the stomach, but the dose of $\frac{1}{65}$ gr. can generally be administered in the cases here referred to.

In addition to the formula given above, the following is recommended (Gill): R. Hyoscyaminæ gr. x; spt. vin. rect. ʒj; ætheris sulph. fʒiv. The two latter are mixed, and the mixture will fully dissolve the hyoscyamine; then water is added to make the whole 20 ounces. This solution contains $\frac{1}{2}$ grain of hyoscyamine to the ounce.

Hyoscine may be given subcutaneously or internally. The commencing dose by the former method should not, in chronic cases of insanity, exceed Gm. 0.0005–0.001 (gr. $\frac{1}{130}$–$\frac{1}{65}$), nor be continued longer than a few days at a time. By the mouth the dose should be about twice as great as that given hypodermically. In this manner it acts more slowly, but maintains its action longer, and is less dangerous (Darnbluth, Kry, Rabow) both in its primary action and when given continuously. As it is tasteless, it can be concealed in various drinks without being recognized by patients, especially when they revolt, as they are apt to do, against the hypodermic syringe. Iodide of hyoscin, Gm. 0.01 (gr. $\frac{1}{6}$), distilled water, Gm. 10 (fʒiiss), S. Gm. 0.50 (8 drops), in water, milk, or wine (Rabow). R. Iodide of hyoscine, gr. j, distilled water, ♏200. Each minim contains $\frac{1}{200}$ gr. of the salt, which is held (Bruce) to be sufficient for the first hypodermic injection.

The best antidote for hyoscine is said to be chloral.

Duboisia.—The first experiments made with the extract of duboisia and the sulphate of duboisine showed them to be powerful mydriatics, dilating the pupil more promptly and energetically than atropine, and sustaining this influence for a longer time. In its action on the eye duboisine differs from atropine in this, that it rapidly produces dilatation of the pupil and almost simultaneously total paralysis of accommodation, while repeated applications of atropine are necessary to paralyze the ciliary muscle completely.

Duboisia Hopwoodii furnishes *pituri*, whose action differs from that of duboisine. According to Ringer, "it produces faintness, pallor, giddiness, tremor, hurried and superficial breathing, and increased frequency of the pulse, with perspiration; in large doses, salivation, drowsiness, convulsive twitching, and spasmodic rigidity of the extremities. In small doses, internally, it contracts, and in large doses widely dilates, the pupils; locally applied, also, it contracts, and then widely dilates, the pupils." It seems to be a feeble mydriatic (*Amer. Jour. of Med. Sci.*, Apr. 1879, p. 539).

Duboisine may be used as a substitute for atropine in all *affections of the eye* for which the latter is employed, including disorders of *accommodation*, *iritis*, and diseases of the *cornea*. "The greater rapidity with which the dilatation of the pupil, and the paralysis of accommodation caused by it, pass off, renders it superior to atropine for use in determining the refraction; while, on the other hand, its greater tendency to produce constitutional disturbance should cause it to be carefully used" (Norris). According to Little, the only superiority of duboisine over atropine consists "in gaining time in the study of refraction" (*Phila. Med. Times*, x. 321). According to Jones, it is more certain than atropine, and less liable to be followed by irritable conjunctiva. It appears to have the same effect as atropine in moderating the *sweats* of phthisis, and the additional merit of reducing instead of accelerating the pulse. Dujardin-Beaumetz, Desnos, and others have used this preparation in the treatment of *exophthalmic goitre*, causing a marked diminution of the cardiac palpitation and vascular throbbing. It does not, however, lessen the tumor nor permanently suspend the symptoms of the disease (*Bull. de Thérap.*, xcix. 89; c. 59). It has been alleged to be a valuable remedy in the typhoid state and for the somnolence produced by dentition. Such erroneous conceptions of therapeutics cannot be too strongly condemned.

Duboisine may be given hypodermically in the dose of Gm. 0.0005 to 0.001 ($\frac{1}{130}$ to $\frac{1}{65}$ grain), and for ophthalmological purposes a solution is used of Gm. 0.20–0.25 (3 or 4 grains) in Gm. 32 (a fluidounce) of distilled water.

HYPERICUM *Fr. Cod.*—St. John's Wort.

Millepertuis, Casse-diable, Fr.; *Johanniskraut, Hartheu*, G.; *Hypericon*, Sp.

Hypericum perforatum, *Linné.*

Nat. Ord.—Hypericaceæ.

Description.—This plant grows in fields and on roadsides throughout Europe, Northern Africa, and a considerable portion of Asia, and has been extensively naturalized in North America and in other countries. It has a perennial woody and branching dark-brown root and a somewhat two-edged stem about 60 Cm. (2 feet) high. The leaves are

opposite, sessile, oblong or linear-oblong, nearly 25 Mm. (one inch) long, obtuse, entire on the margin, and pellucid-punctate. The flowers are in open terminal cymes, deep-yellow, nearly 25 Mm. (one inch) broad, and are furnished with numerous stamens clustered in three groups, and with a three-celled ovary. The petals, anthers, leaves, and stem are more or less marked with black dots. When bruised the herb has a slight balsamic odor; its taste is somewhat resinous, bitter, and slightly astringent. The flowering-tops, on drying, lose from 60 to 65 per cent. in weight.

Constituents.—Buchner (1830) found in the flowers a little tannin, producing a dark-green color with ferric salts, some pectin, and 8 per cent. of a red coloring principle, *hypericum red*, which is soluble in alcohol, ether, volatile oils, and warm olive oil, and dissolves with a green color in ammonia and other alkalies; calcium and lead salts produce yellow precipitates, ferric chloride a yellowish-green one. According to Clamor-Marquart, this coloring matter is a mixture of a red and a yellow principle, and is mainly contained in the black glands.

Pharmaceutical Uses.—The fresh flowering-tops, digested with olive oil sufficient to cover them, yield a yellowish-red liquid, *Oleum hyperici*, which is popularly known as *red oil*. Linseed oil is sometimes used in place of olive oil.

Allied Plants.—Several other European species of Hypericum possess similar properties, and some of our North American species may be equally effective.

Hypericum sarothra, *Michaux* (Sarothra gentianoides, *Linné*, s. Sar. hypericoides, *Nuttall*), has thin almost thread-like branches, opposite awl-shaped scaly leaves, and minute sessile yellow flowers. It is common in sandy fields in the United States, where it is known as *orange-grass* or *pine-weed*, and is sometimes used like the preceding.

Ascyrum crux-Andreæ, *Linné* (*St. Andrew's cross*), is a decumbent North American herb with narrow oblong-obovate leaves and solitary flowers, having the four linear-oblong yellow petals arranged in the form of a cross.

Action and Uses.—The aromatic and terebinthinate odor of this plant when it is crushed in the hand, and its resinous and bitter taste, sufficiently account for the vogue which it enjoyed in certain diseases even from ancient times. The ancients attributed to it stimulating, drying, cleansing, and cicatrizing powers, and held it to be diuretic and emmenagogue and a specific remedy for wounds, ulcers, and burns. In the Middle Ages analogous virtues were ascribed to it, as well as curative powers in calculous affections, intestinal worms, and mental disorders. In more recent times it was given for the relief of chronic *catarrh* of the *lungs*, *bowels*, and *urinary passages*, and was especially esteemed in the last. It was also used in hot infusion to bring on retarded *menses*. Externally, it was applied in the fresh state, bruised, as a discutient for recent *contusions* and for the relief of local *pains*. Red oil, above described, is one of the most popular applications made to *excoriations*, *wounds*, and *bruises* both in Europe and in this country. In 1883 (*British Med. Jour.*, Dec. 8) it was recommended by Snow as an application to *bed-sores*. An infusion may be prepared with Gm. 32 (an ounce) of the plant in a pint of hot water. *H. Sarothra* is said to be an aperient, and the bruised root of Ascyrum Crux-Andreæ has been applied as a resolvent to enlarged and indurated glands.

HYSSOPUS.—Hyssop.

Hysope, Fr. Cod.; *Isop*, *Ysop*, G.; *Hissopo*, Sp.

Hyssopus officinalis, *Linné*.

Nat. Ord.—Labiatæ, Satureieæ.

Description.—Hyssop is an herbaceous perennial indigenous to Southern Europe, frequently cultivated and sparingly naturalized in the United States. It is about 30 Cm. (1 foot) high, with wand-like simple quadrangular branches and opposite, sessile, linear-lanceolate, entire, and nearly obtuse leaves, which are about 25 Mm. (one inch) long, nearly smooth, and finely punctate on both sides. The purplish-blue flowers are in small clusters, and have a fifteen-ribbed calyx, a two-lipped corolla with a rather short and notched upper lip, and four exserted and divergent stamens. Hyssop has an aromatic somewhat camphoraceous odor and a pungent, aromatic, and bitterish taste.

Constituents.—Aside from tannin, resin, fat, sugar, mucilage, etc., the most important constituent is *oil of hyssop*, of which the fresh herb yields ¼ to ½ per cent. It is pale-yellow or greenish, limpid, of about the specific gravity 0.94, and freely soluble in alcohol; it contains oxygen, and commences to boil at 142° C. (287.6° F.), the boiling-point rising to 180° C. (356° F.). It has the odor and taste of the herb. The *hyssopin* of Herberger (1829) was found by Trommsdorff to be impure calcium sulphate.

Allied Plants.—Cunila mariana, *Linné*, (*Dittany*), a North American plant, grows in dry soil, has a thin, purplish, much-branched stem and nearly sessile, ovate, serrate, smooth leaves, which are rounded or subcordate at the base. The pale-purple flowers are in small pedunculate clusters and have two exserted stamens.

Satureja hortensis, *Linné.*—Summer savory, *E.;* Sarriette, *Fr.;* Saturei, Bohnenkraut, *G.*—This South European annual is cultivated as a culinary herb. The stem is much-branched, roughish-pubescent; the leaves are linear-lanceolate or oblong-linear, entire, acute, and tapering into a very short petiole; the cymules are about three-flowered, with the corolla pale-purplish, and with four diverging rather included stamens.

Satureja montana, *Linné*, (Micromeria, *Reichenbach*).—Winter savory, *E.*—It is suffruticose, retrorsely hairy, and has hairy whitish or reddish flowers in small axillary clusters, and linear-lanceolate, mucronate leaves, pellucid punctate and rough on the margin. Haller (1882) obtained from it 0.83 per cent. of volatile oil having an orange-yellow color, an odor resembling that of origanum, and the density 0.7394 at 17° C.; it is levogyre, and contains two hydrocarbons and two phenols, one of the latter being identical with *carvacrol.*

Salvia axillaris, *Sesse*, is the hyssop of Mexico.

Pycnanthemum linifolium, *Pursh* (*Virginia thyme*), has rigid, narrowly linear sessile crowded leaves, which are entire and three-nerved; the flowers are in terminal hemispherical clusters, supported by imbricate, rigidly-pointed bracts. It has been popularly regarded as useful in hydrophobia, and has been employed in atonic dyspepsia.

Pycn. lanceolatum, *Pursh*, resembles the preceding, but has lanceolate or lance-linear leaves; both have a resinous and bitter taste.

Pycn. incanum, *Michaux*, has broader ovate-oblong, hoary, pubescent leaves and an aromatic mint-like taste. It is known as *mountain-mint*, *wild-basil*, and in some places as *horse-mint*, and is used like Monarda.

Ch. Mohr (1876) isolated from Pycn. linifolium a tannin which is very similar to, if not identical with caffeo-tannic acid; volatile oil, resin, bitter principle, etc. were likewise obtained.

Thymus vulgaris, *Linné* (Bentley and Trimen, *Med. Plants*, 205); Herba thymi, *P. G.*—Garden thyme, *E.;* Thym, *F. Cod.:* Thymian, Römischer Quendel, *G.:* Tomillo, *Sp.*—A small South European suffruticose plant which is often cultivated for culinary purposes. The leaves are ovate-oblong or linear, revolute on the margin, grayish-green, glandular, punctate on both sides and pubescent beneath, the upper ones bearing in their axils small clusters of whitish or reddish flowers with exserted stamens.

Thymus serpyllum, *Linné;* Herba serpylli, *P. G.*—Wild thyme, *E.;* Serpolet, *F. Cod.:* Quendel, Feldthymian, *G.;* Serpol, *Sp.*—It is a common prostrate suffruticose plant indigenous to Europe and Northern Asia and to some extent naturalized in North America. The leaves are petiolate, flat, ovate or roundish-lanceolate, occasionally linear, entire, ciliate near the base, glandular on both sides, otherwise smooth. The purple or rose-colored flowers are aggregated heads or dense spikes terminating the branches, and have the four stamens included or sometimes exserted. It is a variable plant, including several nominal species, among them Thymus citriodorus, *Schreber*, the *lemon-thyme*, which has an agreeable odor resembling that of melissa and of lemon. Both thymes have a strong aromatic odor due to volatile oil. (See Oleum Thymi.)

Micromeria Douglasii, *Bentham*, s. Mic. barbata, *Fischer et Meyer.* It is a perennial creeping or trailing, sweet-scented herb of the Pacific coast from California to Washington Territory, and is known as *yerba buena.* The leaves are roundish-ovate, thin, sparingly toothed and short-petioled; the purplish flowers are mostly solitary in the axils on long and filiform peduncles.

Action and Uses.—Anciently hyssop seems to have been used as a cathartic, for we read in Scripture, "Purge me with hyssop, and I shall be clean;" and, if this passage be thought to apply only to external cleansing, Pliny says expressly that "mixed with figs it purges, and with honey vomits." He also refers to its external use in phthiriasis. Nevertheless, it is by no means certain what plant or plants were anciently called hyssop. Down to a quite recent period hyssop was used to improve digestion, particularly in atonic and flatulent *dyspepsia*, and, like other plants which are so employed and contain an essential oil associated with a bitter and astringent principle, it is found useful in subacute and chronic *bronchitis*, especially in old persons, also in *amenorrhœa*, and externally as a stimulant application to *bruises* and in muscular *rheumatism.* Its infusion was also employed as a gargle in *sore throat* of the diphtheritic form. Hyssop may be given in an infusion made with Gm. 4 (℥j) of the herb to a pint of water. The essential oil was formerly given in doses of Gm. 0.06–0.12 (gtt. j–ij).

Maryland cunila (dittany) is employed as a diaphoretic in slight fevers and colds. *Summer savory* and *Winter savory* have essentially the same medicinal virtues as the other plants in this group. They are used as vermifuges and for the itch, and also for dyspeptic disorders. *Ditana digitifolia*, a native plant of Brazil, is reputed to be a galactagogue (*Med. Record*, xx. 420; *Therap. Gaz.*, x. 100; xi. 122).

ICHTHYOCOLLA, *U. S.*—Isinglass.

Colla piscium.—Fish glue, E.; *Ichthyocolle, Colle de poisson*, F. Cod.; *Hausenblase, Fischleim*, G.; *Col de pescado*, Sp.

The swimming-bladder of Acipenser Huso, *Linné*, and of other species of Acipenser. Class Pisces. Ord. Sturiones.

Origin.—Isinglass is mentioned by the British Pharmacopœia among the articles employed in chemical testing. The kind preferred is that known in commerce as *Russian isinglass*, which is obtained from several sturgeons, species of Acipenser, which inhabit the Caspian and Black Seas and their tributary rivers, and the most important of which are Ac. Huso, *Linné*, or *belugo;* Ac. Güldenstädtii, *Ratzeburg*, or *osseter;* Ac. ruthenus, *Linné*, or *sterlet;* and Ac. stellatus, *Pallas*, or *sevruga*. It is prepared by cutting the air-bag or swimming-bladder open, washing and soaking it in water, and spreading it upon boards, the outer silvery membrane being turned upward and removed by rubbing. The bladder is then merely dried in sheets, and constitutes *leaf isinglass*, or several are put together and folded before they are completely dry, forming *book isinglass*, or each bladder is rolled up and folded around a few pegs in the form of a horseshoe, heart, or lyre, in which shape it is dried. The latter is the *staple isinglass*, which, according to its dimensions, is again divided into *long* and *short staple*. The kind now most commonly met with in our commerce is the leaf isinglass.

Description.—Russian isinglass is a somewhat horny and tough membranous tissue, which is semi-transparent, of a whitish or pale-yellowish color, pearly appearance, and iridescent; it is best torn in the direction of its fibres, is inodorous, and quite insipid in taste. Immersed in water or diluted alcohol, it swells, becomes opaque, and dissolves at a somewhat elevated temperature, leaving a flocculent residue not exceeding 2 per cent.; on cooling, its solution with 24 parts of water congeals to a transparent jelly. On incineration, it leaves 0.5 per cent. of ash. Isinglass which is discolored or less soluble in water is not adapted for medicinal purposes.

Constituents.—Besides membranous matter and some salts, isinglass consists of that variety of gelatin known to chemists as *glutin*. (See Gelatina, page 767.)

Adulterations.—In the place of Russian isinglass the swimming-bladder of other fishes is sometimes sold, and the intestines of various animals are said to be coated with gelatin and used for a like purpose. Such substitutions or adulterations are easily recognized by the larger amount of ash (3 to 10 per cent.) left on incineration or by the larger proportion of matter insoluble in hot water. Gelatin immersed in cold water swells, retains its transparency, and becomes soft and easily disintegrated.

Other Varieties of Isinglass.—The air-bags of most large fishes appear to be adapted for some of the purposes for which isinglass is used in the arts; when they are dried without being split open they are known as *purse* or *pipe isinglass*.

American isinglass, according to C. T. Carney (1857), is prepared from the sounds of Gadus merluccius, *Linné*, or *hake;* they are cleansed, soaked in water, passed through rollers, and dried in the form of ribbons or thin and transparent sheets. C. C. Meyer (1873) found the former to leave 30 per cent., and the latter only 18 per cent., of matter insoluble in water; the fresh bladder of a hake weighing 15 ounces left 1 ounce undissolved. Storer states that the swimming-bladder of Otolithus regalis, *Cuvier*, the *weakfish*, likewise furnishes some isinglass.

Brazilian isinglass comes from species of the genera Pimelodus and Silurus, the entire sounds being often dried so as to adhere together (*lump isinglass*), and the lumps are sometimes split open (*honeycomb isinglass*). A false isinglass from Para consisted, according to Pereira (1853), of the ovaries of a fish, probably Sudas gigas.

East Indian isinglass is produced from several large fishes, and is met with in the form of purses and of leaves.

Japanese or *Chinese isinglass* is a vegetable product. (See Chondrus.)

Action and Uses.—Isinglass was anciently applied as a protective to the skin when it was *abraded* or affected with *eruptions*. It is emollient and nutritive, and forms a valuable addition to boiled milk or to farinacea prepared with milk in treating the chronic bowel complaints of children. In court-plaster it is used for its adhesive qualities.

ICHTHYOLUM.—Ichthyol.

Source and Preparation.—The various compounds at present on the market under such names as ammonium ichthyol, sodium ichthyol, zinc ichthyol, etc., are all salts of a bibasic acid known as ichthyolsulphonic or sulphoichthyolic acid. When no specification is made the simple term ichthyol is understood to refer to the ammonium salt. The source of this class of preparations is a crude oil, obtained by destructive distillation of

bituminous rock found in immense quantities near Seefeld in the Tyrol mountains of Europe at an elevation of 3000–4000 feet; the rock is filled with petrified remnants of prehistoric fish and marine animals—hence the name—ichthyol oil from the Greek word *ἰχθύς* (fish). The crude oil is a brownish-yellow transparent liquid of 0.865 specific gravity, boiling between 100° and 225° C. (212°–437° F.), and possessing a peculiar penetrating somewhat aromatic odor. If subjected to fractional distillation about 6 per cent. will pass over between 100°–120° C., 53 per cent. between 120°–160° C., 33 per cent. between 160°–225° C., and about 6 per cent. between 225°–255° C. The crude oil mixed with an excess of concentrated sulphuric acid, becomes heated, reaching a temperature of 100° C. (212° F.), and forms ichthyolsulphonic acid with copious evolution of sulphur dioxide. After the reaction has ended the mixture is repeatedly treated with concentrated solution of sodium chloride, whereby sulphurous and sulphuric acids are removed, while the newly-formed sulphonic acid separates in form of a dark extract-like mass which retains a small quantity of unchanged oil, and hence its odor.

Ichthyol contains a large proportion of sulphur—about 10 per cent—combined in a manner not yet understood; it cannot be extracted with boiling soda or potassa solution nor by treatment with sodium-amalgam.

Ammonium ichthyolsulphonate or ammonium ichthyol is obtained by saturating the acid with ammonia, and occurs as a clear, reddish-brown syrupy liquid with a bituminous odor and taste. It is soluble in water and in a mixture of equal volumes of ether and alcohol (the solution being faintly acid); alcohol or ether alone take up only a part of it, so also petroleum benzin. Dried on a water-bath, ammonium ichthyol loses about 45 per cent. of its weight. It is chiefly employed in form of an ointment (10 to 50 per cent.), made with lanolin or petrolatum, and has been found serviceable in the treatment of erysipelas and rheumatism. Internally it has been given in doses of 5 to 20 minims in milk.

Other salts of ichthyolsulphonic acid such as sodium, lithium, zinc, and mercury are prepared by saturating the acid with the respective oxides or carbonates. They all occur as brownish, black, tar-like masses, but the sodium salt is the only one of importance, being employed when it is desired to give ichthyol in pill form.

Allied Drugs.—Thiolum—Thiol.—This compound has been proposed as a substitute for ichthyol, and occurs both in dry and liquid form. It is prepared by heating brown-colored paraffin or gas oils of 0.890 to 0.900 spec. grav. with sulphur and extracting the sulphurated unsaturated hydrocarbons with alcohol. Upon removing the alcohol by distillation a dark brown oily liquid remains; this oil when treated with concentrated sulphuric acid is changed into a water-soluble compound, which is then purified by ammonia to remove free acid, and finally precipitated by sodium chloride or sulphate. Pure thiol is a neutral solid body non-hygroscopic and soluble in water; it occurs in powder form and also in aqueous solution, the former of dark brown color, and the latter a dark reddish-brown syrupy liquid, containing about 40 per cent. of thiol.

Tumenolum—Tumenol.—This is a mixture of sulphones and sulphonic acids, obtained from purified mineral oils by the direct action of concentrated sulphuric acid, without previous sulphuration. It occurs as a dark-colored acid syrup; the separated sulphones (extracted by ether from a neutral mixture prepared with soda) are known as tumenol oil, a dark-yellow thick liquid, insoluble in water but readily soluble in ether and benzene. Crude tumenol may be freed from adhering acid by repeated solution in water and precipitation by sodium chloride; it is a tough brown mass, resembling ichthyol, and consists of a mixture of tumenol sulphone and tumenolsulphonic acid; the latter substance occurs as a dark-colored faintly bitter powder, readily soluble in water. Like ichthyol and thiol, tumenol has been successfully employed in eczema, pruritus, etc.

(For Action and Uses, see page 1209).

ILEX.—Holly.

Houx, Fr.; *Stechpalme, Christdorn*, G.; *Acebo*, Sp.

The leaves of different species of Ilex.

Nat. Ord.—Aquifoliaceæ.

Origin and Description.—Ilex opaca, *Aiton* (*American Holly*). It is indigenous to the United States, and is either shrubby or a tree 9 or 12 M. (30 or 40 feet) high. The leaves are petiolate, coriaceous, and evergreen, about 5 Cm. (2 inches) long, oval in shape, and with a wavy-toothed margin, the teeth being furnished with rigid and sharp spines. They are without odor and have a mucilaginous, bitterish, and astringent taste.

Ilex aquifolium, *Linné* (*European Holly*), is very closely related to the preceding. The leaves differ in being rather ovate, dark-green and glossy on the upper surface,

Ilex cassine *Linné* (known as *yaupon*, *youpon*, or *cassena*). It grows in the United States from Virginia southward. The leaves are shortly petiolate, about 25 Mm. (1 inch) long, coriaceous, varying in shape between lance-ovate, ovate, and oblong, crenate on the margin, smooth, dark-green, and glossy above, and paler beneath. They are inodorous, and have an astringent and bitterish taste.

The following two species are likewise known as *cassena* in the Southern States:

Ilex dahoon, *Walter*, has leaves about 5 Cm. (2 inches) long, which are oblong or oblanceolate, with the margin revolute or entire or sharply serrate toward the apex.

Ilex myrtifolia, *Walter*. The leaves are linear-lanceolate or linear-oblong, 25 Mm. (1 inch) long, entire on the margin or furnished with a few sharp teeth.

The fruit of these species is a red drupe, usually containing four one-seeded ribbed or grooved nutlets.

Ilex paraguayensis, *St. Hilaire*, is a small tree indigenous to Brazil and the Argentine Republic. The leaves are oblong or lanceolate, wedge-shaped at the base, rather obtuse at the apex, and with distant teeth on the margin. They furnish the *yerba mate* or *Paraguay tea*, also known as *Jesuits' tea* and *St. Bartholomew's tea*, which is extensively used in South America, the annual consumption in the Argentine Republic alone being estimated at 27,000,000 pounds, or about 13 pounds per head. It is prepared as follows: The small branches with the leaves are placed in the *tatacúa*, a plot of earth about 6 feet (1.8 M.) square, surrounded by fire, where they undergo their first roasting. They are thence taken to the *barbacúa*, which is a grating underneath which burns a fire, where they are somewhat torrefied to develope the aromatic principle. The leaves are subsequently reduced to powder in a sort of mortar formed of pits dug in the earth and well rammed. More recently, suitable furnaces have been erected for drying and torrefaction, and mills are used for powdering. According to Peckolt, the leaves possess most aroma when the fruit is nearly ripe, and are collected in different parts of South America from December or January till the following August or September.

Constituents.—The leaves of the European holly were examined by Lassaigne (1822), Déleschamps (1832), Lebourdais (1841), Moldenhauer (1857), and Bennemann (1858). The four first-named investigators obtained the bitter principle as a more or less colored amorphous mass; Bennemann, in the form of feathery crystals too small in quantity for further investigation. Déleschamps' *ilicin* was *not*, but Moldenhauer's and Benneman's *was*, precipitated by lead subacetate; Lebourdais's ilicin was absorbed from the decoction by animal charcoal and extracted from it by boiling alcohol. D. P. Pancoast's (1856) ilicin was obtained by Lebourdais's process from the fruit of the American holly, and is described as being in minute needles; the same process applied to the leaves yielded an amorphous green mass.

Moldenhauer isolated *ilixanthin*, $C_{17}H_{22}O_{11}$, the yellow coloring matter of the leaves, in the form of straw-yellow needles which are soluble in alcohol and boiling water, but insoluble in ether. *Ilicic acid* is syrupy; its barium salt is amorphous; the calcium salt crystallizes in scales.

The yaupon contains 0.122 per cent. of *caffeine*, 2.409 per cent. of tannin, 4 per cent. of ash, besides wax, resin, etc., according to the analysis of H. M. Smith (1872). Caffeine was also found in mate by Stenhouse (1843), who regards the tannin as differing somewhat from caffeo-tannic acid. Rochleder, on the contrary, considered the tannin from the two sources as identical, but, according to Arata (1877), *matetannic acid* gives with baryta-water a green, and with lead acetate a yellow-greenish, precipitate, and its precipitate with gelatin is insoluble in the tannin solution; like caffeo-tannin, it is not precipitated by tartar emetic, and on dry distillation yields pyrocatechin. Alonzo Robbins (1878) examined seven samples of maté, and found the caffeine to vary between 0.2 and 1.6 per cent. and the tannin between 10 and 16 per cent.; the samples containing the largest amount of caffeine yielded the least tannin, and *vice versâ*. Stenhouse had found 0.13 (in 1843) and 1.2 (in 1851) per cent. of caffeine. According to Peckolt, the average is 0.5 per cent., and the air-dried leaves vary to about the same extent as mate in the percentage of caffeine; 0.24 per cent. of crystallizable mateviridic acid is present in both, also a minute quantity of volatile oil and stearopten.

Action and Uses.—According to Barbier, holly-leaves (*I. aquifolium*) and their preparations produce a sense of heat and oppression in the stomach, with some nausea, followed by colic without diarrhœa. The berries vomit and purge, and at least one case is recorded of their proving fatal to a child. The leaves, being bitter, were naturally employed for the cure of *intermittent fever*, but clinical observations by competent physicians have proved that the curative power of the medicine in this disease is abso-

lutely null. The leaves have been used in *rheumatism*, internally and topically, and the berries as cathartics in *dropsy*. The leaves of *I. Cassine* are reported to be diuretic, and are employed in calculous disorders, and also as a mild emetic. They were formerly used by American Indians for the latter purpose (*Therap. Gaz.*, lx. 504). An American species, *I. opaca*, is demulcent, and is used in decoction to palliate *cough* and promote expectoration. *I. paraguayensis*, or Paraguay tea, is employed in its native country very much as Chinese tea is used elsewhere, and for similar purposes and with like effects, or, more precisely, with effects like those of coca. According to Couty (1879), when its infusion was injected into an animal's stomach it excited efforts to urinate, with priapism and quickening of the pulse (*Archives gén. de Méd.*, 7 sér. iii. 239). In 1881, Couty and Arsonval declared that it "diminished the carbonic acid and the oxygen of the arterial blood to the extent of one-third or even one-half," and that thus it exerted a powerful influence upon the nutritive function (*Bull. de Thérap.*, ci. 81). Its infusion is said to be sudorific or diuretic, and in large doses drastic.

ILLICIUM, *U. S.*—Illicium.

Anisi stellati fructus, Br.; *Semen badiani.—Star-anise, Chinese anise*, E.; *Badiane, Anise étoilé*, Fr.; *Sternanis*, G.; *Semen estrellado*, Sp.

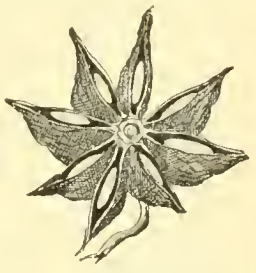
The fruit of Illicium verum, *Hooker filius*. Bentley and Trimen, *Med. Plants*, 10.

Nat. Ord.—Magnoliaceæ.

Origin.—This is a shrub or small tree 2.4 or 3.0 M. (8 or 10 feet) high, with evergreen lanceolate, entire, pellucid-punctate leaves and greenish-yellow polypetalous flowers. It is indigenous to the high mountains of Yunnan in South-western China and to the west of Canton.

Description.—Star-anise consists of about eight boat-shaped follicles, which are horizontally arranged in one circle around a pedunculate short axis. The follicles are about 12–15 Mm. ($\frac{1}{2}$ to $\frac{3}{5}$ inch) long, have a shallow depression above near the apex, and a straight beak, which in the commercial article is usually partly broken off; they are rather woody, externally wrinkled and brown, internally smooth, red-brown, and glossy, and on the upper margin usually split open. Each carpel has a single seed, which is oval, flattened, oblique at the base, smooth, and of a polished brown-yellow color, and contains a large oily albumen enclosing the small embryo. Star-anise yields about 78 per cent. of capsular integuments, which have a very agreeable anise-like odor and a sweetish aromatic taste. The seeds weigh about 22 per cent., are but slightly aromatic, and have an oily taste. The poisonous fruit of Ill. religiosum, described below, has been occasionally mixed with star-anise.

Fig. 155.



Star-anise.

Constituents.—The fruit and seeds were separately examined by Meissner (1818), who obtained from the former 5.3 per cent. of volatile oil, 2.8 of fat, 10.7 of resin, etc.; the fruit seems also to contain a little tannin, mucilage, and pectin. The seeds were found by Meissner to yield only 1.8 per cent. of volatile oil and 2.6 per cent. of resin, but about 20 per cent. of fixed oil. The volatile oil is chemically identical with that of Pimpinella Anisum. (See Oleum Anisi.) According to Eykman (1880), the fruit contains an alkaloid, which has not been further examined.

Allied Plants.—Illicium religiosum, *Siebold*. This has usually been regarded as identical with the preceding, until attention was directed to the important distinctions by Geerts, Eykman, and Holmes in 1880. The plant is indigenous to Eastern Asia, and is often cultivated in Japan near the temples; it is a tree 7.5–9 M. (25 to 30 feet) high, with broader and more glaucous leaves and with an aromatic bark. The fruit, like the preceding, consists of eight follicles spreading horizontally, but only a portion of these are usually developed to maturity; each follicle is about 3 or 10 Mm. ($\frac{1}{3}$ or $\frac{2}{5}$ inch) long, is woody, often shrivelled, has near the apex a short and rather deep depression, terminates with a short curved beak, and has a faint clove-like odor and an unpleasant taste. The plant is known in Japan as *sikimi* or *shikimi*. Eykman found in the fruit an alkaloid and a poisonous neutral principle, *sikimin*, which crystallizes in hard prisms or needles, is insoluble in petroleum benzin, slightly soluble in cold water, more freely soluble in hot water, ether, and chloroform, and easily soluble in alcohol and glacial acetic acid. The volatile oil is somewhat heavier than water, slightly levogyre, reduces ammoniacal silver solution, and consists of a terpene boiling near 175° C. (347° F.) and of liquid anethol boiling at 232° C. (450° F.).

Fig. 156.

Illirium religiosum.

Ill. parviflorum, *Michaux*, a native of Florida and Georgia, has yellow flowers and an eight-

carpelled fruit, with a sassafras-like flavor; according to R. E. Griffith, the bark may be used as a substitute for cascarilla.

Ill. floridanum, *Ellis*, grows in Florida and westward to Louisiana, and has purple flowers. The fruit consists of thirteen carpels, has a rather unpleasant terebinthinate taste, and, like the leaves, is poisonous. The plant is known in Alabama as *poison-bay*, and in Louisiana as *stink-bush*.

Ill. Griffithii, *Hooker filius et Thomson*, a native of Eastern Bengal, has a thirteen-carpelled fruit of a bitter and somewhat acrid taste.

Ill. majus, *Hooker filius et Thomson*, grows in the Malayan Peninsula, and has a black-brown fruit consisting of eleven or thirteen carpels, and is of a mace-like taste.

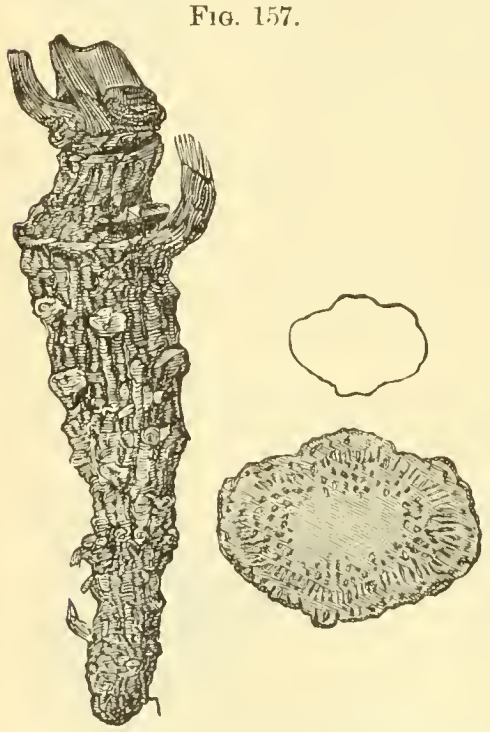
Action and Uses.—Star-anise has the same qualities as the officinal anise, and in the East its seeds and oil are used for similar purposes—viz. as carminative, anodyne, stimulant, and diuretic, and as condiments for vegetable food. Externally, they are applied to allay local pains, such as *colic*, *rheumatism*, *earache*, etc. In Germany they are employed in a similar manner internally and for the relief of *bronchitis*. The native species, *I. floridanum*, is aromatic in its leaves, bark, and seeds; the bark has been suggested as a substitute for cascarilla, and the seeds for those of anise. The root of *I. parviflorum* is said to resemble that of sassafras in its properties, but the properties of the seeds seem to be identical with those of *I. religiosum*. The officinal illicium may be administered in the same manner as anise.

I. religiosum has attracted attention within several years on account of its poisonous properties and its close resemblance to star-anise. In 1880 cases of poisoning by the former occurred in Holland, owing to its having been mistaken for the latter (*Am. Jour. Phar.*, Aug. 1881, p. 407); and in the same year in Japan, of five children between two and five years old who had eaten of the fruit, three died, unconscious, in convulsions, and foaming at the mouth. Dr. Langgaard, who relates this case (*Virchow's Archiv*, lxxxvi. 222), states that the Japanese use the powder of the plant, every part of which is poisonous, to destroy rats, and also to kill fish, which are edible in spite of their mode of death.

IMPERATORIA.—Masterwort.

Rhizoma (*Radix*) *imperatoriæ*, P. G.; *Impératoire*, Fr. Cod.; *Meisterwurz*, *Kaiserwurz*, G.

Fig. 157.



Imperatoria Ostruthium, *Linné*: root-stock natural size; and transverse section, natural size and magnified.

The root-stock of Peucedanum (Imperatoria, *Linné*,) Ostruthium, *Koch*.

Nat. Ord.—Umbelliferæ, Peucedaneæ.

Origin.—Masterwort is indigenous to the mountainous regions of Southern and Central Europe, grows 60 or 90 Cm. (2 or 3 feet) high, and has large umbels of many white or reddish flowers. The root-stocks are produced at the termination of thin rhizomes which are about 15 Cm. (6 inches) long.

Description.—The horizontal root-stock is 5—10 Cm. (2 to 4 inches) long, of the thickness of a finger, somewhat conical, and slightly flattened. Externally, it is dark brownish-gray, wrinkled, with warty protuberances or scars, and finely annulate. Internally, it is brownish-white, and exhibits upon the transverse section a thin bark and a large central pith, both containing many brown-yellow resin-cells; the wood-bundles are small, yellowish, and form a loose circle. Masterwort has a strong balsamic odor and an aromatic, pungent, and bitter taste. It has been noticed by Holmes (1877) as an adulteration of aconite-root.

Constituents.—Masterwort contains about ¾ per cent. of volatile oil, which, according to Hirzel (1849) is a mixture of several hydrates of a hydrocarbon, $C_{10}H_{16}$. Wackenroder (1831) obtained colorless shining crystals of *imperatorin*, $C_{12}H_{12}O_3$, which, in alcoholic solution only, have a pungent taste. Schlatter (1833) obtained *peucedanin* from the root of Peucedanum officinale, *Linné*, which was after-

ward proved by R. Wagner to be identical with imperatorin. Both principles, when boiled with an alcoholic solution of potassa, are resolved into *angelic acid* and *oreoselin*, $C_{14}H_{15}O_4$. The latter body may also be obtained from *athamantin*, $C_{34}H_{30}O_7$, which was discovered by Winckler (1842), in the root of Athamanta (Peucedanum, *Mœnch*) Oreoselinum, *Linné*. Athamantin resembles imperatorin, unites with dry hydrochloric acid, and on boiling this compound with alcohol is split into *valerianic acid* and *oreoselon*, $C_{40}H_{10}O_3$, which crystallizes in needles, and on being boiled with water and an acid yields the crystalline oreoselin.

Allied Drug.—Peucedanum officinale, *Linné*.—The root is blackish, internally brownish-yellow, and has a rather thick bark containing numerous orange-colored resin-cells in radial rows, and enclosing a soft porous wood, with resin-cells in the medullary rays.

Action and Uses.—The acrid and aromatic taste of this plant and its odor resembling that of angelica, depend upon its essential oil, and to the stimulating operation of this oil nearly all the medicinal virtues of the medicine are due. It is but little used at the present day, but it was formerly prescribed in various conditions of local or general debility. Among these were the *typhoid state* of fevers and inflammations, *intermittent fever*, *delirium tremens*, and some forms of *dropsy*, atonic *dyspepsia*, *flatulent colic*, *hysteria*, and *asthma;* and locally it was used as a masticatory to relieve *toothache* and *paralysis* of the tongue or palate and as a stimulant of unhealthy *ulcers*. It may be administered in an infusion made with from 5 to 10 parts of the root and 100 parts of hot water.

INDIGO.—Indigo.

Indicum, *Pigmentum indicum.*—*Indigo*, Fr., G., Sp.; *Indaco*, It.; *Añil*, Sp.

A blue dyestuff extracted from different species of Indigofera. Bentley and Trimen, *Med. Plants*, 72.

Nat. Ord.—Leguminosæ, Papilionaceæ, Galegeæ.

Origin.—The genus consists of herbaceous or suffruticose plants which are indigenous to and cultivated in tropical and subtropical countries. The most important species are Indigofera tinctoria, *Linné* (s. I. indica, *Lamarck*), I. Anil, *Linné*, and I. argentea, *Linné* (s. I. glauca, *Lamarck*, I. cœrulea, *Roxburgh*). The same coloring matter is also contained in the *woad*, Isatis tinctoria, *Linné* (Cruciferæ), of Europe, in Polygonum tinctorium, *Linné* (Polygonaceæ), of China, in Gymnema (Asclepias) tingens, *Sprengel*, and in Wrightia (Nerium) tinctoria, *R. Brown*, of Hindostan, which plants are employed for dyeing.

Preparation.—The plants are immersed in water until fermentation has set in, whereby the chromogene is dissolved. When the liquid has assumed a sherry color it is drawn off and briskly stirred, so as to bring it freely into contact with air. As the chromogene becomes oxidized the newly-formed coloring matter, which is insoluble in water, subsides. The supernatant liquid is then decanted, and the deposit heated to boiling to arrest fermentation, after which the precipitate is collected, pressed, and dried. About 3,000,000 pounds of indigo are imported into the United States annually.

Properties.—Indigo is met with in porous, hard, but brittle lumps or cubical cakes, which are inodorous, tasteless, and of a deep-blue color, assuming a coppery lustre when scratched or rubbed with a hard body; inferior qualities are of a dull hue, with a greenish or grayish tint, dense, firm, and not brittle. It is insoluble in the ordinary solvents, dissolves freely in concentrated sulphuric acid, and when rapidly heated sublimes partly in purple-colored vapors which condense into copper-colored needles. The blue color of indigo is destroyed by reducing agents in the presence of alkali and by oxidizing agents.

Constituents.—Indigo of good quality yields about 7 per cent. of ash, and contains the proteid *indigo-gluten*, which is soluble in warm diluted acids, and various brown, red, and yellow coloring matters, besides from 50 to 70 per cent. of the most important principle, *indigo-blue* or *indigotin*, which does not pre-exist in the plant, but is formed from a colorless syrupy bitterish compound called *indican*, $C_{26}H_{31}NO_{17}$. During the treatment described above indican is split, mainly, into a saccharine body, *indiglucin*, $C_6H_{10}O_6$, and indigotin, $C_{16}H_{10}N_2O_2$. On treating indigo with an alkali and grape-sugar or ferrous salt, a yellow solution containing *indigo-white*, $C_{16}H_{12}N_2O_2$, is obtained, from which, on exposure to air, pure indigotin is deposited; and this, by oxidation with nitric acid, forms yellowish-red, bitter prisms of *isatin*, $C_{16}H_{10}N_2O_4$, which on distillation with potassa yield *aniline*. Indigotin is soluble in hot phenol, aniline, nitrobenzene, paraffin, fixed oils, and chloroform.

Soluble indigo, or *sulphate of indigo*, is prepared by gradually adding 1 part of powdered indigo to 5 parts of Nordhausen sulphuric acid or 8 parts of oil of vitriol, and preventing

a rise of temperature by immersing the vessel in cold water. In the course of 2 or 3 days it becomes a dark-blue pasty mass, the solution of which in about 2 parts of water is *liquid blue*. The solution contains *sulphopurpuric acid* or *indigo-purple*, $C_{16}H_9N_2O_2.HSO_3$, and *sulphindigotic* or *sulphocærulic acid*, $C_{16}H_8N_2O_2(HSO_3)_2$; the first one of these is insoluble in dilute acids, in which the second remains dissolved, and is obtained pure by transferring it from its dilute solution to wool and dissolving it from the latter by means of a weak alkali. Its salts are amorphous; the sodium salt is sold in commerce as *indigo-carmine*, and is usually obtained by adding a sodium salt to a solution of sulphate of indigo, washing the precipitate with a solution of the same salt, and expressing; the product is soluble in pure water.

The *synthetical preparation* of indigo-blue has been accomplished by Prof. Adolf Baeyer (1878) by converting toluene, through a number of intermediate products, into isatin, and finally into indigotin. But for use in the arts it is manufactured from cinnamic acid by converting it into *nitro-cinnamic acid*; then into *nitrodibrom-cinnamic acid*, and by the action of caustic alkali into *orthonitrophenyl-propiolic acid*, $C_6H_4(NO_2)C_2COOH$. On heating this with an alkaline solution of grape-sugar, which acts as a reducing agent, oxygen and carbon dioxide are eliminated, and indigotin $(C_6H_4NCHCO)_2$ is produced.

Valuation.—This is based upon determining approximately the amount of indigotin contained in indigo by the process given above, or by exhausting powdered indigo successively with boiling water, dilute hydrochloric acid, dilute potassa or soda (to remove indigo-brown), and alcohol (to dissolve indigo-red); the residue consists of indigotin, from which the ash must still be deducted. Oxidizing agents are also employed for the valuation of indigo; but they affect also other constituents besides indigotin.

Adulteration.—Indigo when dried at 100° C. (212° F.) should lose not over 6 per cent. of moisture, and yield not over 8 per cent. of ash when incinerated. Gum or starch, if present, forms with hot water a mucilaginous liquid or paste, and if treated with strong sulphuric acid is carbonized, coloring the indigo black. Adulteration with Prussian blue is detected with caustic potassa or soda, which does not alter indigo, but liberates from Prussian blue ferric hydroxide, while potassium or sodium ferrocyanide remains in solution.

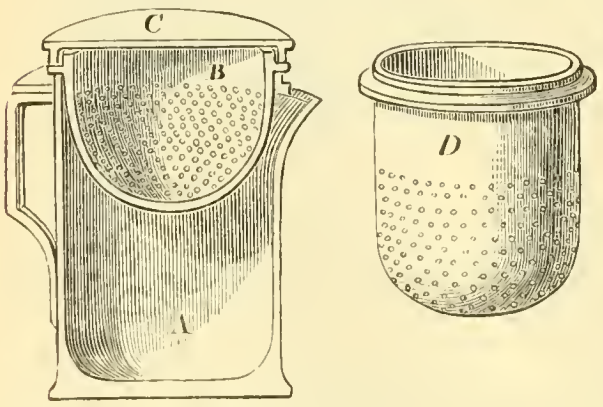
Action and Uses.—During the experiments made many years ago with indigo in the treatment of *epilepsy*, it was given in very large doses, and, as a consequence, deranged the digestive organs, causing vomiting and purging, with debility and some nervous disorder. In some instances the urine and sweat acquired a bluish color. There is not the slightest ground for believing that it exhibits curative virtues in epilepsy or in any other disease. Its dose is usually stated to be from Gm. 0.30 to 1 (gr. v–xv) and upward. *Sulphate of indigo* has been alleged to be a powerful emmenagogue (*Med. Record*, xxxii. 47).

INFUSA, *U. S.*, *Br.*, *P. G.*

Infusions, E., Fr.; *Infusés*, Fr.; *Infusionen*, *Aufgüsse*, G.

Infusions are aqueous solutions of the soluble principles of vegetable or animal drugs obtained by maceration or digestion in hot or cold water, and differ from decoctions only in the lower degree of heat employed in their preparation. Substances containing volatile or other principles which would be dissipated or injured by boiling are particularly adapted for this purpose. Except in a few cases in which percolation is directed, the pharmacopœial infusions are prepared by pouring boiling or cold water upon the material and allowing them to remain in contact for a definite length of time, at the expiration of which the solution is poured upon a strainer, and the solid material expressed to recover the liquid absorbed by it. A convenient apparatus, well adapted for making these preparations, is Squire's infusion-pot: this consists of a jar A, with a projecting ledge near the top, which supports a strainer, B or D, containing the material to be exhausted; the jar is closed by a well-fitting cover, C. The advantages of this contrivance are—that the material is exhausted by circulatory displacement, the liquid, as it becomes charged with the soluble ingredients descending to the bot-

Fig. 158.



Squire's Infusion-Pot.

tom, giving place to fresh portions of less saturated menstruum, and that no further straining is required should care have been taken not to use too fine a powder.

The drugs are best adapted for exhaustion with water if cut into thin slices by a suitable knife, so that they may be easily permeated by the liquid; when cutting is inadmissible they should be bruised to a coarse powder. Ligneous drugs, however, should be in a fine or moderately fine powder, which is also best adapted for most of those which may be made by percolation.

The time directed for the maceration with boiling water is, in the U. S. Pharmacopœia, usually a half hour, and in the British Pharmacopœia fifteen or thirty minutes.

The strength of the infusions of the British Pharmacopœia is usually such that the virtues of 1 part of the drug are represented by 20 or 40 parts of the infusion; the simple infusions for which special directions are given in the U. S. Pharmacopœia are made in the proportion of 1½, 4, or 6 parts to 100 parts by weight. The French Codex classifies these preparations according to their strength, and designates such, 100 or 200 parts of which represent 1 part of the drug, as *tisanes*, *ptisanæ;* they are made either by maceration, infusion, or decoction, and are intended to be used freely. *Bouillons* are similar preparations made from lean meat, with or without the addition of aromatics and other substances. *Apozèmes* are infusions or decoctions differing from tisanes only in being more concentrated.

Infusions are not intended to be kept, except for a very limited period. Exposed to air, as they necessarily must be in the sick chamber through the vial containing them being opened from time to time, decomposition must ensue after a day or two, and may be retarded somewhat only by keeping the vessel in a cool place, or, better still, on ice. When desirable to have a larger quantity prepared the liquid may be preserved by *Appert's method:* it is put into convenient-sized vials, which are heated by a water-bath gradually to the boiling-point, and stopped at that temperature. However, considering that infusions are rarely made by the pharmacist, but are usually prepared by the attendants of the patient, and may be frequently made as required, there is little necessity for such a course or for any of the various contrivances that have been proposed for obviating fermentation and other changes in infusions. But for the physician it may be useful to know that most of the infusions may be prepared in a more concentrated form, or reduced in volume by evaporation at a moderate heat, and then be kept unaltered for a considerable time by the addition of one-third their volume of alcohol. Dissolving ½ grain of salicylic acid in each fluidounce of the infusion will have a similar preservative effect.

Nearly all the infusions will yield precipitates or become discolored with the salts of iron, lead, mercury, silver, and other heavy metals, and are therefore incompatible with them.

The U. S. Pharmacopœia has adopted the plan of ordering all infusions unless otherwise directed by the physician, and with the exception of four specially enumerated, to be made of 1 part of material to 20 parts of infusion according to the following directions: "An ordinary infusion, the strength of which is not directed by the physician nor specified by the pharmacopœia, shall be prepared by the following formula: Take of the substance, coarsely comminuted, 50 Gm.; boiling water, 1000 Cc.; water a sufficient quantity, to make 1000 Cc. Put the substance into a suitable vessel provided with a cover, pour upon it the boiling water, cover the vessel tightly, and let it stand for ½ hour. Then strain, and pass enough water through the strainer to make the infusion measure 1000 Cc. *Caution.*—The strength of infusions of energetic or powerful substances should be specially prescribed by the physician."

The official strength of infusions is equal to about 23 grains of drug for each fluidounce.

The Pharmacopœia omits to direct the expression of the drug after infusion, but it is evident that bulky herbs and flowers, which are best adapted to this process, would retain a considerable proportion of the liquid, which cannot be washed out simply by passing water through the strainer to make up the deficiency in volume.

The strength of infusions of the German Pharmacopœia is double that of our own, but the general directions given for their preparation are nearly identical with the above, from which they differ only in this, that the mixture of drug and boiling water is heated for five minutes in a vapor-bath of boiling water, occasionally stirred, allowed to cool, and strained. The *concentrated* and *highly-concentrated infusions*, made respectively with 1½ and 2 parts of drug to 10 parts of infusion, are no longer recognized.

INFUSUM ANTHEMIDIS, *Br.*—Infusion of Chamomile.

Infusum chamomillæ romanæ.—Tisane de chamomille romaine, Fr.; *Römisch-Kamillen-thee*, G.

Preparation.—Take of Chamomille-flowers ½ ounce; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for fifteen minutes and strain.—*Br.*

A fluidounce of this infusion represents 22 grains *Br.*, or 23 grains of chamomile, if made by the general formula above.

Uses.—The *dose* of this infusion is about a wine-glassful (Gm. 64) before meals; it is more apt to agree with the stomach when made with cold water. The infusion, when warm, is an efficient and gentle emetic. When cold it has been particularly recommended in the *diarrhœa* connected with dentition, when the stools are many, green, slimy and streaked with blood (Elliott).

INFUSUM AURANTII, *Br.*—Infusion of Orange-peel.

Tisane d'écorce d'orange, Fr.; *Pomeranzenschalen-Anfguss*, G.

Preparation.—Take of Bitter Orange-peel, cut small ½ ounce; Boiling Distilled water 10 fluidounces. Infuse in a covered vessel for fifteen minutes, and strain.—*Br.*

Uses.—This infusion may be prescribed to allay pain and flatulence in *colic* and as a vehicle for other medicines, particularly magnesia. *Dose*, Gm. 32–64 (f℥j–ij).

INFUSUM AURANTII COMPOSITUM, *Br.*—Compound Infusion of Orange-peel.

Tisane d écorce d'orange composée, Fr.; *Pomeranzen- und Citronenschalen-Aufguss*, G.

Preparation.—Take of Bitter Orange-peel, cut small, ¼ ounce; Fresh Lemon-peel, cut small, 56 grains; Cloves, bruised, 28 grains; Boiling Distilled Water, 10 fluidounces. Infuse in a covered vessel for fifteen minutes and strain.—*Br.*

Uses.—The compound infusion of orange peel is a grateful carminative, appropriate in *flatulence* and also in slight *diarrhœa* caused by indigestion. *Dose*, Gm. 32–64 (f℥j–ij).

INFUSUM BUCHU, *Br.*—Infusion of Buchu.

Infusum diosmæ s. barosmæ.—Tisane de bucco, Fr.; *Buchuaufguss*, G.

Preparation.—Take of Buchu-Leaves, bruised, ½ ounce; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for thirty minutes, and strain.—*Br.*

A fluidounce of this infusion represents 22 grains, *Br.*, or 23 grains of buchu if made by the general formula given above.

Uses.—This preparation contains all the virtues of buchu, and is preferable to more concentrated forms of the medicine. *Dose*, Gm. 32–64 (f℥j–ij). It is usual to make an infusion with equal proportions of buchu and uva ursi.

INFUSUM CALUMBÆ, *Br.*—Infusion of Calumba.

Infusion of columbo, E.; *Tisane de colombo*, Fr.; *Kolombo-Infusion*, G.

Preparation.—Take of Calumba-root, cut small, ½ ounce; Cold Distilled Water, 10 fluidounces. Macerate in a covered vessel for thirty minutes, and strain.—*Br.*

The infusion made with hot water is much more mucilaginous and unsightly than if made with cold water, either by maceration or percolation. Each fluidounce represents 22 grains *Br.*, or 23 grains if made by the above general formula.

Uses.—This is probably the most useful preparation of colombo if made with due precautions and care be taken to prevent its fermentation. *Dose*, Gm. 64 (f℥ij) before meals.

INFUSUM CARYOPHYLLI, *Br.*—Infusion of Cloves.

Tisane de girofle, Fr.; *Gewürznelken-Infusion*, G.

Preparation.—Take of Cloves, bruised, ¼ ounce; Boiling Distilled Water 10 fluidounces. Macerate in a covered vessel for thirty minutes, and strain.—*Br.*

1 fluidounce of this infusion represents 11 grains *Br.*, and if made by the general formula, 23 grains.

Uses.—Infusion of cloves is used to allay flatulent colic and nausea from exhaustion. *Dose*, Gm. 16 (f℥ss).

INFUSUM CASCARILLÆ, *Br.*—Infusion of Cascarilla.

Tisane de cascarille, Fr.; *Kaskarilla-Aufguss*, G.

Preparation.—Take of Cascarilla-bark, in No. 20 powder, 1 ounce; Boiling Distilled Water 10 fluidounces (Imperial measure). Infuse in a covered vessel for thirty minutes, and strain.—*Br.*

This is of precisely double the strength as indicated by the general formula on page 867.

Uses.—Cascarilla is best administered in this form. It may be given in *doses* of Gm. 64 (f℥ij) two or three times a day.

INFUSUM CATECHU, *Br.*—Infusion of Catechu.

Infusum catechu compositum, U. S. 1870.—*Compound infusion of catechu*, E.; *Tisane de cachou composée*, Fr.; *Catechuaufguss mit Zimmt*, G.

Preparation.—Take of Catechu, in coarse powder, 160 grains; Cinnamon-bark, bruised, 30 grains; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for thirty minutes, and strain.—*Br.*

Made by the present general formula, it would be about 50 per cent. stronger.

Uses.—The addition of cinnamon to catechu in this preparation increases its astringency, and renders it stimulant and anodyne at the same time. It is a convenient remedy for diarrhœa with flatulent colic, provided the bowels are free from irritating ingesta. *Dose*, from Gm. 32–96 (f℥j–iij).

INFUSUM CHIRATÆ, *Br.*—Infusion of Chiretta.

Tisane de chirette, Fr.; *Chiretta-Thee*, G.

Preparation.—Take of Chiretta, cut small, ¼ ounce; Distilled Water, at 120° F., 10 ounces. Infuse in a covered vessel for thirty minutes, and strain.—*Br.*

Uses.—This infusion resembles that of quassia in its qualities, and may be used where simple bitters are needed, in the *dose* of Gm. 64–96 (℥ij–iij).

INFUSUM CINCHONÆ, *U. S.*—Infusion of Cinchona.

Infusum cinchonæ acidum, Br.; *Acid infusion of cinchona*, E.; *Tisane acidulée de quinquina*, Fr.; *Saurer China-Aufguss*, G.

Preparation.—Cinchona, in No. 40 powder, 60 Gm.; Aromatic Sulphuric Acid 10 Cc.; Water a sufficient quantity, to make 1000 Cc. Mix the acid with 500 Cc. of water, and moisten the powder with 30 Cc. of the mixture; pack it firmly in a conical glass percolator, and gradually pour upon it first the remainder of the mixture, and afterward water until the infusion measures 1000 Cc.—*U. S.* When no variety of cinchona is specified by the physician directing this infusion, use yellow cinchona.

To make 1 pint of the infusion would require 438 grains of cinchona and about 80 minims of aromatic sulphuric acid; the acid should be mixed with 8 fluidounces of water.

Red cinchona-bark, in No. 20 powder, ½ oz. (1 part); aromatic sulphuric acid 1 fl. drachm (¼ fl. part); boiling distilled water 10 fl. oz. (20 fl. parts). Infuse in a covered vessel for one hour and strain.—*Br.*

The first process, if well conducted, obtains all the alkaloids of the bark in a soluble condition, and is, in point of fact, simply a solution of the sulphates of these alkaloids slightly weaker than that made by the Pharmacopœia of 1870. The second process will yield a very similar preparation, the straining being effected when cold. The chief difference between the two preparations is that in the former any good variety of cinchona may be employed, while for the latter red bark from cultivated plants is used.

Infusum cinchonæ flavæ, Br. 1867, was made with boiling water, no acid having been used. Such infusions, if strained while hot, will become turbid; and if strained after cooling are clear, but retain merely those alkaloids which in the natural combination are soluble in cold water.

Uses. The infusion of cinchona is used only as a tonic, and not as an anti-periodic, and may be prescribed in the *dose* of Gm. 64 (f℥ij) three times a day.

INFUSUM CUSPARIÆ, *Br.*—Infusion of Cusparia.

Infusum angusturæ, U. S. 1870.—*Infusion of angustura* E.; *Tisane d'angusture*, Fr.; *Angustura-Infusion*, G.

Preparation.—Take of Cusparia-bark, No. 40 powder, ½ ounce; Distilled Water, at 120° F., 10 fluidounces. Infuse in a covered vessel for one hour, and strain.—*Br.*

1 fluidounce of this infusion contains the virtues of nearly 22 grains, *Br.*, 23 grains *U. S.* 1890 (15 grains *U. S.* 1870), of angustura-bark.

Uses.—It may be used in the treatment of atonic dyspepsia, and in feeble digestion, generally, in *doses* of Gm. 32–64 (f℥j–ij).

INFUSUM CUSSO, *Br.*—Infusion of Kousso.

Infusum brayeræ, U. S., 1880; *Apozème de cousso*, Fr.; *Kossotrank*, G.

Preparation.—Take of Kousso, in coarse powder, ½ ounce; Boiling Distilled Water 8 fluidounces. Infuse in a covered vessel for fifteen minutes. Not to be strained.—*Br.* Kousso 20 Gm.; boiling water 150 Gm.—*Fr. Cod.*

Uses.—Following the Abyssinian mode of administering this vermifuge, the coarsely-powdered flowers are taken along with the water in which they are infused. The 8 fluidounces should be divided into two portions, and used with an interval of an hour between them in the morning fasting.

INFUSUM DIGITALIS, *U. S.*, *Br.*—Infusion of Digitalis.

Tisane de digital, Fr.; *Fingerhutaufguss*, G.

Preparation.—Digitalis, bruised, 15 Gm.; Alcohol, 100 Cc.; Cinnamon-water, 150 Cc.; Boiling Water, 500 Cc.; Water, cold, a sufficient quantity to make 1000 Cc. Upon the digitalis, contained in a suitable vessel, pour the boiling water, and allow it to macerate until the mixture is cold. Then strain, add the alcohol and cinnamon water to the strained liquid, and pass enough cold water through the residue on the strainer to make the product measure 1000 Cc.—*U. S.*

To make 1 pint of the infusion 110 grains of digitalis should be macerated in 8 fluidounces of boiling water until cold; after straining 13 fluidrachms of alcohol, 2½ fluidounces of cinnamon-water and sufficient cold water are to be added to bring the volume of the liquid up to 16 fluidounces.

Take of digitalis-leaves, dried 28 grains; boiling distilled water 10 fluidounces. Infuse in a covered vessel for 15 minutes, and strain.—*Br.*

The bitter taste of digitalis is masked in the first preparation by the cinnamon, and the small quantity of alcohol and oil of cinnamon will preserve the infusion for several days before a precipitate makes its appearance, which probably contains a portion of the digitalin. D. E. Prall (1878), however, did not succeed in isolating digitalin from the precipitate. 1 fluidounce of the infusion represents 7 grains, *U. S. P.*, 3 grains, *Br.* of digitalis.

Uses.—The infusion is probably the most certain diuretic preparation of digitalis. In the treatment of *dropsy* it should be steadily continued until it begins to act either upon the kidneys, the stomach, the pulse, or the bowels. Then, however, it ought at once to be suspended or the dose greatly lessened. Its physiological effects, it should be remembered, continue for several days after the medicine is discontinued, and its diuretic action occurs most readily during a state of rest. *Dose*, Gm. 16–32 (f℥ss–j) two or three times a day. A compound vinous infusion is a more efficient diuretic than the simpler officinal preparation; thus: White wine 750 parts; juniper-berries, bruised, 50 parts; digitalis 10 parts; squill 5 parts. Macerate for 4 days, and add potassium acetate 15 parts. *Dose*, Gm. 16 (f℥ss) three times a day.

INFUSUM DULCAMARÆ.—Infusion of Dulcamara.

Tisane de douce-amère, Fr.; *Bittersüssaufguss*, G.

Preparation.—Take of Dulcamara, bruised, 1 ounce; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for one hour, and strain.—*Br.* 1867

Uses.—The infusion is probably the most efficient preparation of dulcamara. Its very dilution increases its activity. *Dose*, Gm. 32–64 (f℥i–ij).

INFUSUM ERGOTÆ, *Br.*—Imfusion of Ergot.

Tisane de seigle ergoté, Fr.; *Mutterkornaufguss*, G.

Preparation.—Take of Ergot, in coarse powder, ¼ ounce; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for thirty minutes, and strain.—*Br.*

Uses.—The *dose* of this preparation for a woman in *labor* is Gm. 32–64 (f℥i–ij). Each fluidounce (Gm. 32) contains about 10 grains (Gm. 0.60) of ergot.

INFUSUM GENTIANÆ COMPOSITUM, *Br.*—Compound Infusion of Gentian.

Tisane de gentiane composée, Fr.; *Enzianaufguss*, G.

Preparation.—Take of Gentian-root, sliced, Bitter Orange-peel, cut small, each 55 grains; Fresh Lemon-peel, cut small, ¼ ounce; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for thirty minutes, and strain.—*Br.*

Take of gentian, in moderately coarse powder, ½ troyounce; bitter orange-peel, in moderately coarse powder, coriander, in moderately coarse powder, each 60 grains; alcohol 2 fluidounces; water a sufficient quantity. Mix the alcohol with 14 fluidounces of water, and, having moistened the mixed powders with 3 fluidrachms of the menstruum, pack them firmly in a conical percolator, and gradually pour upon them first the remainder of the menstruum, and then water, until the filtered liquid measures a pint.—*U. S.* 1870.

The first formula yields an agreeable preparation, which, however, does not keep as well as that made by the second formula, in which alcohol is present in sufficient quantity to preserve it unaltered for some days. As it is an elegant preparation, frequently prescribed in small quantities, J. T. Shinn (1862) proposed to exhaust four times the weight of material directed by percolation with diluted alcohol sufficient for obtaining 1 pint of tincture, 4 fluidounces of which, diluted with 12 fluidounces of water, will exactly represent 1 pint of the infusion, as directed by the U. S. P. 1870. (See also Mistura Gentianæ).

Uses.—This is an agreeable and efficient stomachic tonic, and may be used in *doses* of Gm. 32 (f℥j) two or three times a day.

INFUSUM KRAMERIÆ, *Br.*—Infusion of Rhatany.

Tisane de ratanhia, Fr.; *Ratanha-Aufguss*, G.

Preparation.—Take of Rhatany-root, in No. 40 powder, ½ ounce; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for thirty minutes, and strain.—*Br.*

A fluidounce of this infusion, made by the U. S. P. 1870, represented 30 grains; made by the present general formula, 23 grains.

Uses.—In all cases of internal *hæmorrhage* to which astringents are applicable this infusion may be advantageously employed, the more so the more passive the bleeding. It is also useful in *mucous profluvia* of the *bronchia* and the *gastro-intestinal* tube. A watery solution of extract of rhatany is, however, generally preferable. *Dose*, Gm. 64 (f℥ij).

INFUSUM LINI, *Br.*—Infusion of Linseed.

Infusum lini compositum, U. S., 1870.—*Infusion of flaxseed*, E.; *Tisane de lin*, Fr.; *Leinsamenaufguss*, G.

Preparation.—Take of Linseed 150 grains; Dried Liquorice-root, in No. 20 powder, 50 grains; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for two hours, and strain.—*Br.*

Liquorice-root is added in this infusion with the view of improving its flavor. As the mucilage is contained in the covering of the seed, it should not be bruised, otherwise the oil will be emulsionized, and the swelling of the entire tissue will prevent the straining of the liquid.

Uses.—The apparent intention of this preparation is to provide an appropriate remedy for acute mucous inflammations of the respiratory tract, an object which scarcely required a special formula, since in domestic practice it is customary to add extract of liquorice, sugar, or lemon-juice to flaxseed tea for these affections. The liquorice also renders the infusion less appropriate for bowel and urinary disorders, to which the simple flaxseed tea is generally well adapted. It may be drunk freely.

INFUSUM LUPULI, *Br.*—Infusion of Hop.

Infusum humuli, U. S. 1870.—*Tisane de houblon*, Fr.; *Hopfenaufguss*, G.

Preparation.—Take of Hop ½ ounce; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for one hour, and strain.—*Br.*

If made by the present general formula, the infusion will be of about the same strength.

Uses.—It is the most eligible form for the administration of hop when alcohol is contraindicated. *Dose*, Gm. 64–128 (f℥ij–iv) every two or three hours.

INFUSUM MATICÆ, *Br.*—Infusion of Matico.

Tisane de matico, Fr.; *Matico-Aufguss*, G.

Preparation.—Take of Matico-leaves, cut small, ½ ounce; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for thirty minutes, and strain.—*Br.*

Uses.—This astringent but not very efficient preparation may be prescribed in *doses* of Gm. 32 (f℥j) or more.

INFUSUM PRUNI VIRGINIANÆ, *U. S.*—Infusion of Wild Cherry.

Tisane d'écorce de cerisier sauvage, Fr.; *Wildkirschen-Thee*, G.

Preparation.—Wild Cherry, in No. 40 powder, 40 Gm.; Water a sufficient quantity, to make 100 parts. Moisten the powder with 60 Cc. of water and macerate for one hour; then pack it firmly in a conical glass percolator, and gradually pour water upon it until the infusion measures 1000 Cc.—*U. S.*

To make 1 pint of the infusion 293 grains of wild-cherry bark should be macerated with a fluidounce of water for an hour, and then percolated with water until 16 fluidounces have been obtained.

Made with cold water as directed by the Pharmacopœia, this infusion contains volatile oil and hydrocyanic acid, which are not generated by the use of hot water.

Uses.—This is the best form in which wild-cherry-bark can be used, as a mild tonic and a sedative of the *irritable heart*. It is also applicable to the treatment of irritative *dyspepsia*, *nervous cough*, the cough of early pulmonary *phthisis*, and the hectic irritation of the decline of that disease. *Dose*, Gm. 64–96 (f℥ij–iij) several times a day.

INFUSUM QUASSIÆ, *Br.*—Infusion of Quassia.

Tisane de quassie, Fr.; *Quassia-Aufguss*, G.

Preparation.—Take of Quassia-wood, in chips, 55 grains; Cold Distilled Water, 10 fluidounces. Macerate in a covered vessel for thirty minutes, and strain.—*Br.*

We can perceive no objection to the use of warm water in making this infusion, whereby time might be materially economized without interfering with the appearance or efficiency of the preparation; maceration, as directed above, will yield a very bitter infusion, containing, however, only a portion of the quassia. If made by the general formula (see page 867), the infusion will be about four times the strength of the above.

Uses.—Infusion of quassia is the purest of bitter infusions, and is the best form for administering this useful stomachic tonic. The *dose* is Gm. 64 (f℥ij) three times a day.

INFUSUM RHEI, *Br.*—Infusion of Rhubarb.

Tisane de rhubarbe, Fr.; *Rhabarberaufguss*, G.

Preparation.—Take of Rhubarb-root, in thin slices, ¼ ounce; Boiling Distilled Water, 10 fluidounces. Infuse in a covered vessel for thirty minutes, and strain.—*Br.*

Rhubarb being easily permeated by water, it is preferable to employ it for this purpose cut into thin slices, instead of bruising it; in the latter case the finer powder should be sifted off. But in either case the preparation is unsightly, and becomes still more so by long-continued digestion. A handsomer though weaker infusion is obtained by the formula of the French Codex, by maceration for four hours with cold water. In Germany a preparation has long been in use under the name of *Infusum rhei kalinum* or *Tinctura rhei aquosa*, which is now prepared as follows: Rhubarb, sliced, 100 parts; borax and potassium carbonate, each 10 parts; boiling distilled water, 900 parts. Infuse for fifteen

minutes, add alcohol 90 parts, and macerate for one hour; then express lightly, and to 850 parts of the liquid add cinnamon-water 150 parts. The finished preparation represents nearly 10 per cent. of rhubarb, is of a dark red-brown color, transparent in thin layers, mixes clear with aqueous liquids, and has not an alkaline reaction, but is incompatible with all preparations which are decomposed by alkalies. It may be preserved for several months if kept in small vials and in a cool place.

Uses.—This infusion is seldom prescribed, either alone or as a vehicle for other purgatives. In the latter case it has been associated with salines, such as sodium tartrate or potassium bitartrate. The diluted form of this preparation is probably not without its advantages in maintaining a moderate and sustained operation on the bowels. *Dose*, Gm. 33–64 (f℥j–ij), repeated, if necessary, in three or four hours.

INFUSUM ROSÆ ACIDUM, *Br.*—Acid Infusion of Rose.

Infusum rosæ compositum, U. S., 1870.—*Compound infusion of rose*, E.; *Tisane de rose composée*, Fr.; *Saurer Rosenaufguss*, G.

Preparation.—Take of Dried Red Rose Petals, broken up, ½ ounce; Diluted Sulphuric Acid, 1 fluidrachm; Boiling Distilled Water, 10 fluidounces. Infuse in a covered vessel for thirty minutes, and strain.—*Br.*

The U. S. P. of 1870 ordered red rose ½ troyounce; diluted sulphuric acid 3 fluidrachms; sugar 1½ troyounces; boiling water 2½ pints.

This infusion should not be made in a metallic vessel; it has a fine red color and agreeable flavor.

Uses.—The compound infusion of rose is employed as a coloring and flavoring ingredient of mixtures, and as an excipient and solvent for quinine sulphate and magnesium sulphate, whose bitterness it partially covers. It forms an agreeable gargle for inflamed and ulcerated states of the *mouth* and *fauces*, and may be used to moderate profuse sweats. Its virtues are largely due to the sulphuric acid it contains. *Dose*, Gm. 64–128 (f℥ij–iv).

INFUSUM SENEGÆ, *Br.*—Infusion of Senega.

Tisane de polygale de Virginie, Fr.; *Senega-Aufguss*, G.

Preparation.—Take of Senega-root, in No. 20 powder, ½ ounce; Boiling Distilled Water, 10 fluidounces. Infuse in a covered vessel for thirty minutes, and strain.—*Br.*

Uses.—This preparation is supposed to possess certain advantages over the decoction of seneka (*U. S. P.* 1870), which was originally prescribed, and continues to be preferred in this country; but as the senegin is not altered by the heat of boiling water, it is probable that the decoction extracts a larger proportion of it than infusion does. *Dose*, Gm. 32–64 (f℥j–ij).

INFUSUM SENNÆ COMPOSITUM, *U. S., P. G.*—Compound Infusion of Senna.

Infusum sennæ, Br.—*Infusion of senna, Black Draught*, E.; *Tisane de séné composée*, Fr.; *Senna-Aufguss*, G.

Preparation.—Senna, 60 Gm.; Manna, 120 Gm.; Magnesium Sulphate, 120 Gm.; Fennel, bruised, 20 Gm.; Boiling Water, 800 Cc.; Water, a sufficient quantity to make 1000 Cc. Upon the senna and fennel, contained in a suitable vessel, pour the boiling water, and macerate until the mixture is cold. Then strain with expression, dissolve in the infusion the magnesium sulphate and manna, and strain again. Lastly, add enough water through the strainer containing the senna and fennel to make the infusion measure 1000 Cc.—*U. S.*

To make 1 pint of the infusion 445 grains of senna and 148 grains of fennel should be macerated with 13 fluidounces of boiling water until cold; after expression and straining 890 grains each of manna and magnesium sulphate should be dissolved in the infusion and enough water added to make the liquid measure 16 fluidounces.

Take of senna 1 ounce; ginger, sliced, 28 grains; boiling distilled water 10 fluidounces. Infuse in a covered vessel for thirty minutes, and strain.—*Br.*

The first formula yields a preparation which is equivalent to the *black draught* of British pharmacy, and is recognized as such by the U. S. Pharmacopœia. The second formula may be regarded as yielding a simple senna infusion, containing merely a corrective. Long-continued contact with hot water appears to increase the tendency of the senna to

produce griping, particularly if digestion be resorted to. If the leaves have been cut or bruised, digestion for not over ten minutes will yield an active infusion. The flavor being a matter of taste, the selection of aromatics had probably best be left to the physician

Mistura sennæ composita, *Br.;* Potio purgans anglorum, s. Potio nigra. By these titles *black draught* is sometimes prescribed, which in Great Britain is made by dissolving 4 ounces of magnesium sulphate in 15 fluidounces of infusion of senna, and adding 1 fluidounce of liquid extract of liquorice, 2½ fluidounces of tincture of senna, and 1½ fluidounces of compound tincture of cardamoms.

Potion purgative, Médecine noir, *F. Cod.* Senna 10 Gm.; rhubarb 5 Gm.; boiling water 120 Gm.; infuse for thirty minutes, express, and dissolve sodium sulphate 15 Gm. and manna 60 Gm.

Tisane royale, *F. Cod.* Senna, sodium sulphate, and fresh parsley-leaves, each 16 Gm.; anise and coriander, each 5 Gm.; 1 lemon, sliced; cold water, 1000 Gm.; macerate for twenty-four hours.

Infusum sennæ compositum, *P. G.*, also known as *Aqua* (*s. Potio*) *laxativa Viennensis* —Vienna draught, *E.;* Eau laxative de Vienne, *Fr.;* Wiener Trank, *G.*—is made by macerating 5 parts of cut senna with 35 parts of boiling water, and exposing it to the heat of a steam-bath for five minutes; when cold the liquid is expressed, and 5 parts of sodium and potassium tartrate and 15 parts of manna are dissolved in it; after straining it should weigh 50 parts.

Uses.—The fennel-seed or other carminative in the official and analogous preparations lessens the tendency of the senna to gripe. If the infusion is allowed to macerate too long this tendency is increased. It is a very thorough purgative, and should be given in *doses* of from Gm. 64–128 (f℥ij–iv) every hour, or at longer intervals, until it begins to operate.

INFUSUM SERPENTARIÆ, *Br.*—Infusion of Serpentary.

Tisane de serpentaire, Fr.; *Schlangenwurzel-Aufguss*, G.

Preparation.—Take of Serpentary-rhizome, in No. 20 powder, bruised, ¼ oz.; Boiling Distilled Water 10 fl. oz. Infuse in a covered vessel for thirty minutes, and strain.—*Br.*

The infusion recognized under the same name by the U. S. P. 1870 was slightly stronger, and contained 15 grains of serpentaria to the fluidounce.

Uses.—This preparation is preferable to the fluid extract and to the tincture of serpentaria. Its uses are fully detailed under Serpentaria. *Dose*, Gm. 32–53 (f℥i–ii) every two or three hours in typhoid conditions.

INFUSUM UVÆ URSI, *Br.*—Infusion of Bearberry.

Tisane d' uva ursi, Fr.; *Bärentraubenblätter-Aufguss*, G.

Preparation.—Take of Bearberry-leaves, bruised, ½ ounce; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for 1 hour, and strain.—*Br.*

The medicinal principles of uva ursi are not volatile or decomposed by boiling water; a decoction may therefore be prepared.

Uses.—This is a more convenient form than the decoction for extemporaneous use, and is perhaps sufficiently active, since it is certain that the amount of tannic and gallic acids which can be profitably absorbed from the stomach is not unlimited. *Dose*, Gm. 32–64 (f℥i–ii).

INFUSUM VALERIANÆ, *Br.*—Infusion of Valerian.

Tisane de valériane, Fr.; *Baldrian-Aufguss*, G.

Preparation.—Take of Valerian-rhizome, bruised, ¼ ounce; Boiling Distilled Water 10 fluidounces. Infuse in a covered vessel for one hour, and strain.—*Br.*

Infusion of valerian, *U. S. P.* 1870, represented 15 grains of the root in the fluidounce, but made by the present general formula it contains 23 grains.

Uses.—Although partially superseded by the more convenient fluid extract and tinctures, the infusion of valerian is, nevertheless, an efficient preparation, particularly where the medicine be continuously given. *Dose*, Gm.64 (f℥ii).

INJECTIO APOMORPHINÆ HYPODERMICA.—*Br.*

Hypodermic injection of apomorphine, E.; *Injection hypodermique d' apomorphine*, Fr.; *Subcutane Apomorphin-Einspritzung*, G.

Preparation.—Take of Apomorphine Hydrochlorate, 2 grains; Camphor water, 100 minims. Dissolve and filter. The solution should be made as required for use. *Dose*, by subcutaneous injection, 2–8 minims, representing about $\frac{1}{2}\frac{1}{5}$–$\frac{1}{6}$ gr. of the salt.

INJECTIO ERGOTINI HYPODERMICA.—*Br.*

Hypodermic injection of ergotin, E.; *Injection hypodermique d'ergotine*, Fr.; *Subcutane Ergotin-Einspritzung*, G.

Preparation.—Take of Ergotin 1 part (or 100 grains); Camphor water 2 fluid parts (or 200 fluid grains). Dissolve by stirring them together. The solution should be made as required for use. *Dose*, by subcutaneous injection, 3–10 minims, representing about 1–3½ grains of ergotin.

INJECTIO MORPHINÆ HYPODERMICA.—*Br.*

Hypodermic injection of morphia, E.; *Injection hypodermique de morphine*, Fr.; *Subcutane Morphin-Einspritzung*, G.

Preparation.—Take of Morphine Hydrochlorate, 92 grains; Solution of Ammonia-Acetic Acid, Distilled Water, of each a sufficiency. Dissolve the morphine hydrochlorate in 2 ounces of distilled water, aiding the solution by a gentle heat; then add solution of ammonia, so as to precipitate the morphia and render the liquid slightly alkaline; allow it to cool; collect the precipitate on a filter, wash it with distilled water, and allow it to drain; then transfer the morphia to a small porcelain dish with about an ounce of distilled water, apply a gentle heat, and carefully add acetic acid until the morphia is dissolved and a very slightly acid solution is formed. Add now sufficient distilled water to make the solution measure exactly 2 fluidounces. Filter, and preserve the product in a stoppered bottle excluded from the light.—*Br.*

The object of the above process is the preparation of morphine acetate in solution of definite strength, so that each fluidrachm shall contain 6 grains of that salt. On keeping, the solution decomposes, acquiring a brown color and slowly separating morphia, the crystals being very long if the solution remain undisturbed. To prevent this decomposition, Prof. C. Johnston (1873) recommended sulphurous acid, 5 drops of which were found by Jennings sufficient to protect a fluidounce. Squibb (1873) observed that ⅛ per cent. of pure carbolic acid would preserve such solutions, and Limousin (1876) has obtained satisfactory results by using ½ per cent of salicylic acid.

Uses.—The average hypodermic *dose* of this preparation is Gm. 0.06–0.40, (♏i–vi) equal to from $\frac{1}{12}$ grain to ½ grain or Gm. 0.005–1.003 of the salt.

INULA, *U. S.*—Elecampane.

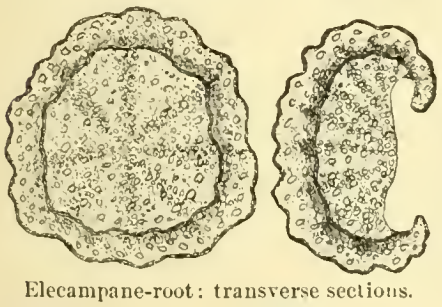
Radix helenii, s. inulæ, s. enulæ.—Aunée officinale, Grande aunée, Fr. Cod.; *Elenio*, It.; *Alantwurzel, Helenenwurzel*, G.; *Enula*, Sp.

The root of Inula (Corvisartia, *Mérat*) Helenium, *Linné*. Woodville, *Med. Bot.*, t. 26; Bentley and Trimen, *Med. Plants*, 150.

Nat. Ord.—Compositæ, Inuloideæ.

Origin.—Elecampane is a native of Central Asia and Southern Siberia, and is found westward to Southern and Central Europe. It is not unfrequently cultivated, and has in many places escaped from gardens and become naturalized. In the United States it grows spontaneously along roadsides and in pastures from New England south to the mountains of North Carolina and westward to Illinois. It has a thick, solid stem 0.9 to 1.8 M. (3–6 feet) high, large radical leaves decurrent on the long petioles, and sessile clasping stem-leaves, all being acute, somewhat toothed, and grayish-hairy on the lower surface. The large flower-heads are terminal, and have a loosely-imbricated involucre, with an outer series of foliaceous ovate bracts; the numerous

Fig. 159.



Elecampane-root: transverse sections.

yellow pistillate ray-florets are ligulate, linear, and three-toothed, and the yellow disk-florets tubular and five-toothed. The akenes are smooth, pale-brown, four-sided, and crowned with a hairy pappus. The root is collected in the fall of the second or the spring of the third year.

Description.—The root is about 15 Cm. (6 inches) long and 25 to 50 Mm. (1–2 inches) thick, divided below into branches 15 to 30 Cm. (6–12 inches) long and 12 to 25 Mm. ($\frac{1}{2}$–1 inch) thick, very fleshy; in commerce usually sliced either longitudinally or transversely. The longitudinal slices have the bark overlapping; the transverse slices are concave, somewhat radially striate; externally irregularly wrinkled and brownish, internally white when fresh; grayish after drying, of a peculiar aromatic odor and an aromatic, bitterish, and pungent taste. The root is hygroscopic and flexible in damp weather, but when dry breaks with a short fracture. The bark is 3 Mm. ($\frac{1}{8}$ inch) and more thick, the inner portion radiate near the cambium-line; the meditullium has small vascular bundles and broad medullary rays, and all parts of the root are dotted with shining yellowish-brown resin-cells.

Constituents.—Elecampane contains a little *volatile oil*, *inula* or *alant camphor*, some acrid *resin*, a *bitter principle* not known as yet in the isolated state, *waxy matter*, *inulin*, etc. On investigating the body formerly known as helenin and elecampane camphor, crystallizing from the concentrated tincture mixed with water, Kallen (1873) isolated *helenin*, C_6H_8O, which is insipid, almost insoluble in water, crystallizes in needles, fuses at 110° C. (230° F.), and is by nitric acid converted into oxalic acid and a resinous body. The volatile *oil of elecampane* was by Kallen (1876) separated into needles of *alantic anhydride*, $C_{15}H_{20}O_2$, and *inulol* or *alantol*, $C_{10}H_{16}O$, which is a yellowish liquid having the odor of peppermint, an aromatic taste, and boiling near 200° C. (392° F.). *Inulin*, $C_{12}H_{20}O_{10}$, is contained in biennial and perennial Compositæ, and is obtained by forcibly expressing the grated juicy roots, when a portion will deposit on standing, and the remainder may be precipitated by alcohol. Kiliani (1881) recommends boiling the roots with water containing sodium carbonate; the liquid is cooled by a freezing mixture, and the precipitate repeatedly dissolved in hot water and reprecipitated by cooling. The autumn roots contain the largest percentage (elecampane 44 per cent.) of inulin, which by the following spring is to a considerable extent changed into mucilage, sugar, and levulin, and in some cases to glucosides. Inulin is a fine white hygroscopic powder, tasteless and inodorous, insoluble in alcohol, slightly soluble in cold water, more so in hot water, and then partly altered, but mostly reprecipitated on cooling; on the slow evaporation of its aqueous solution it may be obtained in crystalline spheres, and by hydration it is converted into gum-like and horny modifications. It appears to be the anhydride of levulose, its formula being $(C_6H_{10}O_5)_6H_2O$, but it does not reduce Fehling's solution. Heated with water in sealed tubes, it yields levulose; with hot baryta-water lactic acid is formed; diluted nitric acid oxidizes it to formic, oxalic, racemic, glycollic, and probably glyoxylic acids. Inulin differs from starch by the absence of concentric layers, does not yield a jelly with water, and it is colored yellow (not blue) by iodine. (Two monographs on inulin were published in 1870—one by Prof. Dragendorff, the other by Dr. K. Prantl.)

Allied Drugs.—Inula (Conyza, *Linné*) squarrosa, *Bernhardi*, s. I. Conyza, *De Candolle;* Conyze, *Fr.;* Dürrwurz, *G.*—Leaves ovate, crenate, tomentose, and rugose; flower-heads with an imbricate involucre and tubular three-cleft ray-florets; odor unpleasant; taste bitter. The herb is used in Southern Europe as an emmenagogue and diuretic, and, when burned, for destroying insects.

Pulicaria (Inula, *Linné*) dysenterica, *Gærtner;* Fleawort, *E.;* Pulicaire, *Fr.;* Flohkraut, *G.*—Stem and leaves woolly or tomentose; involucral scales narrow; ray-florets band-like; pappus double: the outer row short, crown-like; the inner row bristly. Used like the preceding.

Cryptochœtis andicola, *Raim.*, grows in the Andes near the snow-line, and is known as *huamanripa*. Leaves oblong or lanceolate, serrate, narrowed into a petiole; involucre with about 24 scales, having a membranous margin. Bignon (1886) noticed the presence of an aromatic resin and of considerable volatile oil.

Carlina acaulis, *Linné* (tribe Cynaroideæ); Carline thistle, *E.;* Chardon doré, Carline, *Fr.;* Eberwurz, *G.*—A perennial plant of Middle Europe. The root, *radix carlinæ*, is long, fleshy, about 25 Mm. (1 inch) thick, usually cut lengthwise, deeply wrinkled, and has a rather thin light-brown bark and a grayish meditullium, with broad medullary rays. Rather large brown-red resin-cells are found in all parts of the parenchyma. It has a penetrating, unpleasant odor and a sweetish, burning, and bitter taste; its principal constituents are a little resin and a volatile oil, to which the odor and taste are due.

Pharmaceutical Preparation.—Extractum helenii.—Extract of elecampane,

E.; Extrait d'année, *Fr. Cod.*—It is made by extracting the cut root with cold distilled water.

Action and Uses.—Inula was one of the most famous of ancient medicines, and continued in vogue until very recent times. It owed this reputation to its stimulant qualities. Even in the Hippocratic writings it is stated to be a stimulant of the brain, the stomach, the kidneys, and the uterus—qualities which continued to be ascribed to it—as well as to exert a rubefacient action upon the skin. It had a special reputation in all pulmonary affections and as a topical application in sciatica, gout, gravel, facial neuralgia, etc. One of its chief constituents, inulin, is probably quite negative, and whatever virtues the plant possesses must be due to the elecampane camphor which it contains in small proportion, a very minute quantity of volatile oil, and the bitter extractive, which it holds in as large a proportion as of inulin. These elements are apparently too insignificant to justify the ancient repute of elecampane. It continues to be used as a domestic remedy, rather than by physicians, in the treatment of chronic *bronchitis*, *dyspepsia*, *vesical catarrh*, *amenorrhœa* and other menstrual disorders, and internally in chronic eruptions of the skin. Korab claims for helenin a power of destroying bacilli, and especially those of tubercle (*Bull. de Thérap.*, ciii. 271). The same has been affirmed by Blocq (*Med. News*, xliii. 655) and by Baeza (*Med. Record*, xxvii. 377). Inulin has been employed in the treatment of *diphtheria* (*Therap. Gaz.*, x. 314), and of *whooping cough*, in the dose of Gm. 0.01 (gr. $\frac{1}{6}$) ten times a day. Inula is preserved as a candy, like calamus, and is used to flavor the alcoholic beverage *absinthe*. Its retention in the United States Pharmacopœia seems quite superfluous. Elecampane is generally administered in a decoction prepared by boiling Gm. 16 in Gm. 500 (℥ss in Oj) of water, and which may be given in the *dose* of Gm. 64 (f℥ij. or more). Some German writers direct from 5 to 15 parts of elecampane to 100 parts of hot water.

Carlina acaulis had formerly a reputation not inferior to that of inula for very similar virtues. It was held to be powerfully diaphoretic or diuretic, according to the manner of its administration, and in large doses purgative. It was prescribed in *typhoid states* of acute diseases, in *amenorrhœa*, to overcome sexual *impotence*, and relieve local *paralysis*, especially of the tongue. It was administered in powder in *doses* of from Gm. 0.60 to 1.30 (gr. x–xx), in decoction, etc.

IODOFORMUM, *U. S., Br., F. Cod.*—Iodoform.

Iodoformium, P. G.—*Carboneum jodatum*, *Ioduretum carbonici*, *Triiodomethane*, *Iodure de formyle*, *Iodoforme*, Fr.; *Jodoform*, G.

Formula CHI_3. Molecular weight 392.56.

Iodoform should be kept in well-stoppered bottles in a cool and dark place.

Origin.—Iodoform was discovered by Serullas in 1822, and its composition was determined by Dumas in 1834. It is formed by the action of iodine in the presence of fixed alkalies or alkali carbonates upon alcohol, acetic and other easily-saponifiable ethers, aldehyde, acetone, amylene, butyl, capryl, and propyl alcohols, kinic, meconic, and lactic acids, oil of turpentine, and some other compounds (Lieben, 1870). Millon (1846) ascertained that it is also produced, to a limited extent, by the action of the same agents, aided by heat, upon aqueous solutions of sugars, dextrin, and gum, and upon alkaline solutions of albumen, fibrin, casein, and other proteids. Pure ethyl ether, ethyl iodide, and allied compounds, methyl and amyl alcohol, chloral, chloroform, the fruit acids, lower fatty acids, various aromatic acids, glycerin, and other compounds, according to Lieben, do not yield iodoform under the conditions mentioned above.

Preparation.—Wilder (1875) recommends Bouchardat's process as an easy one, and Filhol's as one giving a large yield. By following the former, 100 parts iodine, 100 potasssium bicarbonate, 1200 water, and 250 alcohol are mixed in a flask with a long neck and slowly heated to between 60° and 80° C. (140° and 176° F.) until the color has disappeared, when 25, 20, and 10 parts of iodine are to be added, waiting after each addition until the iodine color has disappeared, and adding at the close, if necessary, a little potassa; after setting aside for twenty-four hours the crystals are collected upon a filter. About one-third of the iodine is recovered as iodoform, the remainder appearing in the mother-liquor chiefly as potassium iodide, and may be obtained by supersaturating with sulphuric, and then adding a little nitric acid.

In Filhol's process this iodine is utilized by liberating it by means of chlorine and converting it into iodoform. The proportions recommended are 2 parts of crystallized sodium carbonate, 10 of water, and 1 of alcohol, warmed as before; 1 part of iodine is added in

small portions, and after cooling the crystals are collected. The filtrate is again warmed, 2 parts of sodium carbonate are added, and a rapid current of chlorine gas is passed through the liquid as long as iodoform is separated, which is again collected, while the filtrate may be made to yield a little more iodoform by repeating the treatment. As much as 72 per cent. of crystals may thus be obtained.

Rother (1873) recommended acidulating the mother-liquid with hydrochloric acid, adding some potassium dichromate to generate chlorine, then potassium carbonate to render the liquid alkaline, and some iodine and alcohol, and finally warming the mixture. The process will thus be continuous until the accumulation of the salts becomes too great. More recently (1882) he recommended bromine in place of chlorine.

The production of iodoform may be explained by the simultaneous formation of potassium iodide, water, and carbon dioxide, as follows: $C_2H_6O + 4I_2 + 2KHCO_3$ yields $2CHI_3 + 2KI + 3H_2O + 2CO_2$. The reaction, however, is never so simple, potassium formate being perhaps always one of the products, in which case the reaction, according to Liebig, is thus explained: $C_2H_6O + 4I_2 + 6KHCO_3$ yields $CHI_3 + 5KI + KCHO_2 + 5H_2O + 6CO_2$. At the same time other reactions take place—one resulting in the formation of acetic ether, another in the production of ethyl iodide and hydriodic acid; and from great variations of the yield observed it is evident that the result is greatly influenced by the relative proportion of the material and the temperature.

In 1889 Sulliot and Raynaud devised a process for the preparation of iodoform direct from the ash of sea-weed (kelp), and this is now largely used in France. The ash is lixiviated, the sulphides and sulphites entering into solution are removed, and the amount of iodine present then determined; from the latter the necessary quantity of the other ingredients is calculated, thus a solution of 50 parts of sodium or potassium iodide is prepared, and to it are added 6 parts of acetone and two parts of caustic soda in 1000 to 2000 parts of water; finally a dilute solution of sodium hypochlorite is added, drop by drop, as long as iodoform is produced. The yield is about the theoretical quantity according to the following equation: $3NaI + 3NaClO + C_3H_6O = CHI_3 + 3NaCl + NaC_2H_3O_2 + 2NaOH$. Iodoform thus prepared is called by Casthélaz "absolute iodoform" since it is obtained in a state of great purity, without production of free iodine capable of giving rise to iodic compounds.

Iodoform can also be produced by subjecting to electrolysis a solution of 50 parts of potassium iodide in 300 parts of water and 30 parts of alcohol, while a constant current of carbon dioxide is led into the liquid. The iodoform will separate as a crystalline powder. A patent was granted for this process in Germany in 1884.

Properties.—Iodoform is in small, lemon-yellow, scale-like, hexagonal crystals, which have a pearly lustre, are somewhat fatty to the touch, and have a strong saffron-like odor and a peculiar sweetish and unpleasantly iodine-like taste. It is nearly insoluble in water, but by heating it with water for about thirty minutes to between 80° and 90° C. (176° and 194° F.) a permanent yellow solution is obtained, which, according to Schadewald (1882), contains between .5 and .7 per cent. of iodine. Iodoform dissolves in 52 parts (*U. S.*), 50 parts (*P. G.*), of alcohol at 15° C. (59° F.), in 12 parts (*U. S.*), about 10 parts (*P. G.*), of boiling alcohol, in 5.2 parts (*U. S.*, *P. G*) of ether, and, according to Vulpius (1881), in 100 parts of petroleum benzin, in 67 parts of benzene, in 25 parts of oil of turpentine, in 14.3 parts of oil of lavender, in 12.5 parts of oil of cloves, in 11 parts of oil of fennel, lemon, or rosemary, in 7 parts of oil of cinnamon, and in 6 parts of oil of caraway; it is readily soluble in chloroform, carbon disulphide, and fixed oils; the solutions have a neutral reaction to test-paper, but when exposed to sunlight liberate iodine. Iodoform has the spec. grav. 2.0, volatilizes slowly on exposure at ordinary temperatures, fuses at about 115° C. (239° F.) to a brown liquid, and sublimes partly unaltered, but at a higher heat is mostly decomposed into iodine and hydriodic acid, with a residue of glossy charcoal, which finally burns without leaving any residue. Heated with water, it volatilizes with the vapors without decomposition; but when boiled with potassa solution a portion of it is decomposed, yielding potassium formate and iodide, and when distilled with alcoholic solution of potassa an oily liquid of an ethereal odor and containing iodine is obtained in the distillate; both the aqueous and alcoholic solutions thus obtained on the addition of nitric acid liberate iodine, recognizable by the blue color produced with starch-paste.

Iodoform contains 96.69 per cent. of its weight of iodine, and the amount present in any of its preparations may be estimated gravimetrically with silver nitrate solution, insoluble silver iodide being formed: $CHI_3 + 3AgNO_3 + H_2O = 3AgI + 3HNO_3 + CO$—392.56 grains of iodoform requiring 508.65 grains of silver nitrate for complete decomposition and yielding 702.57 grains of silver iodide.

The odor of iodoform in mixtures and ointments is unpleasant, and may be disguised by the addition to 1 ounce of from 3 to 5 drops of oil of peppermint; Peru balsam, coumarin, the oils of fennel, anise, and others, have also been recommended. The odor adheres persistently to the vessels in which preparations of iodoform have been made, and may be removed by a few drops of oil of turpentine, followed by soap and water.

Impurities are not likely to be present; the physical properties, and particularly its odor, behavior to solvents, neutral reaction, and complete volatility, determine the absence of impurities which might result from the process of manufacture. Fixed impurities would be left behind on heating a portion upon platinum-foil until the charcoal has been consumed. "If 2 Gm. of iodoform be thoroughly shaken with 10 Cc. of water, the filtrate should be colorless and free from bitter taste (absence of soluble yellow coloring matters, picric acid, etc.), should not affect the color of litmus paper (absence of free acids), and remain unaffected by silver nitrate test-solution (absence of soluble iodides.") —U. S.

Allied Compounds.—1. Aristol. Dithymoldiiodide, Annidalin, $C_{20}H_{24}O_2I_2$.—This substitute for iodoform was introduced in 1889, and is prepared by adding to a solution of 600 Gm. of iodine and 900 Gm. of potassium iodide in 1000 Cc. of water under constant stirring at 15°–20° C. (59°–68° F.) another solution made of 500 Gm. of thymol in 1000 Cc. of a 12-per-cent. solution of sodium hydroxide; a copious dark brownish-red precipitate is formed, which is washed with water and subsequently dried at ordinary temperature. Aristol is an amorphous, almost tasteless powder, of a slight peculiar iodine-like odor, insoluble in water and glycerin, difficultly soluble in alcohol, but readily soluble in ether, collodion, and chloroform; it is also taken up by fixed oils, petrolatum, vaseline, etc., but is not soluble in solution of the caustic alkalies, whether hot or cold. Heat and light decompose aristol, as does also sulphuric acid. The chief value of aristol lies in the large percentage (45.8) of iodine present and the absence of much odor.

2. Europhen. Diisobutylorthocresoliodide, $C_{22}H_{29}O_2I = C_4H_9OCH_3C_6H_3C_6H_2.C_4H_9CH_3OI$.—This compound also belongs to the class of iodoform substitutes, and is prepared in a manner analogous to aristol, except that isobutylorthocresol is used in place of thymol. It is an amorphous yellow powder, of a slightly saffron-like odor, insoluble in water and glycerin, but readily soluble in alcohol, ether, chloroform, and fixed oils. It is permanent when dry, but when moistened with water splits up into iodine and a new soluble iodine compound; alkali hydroxides and carbonates likewise liberate iodine. When heated europhen runs together, and at 110° C. (230° F.) forms a clear brown liquid. It is five times as bulky as iodoform.

The substitution of carvacrol for thymol in the manufacture of aristol results in the formation of carvacrol iodide, $C_{13}H_{13}OI$, a yellowish-brown powder, which softens at 50° C. (122° F.), and is decomposed at temperatures above 100° C. (212° F.).

3. Antiseptol. Cinchonine-iodosulphate. Cinchonine herapathite. This compound was added to the list of iodoform substitutes by Yvon in 1891. It is prepared by adding a solution of 25 Gm. of cinchonine sulphate in 2000 Cc. of water to a solution of 10 Gm. each of iodine and potassium iodide in water; the resulting precipitate is washed with water and dried at a moderate heat. Antiseptol occurs as a light powder of reddish-brown color, insoluble in water, but soluble in alcohol and chloroform. It contains about 50 per cent. of iodine, and its chemical formula is uncertain, varying with the mode of preparation.

4. Antiseptin. Borothymol zinc-iodide.—Although claimed by the originator, Dr. Radlauer, to be of a definite chemical composition, antiseptin has been shown by Goldmann to be simply a mixture of zinc sulphate 85 parts, zinc iodide 2.5 parts, thymol 2.5 parts, and boric acid 10 parts.

5. Losophane. Triiodometacresol, $C_6H_3I_3OH.CH_3$.—Introduced in 1892. It is prepared by adding an aqueous solution of iodine and potassium iodide slowly and under constant stirring to a solution of orthooxyparatoluic acid in sodium bicarbonate and water; after twenty-four hours the triiodometacresol will have separated, and may be washed with water and recrystallized from alcohol. Losophane occurs as colorless, odorless, needle-shaped crystals, which are almost insoluble in water, very difficultly in alcohol, but readily in ether, benzene, and chloroform, and at 60° C. (140° F.) also in fixed oils. It contains 78.39 per cent. of iodine, and melts at 121.5° C. (250.7° F.).

6. Iodol. Tetraiodopyrrol, C_4I_4NH.—This is the oldest of the iodoform substitutes, having been introduced by Ciamician and Silber in 1885. It is obtained by the interaction of iodine and pyrrol in alcoholic solution during twenty-four hours; upon the addition of water iodol is separated in the form of yellow crystalline flocculi. In place of alcohol, methylic alcohol and other liquids can be used as solvents for the iodine. Iodol may also be obtained by following the process mentioned under Aristol, simply using pyrrol in place of thymol. Pure iodol is a pale-yellow, bulky powder, more or less crystalline, which should be free from odor and taste. It is practically insoluble in water, slightly soluble in diluted alcohol, and readily soluble in alcohol (3 parts), ether (1 part), and fixed oils (15 parts); the alcoholic solution is miscible with glycerin. When heated, iodol remains unaffected up to 100° or 120° C. (212°–240° F.), but at 145° C. (293° F.) it is decomposed, and finally burns away without residue. Iodol contains 88.97 per cent. of iodine; it has been used internally in doses of 8 to 15 grains, two or four times a day, in wafers, but is usually employed either as a dusting-powder or in the form of iodol gauze or ointment, and is believed to stimulate granulation.

7. Sozoiodol. Sozoiodolic acid. Diiodoparaphenylsulphonic acid. $C_6H_2I_2OHSO_3H+3H_2O$. This acid and its salts have been especially recommended on account of the large proportions of iodine, phenol, and sulphur present. It is prepared by heating 2 parts of phenol and 1 part of strong sulphuric acid to about 110° C. (230° F.) for two or three days, whereby paraphenylsulphonic (sozonic) acid is formed. Any excess of carbolic acid is removed, and then iodine is added to form sozo-iodolic acid. It contains about 54 per cent. of iodine, 20 per cent. of carbolic acid, and 7 per cent. of sulphur. The ammonium, lead, mercury, potassium, sodium, and zinc salts of this acid are the agents mostly employed, being recommended as substitutes for iodoform on account of their complete lack of odor; the lithium, aluminum, and magnesium salts have also been prepared. The sodium sozoiodolate, however, is most preferred, on account of its ready solubility in water and glycerin (13–14 parts); it occurs in bright prismatic needle-shaped crystals. A 3 to 10 per cent. solution in water is found to be most desirable.

8. Sozal is the name applied to the aluminum salt of sozonic acid (paraphenylsulphonic acid), (which see above). It is very soluble in water and keeps well. It occurs in crystals with an astringent taste and slight carbolic odor, and has been recommended for surgical dressings.

9. Sulphaminol. Thioxydiphenylamine. $C_{12}H_9OS_2N$.—This compound has been especially recommended on account of the entire absence of odor and taste, although it is insoluble in water· it is supposed to be decomposed into carbolic acid and sulphur compounds by the digestive fluids. Sulphaminol is prepared as follows: Metaoxydiphenylamine is boiled with sodium hydroxide solution and sulphur; the filtered solution is treated with ammonium chloride, yielding sodium chloride in solution, and a yellow precipitate of sulphaminol which does not combine with ammonia, and which is washed with water and dried. It is a yellow powder, insoluble in water, readily soluble in alkalies, alcohol, and glacial acetic acid. When heated it turns brown and softens, melting at 155° C. (311° F.). Under the names Sulphaminol—menthol, S. creosote, S. guaiacol and S. eucalyptol solutions of the compound in the different liquids have been introduced to the medical profession, especially for use in laryngeal tuberculosis.

10. Thiophene. C_4H_4S.—This hydro-carbon was discovered in 1883 by V. Meyer; it occurs in all commercial benzenes, and is isolated by active agitation with concentrated sulphuric acid: it is a colorless, mobile, oily liquid, with a feeble odor, boiling at 84° C. (183.2° F.), and not miscible with water. Thiophene itself has not been used in medicine, but two of its compounds have been successfully employed in Europe. Thiophene diiodide, $C_4H_2I_2S$, has been used as a substitute for iodoform in many surgical cases; it occurs in crystalline plates, is insoluble in water, but soluble in the other usual solvents; it contains about 9.5 per cent. of sulphur, melts at 40.5° C., and is volatile at ordinary temperatures. Sodium thiophene sulphonate, $C_4H_3SNaSO_3$, is a white crystalline powder, containing 33 per cent. of sulphur; it has been used with favorable result in prurigo, proving superior to beta-naphtol, being non-toxic and non-irritating.

Action and Uses.—In man doses of from 2 to 5 grains occasion no distinct effects, but 7 or 8 grains have caused a decline of the pulse-rate from 72 to 60. Applied to the sound skin and mucous membranes and to ulcers, it is not irritating; on the contrary, it appears to allay all local painful sensations in them, and even to blunt common sensibility. Thus it may render the anus so insensible that the passage of the fecal mass will not be perceived. Sometimes, however, its application has excited a severe eczematous eruption (*Boston Med. and Surg. Jour.*, March, 1882, p. 250). Sometimes this eruption is papular or *erythematous*. Iodoform appears to be eliminated with the breath and all the secretions, and very speedily after its administration. According to Fehling and others, iodoform is decomposed in the blood and its constituents are secreted with the mother's milk, with danger to the nursing infant (*Therap. Gaz.*, xii. 459), and in the form of an iodide (*ibid.*, xiii. 773). When employed to dress wounds its odor may be perceived upon the breath, and its taste in the mouth, while the urine is colored yellow; and if applied to a large surface it may occasion headache, nausea, and vomiting, and even decided symptoms of poisoning. In two children after the application of iodoform dressings, the symptoms assumed in the one a comatose and in the other a meningitic type (Cazin), and in another choreic movements accompanied the digestive and nervous disorder. Duret describes three forms of poisoning by this preparation—viz. the eruptive, the cerebral, and the syncopal.

In 1882, according to Dentu, there had already been published eleven cases of death following the use of iodoform as a surgical dressing, and many others had been reported in which dangerous or disagreeable phenomena were observed. In 1886, Dr. E. G. Cutler collected, chiefly from German sources, 77 cases of iodoform-poisoning.

After having been used in 1846 by Bouchardat in cases of lymphatic glandular swelling, goitre, and amenorrhœa, it was employed ten years later by Maître for similar affections, syphilis, diseases of the skin, and of the bladder, etc. This physician drew attention to its anodyne virtues, and administered it internally to the extent of 40 or 50 grains daily. Its value was more fully declared in 1862 by Righini, who demonstrated the presence of iodine in all the secretions after the administration of iodoform, and in the urine even after its external application. He stated, however, that, unlike iodine, it

did not cause emaciation or stimulate the glands or act as a local irritant. He enlarged somewhat the sphere of its therapeutical uses. Its most important agency was first announced by Von Mosetig-Moorhof in 1879 to be that of a dressing for surgical wounds, and for this purpose it has been widely and successfully used, especially in Germany. Its anodyne quality was conspicuously displayed in the treatment of *cancer* of the uterus, breast, and other parts, for the progress of the local disease was rendered slower and the exhaustion of the patient's strength was retarded. Indeed, not a few tumors (cancroid), supposed to be cancers, were entirely cured under this treatment. Its special value as a dressing in cases of cancer consists in its relieving the pain and correcting the offensive smell of the discharges. But it also retards the progress of ulceration. Simple ulcers of the cervix uteri are most efficiently treated by its means, although some persons associate with it a carbolic-acid lotion. No agent is more successful in promoting the removal of exudations in *metritis*, *parametritis*, *endometritis*, and *perimetritis*, as well as in relieving the pain of these affections. It may be applied directly by means of a tampon in the vagina or introduced into the rectum in a suppository, or, by insufflation, into the dilated cervix uteri. The absorption of the medicine in these cases is demonstrated by the taste in the mouth of which the patients complain. Moleschott praises highly a mixture of 1 part of iodoform and 15 parts of flexible collodion, applied night and morning with a brush, as a discutient of *swollen glands* in the neck and elsewhere, as well as of *effusions* in the *pleura*, *pericardium*, *peritoneum*, and even the *arachnoid*, and as a curative application to *chronically-inflamed joints*. He ascribes the cure of several cases of *tubercular meningitis* to the use of this compound, which was painted three or four times daily over the nape of the neck, the mastoid processes, the temples, and the forehead.

Warfwinge gives equal credit to friction of the scalp with an ointment composed of 1 part of iodoform to 5 of vaseline applied twice a day (*Med. News.*, liii. 531); and Bruns claims the cure of many *tubercular abscesses* by injecting them with a mixture of equal parts of iodoform, glycerin, and alcohol (*Centralb. f. Med.* v. 636; vii. 351), and equally favorable results have been obtained by Billroth, Wendelstadt, etc. Others have used for surgical abscesses an ethereal solution, 5–10 per cent. strong according to the size of the abscess. The severe pain of the distension produced by the volatilized ether led to the disuse of this preparation and the substitution of olive oil as a solvent (1 : 10), or of an emulsion made with oil and alcohol (*Centralbl. f. Ther.*, vii. 680). A solution in eucalyptus oil has been used by Ransome and others for injecting *pulmonary cavities*—a method more remarkable for its boldness than for its reasonableness or its success. (For the treatment of cold abscesses see below.) Lindley claims remarkable success in the treatment of *diphtheria* by the "liberal application" of iodoform (*Boston Med. and Surg. Jour.*, Sept., 1889, p. 252). Chandeleux injected iodoform dissolved in ether (1 : 8) into the bladder for the relief of *chronic cystitis* (*Therap. Gaz.*, xi. 622), and Frey employed a solution of iodoform in glycerin and water (*Annuaire de Thér.*, 1889, p. 317). Mosetig-Moorhof, Schiff, and others have found that iodoform powder is a very soothing application to *burns*. When they involve the face a vaseline ointment (1 : 20) is preferred. The parenchymatous injection of a 5 per cent. ethereal solution of iodoform has been used successfully by Mosetig-Moorhof in the treatment of *goitre*.

Iodoform has been used topically in the treatment of *gonorrhœa*, especially in females, but without favorable results, except, perhaps, as a palliative of *chordee*. Venereal ulcers, however, of the cervix uteri and vagina are benefited by it, and sometimes in a remarkable degree. Venereal and all other *ulcers* are most favorably influenced by iodoform, the more so in proportion as they are irritable and painful. "Under its use healthy sores heal rapidly, creeping sores generally cease to spread, and sluggish ones take on healthy action" (Hill). Another declares its effects to be almost magical (*Practitioner*, xxii. 321). Mr. Miller says of his treatment of "chancroids:" "I simply dust them with iodoform powder and keep them dry, and they invariably heal up in a few days" (*Edinb. Med. Jour.*, xxviii. 390). This surgeon especially lauds the virtues of the application to venereal sores of the female genitals; he also uses it for buboes after evacuation and for syphilitic ulcers of the mouth, nose, etc. In these encomiums almost all syphilographers unite. A later writer declares that iodoform "will not retard the growth of a large, indurated, infecting chancre, and will not arrest phagedena; it will not remove venereal warts nor materially affect an inflamed gland" (*Med. News*, xli. 98); but, as Brockhardt summarizes the matter, iodoform "is a specific against the virus of soft chancre;" or, as Unna declares, "it destroys the venereal virus in the tissues, and, if early applied, prevents suppurating *buboes*." It seems also to be the most efficient agent in treating the last-named abscesses if they are filled with iodoform

gauze after having been evacuated and cleaned. According to Brockhardt, under iodoform dressing suppurating buboes heal twice as rapidly as under the more usual methods, and with due antiseptic precautions "opened bubo never becomes phagedenic, diphtheritic, or chancrous." It is alleged to exert a favorable influence upon the later constitutional symptoms of *syphilis* when given internally in doses of from ¼ to ½ grain several times a day, and has also been administered hypodermically, suspended in glycerin, for a similar purpose. A solution of 1 part of iodoform in 6 or 7 of ether is considered by some surgeons preferable to the former agent alone, since it acts in smaller quantity and also as a protective to the sore. Whitehead and others also prefer an ethereal solution of iodoform to the powdered drug, or a solution of 1 part of iodoform in 2 parts of ether and seven parts of collodion. It is by no means determined that iodoform given internally is beneficial in constitutional syphilis; some affirm and others deny it. There is more unanimity respecting its subcutaneous administration, and indeed, Brockhardt declares that it "produces a far more constant and effective action than iodide of potassium." Carded cotton thoroughly impregnated with iodoform has also been found very useful for application to the nostrils, vagina, and rectum. In the simple as well as in the syphilitic form of *ozæna* this treatment has been found successful, and an ointment of iodoform prepared with vaseline has been used with equally good results. The same statement is true regarding syphilitic ulcers of the *pharynx*, to which the ethereal solution or the powder has been applied, or which have been treated with gelatin lozenges, each containing 1 or 2 grains of iodoform and allowed to dissolve slowly in the mouth. When the liquid preparations have been used for the purposes under notice, it has been recommended to administer at the same time pills, each containing 1½ grains of iodoform, three times a day in the beginning, the dose being gradually increased until 8 or 10 pills are taken in twenty-four hours. This combined local and general treatment is strongly recommended in cases of syphilitic fissured *ulcer of the tongue*. The application of iodoform as a dressing for open *buboes*, and especially for such as have indurated walls and sinuses, has been singularly efficacious, as it also has in the treatment of *chronic otorrhœa*. In all of the cases now named it deodorizes, while it tends to heal, the ulcerated surfaces. In some of these cases the action of nitrate of silver may be associated with that of iodoform, the latter lessening the pain of the former, while the caustic stimulates more actively than the iodoform.

It is reputed to be an efficient application to *ringworm of the scalp* and in the treatment of *purulent ophthalmia*, *granular* or *ulcerated eyelids*, *ciliary blepharitis*, *pannus*, and *phlyctenulæ* and *ulcers* of the *cornea*. In these affections of the eyeball it is recommended to apply finely-powdered iodoform by means of a camel's-hair brush, and to use for the eyelids an ointment made with 1 part of iodoform to 4 parts, and for the eyeball 1 part to 10 or 15 parts of vaseline. It allays the pain and promotes the healing of blistered surfaces and of ulcers left by *burns*. In some cases of ulcerated fissure of the *anus* it has proved a very useful palliative, as well as in certain *hæmorrhoidal* affections attended with pain in defecation. In both it acts by promoting a more healthy nutrition, while it prevents the irritation and pain which tend to perpetuate them. Iodoform suppositories used in these affections are apt to cause general toxical symptoms. *Pruritus vaginæ* may be palliated by similar means. Riehl has successfully treated *lupus vulgaris* with iodoform after removing the cuticle with caustic potassa. The latter agent occasions pain which the subsequent application of the iodoform neutralizes, while it causes a gradual shrivelling and disappearance of the morbid growth (*Boston Med. and Surg. Jour.*, May, 1882, p. 415). It appears to act in a similar manner upon various local inflammatory swellings of the *lymphatic glands* and the *testes*, and to diminish the size of the *goitrous* tumors. In *diseases of the skin* it seems to have been found more useful in dry and chronic affections than in others; thus in *psoriasis* and *prurigo*, rather than in eczema. It has, however, been declared by Squire to be a very convenient and efficient remedy for *impetigo larvalis* (*British Med. Jour.*, May 14, 1881). Frazer found it useful both in local *eczema* and impetigo and in *prurigo decalvans* (*Practitioner*, xxvii. 280); and it has been applied in an ointment or liniment to prevent pitting in *small-pox*. A solution of one part of iodoform in ten of collodion has been represented to be efficient in arresting *erysipelas* (Burman.) But the examples published seem to have been chiefly cases of erythema, such as various stimulants and protectives cure. An injection of iodoform 25 grs. starch 30 grs., and water 3 fl. oz. has been successfully used to combat the vesical pain and irritability caused by *chronic cystitis*. The symptoms caused by *ulcers of the larynx* have been palliated by a glycerate of iodoform, and also by insufflation of the powdered medicine. On the ground that iodoform is eliminated through the

lungs, Bruns proposed its use in the treatment of *phthisis*, and believed that his view was confirmed by clinical experience. Dr. R. Singleton Smith (1884) also brought a series of cases to confirm this view, but later confirmation is wanting. In chronic *nasal catarrh* powdered iodoform, diluted with a neutral powder, has been successful not only in deodorizing the discharge, but also in arresting it. A similar application, or one of iodoform dissolved in ether, has been found salutary in specific and other *ulcers* of the *throat*, *vagina*, etc. In chronic suppuration of the middle *ear*, but more especially of the internal *auditory canal*, iodoform excels all other applications in diminishing the discharge, correcting its fetor, and restoring the part to its normal condition. Some claims have been made for this medicine as a topical remedy in *diphtheria*, but they rest upon very inadequate grounds. It may be applied in spray or powder, or in a solution of 1 part of iodoform and 2 parts of balsam of Tolu in 10 parts of ether.

The *gangrenous vulvitis* which is so common under certain conditions of constitution and recent sickness in hospital practice is more successfully controlled by powdered iodoform than by any other agent. According to Parrot (*Bull. de Thér.*, c. 382), nothing so easily and promptly cures that aphthous forms of *vulvitis* which attacks feeble and ill-fed children. In other forms of hospital *gangrene* it is efficacious. It is one of the best palliatives of *pruritus pudendi* when applied in an ointment containing about Gm. 1.20 in Gm. 30 (20 grains to the ounce). The anodyne virtues of iodoform displayed in these affections, as well as in various other painful disorders of the rectum, bladder, and uterus, the mouth and the nasal passages, are also exhibited in some internal disorders, and particularly in those of the stomach. *Gastralgia*, alone or associated with simple *gastric ulcer*, is relieved by it, and sometimes permanently cured. In cases of vaginal hyperæsthesia and *vaginismus* its action is favorably exhibited, especially when these conditions depend upon a lesion of the mucous membrane. In the absence of the latter, belladonna may be usefully associated with iodoform. External *neuralgiæ* have, it is said, been cured by iodoform, but as in every case iron was used internally, the cure was very probably due to the latter medicine. But there can be no doubt of its anodyne action in these affections. Topically, it is, like many other anodynes, a palliative of *neuralgia* if applied over the tender points of the nerves. For this purpose iodoform collodion is convenient. According to Moleschott, it has often relieved the most intense pains and other symptoms of *gouty* inflammation within twenty-four hours after painting the affected part with the solution of iodoform in collodion. Testa recommends it in this disease internally, provided that the kidneys be not obstructed, and also as a palliative of arythmia in diseases of the *heart*. An ointment made with 1 part of iodoform and 4 parts of vaseline is said to have promptly reduced the pain and swelling in acute *orchitis* (*Med. Record*, xix. 463). Iodoform has also been recommended to relieve the pain of a *carious tooth*, but it was used along with carbolic acid, oil of peppermint, or other anæsthetic, to which, probably, the relief was mainly due. Owing to the use by German writers of the word "tubercle" in its generic sense, it has been supposed that iodoform was claimed to be a remedy for pulmonary tubercular phthisis; no reasonable physician has preferred so preposterous a claim. Some, however, allege that the medicine is a palliative of the cough, expectoration, fever, and sweating in this disease, and attribute this favorable action to its elimination in part through the lungs.

The application of iodoform as a dressing for surgical and other *wounds*, which was introduced by Mosetig-Moorhof in 1879, became very general in 1880, especially in Germany. It was claimed to be absolutely unirritating; wounds were said to be stimulated by it even less than by carbolic-acid lotions, and the granulating process was thought by Mikulicz (*Wiener Klinik*, Jan. 1882) to be rather retarded than quickened by it. It has a remarkable anæsthetic action, and when kept applied to wounds is a disinfectant which has the advantage of being altogether unirritating. According to the surgeon just named, it is neither as prompt nor as energetic as some other antiseptics, and is quite unsuited for disinfecting the surgeon's hands, instruments, etc. Owing to its mild action, it is recommended as a permanent dressing for recent wounds, and especially for such as are attended with a loss of substance. It is said to be less eligible for granulating wounds. In penetrating wounds and deep cavities the whole interior surface should be coated with iodoform powder, but in recent wounds which are to be healed by the first intention it is, according to this authority, superfluous, if not injurious, to apply the powder to the raw surface, but the part should be dressed with iodoform gauze. In contused, complicated, and other analogous wounds due drainage precautions should be observed. An iodoform gauze dressing is also recommended in all operations involving the peritoneum, intestine, etc., and in those interesting the nasal

cavities, the mouth, pharynx, rectum, vagina, etc. A great value is claimed for iodoform gauze in some of these cases—*e. g.* in excision of the tongue for cancer of that organ, as reported by Billroth (*Amer. Jour. of Med. Sci.*, April, 1882, p. 567). Its advantages are very conspicuous in the treatment of open cancer, *septic* and *gangrenous wounds*, and *ulcers*, in *panarities* and *paronychia*, in *boils* and *carbuncles* after incision, and in the lesions connected with *scrofula*, *lupus*, and *syphilis*. Whitehead claims to have aborted *carbuncles* by injecting into them a saturated solution of iodoform in ether (*Brit. Med. Jour.*, Mar. 9, 1889). A similar treatment of *malignant pustule* has been employed by Rinonapoli (*Therap. Gaz.*, xiii. 788).

The treatment of *cold abscesses* by injections of solutions of iodoform is said to ensure their contraction and cure without marked symptoms of reaction. Practised first by Mickulicz and by Fränkel, others have found the method radically curative. The original solution contained about Gm. 2.60 (gr. xl), of iodoform in glycerin Gm. 32 (℥j), and was required to be used only once to effect a cure in the most favorable cases (*Med. News*, xlv. 491.) Verneuil used Gm. 100–300 (f℥iij–ix) of an ethereal solution 1 : 20, and from that to 1 : 5, after aspirating the abscess. It is said that no toxical symptoms were induced unless the quantity of the solution was greatly in excess of the doses mentioned. The absorption of iodoform from abscesses appear to be very slow (*Bull. de Thérap.*, cviii. 191.) Verchère recommends that for large abscesses a 5 per cent. solution should be used and either a 10 per cent. or a saturated solution for small ones. The distension of the abscess-walls by the vaporized ether soon subsides (*Med. News*, xlix. 403.) These conclusions have been confirmed by Billroth (*Therap. Monatsh.*, iv. 253), Bruns (*Amer. Jour. Med. Sci.*, Aug. 1890, p. 194), Kirschner (*ibid.*, p. 523.)

At the risk of some repetition, a brief summary may here be given of the conclusions of Mosetig-Moorhof, the most enthusiastic promoter of the surgical applications of iodoform (1882): It is a specific against the formation of exuberant granulations, and represses them when they already exist, transforming them into a firm and healthy tissue. To affect this purpose it is necessary to scrape the indolent growth so as to expose a raw surface. After this operation and the dressing the discharge ceases to be purulent. Iodoform is the most certain antiseptic of every description of wound, and in a moderate amount is not hurtful to the system, although it is absorbed and is found excreted with the urine. Its primary action is, indeed, anæsthetic, but secondarily it quickens granulation and absolutely prevents all septic processes in wounds. Under its use the healing process is apyretic, or if at first the evening temperature is raised it does not present the characters of septic fever. Introduced into a wound, it does not prevent union by the first intention. Still, with the iodoform dressing, as with all others, provision must be made for the escape of the secretions. Their discharge does not impair the antiseptic quality of the application, but the rise of temperature that attends their accumulation demands the renewal of the dressing, which also permits an inspection of the wound. If after a few days traumatic fever does not arise, a fresh dressing, although desirable for the sake of cleanliness, is not absolutely necessary. Under this method traumatic erysipelas is very rare. Iodoform as an antiseptic renders other antiseptics unnecessary. Besides it, only pure water is required. Perfect cleanliness of the hands and instruments that touch the wounds is essential. Iodoform is the cheapest, surest, and most permanent of all antiseptic dressings. The materials are easy to manage. Iodoform powder and gauze may be preserved for years without the slightest loss of activity. They may be applied antiseptically to the buccal cavity and in or near the rectum and bladder.

The judgments now given are substantially the same as those of all the leading surgeons of Germany. (Compare *Centralbl. f. d. g. Therap.*, i. 49.) The results obtained by Prof. Boeckel of Strassburg are scarcely less remarkable than those now recorded (*Bull. de Thérap.*, cii. 265, 321). In England most of the reports of the German surgeons have been confirmed (*Med. Record*, xxi. 400), and in this country, although the published accounts of iodoform in surgery are of the same character, they are less numerous than might have been expected (*ibid.*, xxi. 309). It is highly probable that the offensive smell of the preparation is the chief cause of its comparatively limited use outside of Germany. This is the more remarkable in view of the language of hyperbole which its German promoters adopt. Von Mosetig-Moorhof in his enthusiasm exclaims: "The hymn of praise that I have sung to iodoform is not pitched upon too high a key. The most eminent German surgeons join in the chorus that soon will echo around the world. Only let not impossibilities be expected from this agent; it cannot work miracles."

In 1881, Spaeth introduced into the womb of lying-in women threatened with *puerperal fever (septicæmia)* pencils containing iodoform (powdered iodoform 20 parts; gum acacia and starch, of each 2 parts). The cases in which they were employed comprised operations on the uterus, abortion, partial retention of the placenta, endometritis, etc. This treatment was found to allay pain, prevent putrefaction of and diminish the discharges, and also to promote the healing of lesions, while it spared the patient the frequent injections required by the use of carbolic-acid and corrosive-sublimate solutions. One, or at most two, applications in each case sufficed (*Centralbl. f. d. g. Therap.*, ii. 80). The conclusions of Spaeth were confirmed by various gynæcologists, including Ehrendorfer (*Times and Gaz.*, May 31, 1884), and in the United States by Boardman, who employed insufflation of powdered iodoform into the uterus and vagina (*Boston Med. and Surg. Jour*, Sept. 1884, p. 246).

The dose of iodoform is Gm. 0.06–0.20 (1 to 3 grains) three times a day, in pill. It may be applied in a very fine powder, the part having been thoroughly dried, but this method diffuses the preparation and decreases its effectiveness. It is better used in ointments, liniments, or suppositories, each application containing about Gm. 0.10 (2 grains) of iodoform. For some of these purposes it may be dissolved in alcohol, chloroform, ether, collodion, oil, glycerin, or vaseline. It may be used for insufflation or sprinkling mixed with lycopodium, powdered sugar, or starch. As already described, it has been incorporated with gelatin to form pastilles. The following formulæ have been recommended: ℞. Iodoform ʒj–ʒiss; glycerin fʒxij; alcohol fʒiv.—M. ℞. Iodoform gr. xxx; alcohol q. s.; lard ℥j.—M. The following may be used for making suppositories: ℞. Iodoform Gm. 2.50 (gr. xxxviij); cocoa-butter Gm. 40 (℥j, ʒij); yellow wax Gm. 5 (gr. lxxv). Mix at a gentle heat and make ten suppositories. Cylinders made with cocoa-butter, mucilage, and glycerin, or gelatin are used in the treatment of sinuses and other deep and narrow cavities. A solution for topical application may be prepared by dissolving 1 Gm. (15 gr.) of crystallized iodoform in 4 Gm. (60 gr.) of sulphuric ether (60° Baumé). The gauze used as a surgical dressing contains from 10 to 20 per cent. of iodoform (Billroth), or from 30 to 50 per cent. (Mosetig-Moorhof). It is essential that neither the gauze, the powder, nor any other preparation of iodoform should be applied very frequently, for such repetition multiplies the dangers of poisoning.

A 20 per cent. solution of iodoform in ether has been used hypodermically. Thomann recommends a 30 per cent. solution in glycerin, of which Gm. 0.30–0.75 (5 gr. or later on 12 grs.) are employed in each injection for constitutional syphilis. A 25 per cent solution in olive oil and a 10 per cent. solution in glycerin have been injected into the *nasal* and other natural *cavities*, into cold *abscesses* after their evacuation, etc. Iodoform ointments generally contain from 5 to 10 per cent. of iodoform. Elastic collodion, containing from 6 to 10 per cent. of iodoform, is a very useful application to inflammatory *swellings* of various kinds, enlarged lymphatic *glands*, the tender points in *neuralgia*, etc.

The smell of iodoform is intolerable to many and offensive to all, and the ingenuity of surgeons and pharmacists has been taxed to devise methods of neutralizing or concealing it. The latter object has been sought by the use of fragrant substances, such as cumarin, musk, and the oils of bergamot, peppermint, lavender, sassafras, turpentine, cinnamon, thyme, and eucalyptus. Oil of southernwood (Artemisia abrotanum), has been proposed for the same purpose. The following formula has been employed: Iodoform ℥ij; oil of eucalyptus ♏xv; oils of verbena, mirbane, lavender, and lemon, of each ♏v (Arthur). When the powdered drug is kept in a jar with several Tonqua beans its odor is greatly diminished. An ointment recommended by Auspitz contains iodoform and carbolic acid, of each 2 parts; lard 7 or 8 parts. Lindemann claims that 2 parts of balsam of Peru to 1 of iodoform completely mask the smell of the latter. This mixture can be conveniently made up in an ointment with vaseline. Tannin is also stated to lessen the smell of iodoform. Oppler has proposed iodoform 2 parts; finely powdered roasted coffee 1 part; oil of sassafras and oil of Evoida fraxinifolia; and powdered camphor 1 part to 3 parts of iodoform. Dr. Stout claims that 9 parts of this product may be deodorized by 1 of coumarin or of vanillin, or by 2 parts of cinnamic acid. Napthalin, tar, and creolin have also been used for the same purpose.

The poisonous effects of iodoform are to be met by suspending its use, removing all of it that may have been applied, and washing the part with a solution of sodium bicarbonate; at the same time solutions of potassium acetate, lemonade, and analogous drinks should be freely given.

Annidalin, a combination of thymol and iodine, has been used under the name of aristol. It is not an irritant nor poisonous when taken internally (Seifert). Its con-

stituents do not appear in the urine. It was introduced by Eichhoff in 1889 (*Ther. Monatsh.*, iv. 85), who recommended it as being inodorous as well as non-irritant, and as an efficient remedy in various *cutaneous diseases*, including *psoriasis*, *syphilitic sores*, *lupus*, etc. Similar testimony was furnished by Schirren, and Seifert (*ibid.*, pp. 207, 312). Swiecicki stated it to be useful in curing *uterine* discharges (*ibid.*), and Brocq confirmed most of these statements. Löwenstein used insufflations of the powder in ozæna (*Lancet*, July, 1890, p. 549), and Rohrer in various affections of the ear—a practice condemned by Szenes (*Therap. Monatsh.*, iv. 543). Pollak claimed that ointments made with it were very efficient in reducing the size of *goitres*, *scrofulous* glands, *swelled testicles*, etc. (*Therap. Monatsh.*, iv. 340). Neisser, on the other hand (*Centralb. f. Ther.*, viii. 428), did not find it a useful application to soft chancres or in chronic indurated eczema, in lupus, syphilitic ulcers of the skin, and various cutaneous affections. It is reported to act very favorably as a dressing for wounds, ulcers, and various *diseases of the eye* (Wallace, *University Med. Mag.*, iii. 472), and it is one of the numberless applications recommended in poisoning by *Rhus toxicodendron*. Aristol has been applied in powder with sugar of milk, 1 : 10, and in the same proportion in an ointment with cocoa-butter, lard, vaseline, or lanoline. (Compare Egasse, *Bull. de Thérap.*, cxix. 263, 314; Larmuth, *Amer. Jour. Phar.*, lxii. 495; Allen, *Med. Record*, xxxviii. 404.)

Antisepsin is antipyretic in the dose of Gm. 0.02–0.05 (gr. $\frac{1}{3}$–$\frac{3}{4}$) every three hours; and as a topical application to *wounds* and *ulcers* it may be used in powder for the relief of pain and regulating the granulating process. It has been used in suppositories for the relief of *hæmorrhoids*, in the proportion of Gm. 0.2–0.4 to cocoa-butter Gm. 3–4 (gr. 3–6 to gr. 45–60).

Antiseptol, another of the many substitutes for iodoform, and recommended for the same purposes, is thought to be inferior to carbolic acid as an antiseptic, and is far less poisonous. Its clinical uses are the same as those of antisepsin. For external use a 1–10 per cent. solution is recommended, and internally it has been given in a solution of Gm. 6 in water Gm. 1000 (fʒiss in Oij).

Cresol, says Dr. Squibb, and all its compounds, "are powerful antiseptics, but have the disadvantage . . . . of adhering to or rendering slippery the operating instruments and hands, and of readily oxidizing in the air." According to Fränkel, it is only half as poisonous as carbolic acid and far excels it in disinfecting power.

Europhen depends for its virtues essentially upon the iodine in its composition, which is gradually exhaled. Its solubility in oils, and its freedom from offensive smell and poisonous qualities recommend it. It has been extensively used and commended in the treatment of *chancres* and other *ulcers* of the skin and mucous membranes, and especially those which secrete a fetid discharge, including *burns*, *lupus*, *eczema*, etc. A $\frac{1}{2}$ to 1 per cent. ointment with vaseline has been applied to the conjunctiva, and one of 5 to 10 per cent. strength to other parts. Internally doses of Gm. 0.01 (gr. $\frac{1}{6}$) have not been found to occasion any disorder; but a dose of Gm. 0.10 (gr. $1\frac{1}{2}$) is said to have caused pains in the head and abdomen.

Iodol.—In 1885–86 iodol was used in the *syphilitic* wards of Rome by Silber, Ciamiccian, and Mazzini as a dressing for *ulcers*, and was found to act as a wholesome stimulant, deodorant, and anodyne, like iodoform, without the disagreeable smell of the latter. It appears to act as a superficial caustic, forming a whitish film on the ulcerated surface, but not a scab. It does not act favorably upon sloughing sores. Injected into the tissue of *lupus*, it shows a healing power, and in *fungous disease* of the joints its alcoholic solution has caused a cure with shrivelling of the vegetations. In *cancer* of the rectum and of the uterus it has been applied on tampons with excellent palliative effect; in like manner it has cured mucous fluxes of the *vagina*, reduced *condylomata*, and, in general, palliated the local manifestations of *syphilis*, *scrofula*, *lupus*, etc. (*Centralb. f. Ther.*, iv. 515; *Therap. Gaz.*, x. 703). It has been injected into the cavity after the evacuation of *hydrocele*, and also into *abscesses*. Applied as a fine powder or a 20–30 per cent. vaseline salve by Glässner, it was found useful in *pannus*, *corneal opacities*, *serous iritis*, and *blepharitis*, but not in *phlyctenous conjunctivitis*. Trousseau employed in these affections a 2–3 per cent. ointment. Lublinski, Seifert, Wolfenden, and others applied powdered iodol to the treatment of *laryngeal phthisis* and atrophic catarrhs of the *nostrils* and *pharynx*. Stembo claims for this method the cure of *diphtheria* (*Brit. Med. Jour.*, Apr. 9, 1887). The alleged virtues of its internal use in scrofula, chronic bronchitis, and phthisis have not been confirmed (*Med. News*, liv. 17; *Therap. Gaz.*, xiii. 72). Stetler claims for it exceptional efficacy in the treatment of carious suppuration of the auditory canal. He used 1 to 2 parts of iodol in a mixture of 16 parts

of alcohol and 34 of glycerin (*Am. Jour. Med. Sci.*, xciv. 266). The dose of iodol internally has been stated at Gm. 0.13–0.20 (gr. ij–iij) a day, but ten times as much has been given without injury. In chronic laryngitis lozenges, each containing one grain of iodol, have been used. Usually it is directly applied, by insufflation, as a powder, mixed with boric acid or with powdered talc, etc. It may also be used in a vaseline ointment or on prepared gauze.

Iodonaphthol has been applied in the same class of cases and in the same manner as the preceding preparations.

Iodophenin, like the preceding iodous compounds, depends for its virtues upon the iodine in its composition, but owing, it is said, to its yielding its iodine very rapidly, it lacks the characteristic qualities of the preparations above considered.

Soziodol. This compound causes little or no local irritation, and does not act as a poison. Neither Langgaard nor Seifert found any potassium iodide in the urine after its internal use. According to Lassar (*Therap. Monatsh.*, Nov. 1887), and Nitchmann (*ib.*, Jan. 1889), as a powder or in an ointment with vaseline or lanoline it is a useful application to *wounds*, *ulcers*, *cutaneous eruptions*, including the parasitic forms, in diseases of the *nasal passages*, etc. (Fritsche). Larmuth commends its sodium salt in watery solution (3–10 per cent.), on gauze, wool, etc. It has been employed in various forms of *conjunctivitis*. Herzog, Seifert, and others used compounds of soziodol with sodium, potassium, zinc, and mercury, generally mixed with talc and administered by insufflation, the first two with equal parts of talc. The salt of mercury is seldom employed in greater proportion than 1 : 20, and, in the nares, for instance, after the application of cocaine. Both metallic salts of soziodol are irritating to mucous membranes. All the preparations are more or less antiseptic. Soziodol zinc has been used in 2 per cent. solutions to restrain purulent discharges—*e. g. gonorrhœa*, *leucorrhœa*, etc. (Compare Fritschmann, *University Med. Mag.*, iii. 434.)

IODUM, *U. S., Br., P. G.*—Iodine.

Iode, Fr.; *Jod*, G.

Symbol I. Atomicity univalent. Atomic weight 126.53.

A non-metallic element, obtained principally from the ashes of sea-weeds and from the mother-liquor of Chilian sodium nitrate. Iodine should be preserved in glass-stoppered bottles in a cool place.

Origin.—Iodine was discovered in 1811 by Courtois in the ash of sea-weeds, and was soon afterward thoroughly investigated by Gay-Lussac; also by Davy, Soubeiran, and others. It is very widely distributed in nature, but is usually met with in small, and even quite minute, quantity, almost invariably in combination. It is found in some minerals combined with mercury, silver, lead, and other metals; in Chili saltpetre, principally as sodium iodate; in many mineral spring-waters, in sea-water, in coal, and in many plants and animals living in sea-water or near the sea-coast. It is often a constituent of the atmosphere in minute quantities, and occasionally of the ashes of some plants growing inland. During the fiscal year 1866–67 the United States imported 10,701 pounds of crude and 889 pounds of resublimed iodine; in 1878 the amount was 73,687 pounds, and in 1881 182,863 pounds, of the crude article.

Preparation.—*Kelp* is the ash left on the burning of sea-weeds. The weeds are first dried, and then charred or burned at as low a temperature as possible, to avoid loss of iodine. The ash is exhausted with hot water, and the solution concentrated and cooled to remove by crystallization potassium chloride and sodium carbonate and sulphate. More of the latter salt will crystallize after the addition of some sulphuric acid, whereby the sulphides and thiosulphates present are decomposed. To the mother-liquor, heated in lead retorts to a temperature a little over 60° C. (140° F.) manganese dioxide is added in small quantities, when iodine will distil over, and is collected in glass receivers, several of which are connected with each other. The liberation of iodine from the sodium iodide of the liquor is explained by the following equation: $2NaI+3H_2SO_4+MnO_2=I_2+2NaHSO_4+MnSO_4+2H_2O$, acid sodium sulphate and manganous sulphate being formed at the same time. The mother-liquor obtained on the purification of Chili saltpetre contains sodium iodate and iodide; from the latter the iodine is separated by chlorine gas; from the former, by sulphurous, or preferably by nitrous, acid, in which case sodium sulphate or nitrate is produced.

Purification.—In the crude state iodine is chiefly contaminated with water, but it sometimes contains also cyanogen iodide, and occasionally iodine chloride, ICl. Purifica-

tion is effected by drying the product as much as possible by mechanical means, and then subliming it carefully, so that the more volatile compounds named may first sublime; afterward the heat is raised and the receiver changed. The product is the *resublimed iodine* of commerce.

Properties.—Iodine is in flat, scale-like rhombic crystals of a grayish-black or bluish-black color and a bright metallic lustre, in thin splinters transparent with a red color. It is soft and friable, and has a peculiar odor, suggestive of chlorine, and a very caustic and acrid taste. The skin or paper is colored red-brown to dark-brown, the stain disappearing gradually. Iodine has neither an acid nor alkaline reaction, but slowly destroys all vegetable colors. It has the specific gravity 4.95, vaporizes slowly and without leaving any residue at ordinary temperatures, fuses near 115° C. (239° F.), congeals at 113.6° C. (236.5° F.), and boils above 175° C. (347° F.), according to Stas, when quite pure at 250° C. (482° F.); its vapor has the density 8.7, and a reddish or purple, or above the boiling-point a deep-blue, color. Iodine dissolves with a brown-yellow color in about 60 parts of glycerin, and in 7000 parts (Gay-Lussac) (5000 parts, according to U. S. P.) of water, and forms with it gradually hydriodic acid, which dissolves more iodine; its solubility in water is also increased by tannin and by many salts, and particularly by iodides. It requires for solution about 10 parts of alcohol at 15° C. (59° F.), and dissolves freely in ether, both solutions having a brown color; it is easily soluble in chloroform, carbon disulphide, benzene, and other hydrocarbons with a purplish or violet color.

Iodine is readily recognized by the blue color which it imparts to starch-paste, by which test $\frac{1}{400000}$ part of free iodine is recognized. Water containing traces of free iodine will yield it to carbon disulphide, etc., in which solution it is recognized by the purplish color and by the blue color produced with starch-paste. Iodine in combination must previously be liberated by chlorine gas, avoiding an excess of the latter, or, if present as iodate, sulphurous acid or other deoxidizing agent will set it free.

Impurities and Adulterations.—At present iodine is usually met with in commerce in a very pure condition, containing but minute quantities of impurities. An excessive proportion of water is indicated by the iodine adhering to the bottle, and may be removed by placing it under a bell-glass over oil of vitriol at a low temperature; moist iodine yields with benzene or chloroform a turbid solution, from which the water gradually separates, the solution becoming clear. Iodine cyanide and iodine chloride are rather freely soluble in water, and their solutions dissolve iodine with a brown color; they may be separated by heating the iodine in a suitable apparatus for about 15 minutes to 100° C. (212° F.) and cooling the vapors well; the former impurity will sublime as white or yellowish needles, the latter as hyacinthine-red prisms or red-brown oil; both have a pungent odor. For their detection the following processes are given: "If 0.5 Gm. of iodine be triturated to a fine powder, then shaken with 20 Cc. of water for a few minutes, the liquid filtered, and to one-half of the filtrate, contained in a test-tube, decinormal sodium thiosulphate solution carefully added, until the liquid becomes decolorized, then a few drops of solution of ferrous sulphate, and subsequently a little soda test-solution added, and the mixture gently heated, on finally adding a slight excess of hydrochloric acid the liquid should not assume a blue color (absence of *iodine cyanide*). If to the other half of the above-mentioned filtrate, contained in a test-tube, a slight excess of silver nitrate test-solution be added, and the mixture actively shaken, then, after subsidence of the precipitate, the clear, supernatant liquid be carefully and completely decanted, and the precipitate shaken with a mixture of 1 Cc. of ammonia-water and 9 Cc. of water, the filtered liquid, after the addition of a slight excess of nitric acid, should not become more than slightly opalescent (absence of more than *traces of chlorine* or *bromine*)."—U. S. The following is the same test somewhat modified: If iodine be dissolved in sulphurous acid, the solution strongly supersaturated with ammonia, and completely precipitated by silver nitrate, the filtrate, on being supersaturated with nitric acid, should not at once become more than faintly cloudy (absence of more than traces of chlorine or bromine). The amount of iodine is estimated in solution with potassium iodide and water by decolorizing with volumetric solution of sodium thiosulphate, as follows:

0.32	Gm.	iodine,	1.0	Gm.	potassium	iodide,	20	Cc.	water	require	25	Cc.	vol.	solution, *U. S.*
0.20	"	"	1.0	"	"	"	20	"	"	"	15	"	"	" *P. G.*
12.7	gr.	"	15	gr.	"	"	1	oz.	"	"	1000	grain-measures,		*Br.*

By this test absolutely pure iodine is required by the Br. P., while impurities not ex-

ceeding 1.15 per cent. are permitted by the U. S. P. and P. G. Fixed impurities, such as graphite, charcoal, sawdust, metallic compounds, etc., are left behind on volatilizing a little iodine from a porcelain capsule.

Compounds of Iodine.—Iodine combines in several proportions with oxygen, the most important compound being *iodic acid;* it unites with hydrogen to hydriodic acid, and combines with most of the other elements and with many organic componnds.

The iodides of metals are partly crystallizable, and are either white or not unfrequently of a bright color. With the exception of those of gold and allied metals, they are mostly not decomposed by heat, except in contact with air or with oxidizing agents. The alkali iodides are more volatile than the corresponding chlorides, and on being heated with calcium sulphate in the air evolve iodine, while alkali sulphate and calcium oxide remain behind. The iodides are decomposed by chlorine, bromine, nitric acid, and strong sulphuric acid, and on being heated with acid sulphates. Most of the iodides are soluble in water, and these solutions are precipitated dingy white by cuprous and cupric salts, the latter liberating a portion of the iodine; bright yellow by lead salts; brown by bismuth salts; green-yellow by mercurous salts; scarlet-red by mercuric salts; yellowish-white by silver salts; yellow or green with gold salts; black with palladium salts; and dark-brown by platinum salts, the solution acquiring at first a deep brown-purple color.

1. Iodi bromidum. Bromide of iodine, Iodine pentabromide, Bromure d'iode, *Fr.;* Jodbromid, *G.* IBr_5.—Iodine pentabromide is prepared by dissolving 20 parts of iodine in 63 parts of bromine, and heating the solution for sometime in a large flask to about 60° C. (140° F.) until it yields a clear solution with 6 or 8 parts of water. It is a dark reddish-brown liquid, resembling bromine in appearance and sensible properties, but yielding a perfectly transparent brown-red solution with less than 6 parts of water. In the presence of a small quantity of water and at a low temperature the hydrate crystallizes in brown-yellow needles or prisms, melting again at 4° C. (39.2° F.), with separation of water. A solution containing 15 per cent. of the bromide is found in commerce. When the compound is kept for sometime at or above 63° C. (145.4° F.), the boiling-point of bromine, a portion of the latter distils off, and iodine monobromide, IBr., is left as a dark-brown sublimable crystalline mass. Iodine tribromide, IBr_3, may be prepared by using only 37.8 parts of bromine for every 20 parts of iodine. The pentabromide is used locally in diphtheria in solution of 2 drops to a fluid ounce of mucilage.

2. Iodi chloridum. Chloride of iodine, Iodine trichloride, *E.;* Chlorure d'iode, *Fr.;* Jodtrichlorid, Dreifach-Chlorjod, *G.* ICl_3.—If dry chlorine gas be passed over dry iodine union of the two elements takes place, a liquid results, and iodine monochloride will have been formed; the end of the reaction may be determined by ascertaining the proper increase in weight of the iodine. ICl_3 is a reddish-brown liquid which in the course of time deposits crystals, melting at 25° C. (77° F.). If the process be somewhat modified, so that dry iodine be sublimed in vessels containing a constant excess of dry chlorine gas, iodine trichloride will be formed, and is obtained in the form of orange-yellow needles having the spec. gravity 3.11, and gradually changing to large transparent rhombic plates. It has a penetrating, pungent odor, resembling bromine; when heated to 25° C. (77° F.) it liquefies, and is decomposed, chlorine being given off and iodine monochloride formed. Iodine trichloride is soluble in 5 parts of water and also in alcohol and ether; a concentrated aqueous solution keeps well, but a diluted aqueous or an alcoholic solution gradually changes even in the cold. If concentrated sulphuric acid be added to a strong aqueous solution, a white curdy precipitate will form, which is iodine trichloride, and soon assumes the characteristic orange-yellow color. Iodine trichloride contains 54.39 per cent of iodine and 45.61 per cent. of chlorine, and has been employed internally in doses of about $\frac{1}{6}$ grain and externally in aqueous solution ($\frac{1}{10}$–$\frac{1}{5}$ per cent.) as lotion or injection.

3. Iodozone is the name given by Robin to a solution of iodine in ozone. It is recommended to be used as a spray in pulmonary tuberculosis and on open wounds.

Pharmaceutical Uses.—Phenolum iodatum. Iodized phenol, recommended by Dr. R. Battey (1876), is prepared by combining with a gentle heat 1 part of iodine with 2 parts of crystallized carbolic acid. It is solid in cool weather. (See also page 39).

Syrup of Iodotannin. Debauque observed that a solution of tannin will dissolve a considerable amount of iodine without reacting with starch. Demolon has suggested a syrup containing this compound, which is made by dissolving 3 Gm. of iodine and 18 Gm. of tannin in 300 Gm. of water, evaporating the solution until 60 Gm. are left, which are mixed with 960 Gm. of simple syrup.

Action and Uses.—Applied to the skin in ointment or in solution, iodine occasions a sense of warmth in the part, which, if the preparation be very strong, may amount to painful burning and cause redness and swelling of the surrounding integument. The tincture stains the skin a brownish-yellow; the color is more or less permanent, and may only disappear with exfoliation of the cuticle. It may be removed by solution of ammonia and by other articles mentioned below. It has generally been believed that iodine is absorbed by the skin, but carefully-conducted experiments appear to show that, at least in adults, when efficient means are taken to prevent the iodine vapors from reaching the mouth and nostrils, no trace of the substance can be found in the secretions.

The rare cases of alleged poisoning by the application of iodine to the unbroken skin are contradicted by the experiments referred to. Dr. Culpepper of Barbadoes has reported the case of a negro boy, eleven years old, whose legs from the knees to the ankles were painted with tincture of iodine for the relief of eczema. Not until twenty-four hours later did constitutional symptoms arise. They consisted of headache and pain over the loins and bladder. Then followed vomiting, thirst, diarrhœa, suppression of urine, priapism, and hiccough. Later, diarrhœa set in; the temperature was not raised and the skin was dry. Then the stools became bloody, without pain. At the end of about six days death by exhaustion took place (*Therap. Gaz.*, xii. 225). In children, however, the tincture of iodine applied to the unbroken scalp is said to have been absorbed, since its presence was detected in the urine, which, at the same time, became slightly albuminous. The case of a woman who on the light application of tincture of iodine to a tumor between the scapulæ was seized with epigastric pain and oppression, weakness, trembling, sweating, dribbling of urine, and inability to stand erect (*Boston Med. and Surg. Jour.*, July, 1884, p. 4), seems to have been one of nervous apprehension merely. A case in which "iodine" was rubbed into the skin, producing great depression and sickness, besides a bullar eruption, is wanting in details (*Med. Record*, xxxviii. 43).

The raw cutis, the mucous and the serous membranes, and the connective tissue give iodine ready access to the blood. It does not usually occasion severe inflammation when so applied, perhaps from the rapidity of its absorption. When the vapors of iodine are inhaled they irritate the mucous membranes and occasion headache, coryza, lachrymation, and cough. Their prolonged operation, as in certain manufactures, gives rise to dryness of the respiratory tract, dizziness, nervous disorder, etc. Absorbed iodine is readily detected, combined with sodium or potassium, in the blood, milk, tears, saliva, urine, serous effusions in closed cavities, etc. It is excreted chiefly by the kidneys as an alkaline iodide, even when it is taken into the stomach, and sometimes it occasions a temporary albuminuria. When given in full doses the tincture of iodine will sometimes occasion the coryza which is one of the usual effects of potassium iodide.

The direct effects of large doses of iodine Gm. 0.30 (gr. v–vj), taken internally, are those of an irritant poison, such as heat and constriction of the throat, nausea, eructation, salivation, epigastric pain, vomiting, diarrhœa, and collapse. If reaction takes place, the skin is apt to become intensely red. Notwithstanding the great severity of the symptoms, the death of a previously healthy person by the internal use of iodine is extremely rare. In 1888 it was said that to that date only six fatal cases of iodine-poisoning were known (*Zeitsch. f. klin. Med.*, xiv. 472). Dr. Collins in 1889 reported the case of a young woman who had swallowed half an ounce of tincture of iodine when the stomach was empty. Almost immediately starch was administered, followed by a mustard emetic and warm water. No untoward consequences resulted (*Med. Record*, xxxvi. 98).

In the following description of the internal uses of iodine its tinctures are intended unless it is otherwise stated. In *intermittent fever* iodine has been thought to display decidedly curative virtues both in the malarial regions of the tropics and in those of the temperate zones (Concetti, *Centralbl. f. d. g. Ther.*, xx. 73; Hendricks, *Ther. Gaz.*, x. 193). The tincture was given in doses of from Gm. 0.30–1.00 (5 to 15 minims) three times a day, largely diluted. The compound tincture may be given in doses one-half larger. The reports published by Gibbons, Grinnell, Wadsworth, Atkinson, and Woods do not justify a favorable judgment of iodine in this disease. The two last-named physicians, whose field of observation was Baltimore, concluded that in intermittent and remittent fevers iodine "is infinitely inferior to either cinchonidine or quinine" (*Amer. Jour. of Med. Sci.*, July, 1883, p. 77). *Typhoid fever* and other febrile affections have been treated by iodine, but without evident advantage. A physician has so far forgotten what is due to the authority of experience as to allege that "in simple, uncomplicated croupous *pneumonia*" half-drop doses of tincture of iodine given hourly "will arrest the further progress of the disease" (*London Med. Record*, May 15, 1881). *Mercurial salivation* may be diminished by its internal use. Iodide of potassium is less certain in its effects; if we might reason from its evident power of reviving mercury long quiescent in the system, its action should be mischievous when mercurial salivation already exists. *Constitutional syphilis* has sometimes been treated with iodine, but the potassic iodide has supplanted it in this respect. *Hypertrophy* of glandular organs is often reduced by iodine, especially of the mammæ, testes, liver, and spleen, and of the thyroid gland in *goitre*. Indeed, it is probable that all cases of true goitre in persons under middle age are

curable by the internal administration of iodine. For this purpose the compound solution should be administered in doses of from 5 to 10 drops (Gm. 0.30–0.60) three times a day. Its topical use is considered below. Its action upon the other organs mentioned, unless perhaps the mammæ, is more equivocal. It has been used to reduce *polysarcia.* In all cases care should be taken to prevent the medicine from injuring the stomach by giving it largely diluted, while its internal is supplemented by its external use in proper cases. In *scrofula* iodine is most efficient in the glandular forms unconnected with a characteristic deposit; over the latter it has no direct influence. On the other hand, it is of great service in promoting the healing of scrofulous ulcers and curing caries of the same nature, especially in the chronic stages of that process. Anderson recommends iodide of starch (iodine gr. xxiv; starch ʒj), in doses of a heaped teaspoonful three times daily, as a remedy for *lupus erythematodes*, but not for lupus vulgaris. There is reason to believe that even *tabes mesenterica*, or scrofula of the mesenteric glands, may sometimes be cured, and often palliated, by this medicine, especially if it is given, as in other scrofulous affections, with cod-liver oil. In some cases of *ascites* depending upon obstruction of the spleen, liver, or mesenteric glands iodine has proved curative, but in such cases iodide of potassium is preferable. *Chronic articular rheumatism*, and that peculiar disease known as *nodosity of the joints*, have been treated with iodine internally, the former more successfully than the latter. *Excessive lactation* has been controlled by this agent in small and repeated doses, which are also sometimes successful in arresting the *vomiting* of pregnancy. The dose in the latter case should not exceed Gm. 0.10–0.15 (2 or 3 drops) of the tincture, and should be largely diluted. (Compare Stillé, *Therapeutics*, 1874, ii. 875; *Med. Record*, xxxii. 422.) Gaunt (*Amer. Jour. of Med. Sci.*, Apr. 1883, p. 413) used this method in almost every other form of *vomiting*, whether arising from indigestion, phthisis, hysteria, intoxication, nephritis, or cholera infantum, etc., and with uniform success. (Compare Darthier, *Lancet*, Jan. 1890, p. 144; Roques, *Amer. Jour. of Med. Sci.*, Mar. 1890, p. 285.) *Uterine disorders* indicating impaired activity of function sometimes appear to be benefited by the use of iodine.

As a *topical* application it is used both for its counter-irritant and its constitutional effects. *Erysipelas*, when superficial, has often been arrested by the use of the tinctures of iodine, and, as far as any local treatment can go, they would seem preferable to solutions of nitrate of silver and other more or less caustic lotions. In *small-pox* it appears to retard the maturation of the vesicles, or even to prevent it altogether, and in addition to avert pitting. But its operation is not too confidently to be relied on. For this purpose a solution of tincture of iodine 30 parts, glycerin 60 parts, and iodide of potassium ¼ part has been recommended. Lieutenant Payer states that a mixture of iodine and collodion proved most efficacious against *frost-bite* during the Arctic voyage of the *Tegethoff* in 1872. In *burns* and *scalds* its stimulant, substitutive, and protective operations are often useful, and the same may be said of certain cutaneous diseases, as *psoriasis*, *herpes*, *acne*, *favus*, and *lupus*. Its substitutive action in the case of acne seems to be proven by the fact that when this eruption is caused by iodine the contents of the pustules have been found to give the iodic reaction with starch (*Bull. de Thérap.*, xcvii. 335). It is most efficient before the suppurative stage, and introduced upon a probe through an aperture made by a needle in the papule. In favus and lupus a saturated solution of iodine in alcohol must be employed. The stimulant operation of iodine, as well as its deodorizing influence, is useful in *ozæna;* it is a valuable agent for inhalation in chronic affections of the air-passages, and especially in *laryngitis* and *bronchitis*, both in their original form and in that which accompanies *phthisis.* Like other local irritants, it may cure *aphonia* depending upon relaxation of the vocal cords or upon nervous debility. For *laryngeal ulcers* the direct application of the compound or the simple tincture is preferable to the inhalation of iodic spray or vapor. Iodine has been used topically in *diphtheria*, and probably with more advantage in this way than nitrate of silver. It is claimed that doses of from 5 to 7 minims of tincture of iodine every hour or two hours for adults, and for children between six and twelve years 2 or 3 minims every two hours in quince or orange syrup, produce a striking improvement of the general and local symptoms of the disease within thirty-six hours (*Practitioner*, xxxv. 16). It is a most valuable topical agent in *leucorrhœa*, vaginal or uterine, and in chronic engorgements of the *uterus.* The same may be said of its utility in *gleet*, chronic *vesical catarrh*, and chronic *dysentery.* A gargle made with half an ounce of compound tincture of iodine in half a pint of water is efficient in mercurial *ptyalism*, and a weak solution, as of 1 grain of iodine in an ounce of water, is one of the best means of retarding or curing *retraction of the gums.* A strong solution of iodine forms one of the best

applications to chronic *ulcers of the tonsils, fauces*, and *uterus*, in *granular pharyngitis* and *conjunctivitis*, and in *blepharitis*.

As a topical application, also, it sometimes promotes the removal of *pleural* effusions, and is adapted to relieve *muscular rheumatism* and *neuralgia* of the chest, and probably to mitigate *chronic peritonitis*. Injected into the tunica vaginalis testis, the tincture of iodine, diluted with 2 parts, or, as Billroth prefers, 1 part, of water, has long been used for the cure of *hydrocele*. Its superiority has, however, been contested (Allis, *Med. News*, lvii. 503). In like manner, it has been employed to procure adhesion of the opposite sides of other serous cavities, such as *hernial sacs*, *synovial bursæ*, and even *large joints*, as in the cases of white swelling or *hydrarthrosis*. But in the last-named affection the weight of authority is against its use as tending to a fatal result. *Ascites* independent of organic mechanical causes has been cured in this manner, but, as such cases are extremely rare, the evidence in regard to the value of the operation is scanty. When paracentesis is practised in *chronic pleurisy*, tincture of iodine is often injected, either to hasten the adhesion of the opposite pleural surfaces or to correct the fetor of the pleural secretion, or both at once. In recent cases the injection may consist of a solution of iodine in the proportion of 2 to 5 grains in a pint (Gm. 0.10–0.30 in Gm. 500) of water; in more chronic ones a solution of 1 part of the compound tincture of iodine to 4 or 5 of water has sometimes been used. A similar method has been employed unsuccessfully in *hydrocephalus*. Numerous cases are recorded of the cure of *spina bifida* by means of iodic injections, and, among the more notable, those of McWhatt (*Edinb. Med. Jour.*, xxvi. 321), Gould and Clutton (*Trans. of Clinical Soc. of London*, xi. 75; xv. 191; xvi. 34), and Thiersch (*Boston Med. and Surg. Jour.*, May, 1881, p. 502). In England the following solution was employed: Iodine gr. x; iodide of potassium gr. xxx; glycerin ℥j. Of this about ½ drachm was injected at each operation, and gentle but firm pressure by means of collodion and bandages constantly maintained. A portion of the liquid was first removed by aspiration. According to a report made to the Clinical Society of London in 1886, out of 71 cases 35 recovered, 27 died, 4 were relieved, and 5 were unrelieved. Injection of the tinctures of iodine has been extensively used in the case of *cysts* containing either serum, pus, blood, hydatids, or melicerous or atheromatous matter. In the case of *ovarian* serous cysts the operation has been remarkably successful when the tumor was uniloeular. The puncture for evacuating the cyst and injecting the iodic liquid should be made above Poupart's ligament. *Fibrous tumors* of the uterus have been treated with iodine both topically and internally, and, although in some cases there has appeared to be an arrest or even a subsidence of the growth, the treatment cannot be depended upon to secure either. Since 1863, when Luton made better known the treatment of penchymatous and fibrous *goitres*, they have been frequently cured by injections of tincture of iodine (French Codex). As long as the liquid does not reach the loose connective tissue it causes, but little reaction. In most cases the cure proceeds slowly during weeks or even months, and necessitates repeated injections at intervals of from five to fifteen days. In fibrous goitres the results are less favorable than in the parenchymatous variety, but, even where the operation does not remove the tumor, it often improves the power of breathing, etc. (Terrillon et Sébileau, *Archives gén.*, Janv. and Fev. 1887, p. 22, 167: compare Stoudentsky, *Therap. Gaz.*, xiii. 72; Thyssen, *Centralbl. f. Therap.*, vii. 277; Terrillon, *Bull. de Thérap.*, cxvii. 241). Indolent *abscesses* and *fistulæ* of all kinds are curable by injections of a solution of iodine, which appears to act by covering the diseased surface with a protecting film, by stimulating the curative processes, and by correcting the fetor of the secretions. In the first and last respects iodine is superior to nitrate of silver. It has been found a valuable application to *carbuncles*. The tincture of iodine has also been injected into *pulmonary cavities* by means of the needles usually attached to aspirators, and the result appears to be that the operation is less mischievous than might have been expected. Indeed, in some cases where a single superficial cavity existed the expectoration and general symptoms have for a time abated. In *malignant pustule* tincture of iodine has been administered internally, and also injected subcutaneously around the inflamed part, and apparently with excellent results (*Practitioner*, xxix. 290; *Archives gén.*, Feb. 1882, p. 204). A case is reported in which severe inflammation produced by the fumes of *cashew-nut* (Anacardium occidentale) was treated without advantage with lotions of bicarbonate of sodium and cold water, but at once subsided under the topical use of tincture of iodine. The application was very painful (*Amer. Jour. Phar.*, June, 1881, p. 281). Iodine has been used in the treatment of *poisoned wounds*, and is probably one of the most trustworthy applications to wounds made by *venomous serpents*. Brainard formerly testified

to the efficacy of iodine as a local antidote to the rattlesnake's venom, but Dr. S. W. Mitchell's experiments led him to an opposite conclusion. Dr. G. H. Carpenter of West Virginia published several cases in which the use of iodine locally and internally seemed to counteract the poison of the copperhead snake (*Med. News*, xlii. 441). One physician refers to twenty-five cases of bites by *rabid animals* in which the wounds were treated by a strong solution of iodine until active suppuration took place. In not one of these cases did rabies occur (Mussey). Although the evidence so far is entirely negative, there is much reason to believe that iodine must be superior to the other caustics used in such cases with the hope of preventing *hydrophobia*. *Iodide of starch* has been recommended by Bellini as an antidote to ingested *poisons* generally. It is free from any disagreeable taste, and, not being an irritant, can be administered in large doses (*Boston Med. and Surg. Jour.*, Aug. 1879, p. 267). Diluted compound tincture of iodine is said to have been used successfully to dissolve a *splinter of iron* imbedded in the cornea (*Practitioner*, xxviii. 377).

The best antidote for a poisonous dose of an iodic preparation is starch or wheaten flour mixed with tepid water. White of egg and also milk are efficient. A solution of carbonate or bicarbonate of sodium may be given as a chemical antidote. Free vomiting should be encouraged as long as the liquid rejected tinges blue a solution of starch. Opiates, counter-irritants, and repose of the stomach are indicated to allay gastric irritation.

The *dose* of iodine is represented by about Gm. 0.016 (gr. $\frac{1}{4}$). It is seldom given, in substance, by the stomach. Its vapors are sometimes inhaled in laryngeal and pulmonary affections, and externally it is applied to the skin as iodized cotton or in bags or pads containing it in powder, and without an impermeable covering. To attenuate the local action of iodized cotton applied to the ear, vagina, etc., a wad of this material may be wrapped in simple cotton wadding and left *in situ*. These methods are more efficient than painting the part with solutions of iodine. The discoloration of the skin produced by it may be removed by ammonia, carbolic acid, soap liniment, or the sulphites, the bisulphites, or the alkaline hyposulphites. For internal administration the compound tincture is to be preferred, for the simple tincture is precipitated by water. The remarkable solubility of iodine in oil of bitter almonds, and the permanency of their union, render this solution convenient for topical application and for addition to other preparations for internal administration, and especially to cod-liver oil. Gm. 1.30 (gr. xx) of iodine will in the course of two months become perfectly dissolved in Gm. 4 (60 grains) of oil of bitter almonds. Of this solution Gm. 1 (gr. xv) may be added to cod-liver oil Gm. 500 (1 pint). A teaspoonful of this solution contains about Gm. 0.002 (gr. $\frac{1}{32}$) of iodine and Gm. 0.006 (gr. $\frac{1}{10}$) of oil of bitter almonds (Blackwell).

Iodozone, a solution of iodine in ozone, has been suggested to be used as a spray for unhealthy wounds and for pulmonary diseases.

Iodopyrine has been found objectionable on account of the rapid disengagement of iodine from it.

IPECACUANHA, *U. S., Br.*—Ipecacuanha.

Radix ipecacuanhæ, P. G.—*Ipecac*, E.: *Ipécacuanha annele* (*officinale*), Fr. Cod.—*Racine brésilienne*, Fr.; *Brechwurzel, Ruhrwurzel*, G.; *Ipecacuanha officinal*, Sp.

The root of Cephaëlis (Uragoga, *Baillon*) Ipecacuanha, *A. Richard*, C. emetica, *Persoon*, Callicocca Ipecacuanha, *Brotero*. Bentley and Trimen, *Med. Plants*, 145.

Nat. Ord.—Rubiaceæ, Coffeæ.

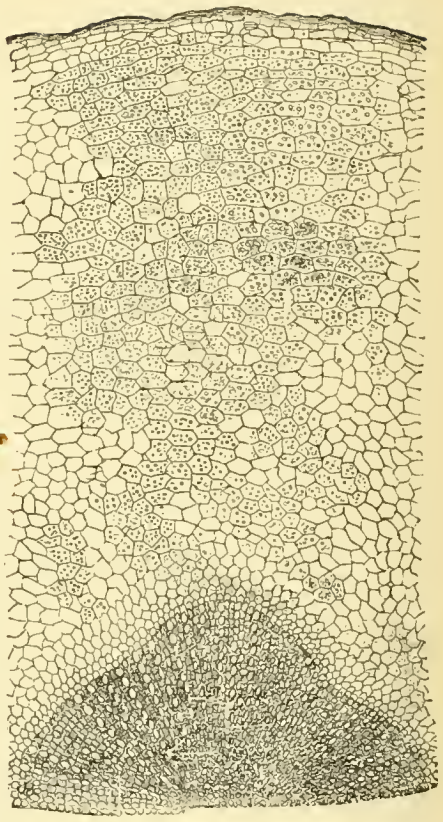
Origin.—The drug first became known in Europe in 1672, and a few years after was successully employed by Helvetius, a Dutch physician living in Paris, from whom (in 1688) Louis XIV. purchased the secret for 1000 louisdors and made it public. Two varieties of the plant are known—one with a woody and the other with an herbaceous stem—both being indigenous to the damp forests of Brazil, New Granada, and the northeastern portion of Bolivia, between about 8° and 22° S. lat. The plant has a spreading root, a stem 30 to 45 Cm. (12 to 18 inches) high, opposite, nearly entire, and somewhat hairy leaves, and small white flowers in a dense head, followed by a cluster of dark purplish-blue berry-like fruits, each containing two plano-convex hard nuts. The plant has been introduced into India, and is cultivated to some extent in Sikkim with but moderate success. In Brazil the roots are collected at all seasons, but principally from January to March; they are dug up by means of a stick and pulling the stems, fragments of the roots remaining, which again produce plants from adventitious buds. The roots are dried in the sun, and finally packed in bales.

Description.—The young, thin, and thread-like roots are rejected; the older roots are in pieces of 2 to 6 inches (5–15 Cm.) in length and about $\frac{1}{6}$ inch (4 Mm.) thick; are mostly simple, bent, and contorted, and externally usually of a dull-gray color, but occasionally of a reddish or blackish tint. The root consists of a thin, toughish, white, and finely-porous ligneous cord, with no distinct medullary rays, and of a thick, brittle bark, which is finely wrinkled and closely annulated by projecting circles, the depressions between the rings being often fissured to the wood. The root breaks with a whitish granular and waxy fracture in the bark, which constitutes 75 to 80 per cent. of the weight and is easily separable from the wood. The bark consists, aside from the thin cork-layer, altogether of parenchyma, without any radiating arrangement, the cells being filled with small starch-granules and becoming smaller near the wood; the latter has a radiating arrangement, and is composed of more or less elongated and fusiform, rather thick-walled, and pitted wood-cells, containing starch and having upon transverse section a nearly quadrangular shape. A variety imported from Carthagena is usually thicker, about 6 Mm. ($\frac{1}{4}$ inch) in diameter, less conspicuously annulated, and with more distinct medullary rays. Small portions of the thin non-annulated stem are not unfrequently found attached to some of the commercial roots. The odor of ipecacuanha is slight, but heavy and nauseous, and the taste bitterish, somewhat acrid, and nauseating. The root yields a light brown-gray powder. When ipecac is sound and free from mouldiness, its quality is proportionate to the thickness of the bark and the thinness of the ligneous portion.

Fig. 160.

Ipecacuanha.

Fig. 161.



Ipecacuanha-root, transverse section, magnified 65 diam.

Constituents.—The important principle of the root is the alkaloid *emetia or emetine*, which is combined with *ipecacuanhic acid*. Emetine was discovered in 1817 by Pelletier and Magendie, and is obtained by evaporating the alcoholic tincture of the root to a syrupy consistence, adding potassa in excess and in a well-filled bottle to prevent access of air, and agitating with chloroform; the chloroformic solution is evaporated, the residue treated with a weak acid, filtered from the resinous matter, and precipitated by ammonia. Lefort takes advantage of the insolubility of the nitrate, which is thrown down from a strong solution of the extract by a concentrated solution of potassium nitrate; it is dissolved in alcohol, decomposed by milk of lime, the alkaloid taken up by ether, and purified as above. It is a grayish or whitish inodorous powder having a bitter taste and an alkaline reaction to test-paper. It is sparingly soluble in cold water, freely so in alcohol and chloroform, less soluble in ether, benzene, benzin, and fixed oils. Nitric acid or nitrates yield with it a slightly soluble brown salt; other dilute acids dissolve it readily, and yield mostly non-crystallizable salts, the solutions of which are precipitated by the general reagents for alkaloids and by potassium nitrate at 70° C. (158° F.). Emetine fuses like wax, and at a higher heat burns without leaving a residue. Its formula, according to Lefort and Würtz (1877), is $C_{28}H_{40}N_2O_5$, and from a concentrated alcoholic solution it may be obtained in groups of fine needles; the yield is little over 1 per cent. By titration with Mayer's solution Zenoffsky (1872) found 3.75 per cent. of emetine; much larger yields have occasionally been reported, but are probably over-estimated. Power (1877) observed that emetine is colored bright-yellow or orange by chlorinated lime; a little acetic acid favors the reaction, which is still observable when dissolved in 6000 parts of water.

Ipecacuanhic acid, $C_{14}H_{18}O_7$, was by former investigators supposed to be identical with gallic acid. Willigk separated it from the precipitate obtained in the decoction by lead acetate, by dissolving in acetic acid and precipitating with subacetate of lead. It is amorphous, brown, very bitter, hygroscopic, soluble in alcohol, little so in ether, colors ferric salts green, and is a glucoside. It appears to be related to caffeo-tannic acid.

Podwyssotzki (1880) named the coloring principle of ipecacuanha *erythrocephalein*, because it acquires a deep purple-red color with alkalies. According to Reich, the bark contains about 40 per cent. and the wood over 7 per cent. of starch.

Arndt (1889) obtained a volatile alkaloid which forms colorless cross-like crystals by distilling ipecac, potassium carbonate, ferric chloride, and water. Crystals form in the condensor while the distillate is alkaline in reaction. The crystals are fluorescent on the edges, and are deliquescent. Heated with sodium hydroxide, the odor of trimethylamine is evolved. Kunz (1887) showed the presence of choline.

Tests.—Mix 10 grains of ipecac with 3 grains of lime and a few drops of water; dry in a water-bath, exhaust with 2 fluidrachms of chloroform containing a minute quantity of acetic acid, evaporate the chloroformic solution; add to the residue 2 drops of water, and add a saturated solution of potassium nitrate, which will give an amorphous precipitate to which Power's test may be applied; the wood treated in the same way gives no precipitate, but yields with tannin or potassio-mercuric iodide a slight turbidity (Flückiger). "Agitate the powdered root with 5 parts of warm water, filter after 1 hour, and add potassio-mercuric iodide, which should produce a copious white amorphous precipitate. If 0.2 Gm. of ipecac be agitated with 10 Gm. of hydrochloric acid, a portion of the filtrate should become blue on the addition of iodine-water, and another portion should become bright-red when a little chlorinated lime is sprinkled upon it."—*P. G.*

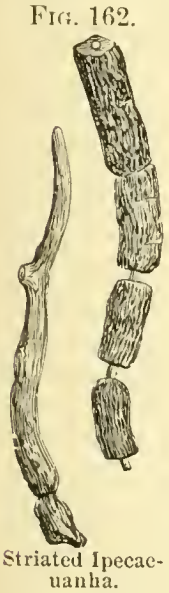
Adulterations.—Besides small portions of the stem, the commercial root is usually free from impurities, and the false ipecacuanhas described below are easily distinguished from the above. But powdered ipecacuanha is said to be sometimes adulterated with various farinaceous substances and with the powder of other roots, which may be detected by the microscope. Almond meal has also been mentioned; the large oblong cells of the scurfy testa and the hexagonal cells of the embryo which are free from starch, but contain oil-drops, readily characterize it under the microscope.

Pharmaceutical Uses.—Emetinum coloratum, which is sometimes used, is made by exhausting ipecacuanha with alcohol, evaporating the tincture to a syrupy consistence, diluting with water, filtering, evaporating the filtrate to dryness, and powdering. The yield is about 3 per cent.

Allied Drugs.—Several emetic roots, known in South America as ipecacuanha or by the Brazilian designation *poaya*, have occasionally been sent to this country as substitutes; none, however, have any particular resemblance to the cephaëlis-root. The following, of which the plants yielding the first three belong to the natural order of Rubiaceæ, are the most important:

1. Striated Ipecacuanha, from Psychotria (Ronobea, *Richard*) emetica, *Mutis*, is blackish-gray, longitudinally striate; the bark has deep circular fissures at irregular distances; is thick, internally purplish-brown. The root is free from starch, contains much sugar, and has a sweet afterward bitter taste. The bark consists of parenchyma, which is not radiating, some of the cells containing acicular crystals; the wood resembles that of ipecacuanha, but the cells are larger and the cell-walls thinner. It is employed in New Granada and Peru.

Fig. 162.



Striated Ipecacuanha.

2. Small Striated Ipecacuanha, noticed by Planchon (1872), probably obtained from a species of Richardsonia, resembles the preceding, but is much smaller, gray-brown or blackish-brown, finely striate, has a thick bark, containing starch; a thin somewhat radiating bast-layer and a thick wood with thick-walled wood-fibres, large dotted ducts, and very fine medullary rays. Its taste is somewhat acrid, not sweet.

3. Undulated or Farinaceous Ipecacuanha, from Richardsonia scabra, *Linné*, a native of Brazil, is, in the fresh state, white when dry, brownish externally, and white farinaceous internally; it is irregular undulate, fissured on alternate sides, and of a somewhat knotty appearance. The non-radiating bark-tissue consists of parenchyma containing starch; the wood is striate by medullary rays, and consists of thick-walled wood-fibres and large dotted ducts.

4. White Ligneous Ipecacuanha, from Ionidium Ipecacuanha, *Ventenat* (Nat. Ord. Violaceæ), indigenous to Brazil. The root is several-headed, somewhat tortuous, not annulate, light-gray or yellowish, internally whitish, and with a yellowish, finely-porous wood, traversed by delicate medullary rays. In Mexico Ionidium polygalæ folium, *Ventenat*, s. Solea verticillata, *Sprengel*, is employed.

Fig. 163.

Undulated Ipecacuanha.

5. Bastard Ipecacuanha, from Asclepias currasavica, *Linné* (see Asclepias).

6. Indian Ipecacuanha, from Tylophora (Asclepias, *Linné*) asthmatica, *Wight et Arnott* (Nat. Ord. Asclepiadaceæ), (Bentley and Trimen, *Med. Plants*, 177). The root-

stock is short, knotty, emitting a considerable number of thin, wiry, brittle, and pale yellowish-brown rootlets. The outer portion of the bark contains large parenchyma-cells, filled with starch and with crystals of calcium oxalate. The drug has little odor; its taste is sweetish afterward acrid. It is free from tannin, but contains an alkaloid, *tylophorine*, isolated by D. Hooper (1891) which yields precipitates with the usual reagents.

Batiator, a Senegambian root from an undetermined plant, is said to have properties similar to those of ipecac. It consists of a knotty and hairy root-stock with fascicles of thick rootlets, which are somewhat flexuose, longitudinally wrinkled, more or less transversely fissured, yellowish- or grayish-brown, breaking with a smooth fracture, inodorous, slightly acrid, and nauseous.

Gardenia campanulata, *Roxburgh* (Rubiaceæ). The shrub is indigenous to India. The roundish-ovate, slightly five-furrowed yellow berries are said to be cathartic and anthelmintic.

Action and Uses.—In man the effluvium or dust of ipecacuanha is apt to occasion coryza and congestion of the larynx and bronchia, causing dyspnœa, cough, and sometimes the rejection of fibrinous sputa. Some persons have a special susceptibility to these effects. In exceptional cases the conjunctival inflammation reaches a high grade and is accompanied by neuralgia of the face and scalp. These anomalous effects have been occasioned by soiling the hand with a drop or two of the tincture of the drug. Internally and in small and repeated doses ipecacuanha occasions malaise, depression, yawning, salivation, eructation, and nausea, with retching or vomiting. Its emetic operation is not protracted and distressing like that of tartar emetic, but it tends to relax the bowels if they were previously in a normal state, and to augment the purgative action of cathartics.

Like many other medicines, ipecacuanha in repeated doses sooner or later brings about toleration, and produces very different effects from the primary emetic phenomena. But the dose of ipecacuanha is not, at any time, a sure criterion of the effects to be expected from it. Often 4 or 5 grains of it will vomit as much as 12 grains. While $\frac{1}{10}$ grain of emetine given to an adult occasioned vomiting. in another case 12 grains were administered within twenty-four hours without exciting either vomiting or diarrhœa. Allowance must be made for the varying degrees of activity of the preparations employed, as well as for the state of the patients who received them.

Although experimental investigations indicate very little if any action of ipecacuanha upon the lungs, it is in affections of these organs that the medicine has been so generally employed that it has come to be classed among expectorants. The conditions to which it is appropriate are dryness of the respiratory mucous membrane on the one hand, and excessive secretion and obstruction upon the other. Its mode of action in the two cases is different. In the former, given in small doses and in the first stage of ordinary *bronchitis*, it promotes the bronchial and laryngeal secretions, and thereby renders the cough less painful and frequent and more productive; in the latter, administered in large doses, it acts as an emetic, producing an expulsion of the contents of the air-tubes, while it renders their secretions less tenacious. It is in the former of these ways that it is so efficient in the commencement of the attacks referred to, and in the latter when the bronchia become filled with mucus, serum, or fibrin, as in *whooping cough*, *suffocative catarrh*, *capillary* and *chronic bronchitis*, *bronchorrhœa*, etc. In addition, perhaps, to these two modes of action a third or antispasmodic action may be recognized in its cure of *spasmodic croup* (spasmodic laryngitis), but quite as probably the relaxation of spasm it occasions is secondary to its sedative, and, therefore, so far as the local disorder is concerned, its depletory action. Like other nauseants, it has been found efficient in expediting labor by relieving *rigidity of the os uteri*. A similar operation, no doubt, explains the reputation of the medicine in *spasmodic asthma*. In *membranous croup* it is not without utility in virtue of the same influences, which, however, are inadequate to the occasion. It is far more efficient in the several diseases mentioned when they occur in children than in adults. The utility of ipecacuanha in *pneumonia*, which has been affirmed, is probably limited to two occasions—the forming or congestive stage of the disease, before solidification has taken place, and the declining stage, when the bronchia are apt to become obstructed with softened exudation-matter and mucus. In both conditions the emetic action of the drug is appropriate—in the former by diminishing the quantity of blood in the lung and the force of its propulsion by the heart, and in the latter by mechanically evacuating the obstructed bronchia. It is probable that the utility of ipecacuanha in *hæmoptysis*, which formerly was admitted by Stoll, Trousseau, and others, depends upon this mode of action. It is true that some reporters have not found it useful in this hæmorrhage (Verardini, *Phila. Med. Times*, xi. 430), but their results are contradicted by theory as well as experience—by theory based on experiment as above described, and by the clinical results of using large doses so as to induce speedy toleration; *e. g.* 90

grains infused in 4 fluidounces of boiling water and sweetened, of which a tablespoonful may be given every hour or two (Pécholier).

The utility of ipecacuanha emetics in *hæmorrhage* from the *stomach*, *uterus*, etc. has long been known. In the seventeenth century Mangetus imputed to this drug the subsidence of *uterine* hæmorrhage. In recent times Trousseau stated that his habit was to administer it to all lying-in women in his hospital service, and he cited Baglivi and others to illustrate its efficiency in hæmorrhage, especially from the uterus, and, in particular, after confinement. The practice has been followed in this country by Carriger and others, who also noted its power, mentioned above, of relaxing the rigid os uteri (*New York Med. Jour.*, Nov. 1878; *Med. Record*, xxi. 601). It it is probable that for the former purpose small and repeated doses, Gm. 0.06–0.12 (gr. j–ii), are appropriate, and for the latter nauseant doses of Gm. 0.30–0.40 (gr. v–vi). In *hæmatemesis* a full emetic dose should be first prescribed, after which smaller and only nauseating doses may be substituted. According to the modern view of the action of the medicine, it may be supposed to control hæmorrhage by contracting the capillaries, but the earlier explanation, that the heart was depressed and the blood no longer circulated so vigorously, should not be lost sight of.

Whether by direct stimulation or by indirectly promoting secretion, there is no doubt that this medicine has proved advantageous in *atonic dyspepsia;* that is to say, when digestion is laborious, painful, attended with flatulence, depression of spirits, cold extremities, etc. The *dose* should not exceed 1 grain, in pilular form, and may be taken in the morning fasting or else immediately after meals. The *vomiting in pregnancy* has sometimes been controlled by hourly doses of a single drop of wine of ipecacuanha. We have known it in a single day to arrest this symptom after it had continued for several weeks. There is some reason to believe, apart from the experiments above described, that ipecacuanha increases the secretion of bile, for large doses of it (20 grains), repeated daily, have relieved cases of catarrhal *jaundice* that had resisted other remedies (Cook, *Practitioner*, xxv. 104).

The title, *Radix antidysenterica*, originally applied to ipecacuanha, denotes the estimate then held of its dominant virtue. It was first used in Europe, about 1686, as a secret remedy for dysentery, and secured for its propagator, Helvetius, celebrity as well as pecuniary rewards. In Brazil it was the specific for dysentery, and its mode of administration was such as to produce vomiting first, and afterward tolerance of the medicine. The efficiency of such a method is intelligible in a country where dysentery is apt to assume a bilious type, and an analogy with it is found in a like treatment of the acute febrile diseases of hot climates which is everywhere adopted. In the present instance antibilious and antipyretic virtues are united in the same remedy. Other forms of acute dysentery than the bilious are not always as advantageously treated by ipecacuanha, and where in such forms the medicine has appeared to be most useful it has usually been combined with opium, whose share in the cure should not be overlooked. Of whatever type the dysentery may be, the remedy is most efficient the nearer to the commencement of the attack it is administered. It ought to be given on an empty stomach, and no liquid should be taken for an hour or two after it is swallowed, the patient meanwhile keeping as still as possible. The original Brazilian method of administration was as follows: An infusion was made with 120 grains of the bruised root in 6 ounces of boiling water, and allowed to stand for 12 hours before the decanted liquid was used. A similar quantity of fresh water was then added to the dregs for the second day, and the same process was repeated on the third day. Each infusion was divided into two or more portions, one of which was given at intervals of two or three hours if the attack was mild, but the whole at one dose if the attack was severe. If vomiting occurred, the medicine was, after an interval, repeated. There can be no doubt that when it operates favorably the stools soon lose their dysenteric character and are voided without pain. In Peru it has been the custom to administer the powdered root mixed with a little syrup, and at the same time enemas made with an infusion of the root with the addition of laudanum. The enema has been found by many practioners in Europe and elsewhere to be sufficient by itself when prepared in the following manner: "Take of bruised ipecacuanha 150 grains, and boil it in 5 fluidounces of water for 10 minutes; strain off the liquid, and repeat the operation with a fresh portion of water a second and a third time; mix the three portions of liquid and evaporate them in a sand-bath to 4 ounces; divide this product into two equal parts, and administer one night and morning by enema, directing them to be retained as long as possible" (*Polichronic*). A simpler and, apparently, as efficient a formula is to boil 60 grains of bruised ipecacuanha for 10 minutes in 5 ounces of water;

let it infuse for 1 or 2 hours, and strain off the decoction. It is only in chronic cases with decided ulceration that any nausea is excited by these enemas. In so important a matter it is desirable to know something of the treatment of dysentery by ipecacuanha in India, where the disease is endemic and often very fatal. No higher authority on the subject could be cited than Surgeon-General Fayrer. His directions, somewhat condensed, are these: "The treatment of an attack of ordinary acute dysentery is to be conducted on the following plan: The patient should remain in a recumbent posture. A dose of 20 or 30 grains of ipecacuanha powder should be given to an adult at once in water, and the patient should resist vomiting as long as possible. It is recommended by some to give a dose of 15 or 20 drops of laudanum before the ipecacuanha, and apply a sinapism to the epigastrium. He must abstain from all fluids except occasional mouthfuls of iced water or bits of ice. My own plan has generally been to repeat the dose of ipecacuanha in 4 or 6 hours a second or third time, according to the effects, and especially if the first dose has been rejected, as it often is. I have generally found that if this treatment be resorted to early in acute dysentery it is most effective, and nothing else is needed. The pain diminishes, the tormina and tenesmus are alleviated, the restlessness is abated, the sense of fulness and desire to go to stool passes away, the skin becomes moist and the motions feculent and assume a peculiar yellow appearance." "When the disease has advanced to ulceration, and when the chronic stage has been fully established, the ipecacuanha is no longer useful" (*Med. Times and Gaz.*, Feb. 1881, p. 143). The advantages claimed for the treatment of acute dysentery by ipecacuanha are—the simplicity, safety, and promptness of its operation, its efficiency in curing, and the rapidity of the cure. Even in *chronic dysentery* the same method of employing it has been very successful, although it is not recommended by Fayrer.

This medicine has long been used in the treatment of *chronic diarrhœa*, either alone or associated with calomel and opium. Of late it has been administered alone, or guarded with opium to prevent its rejection, in *infantile diarrhœa*, in *tuberculous diarrhœa*, and in chronic *dyspeptic diarrhœa*. Of these forms, the one most beneficially influenced by the medicine is the infantile. If the patient is not much exhausted the medicine may be given at first by the mouth, otherwise by enema and in the form of infusion. The diarrhœa of consumption, being due sometimes to intestinal ulcers and sometimes to debility, as well as in both cases to the swallowing of sputa, the results of any treatment must vary with the cause of the symptom. In this case the utility of the medicine is least when the cause is most permanent. If it is too long employed it may create an irritation as great as that which it is intended to relieve. Whether it acts by substitution or astringency, or as a stimulant of the vaso-motor nerves, it very certainly diminishes the secretions of the affected part, and apparently does so during its elimination after absorption. The same mode of operation is probable in the case of *hectic sweats*, which are sometimes completely suspended by enemas of ipecacuanha infusion when other remedies have proved ineffectual. The treatment of *cholera morbus* and of *epidemic cholera* by this medicine has been advocated by numerous physicians, who presented ingenious reasons for its use, but neither their opinion nor their practice has stood the test of experience.

In bilious *remittent* and *intermittent fevers*, when gastro-hepatic congestion is indicated by the muddy eye and skin, and foul tongue, nausea, bitter taste, distended epigastrium and hypochondria, and perhaps bilious vomiting and diarrhœa, an emetic dose of ipecacuanha promptly palliates these symptoms and renders the action of quinine more immediate and certain. Ordinary *intermittent fever* is alleged to have been cured by doses of 1 or 2 grains every three or four hours. In all cases of *indigestion* due to the presence of food in the stomach, of *urticaria* produced by the same cause, and of *poisoning* where it is desired to expel the offending substance, ipecacuanha emetics may be advantageously employed.

As a local application to the eye in purulent *ophthalmia* when the active inflammatory symptoms have subsided, but chemosis remains, with a red and flabby state of the conjunctiva and cloudiness of the cornea, a decoction of ipecacuanha has been found efficient. It may be made by boiling Gm. 2 (gr. xxx) of bruised ipecacuanha for ten minutes in Gm 160 (℥v) of water. When cool the liquid should be strained off and instilled into the eye.

As an emetic the *dose* of powdered ipecacuanha is Gm. 1.30 (gr. xx); or Gm. 0.30–0.60 (gr. v–x) may be repeated every ten minutes, the patient drinking freely of warm chamomile tea, or simply of warm water, as soon as the first signs of nausea appear. Or an *infusion*, prepared with Gm. 8 (gr. 120) of the bruised root in Gm. 190 (6 fluidounces) of boiling water, may be given in doses of Gm. 32 (1 fluidounce) at intervals of

four or five minutes. A *decoction* and its uses have been already described. As a *nauseant* Gm. 0.06–0.12 (gr. j–ij) of the powder may be repeated at short intervals; the same dose, at longer intervals, may be used as a diaphoretic and expectorant. For infants the syrup is preferable.

Batiator is used in its native country for the same purposes as ipecacuanha, as an emetic, and in the treatment of *dysentery*, as ipecacuanha is employed in Brazil. The negroes are said to regard it as a sovereign remedy for *hæmorrhoids*. Its glucoside, and ernonin, is said to be a heart poison.

Ixora (*I. baudhuca* and *I. coccinea*), an East Indian plant, is said to be very efficacious in *dysentery*, and has been compared with ipecacuanha, although it has no nauseating effect. The whole of the fresh root is used to prepare a tincture which has an agreeable aromatic taste and is given in doses of Gm. 0.75 (10 drops) three or four times a day (*Bull. de Thérap.*, xcvii. 45).

Naregamia alata, the Goanese ipecacuanha, is almost identical in its action and uses with the officinal ipecacuanha. It is emetic, expectorant, and antidysenteric (*Am. Jour. Phar.*, lix. 575).

Cocillana bark, as tested by Dr. Rusby (*Therap. Gaz.*, xii. 518), appears to resemble ipecacuanha in its action upon the nasal passages, throat, bronchia, and digestive canal, and, like it, has been used in various forms of *bronchitis* (Stewart, *Med. News*, lv. 197; Wilcox, *Boston Med. and Surg. Jour.*, Jan. 1890, p. 13; Rusby, Mittler, *Therap Gaz.*, xiv. 97, 333).

Hedysarum gangeticum, about 1879, acquired some reputation in the treatment of acute *dysentery*. The powder of the root was administered, as ipecacuanha had been previously, but it occasioned neither nausea nor vomiting, and gradually restored the stools to a normal condition (*Bull. de Thérap.*, xcviii. 46).

IRIS, *U. S.*—Iris.

Blue flag, *Water flag*, E.; *Rhizome d'iris varié*, *Flambe variée*, *Glaïeul bleu*, Fr.; *Verschiedenfarbige Schwertlilie*, *Amerikanischer Schwertel*, G.; *Liria americana*, Sp.

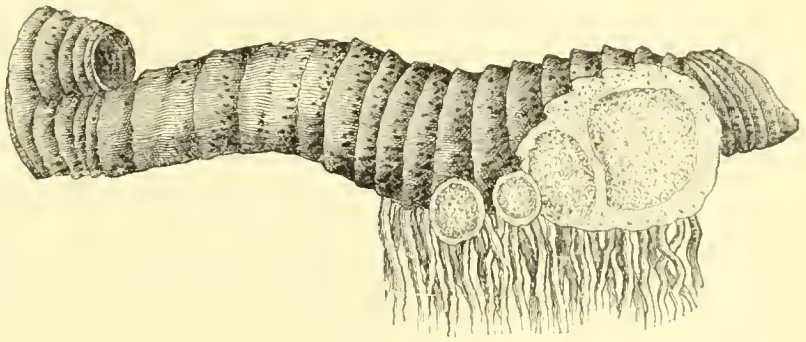
The rhizome of Iris versicolor, *Linné*. Meehan, *Native Flowers*, i. 141.

Nat. Ord.—Iridaceæ.

Origin.—The blue flag is common in wet and swampy meadows from Canada southward to Florida and westward to Minnesota and Arkansas, and flowers in the latter part of spring. The sword-shaped leaves are about as long as the stout stem, which bears a few showy blue flowers, having the three outer lobes of the corolla with a yellow blue-veined base, and the inner lobes paler.

Description.—The rhizome is horizontal, and grows in annual shoots or joints, bearing a flowering stem at their end and producing two, or often four, lateral branches. The joints are 5–10 Cm. (2 to 4 inches) long, cylindrical at the base, the upper portion vertically flattened and 18–25 Mm. (¾ to 1 inch) broad; they have an annulated appearance from the projecting leaf-scars, and at the lower side are beset with simple rootlets, 10–15 Cm. (4 to 6 inches) long, and crowded near the broader end of the joint. The color of the fresh rhizome is yellowish-brown, when dry gray-brown, and internally gray or brownish. A distinct nucleus-sheath separates the cortical layer from the central portion, in which nearly all the scattered wood-bundles are contained; the parenchyma contains mainly starch and some crystals. The dry rhizome has no marked odor; its taste is acrid and nauseous.

Fig. 164.



Iris versicolor, *Linné*: joint of rhizome and section of branches.

Constituents.—The rhizome contains starch, gum, tannin, fat, and acrid resinous matter; the latter may probably represent its medicinal virtues. D. W. Cressler's experiments (1881) render it probable that blue flag contains a brownish viscid alkaloid which is soluble in amyl alcohol and in dilute acetic acid, and may be obtained from the

alcoholic extract by treatment with acetic acid. The resin, amounting to about 25 per cent., is soluble in ether, chloroform, and hot alkalies, and from the latter solution reprecipitated by acids.

Allied Plants.—Iris virginica, *Linné* (Meehan, *Native Flowers*, i. 189), the slender blue flag or *Boston iris*, and Iris verna, *Linné*, the *dwarf iris*, have much smaller rhizomes than the pharmacopœial species, but they are otherwise of the same appearance and possess similar properties. The Boston iris grows near the coast southward to South Carolina; the dwarf iris is found on hillsides from Virginia and Kentucky southward.

Action and Uses.—The fresh root has an acrid taste, and its expressed juice is emetic and cathartic, producing great prostration. Diuretic and cholagogue virtues are also ascribed to it. It was a medicine highly esteemed by the aborigines of this country. Its activity appears to depend upon its acrid resin ("iridin") which may be used as a purgative in the dose of Gm. 0.05–0.10 (gr. j–ij). According to the experiments of Rutherford and Vignal, 5 grains of iridin, when mixed with a little bile and water and placed in the duodenum of a dog, very powerfully stimulated the liver. It is also a decided stimulant of the intestinal glands. It appears to be less irritant than podophyllin and a less active cholagogue, but its purgative effects are greater than those of euonymin. It may be used as a cathartic in constipation associated with evidences of imperfect hepatic action. The *dose* of the dried root is stated to be Gm. 0.60–1.30 (gr. x–xx).

IRIS FLORENTINA.—Florentine Orris.

Rhizoma iridis, P. G.; *Radix iridis Florentinæ*, *Radix ireos.—Orris-root*, E.; *Iris de Florence*, Fr. Cod.; *Veilchenwurzel*, G.; *Liria de Florencia*, Sp.

The rhizome of Iris germanica, *Linné*, I. pallida, *Lamarck*, and I. florentina, *Linné*. Stephenson and Church, *Med. Bot.*, i. t. 27; Bentley and Trimen, *Med. Plants*, 273.

Nat. Ord.—Iridaceæ.

Origin.—Florentine orris, or *white flag*, is found in dry localities from the southern shores of the Black Sea westward along the north shore of the Mediterranean; though wild near Florence and Lucca, Hanbury does not regard it as indigenous to those places. It has large sweet-scented white flowers, the sepals with a yellow beard and brownish veins. It is cultivated together with Iris pallida, which is likewise indigenous to Southern and South-eastern Europe, has a rather tall stem, and pale-blue or purplish flowers, and with Iris germanica, which is indigenous to Southern Europe, and is met with in Northern Africa and Northern India; this has a lower stem, bears deep-blue or purplish-blue flowers, and is known in England as *blue flag*, in France as *flambe*, and in Germany as *Blauer Schwertel* or *Schwertlilie*. The rhizomes of the three species are collected, and, as it appears, those of the last two much more frequently than of the first. They resemble each other very closely, and, though the branches of the second species are usually broad and stout, there are no permanent characters by which they may be distinguished. The rhizomes are collected in the latter part of summer, peeled, and dried in the sun.

Description.—The horizontal rhizome is composed of joints, which are 5 to 10 or 15 Cm. (2 to 4 or 6 inches) long, the broadest part near the apex, about 25 to 40 Mm. (1 to 1½ inches) wide, tapering below, and abruptly narrowed above to the circular stem-scar, from two sides of which similar joints are produced. The rhizome is vertically compressed, and when peeled of a white or whitish color externally and internally. The leaf-scars on the upper side are indicated by transverse lines of fibro-vascular bundles, and the rootlets on the lower surface by circular brownish scars, which are more crowded near the upper end. The texture is firm, the rhizome breaks irregularly, and shows upon the transverse fracture, near the surface and parallel with it, a distinct nucleus-sheath enclosing a number of scattered wood-bundles. The parenchyma-cells enclose mainly small oblong or elliptic starch-granules and few crystals. Orris-root has an agreeable violet-like odor, which is slowly developed on drying, and a mealy afterward bitterish and somewhat acrid taste. The powder has a whitish color.

Constituents.—Orris-root contains a minute quantity of volatile oil, which is solid, crystalline, and of a pearly lustre, as described by Dumas (1835). By distillation with steam about .8 per cent. of a solid crystallizable substance is obtained, which Flückiger found to consist mainly of *myristic acid* impregnated with a little volatile oil; this acid, however, does not pre-exist in the rhizome. This constitutes the commercial *oil of orris-root*, but a *liquid oil of orris* has appeared in the market, which is said to be made by adding oil of cedar-wood to the crushed rhizome and distilling the mixture with water.

Orris-root contains also a large quantity of starch, some soft brownish resin of an acrid taste, and a little tannin which colors ferric salts green.

Adulterations.—The rhizomes of other species of Iris in most cases resemble the officinal one in shape, but are destitute of its agreeable odor; those of Iris pseudacorus, *Linné*, and I. fœtidissima, *Linné*, which are indigenous to Europe, have a dark color and a more astringent and acrid taste, and cannot be mistaken for Florentine orris. The adulteration of powdered orris is best detected by the microscope from the different shape of the starch-granules contained in the material employed for the purpose.

Action and Uses.—The fresh root is said to possess irritant properties, and, taken internally, to cause colic, vomiting, and purging, while the dry root acts as a moderate digestive stimulant. When powdered and applied to the nostrils it excites sneezing and increased secretion, and in the mouth a flow of saliva. It is said that when freely sprinkled in the hair it has caused alarming nervous symptoms. It was formerly used along with more active medicines in the treatment of *chronic diarrhœa* and *bronchitis*, and also as a diuretic and sternutatory. A piece of the root was, and occasionally is still, employed for children to bite upon while teething; it probably excites salivation and mitigates the pain of dentition. Iris is also used to make issue "peas," is often added to dentifrices on account of its aromatic flavor and its favorable action on the gums, and is an ingredient in *pastilles* used for the same purpose or to conceal fetor of the breath. Its liability to be attacked by insects renders care in its use as an issue "pea" desirable. The dose of the powdered rhizome may be stated at Gm. 0.30–1 (gr. v–xv).

JACARANDA.—Jacaranda.

Jacaranda procera, *Sprengel*, s. Bignonia Copaia, *Aublet*, s. B. Caroba, *Velloso*.

Nat. Ord.—Bignoniaceæ.

Description.—This tree, which grows to the height of about 12 M. (40 feet), is found in the forests of Guiana and southward, and is known in Brazil as *caroba*. The root is of a deep red-brown and internally yellowish color; the bark is ash-gray; the leaves are bipinnate, the leaflets nearly sessile, varying in length between about 0.9 and 6 Cm. ($\frac{3}{4}$ and $2\frac{1}{2}$ inches), elliptic, oblong or lance-oblong, rather obtuse, or more frequently acute, the base uneven and oblique, the margin entire or occasionally with one or two irregular teeth, the texture rather leathery, the lower surface somewhat velvety near the veins, both sides with short hairs and glands; the odor is slight and the taste bitter and astringent.

Constituents.—Hesse (1880) found the leaves to be free from alkaloid and to contain mainly aromatic resin, which Peckolt (1881) named *carobone;* it exists in the leaves to the extent of 2.67 per cent., is greenish, amorphous, and has slight acid properties. Peckolt found also 1.44 caroba-balsam of a tonka-like odor, a bitter principle, tannin, crystallizable inodorous *carobin*, tasteless resin, and several acids. The bark likewise contains carobin, bitter principle, tannin, resin, etc.

Allied Plants.—Several plants of the same order are known in Brazil as caroba, and are more or less employed like the preceding—namely, Jacaranda subrhombea, *De Cand.;* Jac. oxyphylla, *Chamisso;* Bignonia nodosa, *Manso;* Cybistax antisyphilitica, *Martius*, Caroba de flor verde, *Sp.;* and Sparottosperma lithontripticum, *Martius*, Jacaranda branca, *Sp.*

Action and Uses.—Mennell (*Brit. Med. Jour.*, Feb. 14, 1885) and Wright (*Lancet*, Feb. 18, 1885) employed this drug, the latter in *gonorrhœa* alone, and the former also in affections of the *bladder* with purulent urine. In its native country, Colombia, S. A., it is said to be used in venereal diseases without causing nausea or other inconvenience. The dose of the fluid-extract prepared from the leaf is stated at 20 or 30 minims several times a day. Its active principle, carobin, resembles sarsaparillin. Peckoldt prescribed it in Gm. 0.06 (one grain) doses for scrofula and syphilis.

JALAPA, *U. S., Br.*—Jalap.

Tubera jalapæ, P. G.; *Radix jalapæ.—Jalap tubéreux, J. officinal*, Fr. Cod.; *Jalape, Jalapenknollen*, G.; *Jalapa*, Sp.

The tuberous root (tubercles) of Ipomœa (Exogonium *Baillon*) Jalapa, *Nuttall*, Ip. Purga, *Hayne*, Ip. Schiedeana, *Zuccarini*, E. Purga, *Bentham* (*Bot. Mag.*, vol. lxxiii. plate 4280; Bentley and Trimen, *Med. Plants*, 186), Convolvulus Purga, *Wenderoth*, C. Jalapa, *Schiede*.

Nat. Ord.—Convolvulaceæ, Convolvuleæ.

Origin and Collection.—This twining herbaceous perennial is indigenous to the damp and shady woods on the eastern slope of the Mexican Andes, at an altitude of from 1520–2440 M. (5000 to 8000 feet). It has been introduced into India, and flourishes well in the Nilgherry Mountains. Its cultivation has also been carried on to some extent in Jamaica. The plant has alternate cordate leaves, acute at the apex and the basal lobes, and axillary cymes of three to five dark pink-colored flowers, with a long tube, spreading border, and protruding stamens. The tubers (hypertrophied roots, *Bentley*) are collected during the whole year, but principally in the spring. Owing to the wet climate, the drying cannot be effected by exposure to the sun, but is accomplished by suspending the tubers in a net over a wood-fire; the smaller pieces are dried entire, the larger ones are incised to facilitate the drying. The supply of jalap is very variable.

Description.—Jalap, when fully developed, is napiform or depressed globose in shape, above marked by the scar of the overground stem, below suddenly contracted into a thin root. The tubers are often pyriform, ovate, oblong, or nearly cylindrical in shape, and vary in size from that of a walnut to 37–50 Mm. (3 to 4 inches) in diameter. They are externally of a dark-brown color, and usually of a smoky appearance, more or less longitudinally wrinkled, and beset with brown, broad, corky warts, becoming transversely confluent. Jalap is hard and compact, and breaks irregularly; the transverse fracture is not fibrous, and shows a distinct concentric arrangement. The bark is quite thin, gray-brown, with a large number of resin-cells forming a dense zone near the cambium-line. The central portion of jalap has the resin-cells arranged in concentric circles, which vary in width, a zone of two or four rows of resin-cells usually alternating with one of a single row. The parenchyma consists of smaller cells containing subglobular starch-granules, which, particularly in the outer layers, are more or less transformed into a pasty mass; crystals of calcium oxalate are sparingly met with. The vascular tissue exists in small circularly-arranged groups of spiral vessels. Jalap has a very faint radiate appearance, the fibro-vascular bundles being small and not very numerous. It has a slight smoky and sweetish odor and a sweetish afterward acrid taste. Good jalap should not be deeply wrinkled or sticky internally, but should be plump, heavy, and hard, and when fractured should present a resinous appearance.

Fig. 165.

Transverse section of Jalap.

Fig. 166.

Jalap: transverse section, nat. size.

Impurities and Substitutions.—Jalap appears to be sometimes collected in an immature state or at an improper season; at least many of the tubers frequently contain little resin, but otherwise present all the characteristics of genuine jalap. Occasionally jalap has been met with which has been previously deprived of the resin, and is then sticky upon the surface and of a dark color internally. Hager (1882) states that good jalap will sink in a solution of sodium chloride of spec. grav. 1.140, while if exhausted by alcohol it will float in this liquid. A *mealy jalap* has been observed which resembles true jalap externally, but has few scattered resin-cells and a mealy fracture.

Valuation.—"On exhausting 100 parts of jalap with alcohol, concentrating the tincture to 40 parts, and pouring it into water, a precipitate of resin should be obtained which, when washed with water and dried, should weigh not less than 12 parts (10 p., *Br.*, *P. G.*), and of which not over 10 per cent. should be soluble in ether.—*U. S.*

Constituents.—Jalap contains starch, gum, unerystallizable sugar, and extractive matter; its medicinally important constituent, however, is *resin*, of which selected pieces may contain 22 per cent., but which varies in good commercial jalap between 12 and 18 per cent. Jalap grown in Jamaica yielded to Thos. Greenish (1881) only 8.27 to 8.68 per cent. of resin. About one-twelfth or one-tenth (occasionally one-eighth) of the resin is soluble in ether, of a brown color, acid reaction, and acrid taste; it is soluble in alkalies, and reprecipitated from these by acids. It is contained in the pharmacopœial resin of jalap, the main constituent of which is the resin insoluble in ether; this, investigated by Kayser (1844), was named *rhodeoretin*, and by W. Mayer (1852) *convolvulin*. Pure convolvulin is colorless, transparent in thin layers, inodorous, and tasteless, but in alcoholic solution it has an acrid taste. It is insoluble, or nearly so, in carbon disulphide, chloroform, petroleum, benzin, and volatile oils, but dissolves in acetic and cold nitric acid; when dry it melts at

150° C. (302° F.), but at a much lower temperature if mixed with water. It consists of $C_{62}H_{100}O_{32}$, dissolves readily in caustic alkalies, and is not reprecipitated by acids, but converted into *convolvulic acid*, $C_{62}H_{106}O_{35}$, of which convolvulin is the anhydride. Both are glucosides, and when boiled with dilute acids yield sugar and *convolvulinol*, $C_{26}H_{50}O_7$, which crystallizes in needles, is bitter and acrid, and when treated with alkalies loses water and is converted into *convolvulinolic acid*, $C_{26}H_{48}O_6$. Convolvulin and its derivatives, on being oxidized with nitric acid, are finally converted into oxalic and *ipomic acids*, the latter being $C_{10}H_{18}O_4$, and, according to Nelson and Bayne (1874), identical with *sebacic acid*, one of the products of the destructive distillation of olein.

W. Mayer (1855) has very improperly given the name of *jalapin* to the resin obtained from orizaba-root, which, with all its derivatives, is homologous to the preceding. *Jalapin*, $C_{68}H_{112}O_{32}$, closely resembles convolvulin, but is soluble in ether and chloroform, also in acetone, benzene, and phenol. Dissolved in alkalies, it is converted into *jalapic acid*, $C_{68}H_{118}O_{35}$, which is soluble in water; when treated with dilute acids, into sugar and *jalapinol*, $C_{32}H_{62}O_7$, which is acrid; and with alkalies yields *jalapinolic acid*, $C_{32}H_{60}O_6$. Nitric acid oxidizes these compounds to oxalic and sebacic acids. Spirgatis (1860) considers jalapin chemically identical with *scammonin*.

The resin of tampico-root is likewise homologous. Spirgatis (1870) calls it *tampicin*, $C_{68}H_{108}O_{28}$, which yields with alkalies *tampicic acid*, $C_{68}H_{120}O_{34}$, and with diluted acids sugar and *tampicolic acid*, $C_{32}H_{64}O_6$.

Allied Drugs.—The so-called *jalap-stalks*, *male*, *fusiform*, or *woody jalap*, consist of the tuberous root of Ipomœa orizabensis, *Ledanois* (Convolvulus, *Pelletan*), often cut into transverse slices 50–75 Mm. (2 to 3 inches) broad, light-brown, compact, often horny, distinctly radiate and more fibrous in texture; it is spindle-shaped 60 Cm. (2 feet) long, and contains resin which is entirely soluble in ether. *Tampico jalap*, from Ipomœa simulans, *Hanbury*, forms globular or elongated tuberous pieces which are often smaller, but occasionally larger, than true jalap, deeply wrinkled, destitute of transverse scars, and of a more woody fracture; the resin contained in it is completely soluble in ether.

The tuberous root of Mirabilis Jalapa, *Linné*, or *Four-o'clock*, resembles jalap somewhat in shape, but is darker externally and contains a large number of acicular crystals.

Radix mechoacannæ, probably obtained from a Convolvulaceæ, is found always in sections, of whitish or gray color, destitute of resinous circles; it cannot be mistaken for jalap.

The following are among the numerous species of Ipomœa which have been used like jalap:

Ipomœa orizabensis, *Ledanois*, (Convolvulus, *Pelletan*) grows near Orizaba and in Mechoacan.

Ipomœa pandurata, *Meyer*, (Convolvulus, *Linné*) grows on sandy banks in the United States, and is known by its pointed, heart-shaped leaves, which are sometimes contracted near the middle and fiddle-shaped. The root is elongated, cylindrical, abruptly contracted above to the thickness of a finger. It is pale-brownish externally, grayish-white internally, and emits when wounded a resinous milk-juice. The resin-cells form a dense zone in the inner portion of the thin bark, and are irregularly scattered in the medullary rays. It is known as *man-root*, *man of the earth*, *wild jalap*, and *wild potato*, and is feebly cathartic. Analyzed by C. Manz (1881), sugar, gum, starch, a tannin-like body, and 1.5 per cent. of resin were obtained. The latter is purgative, completely soluble in alcohol, ether, chloroform, and potassa, and from the latter solution again precipitated by acids; it consists of an acid resin soluble in methyl alcohol and precipitated by lead salt, and of a non-acid resin, which, like the former, is a glucoside.

Five or six Brazilian Convolvulaceæ have tuberous roots containing purgative resins; though employed in their native country like jalap, they are not articles of general commerce. They are popularly known as *purga*, *batata purgante*, *jalapinha*, *jcticucú* and *embureremho*, and are obtained from plants of the genera Convolvulus, Ipomœa and Piptostegia.

Ipomœa turpethum, *R. Brown*, *turpeth-root*, (*Turbith végétal*, Fr. Cod.) is indigenous to India and East Indian Islands. The root is met with in commerce in pieces of various length, frequently with pieces of the woody stem attached, reddish-brown externally, internally grayish or brownish. The bark is thick, mealy, and contains numerous small brown resin-cells in concentric rows, and several, or in older roots numerous, woody groups. The central wood is pale-brown, porous, and divided by narrow medullary rays into four or six parts. The resin amounts to about 4 per cent., a portion of which is soluble in ether; the insoluble portion, *turpethin*, $C_{34}H_{56}O_{16}$, resembles jalap resin in its behavior to alkalies and dilute acids.

Ipomœa Nil, *Roth*, s. Convolvulus (Pharbitis, *Choisy*) Nil, *Linné* (Bentley and Trimen, *Med. Plants*, 185), is indigenous to the tropics, and grows spontaneously in the Southern United States. The seeds are black, somewhat triangular, rounded on the back, of a rather heavy odor while fresh, and of a sweetish afterward acrid taste. The seeds are known in India as *kaladana*, and roasted or in powder are used as a purgative, like, but somewhat weaker than, jalap; they contain a fixed oil and 8 per cent. of *pharbitisin*, which appears to be identical with convolvulin (*Pharmacographia*). In Japan the seeds of Pharbitis triloba, known as *Kengashi*, are employed in a similar manner; they contain convolvulin.

Action and Uses.—Jalap and its resinous principle, convolvulin, act as local irritants, and taken into the stomach, excite irritation of that organ, with nausea, vomit-

ing, colic, and mucous, watery, and even bloody dejections, according to the dose. The experiments of Rutherford and Vignal led them to conclude that jalap is an hepatic stimulant of considerable power, rendering the bile more watery, but at the same time increasing the secretion of biliary matter. Its action on the liver is, however, far less apparent than its effects on the intestinal glands. Its medicinal virtues depend upon its being a hydragogue cathartic whose operation is not rendered less decided by a repetition of the medicine. Hence it is profitably employed for the removal of *dropsical effusions* from whatever cause they arise, the duration of its usefulness depending upon the nature of the cause of dropsy. It is usually associated with potassium bitartrate for this purpose, and with calomel in congested states of the liver or spleen. It is to be commended in *constipation* attended with habitual dryness of the intestine, when it should be given in a dose of Gm. 0.10–0.20 (gr. ij–iij) in the morning, fasting, and followed within an hour by a draught of cool water. A grain or two of aloes given the night before renders its operation more certain, and apparently promotes the biliary secretion. Jalap is not an anthelmintic, but a *vermifuge*, and is associated habitually with proper anthelmintic medicines.

The purgative *dose* of jalap is Gm. 1–1.30 (gr. xv–xx). Its powder should be thoroughly triturated with sugar and flavored with an aromatic oil. The resin is estimated to be from two to four times as strong as jalap. The syrup of rhubarb is said to completely dissolve it and to increase its efficiency.

JEFFERSONIA.—Twinleaf.

Jeffersonia diphylla, *Barton.*

Nat. Ord.—Berberidaceæ.

Origin.—The twinleaf is an herbaceous, acaulescent perennial growing in woods in the Middle, Southern, and Western United States. The leaves are on long petioles composed of two obliquely ovate leaflets; the scape is about 25 Cm. (10 inches) high bearing a white flower 25 Mm. (1 inch) broad, which has four fugacious sepals, eight spreading petals, and eight stamens, and produces an obovate capsule with many seeds. It flowers in April and May.

Description.—The rhizome is horizontal, knotty, beset with long, fibrous, and matted roots of a yellowish or dark-brown color, somewhat corrugated and transversely fissured; the bark is brown, of a resinous appearance, and has a bitter and acrid taste. The pale-yellowish wood is destitute of taste.

Constituents.—The rhizome was analyzed by E. S. Wayne (1855), and contains, besides the ordinary vegetable principles, tannin, precipitating ferric salts dark-green, a bitter principle and an acrid acid analogous to polygalic acid. F. F. Mayer (1863) states that the rhizome contains a small quantity of *berberine*, a larger proportion of a *white alkaloid*, and a considerable amount of *saponin.*

Action and Uses.—No recent observations seem to have been made of the virtues of this plant, which is said to be diuretic, tonic, and expectorant in small, and emetic in large, doses. It has been compared to seneka.

JUGLANS, *U. S.*—Butternut-Bark.

Écorce de noyer gris, Fr.; *Graue Wallnussrinde*, G.; *Nogal*, Sp.

The bark of the root of Juglans cinerea, *Linné* (J. cathartica, *Michaux*, J. oblonga, *Miller*) collected in autumn. Bentley and Trimen, *Med. Plants*, 247.

Nat. Ord.—Juglandaceæ.

Origin.—A handsome tree, 9–12 M. (30 to 40 feet) high, growing in forest and bottom-lands in Canada and the greater portion of the United States westward to Missouri and Arkansas. It has a brown, soft, but durable and easily-worked wood; the leaves are composed of about fifteen sessile, oblong-lanceolate, serrate, and underneath pubescent leaflets; the staminate flowers are in aments about 10 Cm. (4 inches) long; the pistillate flowers, to the number of about five, form a spike; the fruit is ovoid-oblong and viscid pubescent. The tree flowers in April and May, and ripens its fruit in September and October. The bark is collected in May or June, or, according to the Pharmacopœia, in autumn, and is deprived of its corky layer.

Description.—The liber, of which the medicinal article exclusively consists, is white when fresh, but rapidly turns yellow and deep-brown on drying. It is met with in commerce in flat or in curved pieces, about 3 or 6 Mm. ($\frac{1}{8}$ or $\frac{1}{4}$ inch) thick, and varying in

length, both ends being usually cut off obliquely. The outer surface has often thin patches of cork adhering; the inner surface is smooth and striate. The tangential arrangement of the brownish bast-fibres, alternating with white parenchyma and crossed by the numerous fine white medullary rays, gives the cross-section a delicately checkered appearance. The bark breaks readily with a short fracture both transversely and longitudinally. It has a feeble odor and a bitter somewhat acrid taste. If collected in April it has a sweetish, insipid taste, and is said to be less active.

Constituents.—The bark has been examined by Thiebaud (1872) and by Dawson (1874). The latter found a little tannin, trace of volatile oil, a little resin, and 14 per cent. of fixed oil; also a volatile acid, called by Thiebaud *juglandic acid*, but which is doubtless identical with the *nucin* of Reischauer and Vogel (1856), discovered by them in the pericarp and leaves of Juglans regia, *Linné*. Nucin, or *juglone*, which seems to have the composition $C_{36}H_{12}O_{10}$, has an acrid taste, an acid reaction to test-paper, and is sparingly soluble in water, more so in alcohol, and readily so in ether, chloroform, and carbon disulphide; it crystallizes as orange-yellow needles, and acquires, with alkalies and with the alkali borates and phosphates, a handsome purple color. If the properties of the bark depend wholly or in part on this principle, it is easily explained why continued boiling should render it less efficacious. Tanret and Villiers (1877) obtained from the leaves of the European walnut a crystallizable non-fermentable sugar, *nucit*, $C_6H_{12}O_6.2H_2O$, and Tanret (1876) reported having isolated a crystallizable alkaloid. According to Sestini, the root of the European walnut contains *glycyrrhizin*.

Allied Plants.—Juglans regia, *Linné*, *English walnut*. The green pericarp (Cortex fructus juglandis) and the leaves (Folia juglandis, *P. G.*) have a peculiar odor and a somewhat astringent and bitter taste. The young fruit of both species is used for pickles, and when ripe the kernels yield a bland and drying fixed oil known as *nut oil;* it is greenish or pale-yellow, congeals like lard at about −18° C. (0° F.), and acquires a red color with nitric acid and a dark-brown one with a mixture of nitric and sulphuric acids. Similar oils are contained in the butternut and in the seeds of Juglans nigra, *Linné*, Carya olivæformis, *Nuttall* (*pecan-nut*), and other species of Carya, the various *hickory-nuts*.

Action and Uses.—Butternut is employed medicinally in the form of the officinal extract alone, which, according to Rutherford's experiments, is a "moderately powerful hepatic and a mild intestinal stimulant."

Juglans regia, or English walnut, was once reputed to be a remedy for *scrofula*, and in France about 1840 it was actively advertised for this purpose by Négrier and others, but its credit was not sustained. The leaves are a popular cure for *leucorrhœa* when used in decoction as an injection, and for other mucous profluvia internally. An extract of the leaves has been claimed by Luton to be curative of tubercular *meningitis* (*Etudes de thérapeutique*, 1882); and his reports are more or less sustained by those of Tanret, Meslier, and Guénot (*Bull. de Thérap.*, tom. xc. xci.), but they have not been confirmed by ulterior observation. In France the leaves, the rind of the fruit, and the inner bark of J. regia have long been in popular and medical use for repressing the *mammary secretion*, for curing *ulcers* of all parts, including the uterus, for treating *diarrhœa*, *leucorrhœa*, *ulcerated sore mouth*, affections of the *tonsils*, *uterine hæmorrhage*, etc. In 1853, Pomeyrol treated with singular success *carbuncle* and *malignant pustule* by the simple application of the fresh leaves of black walnut frequently renewed (Cazin, *Plantes médicinales*, p. 640). Juglans nigra, or black walnut, says Griffith, has a styptic and acrid bark, seldom used except in dyeing. The rind of the unripe fruit is said to remove *ringworm* and *tetter*, and a decoction of it has been given as a *vermifuge*. A decoction of black walnut leaves was also advantageously substituted for a complex and perturbative treatment of *diphtheria* by Dr. Curtis (*Boston Med. and Surg. Jour.*, March, 1881, p. 226).

In England a preparation known as "spirit of walnut" is made by distilling alcohol from fresh walnuts, and is stated to be very efficient in "hysterical *vomiting*, the vomiting of pregnancy, and even for cerebral vomiting" (Mackey, *Practitioner*, xxi. 401).

JUJUBA.—Jujube-berries.

Jujube, F. Cod.; *Brustbeeren*, *Judendornbeeren*, G.; *Azufayfas*, Sp.

The fruit of Zizyphus vulgaris and Z. Lotus, *Lamarck*.

Nat. Ord.—Rhamnaceæ.

Origin.—The jujube-shrubs are indigenous, the former to Asia Minor and Syria, the latter to Northern Africa, and are cultivated in Southern Europe. They are shrubby or sometimes tree-like, and have alternate ovate and serrate three-nerved leaves, at the base

with two prickly afterward spiny stipules. The fruit is a two-celled and two-seeded, or by abortion one-celled and one-seeded, drupe.

Description.—Jujubes are roundish oblong and nearly 25 Mm. (one inch) long, but obtained from the second species are subglobular and about 15 Mm. ($\frac{3}{5}$ inch) long; they are bright-red, or after drying brownish-red, wrinkled, with a thin leathery pericarp, a soft mucilaginous and sweet sarcocarp, and an ovate, acute, wrinkled, and usually one-seeded endocarp.

The fruits of Ziz. Jujuba, *Lamarck*, a slender East Indian tree, and of several other species, possess similar properties.

Constituents.—Jujubes contain mucilage and sugar. The bark contains tannin.

Pharmaceutical Uses.—Massa de jujubis—Jujube paste, *E.;* Pâte de jujubes, *Fr.*—is prepared by extracting 5 parts of jujubes with sufficient water to obtain 35 parts of infusion, in which are dissolved gum-arabic 30 parts and sugar 20 parts; the solution is evaporated, 2 parts of orange-flower water added, kept slowly boiling for 12 hours, and then poured into moulds.—*F. Cod.* In the jujube paste, as sold in the United States, the jujubes are usually omitted.

Action and Uses.—In the native countries of the jujube its fruit is ranked with figs and raisins and other more or less saccharine and acidulous fruits which are used in tisanes for acute irritations of the *throat* and *air-passages*, as in this country we employ the syrup and jelly of currants, blackberries, etc.

JUNIPERUS.—Juniper.

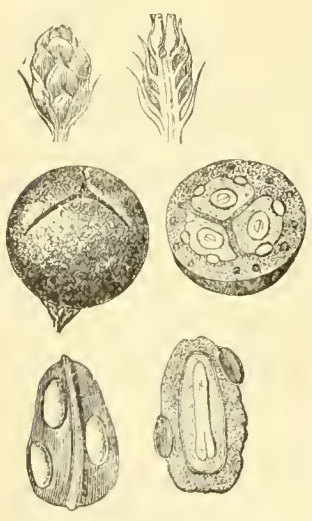
Fructus juniperi, P. G.; *Baccæ, s. Galbuli juniperi.—Juniper-berries*, E.; *Genièvre, Baie (Fruit) de genièvre*, F. Cod.; *Wachholderbeeren, Kaddigbeeren*, G.; *Enebro*, Sp.

The fruit of Juniperus communis, *Linné.* Bentley and Trimen, *Med. Plants*, 255.

Nat. Ord.—Coniferæ, Cupresseæ.

Origin.—Juniper is indigenous to the northern hemisphere, and is found in North America from the Southern United States and Canada to Greenland, and westward to the Pacific, throughout Asia from the Himalayas northward, in Northern Africa, and throughout Europe. It is commonly a shrub, sometimes arborescent, or in the variety alpina (Jun. nana, *Willdenow*), prostrate and spreading, the latter being met with in Arctic and mountainous localities. The numerous leaves are persistent, spreading, in whorls of three, linear and sharp-pointed; the staminate flowers are arranged in short ovate catkins; the pistillate form a short cone consisting of about five imbricate whorls, each of three scales. Three naked ovules are situated at the base of the upper whorl, and, after fructification, these scales enlarge, coalesce, become fleshy, and ultimately enclose the seeds, forming the official berry-like galbulus, which ripens during the second year.

Fig. 167.



Juniperus communis, *Linné: a*, fertile catkin and longitudinal section; *b*, galbulus and transverse section; *c*, seed and longitudinal section, magnified.

Description.—Juniper-berries are nearly globular, about 8 Mm. ($\frac{1}{3}$ inch) in diameter, dark-purplish, and covered with a bluish-gray bloom; the short stalk at the base contains one or two whorls of the small scales, and the apex is marked by three radiating furrows, which are surrounded by ridges enclosing a triangular space. The three, or by abortion one or two, bony seeds are ovate in shape, triangular above, have six to ten large oil-sacs on their surface, and are imbedded in a brownish pulp which likewise contains oil-cells. Juniper-berries have an aromatic somewhat balsamic odor and a sweet, terebinthinate, bitterish, and slightly acrid taste.

Constituents.—Juniper-berries were analyzed by Trommsdorff (1822), Nicolet (1831), Steer (1856), and Donath (1873). They contain from $\frac{1}{2}$ to $2\frac{1}{2}$ per cent. of volatile oil (see Oleum Juniperi), about 30 per cent. of sugar, resins amounting to 10 per cent., 4 of protein compounds, fat, wax, formic and acetic acids, malates, and *juniperin*, which is light-yellow, slightly soluble in water, freely so in alcohol and ether, and with a golden-yellow color in ammonia. Ritthausen (1877) obtained from juniper-berries, containing 10.77 per cent. of water, only 14.36 per cent. of sugar, 3.77 of ash, and 31.60 of cellulose.

Pharmaceutical Uses.—Infusum juniperi.—Infusion of juniper-berries, *E.;*

Tisane de genièvre, *Fr.;* Wachholderbeeren-Aufguss, *G.*—Bruised juniper-berries a troy-ounce, boiling-water a pint; macerate for an hour in a covered vessel, and strain.—*U. S. P.* 1870.

Species diureticum.—Harntreibender Thee, *G.*—Lovage, rest-harrow, liquorice-root, cut, of each 1 part, and bruised juniper-berries 1 part.—*P. G.*

Action and Uses.—Juniper is stimulant, stomachic, carminative, diuretic, and emmenagogue. It communicates a special odor to the urine. It is much used in the treatment of *dropsies*, and especially of scarlatinous and other forms of dropsy due to tubular obstruction of the kidneys. (Juniperi contus., Potassii bitart. āā ℥ss; Aquæ fervent. Oj. Make an infusion, to be used in divided doses during twenty four hours. Potassium acetate may be substituted for the bitartrate in this formula but in half the quantity. The diuretic virtues of the infusion may be increased by the addition of parsley, buchu, horse-radish, etc.) In chronic catarrhal affections of the *urinary passages* juniper is useful, and also when sabulous matter is habitually voided. The inspissated juice of fresh juniper berries diluted with water and sweetened is recommended as an agreeable and efficient diuretic for children (Goldschmid). As an anodyne for painful *swellings*, and generally for *local pains*, bruised juniper-berries are sometimes used, and fumigations made by throwing the berries upon hot coals may be employed to relieve *rheumatic pains*. Haydon states that the Hudson's Bay Indians apply the bruised inner bark to wounds and especially to foul wounds and sores.

KALMIA.—Mountain Laurel.

Calico-bush, Spoon-wood, E.; *Kalmie*, Fr., G.

The leaves of Kalmia latifolia, *Linné*.

Nat. Ord.—Ericaceæ, Rhodoreæ.

Origin.—This shrub is found from Canada south along the mountains to West Florida and Alabama, and is usually about 1.8 M. (6 feet) high, but sometimes tree-like and about 9 M. (30 feet) high. The wood is yellowish, close-grained, very hard and strong; the elegant but inodorous flowers appear in May and June, are in dense racemose corymbs, and have a rose-red or whitish subcampanulate corolla, which, in the lower part, is furnished with ten cavities holding the ten anthers until they begin to shed their pollen. The Indians are said to have made spoons from the wood.

Description.—The leaves are alternate, 5–8 Cm. (2 or 3 inches) long, petiolate, coriaceous, oval-lanceolate, or elliptic, entire, acute at both ends, smooth and green on both sides. They are without odor and have an astringent and bitterish taste.

Constituents.—Charles Bullock (1848) proved the leaves to contain tannin, a principle resembling mannit, an acrid principle, resin, gum, and other common constituents of plants. Kennedy (1875) isolated a small proportion of *arbutin*. The poisonous principle is *andromedotoxin*, $C_{31}H_{51}O_{10}$ (Plugge, 1889), which is prepared by precipitating the infusion with normal and basic lead acetate, treating the filtrate with hydrogen sulphide, concentrating and extracting with chloroform; it is soluble in 400 parts of chloroform, 35 of water, and 9 of alcohol, sparingly soluble in ether, and by mineral acids is colored red; evaporation with dilute sulphuric acid causes a rose-red color; reagents for alkaloids do not precipitate. The same principle has been shown to exist in a number of poisonous Ericaceæ.

Allied Plants.—Kalmia angustifolia, *Linné*, known as *sheep-laurel*, *sheep-poison*, and *lamb-kill*, has petiolate opposite or ternate linear-elliptic leaves, 2 to 5 Cm. (1 or 2 inches) long, and whitish or brownish beneath. The small flowers are of a crimson color (Mechan, *Nat. Flowers* [2], ii. 181). Laschè (1889) determined the presence of andromedotoxin.

Kalmia glauca, *Aiton*, *Swamp-laurel*, has two-edged branches, pale purple flowers, and opposite subsessile lanceolate and glaucous leaves. It grows westward to Colorado.

Ledum palustre, *Linné*, *Marsh tea*, *Marsh cistus*, *Wild rosemary*, E.; *Lédon*, *Romarin sauvage*, Fr.; *Porsch*, *Sumpfporst*, *Wilder Rosmarin*, G.; a shrub growing in marshy locations in the northern sections of the northern hemisphere. The leaves are coriaceous, 25 Mm. (1 inch) long, linear, obtuse, revolute on the margin, dark-green, and smooth above, and rusty woolly beneath; odor, peculiar heavy aromatic; taste bitter aromatic, somewhat camphoraceous. They contain *leditannic acid*, about 1 per cent. of volatile oil, *ledum camphor*, ericolin, citric acid, resin, etc. Andromedotoxin is absent (Plugge, 1889).

Ledum latifolium, *Aiton*, known as *Labrador tea* and *James tea*, is indigenous to North America and Minnesota eastward. The leaves resemble the preceding, but are broader, elliptic-oblong, and occasionally slightly heart-shaped at the base. West of the Rocky Mountains it is replaced by L. glandulosa, *Nuttall*.

Rhododendron, *Rosebay, Snow rose*, E.; *Rosage*, Fr.; *Alpenrose, Schneerose, Gichtrose*, G.; This genus contains evergreen shrubs and low trees inhabiting mountainous localities of the northern hemisphere. They have leathery, entire, somewhat revolute and petiolate leaves, often crowded near the end of the branches, and showy flowers in compact terminal clusters or corymbs. The leaves of the following species have been used:

Rhod. chrysanthum, *Linné*, indigenous to Siberia, has yellow flowers. The leaves are pale rust-colored beneath, and when fresh have a slight rhubarb-like odor; their taste is astringent and unpleasantly bitter, and they contain a little volatile oil, tannin, and andromedotoxin.

Rhod. maximum, *Linné*, grows in North America, and has rose-colored and whitish flowers. Its leaves are about 18 Cm. (7 inches) long, elliptic-oblong, or obovate-oblong, acute, smooth, dark-green, shining paler beneath. Their taste is astringent and somewhat pungent. G. F. Kuehnel (1885) found in the leaves tannin, arbutin, ericolin, ursone, etc.; Plugge (1889) showed the presence of andromedotoxin.

Rhod. ferrugineum, *Linné*, a European species, has purple glandular-dotted flowers, and lance-oblong, rust-colored, and beneath scaly leaves, an astringent and bitter taste, due to tannin and ericolin.

Andromeda polifolia, *Linné* (Ericaceæ, Andromedeæ), growing in marshes of the northern hemisphere, is known as *wild rosemary*. The leaves are about 25 Mm. (1 inch) long, linear-lanceolate, strongly revolute at the margin, greenish-white beneath, not aromatic, of a somewhat acrid taste. They contain andromedotoxin, which is probably also present in

Andromeda mariana, *Linné*, or *stagger-bush* (Meehan, *Native Flowers*, ii. 185), reported to be poisonous to lambs and calves. It is a shrub, produces clusters of white, nodding, ovate-cylindrical flowers, and has thickish but deciduous, smooth, oval or oblong, entire leaves, about 5 Cm. (2 inches) long. It grows in the seaboard States from New England to Florida, Tennessee and Arkansas.

Action and Uses.—The leaves and berries of mountain-laurel have long been known to be poisonous, but their action has chiefly been learned through the effects produced in man by eating the flesh of partridges (Tetrao umbellus) that have fed upon the berries. From a number of cases observed or collected by Dr. Jacob Bigelow he prepared (1857) the following summary of the symptoms of this poisoning: The flesh of the bird "acts as a direct sedative poison, impairing the functions of the brain, and, in connection, those of the digestive and circulatory systems. The cerebral symptoms, in a majority of the cases, have been vertigo, loss of sight, tinnitus aurium, and in bad cases general loss of the power of sensation and voluntary motion. Respiration has been slow, sometimes to a great degree. In the circulatory system there has been syncope, feeble and sometimes irregular action of the heart, weak, slow, and sometimes imperceptible pulse, cold surface, and pale or livid complexion. In the digestive system there are oppression, nausea with a tendency to vomit, and in many cases pain in the abdomen, extending through to the back. In more rare cases pain has been felt in the head and limbs. . . . The poison of the partridge has never, to my knowledge, proved fatal." The medicinal value of this plant is almost entirely conjectural. The bruised leaves, and also a decoction, are said to have been applied to certain *cutaneous eruptions*, and it is added that alarming symptoms have sometimes resulted, probably because the skin was not whole. It might be profitable to test their efficacy in neuralgic and other local pains by applying them in the same manner.

"The twigs with leaves and flowers" of K. angustifolia "are used in bowel complaints and as a tonic" by the Cree Indians of Hudson's Bay Territory (*Amer. Jour. Phar.* lvi. 617).

Ledum has been ranked with acrid-narcotic medicines, and is stated, in large doses, to occasion headache, restlessness, sleeplessness, dyspnœa, cough, dilatation of the pupils, a sort of intoxication, with pain in the limbs, increased secretion of the urine, saliva, and especially of sweat, with itching and an eruption of papules or pustules on the skin. It is said to have been used in the manufacture of beer to make it more intoxicating. It was formerly employed in diarrhœa, dysentery, whooping cough, croup, gouty and rheumatic pains, and all sorts of chronic cutaneous eruptions. Its use for such purposes is, however, obsolete. Hilbert extols it in acute and chronic bronchitis. The *dose* is stated to be Gm. 0.30–1 (gr. v–xv). An infusion may be prepared with from 5 to 10 parts of the leaves in from 100 to 200 parts of hot water. A strong decoction of the plant is used to destroy *cutaneous parasites* in horses and neat cattle and to cleanse bedsteads of *vermin*, and the leaves and twigs of the fresh plants are laid among woollen clothing to protect it against moths.

Ledum latifolium is said to be expectorant and tonic and to allay the pain of insects' stings.

Andromeda polifolium was formerly used as a sedative.

Rhododendron, the Siberian or snow rose, is said to be an active medicine. It is re-

lated that a goat after eating its leaves became excited, tottered and fell upon its knees, and did not recover for two hours. In man small doses appear to increase the secretions and especially to act as a diaphoretic. Larger doses render the mouth and throat dry and constringe them, promote the alvine and cutaneous secretions, and excite a sense of formication and prickling of the skin, which also exhales an aromatic smell. In still larger doses it causes giddiness, confusion of the senses and ideas, dimness of vision, constriction of the throat, dyspnœa, hebetude, paralysis of sensibility and motility, and even convulsions. Sometimes it acts principally as an evacuant upon the stomach and bowels, and in other cases excites profuse diuresis or sweating, itching or eruptions of the skin, pain and twitching of the limbs, etc. It is said to reduce the pulse and render it intermittent.

Rosebay has been almost exclusively employed in the treatment of *rheumatism* and *gout*, a hot infusion being made at the commencement of the attack when acute; but in the chronic forms of these diseases a moderate but steady action of the medicine is maintained for weeks, and even months, the evidence of its utility being furnished by painful sensations in the affected parts. It has also been used in *sciatica*, in chronic *diseases of the skin*, and chronic *diarrhœa* and *dysentery*. It is given in powder in doses of Gm. 0.60 (gr. x) several times a day, or in a decoction made with Gm. 8–16 in Gm. 320 (℥ij–iv in f℥x) of water.

KAMALA, *U. S.*, *Br.*, *P. G.*—Kamala.

Rottlera, U. S. 1870; *Glandulæ rottleræ.*—*Kameela*, *Kamala*, Fr., G.; Sp.

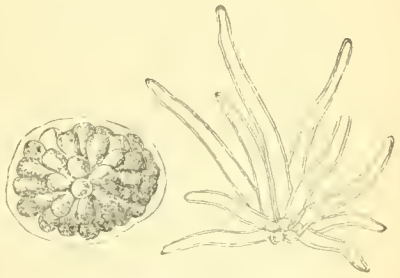
The glands and hairs obtained from the capsules of Mallotus (Echinus, *Baillon*) philippinensis, *Müller Arg.*, s. Croton philippense, *Lamarck*, s. Rottlera tinctoria, *Roxburgh*. Bentley and Trimen, *Med. Plants*, 236.

Nat. Ord.—Euphorbiaceæ.

Origin.—The kamala grows wild in Australia, Eastern China, India, Southern Arabia, and Abyssinia, and in most of the islands lying between these countries from the Philippines westward. It is a large shrub or small tree, with petiolate, ovate, acute, and entire leaves, and produces globular tricoccous three-seeded capsules, from which the glands are obtained by rubbing and sifting in baskets.

Description.—Kamala is a fine granular, mobile powder of a brick-red or brownish-red color, somewhat resinous appearance, inodorous, and nearly tasteless. It is with difficulty mixed with water, imparts to boiling water only a yellow tinge, but a deep-red color to alkaline solutions, alcohol, ether, chloroform, and benzene. When thrown into a flame it burns similar to, but less rapidly than, lycopodium, and when heated in a crucible it leaves a small amount of ash, which weighs from pure kamala 1.37 per cent. (*Pharmacographia*) Examined under the microscope, the glands are seen to be depressed-globular, and to consist of a thin transparent membrane enclosing a yellowish mass in which are imbedded many club-shaped vesicles radiating from a common centre, and containing a red substance; this structure becomes more apparent after treating the glands with potassa and pressing them between glass. The glands are always mixed with colorless stellately-arranged simple hairs, but fragments of leaves and stems should not be present. When heated in a crucible to redness, kamala should leave not more than 8 per cent. (*U. S.*; 6 per cent. *P. G.*; at most 10 per cent. *Br.*) of ash, having a gray, not a red, color.

Fig. 168.



Kamala, magnified 190 diameters.

Constituents.—Pure kamala contains only between .5 and 3.5 per cent. of moisture, and yields to ether, alcohol, amyl alcohol, glacial acetic acid, or carbon disulphide about 80 per cent. of resin, which is also soluble in alkalies, but not in benzin, and whose alcoholic solution is colored dingy-green by ferric chloride (Flückiger). Leube (1860) analyzed a sample of kamala which yielded nearly 29 per cent. of ash, 47.6 of resin, and 19.7 of other soluble matters, consisting of citric, oxalic, and tannic acids, gums, etc. Cold alcohol dissolved a resin, $C_{15}H_{18}O_4$, fusible at 80° C. (176° F.), and left a more sparingly soluble resin, $C_8H_{12}O_5$, melting at 191° C. (376° F.). Both resins are brittle, red-yellow, soluble in alkalies with a red color, not altered by dilute acids, and when treated with nitric acid yield oxalic acid. Leube could not obtain Anderson's *rottlerin*, $C_{22}H_{20}O_6$ (1855), which crystallized from the concentrated ethereal tincture in yellow silky needles. Groves (1872) ascertained that it is easily modified by exposure to air, and is consequently

obtained only from the recent drug. Flückiger subsequently observed that on being fused with potassa rottlerin yields *paraoxybenzoic acid*. Anderson's *resinous coloring matter* has the composition $C_{30}H_{30}O_7$, melts at 100° C. (212° F.), is easily soluble in alcohol and ether, and yields with lead acetate an orange-colored precipitate. By treating kamala with boiling alcohol, and cooling, amorphous flocculæ of the composition $C_{20}H_{34}O_4$ are obtained, which are sparingly soluble in cold alcohol and ether, and are not precipitated by lead or silver salts.

A. G. and W. H. Perkins (1886) by extracting with carbon disulphide obtained *mallotoxin* $C_{19}H_{10}O_3$ or $C_{18}H_{16}O_5$, which crystallizes in flesh-colored needles, readily soluble in alkalies, with a yellowish-red solution from which it is precipitated by acids.

Allied Drugs.—Mesenna, Mussena, Bussena, and Bisinna are the Abyssinian names for the bark of Acacia (Albizzia, *Courdon*; Besenna, *Richard*) anthelmintica, *Baillon* (*Nat. Ord.* Leguminosæ, Mimoseæ), which was first sent to Europe in 1838. It comes in flat or bent pieces 2 to 5 Cm. (1–2 inches) wide, and 5 Mm. ($\frac{1}{5}$ inch) thick, and 30 Cm. (12 inches) long, gray or yellowish-brown, smooth or somewhat fissured, the middle bark granular yellowish and the tough bast pale yellow; it is inodorous, and the inner layers have a nauseous sweet, bitterish, and persistently acrid taste. Thiel (1862) showed the presence of a saponin-like amorphous body, *Musenin*, bitter, saccharine, and coloring principles, and about 5.5 per cent. of ash. The infusion is colored yellow by ferric chloride.

Saoria, from Abyssinia, is the fruit of Mæsa lanceolata, *Forskal*, s. M. picta, *Hochstetter* (*Nat. Ord.* Myrsineæ). It is drupaceous, globular-ovate, about 4 Mm. ($\frac{1}{6}$ inch) thick, partly united with the calyx, brownish-green, and contains a resinous pulp with many turbinate angular seeds attached to the central placenta; the taste is bitterish, pungent, and acrid. Apoiger (1857) met with an acrid principle, some iron-greening tannin, volatile oil, fat, pectin, etc.

Satzé or Tatzé, the fruit of Myrsine africana, *Schimper*, differs from the preceding in being more globular, not united with the calyx, of a reddish-brown color, and in containing only one nearly globular seed, which is grooved at the base. The taste of the fruit is more disagreeable than that of saoria.

Embelia Ribes, *Burmann*, *Nat. Ord.* Myrsineæ, grows in India. The dark-red drupe is of the size of black pepper, but is very aromatic. Warden (1887, 1888) isolated from it *embelic acid*, $C_9H_{14}O_2$, which crystallizes in brilliant golden spangles and is insoluble in water; its alcoholic solution combined with ammonia turns red, and on spontaneous evaporation yields the salt crystalline and tasteless.

Wars, Warras, or Wurrus. This name, which is the Arabian for saffron, has occasionally been given to kamala, but in Eastern Africa is given to a distinct drug of unknown origin, but used for dyeing, and medicinally like kamala. It forms a rather coarse powder of a deep-purple color and slight odor, becomes black at the temperature of a water-bath, yields from 6 to 12 per cent. of ash, and under the microscope is seen to consist of cylindrical or subconical glands enclosing oblong vesicles arranged in three or four tiers; the glands are mixed with rather long, simple hairs.

Action and Uses.—Kamala has long been employed in Hindostan as a remedy for *tænia*. It does not occasion much nausea, colic, or purging. British soldiers in India, it is said, often apply for a dose of the medicine, "after which they invariably part with the worm in the course of a few hours, and then go on with their military duty as if nothing had happened." In general, the parasite seems to have been discharged dead. On the other hand, Bérenger-Féraud states that it is apt to occasion nausea, colic, vertigo, and headache, and that it does not cause the discharge of the head of tæniæ (*Bull. de Thérap.*, cxvi. 103). The medicine appears to be efficient in removing *lumbricoid worms* and rectal *ascarides*.

The *dose* of powdered kamala is Gm. 4–8 (ʒj–ij). To prevent its griping hyoscyamus may be associated with it. A saturated tincture has been found efficient in doses of from Gm. 4–12 (fʒj–iij), diluted with cinnamon-water, or the extract produced by evaporating the tincture may be employed. The dose of either preparation should be repeated several times at intervals of about three hours.

Musenna is used by the Abyssinians to expel *tæniæ*. They take Gm. 90–120 (ʒiij–iv) of the powdered bark made into an electuary with honey, after fasting for twenty-four hours. The parasite is discharged, neither whole nor in fragments, but reduced to a sort of pulp. The medicine thus administered is apt to occasion nausea, but neither colic nor diarrhœa, and its use is followed after several hours by a purgative, usually of castor oil. When musenna has been employed in Europe it generally failed to produce the results as a tænicide which are attributed to it in its native country.

Saoria gives a violet tint to the urine and occasions slight nausea and liquid stools. According to some authorities, it is a more certain remedy for *tænia* than the indigenous tænifuges of France, but others regard its action as uncertain. It may be given in powder, mixed with porridge, in the *dose* of Gm. 32–48 (ʒj–ʒiss).

Tatzé has a persistently acrid and disagreeable taste, and is apt to produce vomiting and purging. Dr. Strohl found it partially successful in six cases of *tænia*. He administered from Gm. 128–192 (4 to 6 drachms) of the powder in a liquid vehicle.

Embelia Ribes. The berries of this plant are stated to be efficacious against *tape-worm*. Gm. 8–12 (ʒij–iij), powdered, are given with milk before breakfast, and followed some hours later by a dose of castor oil or other purgative (*Amer. Jour. of Phar.*, lx. 340).

KINO, *U. S.*, *Br.*—Kino.

Gummi (*s. Resina*) *Kino.—Kino de l'Inde*, Fr. Cod.; *Kino*, G.; *Goma quino*, Sp.

The inspissated juice of Pterocarpus Marsupium, *Roxburgh*. Bentley and Trimen, *Med. Plants*, 81.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—The kino tree, called *bija* in Bengal, is 18–24 M. (60 to 80 feet) high, has numerous spreading branches, a red inner bark, unequally pinnate deciduous leaves, yellowish flowers in loose racemes, and nearly orbicular and winged pods, which contain a single kidney-shaped seed. It is indigenous to India and Ceylon, and on incisions being made through the bark yields a red juice, which is dried by exposure to the air and sun. Pter. indicus, *Willdenow*, a native of Southern India and of the Philippine Islands, yields kino of a fetid odor.

Description.—East India or Malabar kino is met with in small, angular, dark brownish-red, glistening, and brittle pieces, which in thin layers are transparent and of a ruby-red color, and tinge the saliva deep-red; it softens between the teeth, is inodorous, and has a very astringent and sweetish taste. It is partly soluble in cold water, leaving a flocculent residue, and is entirely soluble in alcohol and nearly insoluble in ether. The solutions have an acid reaction; the aqueous solution is precipitated green-black by ferric salts, gray-purplish by lead acetate, light-brown by tartar emetic, and reddish by mercuric chloride. The solution in diluted alcohol is apt to gelatinize.

Constituents.—By treating kino with ether Eissfeldt (1854) obtained a minute quantity of *pyrocatechin* which Kremel (1883) could not obtain. The products of the dry distillation of kino contain a larger quantity of the same substance, which may be obtained pure by subliming in a benzoic acid apparatus. Kino contains no *catechuic acid*, but its tannin, *kino-tannic acid*, seems to be chemically related to catechu tannin, since it yields similar decomposition-products; but it has not yet been obtained in a pure condition, being accompanied by red coloring matter, and, according to Hennig (1853), by a pectin compound from which it cannot easily be freed. The aqueous solution of the acid gives with pure ferrous salts when carefully neutralized a violet color, and with ferric salts a blackish-green one. Mineral acids and many metallic salts produce precipitates; hot nitric acid converts it into oxalic acid. In solution it is darkened by alkalies, and when treated with potassa it is decomposed into *protocatechuic acid* and *phloroglucin*. On exposure to air the aqueous solution yields a red precipitate, slowly at the ordinary, more rapidly at the boiling, temperature: this is *kino-red*, an amorphous, tasteless mass, the alcoholic solution of which has a slight acid reaction. Kino-red, $C_{28}H_{22}O_{11}$, is also produced by heating *kinoin* to 130° C. (266° F.). This compound was obtained by Etti (1879) by boiling kino with diluted hydrochloric acid and agitating the clear liquid with ether; it forms white crystals, the solution of which in water becomes red with ferric chloride. The compound which yields pyrocatechin and gallic acid was obtained by Flückiger from Australian, but not from Malabar, kino. Kino yields about 1.3 per cent. of ash.

Other Varieties of Kino.—African or Gambia Kino exudes naturally from Pter. erinaceus, *Poiret*, of Western Africa, and agrees with the Bengal kino in behavior; it is not an article of commerce.

Australian or Botany Bay Kino is usually referred to Eucalyptus resinifera, *Smith* (Myrtaceæ), but F. von Mueller sent exudations from sixteen different species to Wiesner (1871), who found the products of E. rostrata, *Schlechtendal*, E. corymbosa, *Smith*, E. piperita, *Smith*, and of some others, to agree well with Malabar kino, while the exudation of E. resinifera, E. gigantea, *Hooker*, and others contains much gum, which is colored red by a kino-like substance. A kino-like substance is occasionally obtained from E. globulus, *Labillardière*.

Bengal or Palas Kino, *Butea gum*, from Butea frondosa, *Roxburgh* (Leguminosæ), is in dark ruby-colored tears and fragments, of which only about one-half or less is soluble in hot alcohol, the remainder being mucilaginous matter. According to Eissfeldt, it does not contain pyrocatechin, but yields this compound on dry distillation. When incinerated, Butea gum leaves about 1.8 per cent. of ash.

Jamaica, West Indian, or Caracas Kino, from Coccoloba uvifera, *Linné*, or *sea-side grape* (Polygonaceæ), is obtained by boiling the wood and bark and evaporating the decoction. It resembles Malabar kino in appearance, but is of a brown tint, less glossy, and has a bitterish rather than a sweetish taste; it is soluble in both alcohol and water to the extent of about 90 or 93 per cent. The tannin of this kino seems to be closely related to, if not identical with, that of the officinal article. The plant named is a large tree of the West Indies and Southern Florida, and has a heavy, hard, and durable violet-brown wood. Whether the wood of Coccoloba floridana, *Meissner* (C. parvifolia, *Nuttall*), or *pigeon plum*, of Southern Florida, may yield kino has not been ascertained.

Action and Uses.—This medicine is more lenitive than other astringents, in consequence, probably, of the pectin it contains. Its modified astringency renders it in some degree a local tonic. It is chiefly used in the treatment of *diarrhœa* and of that form of gastric disorder known as *pyrosis*. In the former it may be profitably employed when pure astringents would be too irritating, and is generally associated with opium, as it also should be in the treatment of water-brash. It has sometimes been given with apparent advantage to check *sweating* in phthisis, urination in *diabetes*, and bleeding in *menorrhagia*. Its solution may be used as an injection in *diarrhœa*, *dysentery*, and *leucorrhœa*, as a dressing for flabby *ulcers*, and as a gargle in ulcerated *sore throat*. In powder it has been employed as a *hæmostatic*. But as a local application it is inferior to other astringents, and especially to tannin.

Kino may be prescribed in powder in the *dose* of from Gm. 0.60–1.30 (gr. x–xx). An infusion may be made with Gm. 8 (℥ii) of kino in Gm. 250 (f℥viij) of boiling water. When cool it should be strained and given in doses of 1 or 2 tablespoonfuls. Owing to the tendency of its gummy matter to coagulate, it is less eligible than catechu as an ingredient of chalk mixture.

KRAMERIA, *U. S.*—Rhatany.

Krameriæ radix, Br.; *Radix ratanhiæ*, P. G.; *Radix ratanhæ.—Rhatany-root*, E.; *Ratanhia*, Fr.; *Ratanhawurzel*, G.; *Ratania*, *Crameria*, Sp.

The root of Krameria triandra, *Ruiz et Pavon* (*Flor. Peruv.;* Bentley and Trimen, *Med. Plants*, 30, 31), and of Krameria Ixina, *Linné*.

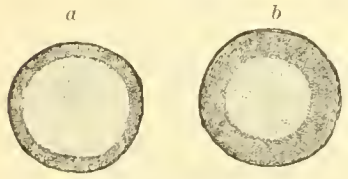
Nat. Ord.—Polygalaceæ, Kramericeæ.

Origin.—The *ratanhia* is a low shrub with spreading branches, a native of Bolivia and Peru, and grows in sandy localities in the mountains at an altitude of 900–2440 M. (3000 to 8000 feet); it has a striking appearance from the sessile leaves, which are densely covered with silvery hairs, and from the flowers, which have four scarlet sepals arranged in the form of a cross and four small dissimilar red petals. The root is chiefly exported from Payta, and is therefore distinguished in commerce as *Payta* or *Peruvian rhatany*.

The species Kr. Ixina, as recognized by most botanists, extends from North-eastern Brazil northward to Mexico, Venezuela, and the West Indian islands, and exists in several well-marked varieties; it has longer petiolate leaves and loose terminal racemes of red flowers with five dissimilar petals. The root is exported from the Columbian ports of Sabanilla, Cartagena, and Santa Marta, and is known in commerce as *Savanilla* or *New Granada rhatany*.

Description.—Payta rhatany-root has several knotty heads, and consists of a woody main root, which is 25–38 Mm. (1 or 1½ inches) thick and from 5–10 Cm. (2 to 4 inches) long, when it divides into several spreading and bent branches, 25–45 Cm. (10 to 18 inches) long and varying in thickness from 3–12 Mm. (⅛ to ½ inch). The latter constitute what is sometimes called *long rhatany*, while the less desirable heads and main root are called *short* or *stumpy rhatany*. The bark is smooth, or in the older roots scaly; of a peculiar rust-brown or blackish-brown color; from 2–3 Mm. ($\frac{1}{12}$ to ⅛ inch) thick; somewhat resinous in the outer, and rather fibrous and brownish-red in the inner layer. The wood is from six to ten times thicker than the bark, of a pale-brownish or reddish color, and is radially striate by numerous fine medullary rays, very tough, and nearly tasteless. The bark, like the wood, is inodorous, but has a strongly astringent taste, which accounts for the superiority of the *long* root. The tincture made with alcohol gives with an alcoholic solution of lead acetate, a brownish-red precipitate and a brown-red filtrate (Flückiger).

Fig. 169.



Rhatany-Root: *a*, Payta root; *b*, Savanilla root.

Savanilla rhatany-root resembles the Peruvian rhatany, but is always less knotty

and more slender; its bark has a distinct purplish hue, is smooth or longitudinally somewhat wrinkled, occasionally deep-fissured, and 3–4 Mm. ($\frac{1}{8}$ to $\frac{1}{6}$ inch) thick; the wood is only three or four times thicker than the bark, the tannin of which appears to differ somewhat from that of the first variety. The alcoholic tincture yields with alcoholic solution of lead acetate a purplish-gray precipitate and a colorless filtrate. Both roots tinge the saliva brown-red; the coloring matter is contained in the bark-parenchyma, in which also small subglobular starch-granules are found; the small bundles of bast-fibres are radially arranged, and accompanied by cells with fine crystals of calcium oxalate.

Payta rhatany alone is recognized by the German Pharmacopœia, while those of the United States, Great Britain, and France admit also the Savanilla variety.

Constituents.—The most important constituent is *ratanhia-tannic acid*, of which Wittstein (1854) obtained nearly 18 per cent. from the bark of Payta rhatany in the form of a red amorphous powder. It is precipitated dark-green by ferric salts and flesh-colored by gelatin, but not precipitated by tartar emetic; on dry distillation *pyrocatechin* distils over. Grabowski (1867) observed that by fusion with potassa the tannin is decomposed into *protocatechuic acid* and *phloroglucin*, and that the *ratanhia-red* of Wittstein, which is obtained by boiling with dilute sulphuric acid, has the same composition, $C_{26}H_{22}O_{11}$, as the similar product obtained by Rochleder (1866) from the tannin of the horse-chestnut, and by Rembold (1868) from that of tormentil. The tannins obtained from the three plants appear to have the composition $C_{26}H_{24}O_{11}$. The other constituents of rhatany-root are wax, gum, and uncrystallizable sugar.

Savanilla rhatany contains essentially the same constituents. Wittstein obtained from the bark of Payta rhatany, by means of ether, 17.8 per cent., and subsequently, by alcohol, 17 per cent., of extract, while Savanilla rhatany yielded respectively 3.2 and 34 per cent. The ethereal extracts contained the tannin described above, but the tannins of the alcoholic extracts appeared to differ in several reactions.

From an extract of rhatany formerly exported from South America, Wittstein isolated a crystalline body which he regarded as identical with *tyrosin*, but which Städeler and Ruge (1862) found to be $C_{10}H_{13}NO_3$; they named it *ratanhin*. Gintl (1869) proved it to be identical with the *angeline* of Peckolt, obtained from the *resina d'angelim pedra*, the exudation of Ferreira (Andira, *Saldanha*) spectabilis, *Allemao*, and suggested that some kino-like extracts from this and allied plants had been used as substitutes or adulterations of the extract of rhatany.

Other Rhatany Roots have occasionally appeared in commerce.

Para, Brazilian, or Ceara Rhatany was described by Berg (1865) and by J. G. S. Cotton (1868) in two varieties as *rhatanhia des Antilles*. It has a dark gray-brown or blackish bark, which adheres firmly to the flexible wood, and is longitudinally striate or transversely short-fissured, sometimes dotted with circular warts, and breaks with a glossy somewhat resinous fracture. The relative proportion of bark to wood is about the same as in the Savanilla variety, but the bark is not deep-fissured and is destitute of a purple tint. Its alcoholic tincture behaves nearly like that of the former root. Flückiger and Hanbury refer it to Krameria argentea, *Martius*, which is known in Brazil as *ratanhia da terra*. Several other species of Krameria besides the two named are indigenous to Brazil.

Krameria cistoidea, *Hooker*, a native of Chili, produces a root which, according to Schroff (1869), closely resembles Payta rhatany; the wood of the thick main root is pale-reddish in the outer layer and brown-red in the centre.

Texas rhatany has been described by Berg; it is derived from Kr. secundiflora, *De Candolle*, and consists of a roundish root-stock about 2 inches (5 Cm.) thick, from which a number of long roots emanate which have a blackish-brown, internally reddish, bark of the same thickness as the wood.

Action and Uses.—In small doses slightly tonic, in larger doses astringent, in still larger doses rhatany causes dyspeptic uneasiness and oppression, with constipation—effects probably due to its astringent qualities. It has been chiefly employed to restrain *hæmorrhages* of every variety, but is most efficient in those of the passive sort, and particularly in that form of uterine hæmorrhage in which the flow, without being profuse, is habitual. It is not without utility, as an internal medicine, in *uterine leucorrhœa*. It may be used with benefit in atonic and chronic *diarrhœa*, and in *incontinence of urine* from debility of the urinary organs.

Locally, it is applied by injection to the treatment of *dysentery*, vaginal *leucorrhœa*, and *gleet*, and has enjoyed considerable reputation as a remedy for *fissure of the anus*. Its mode of action is thought to consist partly in constringing the walls of the rectum, and thereby preventing the formation there of a large fecal mass, which tends to stretch the fissures and render defecation more painful. But it appears also to promote directly the

healing of the fissures by limiting the amount of blood that reaches them. The application of it consists merely in emptying the rectum with an emollient enema, and half an hour later throwing into the bowel a solution of Gm. 4–6 (gr. lx–xc) of extract of rhatany in 5 ounces of water. This enema is employed night and morning, and on both occasions it is retained for only a few moments, or else it is allowed to run out at once, and is again thrown into the bowel; and this process is renewed for several minutes at a time. The bowels are meanwhile prevented from becoming confined by the use of appropriate food or of gentle laxative, such as sulphur, cassia, etc., or, as has been especially recommended, the administration of powdered belladona-root in the dose of Gm. 0.06 (1 grain) or less, given at night. The administration of the enema, which is painful at first, gradually and indeed rapidly ceases to be so, and if steadily persevered in a cure is usually effected.

A watery solution of rhatany or its extract is of service in the treatment of *fissured nipples*. A mixture of the extract with white of egg may also be employed. The part should be cleansed when the child nurses, which ought to be as seldom as possible. In non-syphilitic *ozæna* an infusion of rhatany is sometimes serviceable, introduced into the nostrils with a sponge or injected with a nasal douche several times a day. The addition of chlorinated soda is advantageous, or chloride of lime may be added to the infusion in the proportion of Gm. 0.30–0.60 (gr. v–x) to Gm. 32 (f℥j) of liquid, which, after standing for a time, should be strained.

Powdered rhatany is seldom employed, but may be prescribed in *doses* of Gm. 0.50–2.0 (gr. viii–xxx); the extract, fluid extract, and tincture are officinal.

LABDANUM.—Labdanum.

Resina ladanum.—Labdanum, Ladanum, E., Fr., G., Sp.

A resinous exudation of Cistus creticus, *Linné*, C. cyprius, *Lamarck*, C. ladaniferus, *Linné*, and of other species of Cistus. Bentley and Trimen, *Med. Plants*, 24.

Nat. Ord.—Cistaceæ.

Collection.—The resinous exudation of these handsome shrubs, indigenous to Greece and the Levant, is collected during hot weather by means of the *labdanisterion*, consisting of a wooden handle with many narrow leather bands on one end, which are drawn over the branches, the resin being afterward scraped off, and often kneaded together with sand and other material. An inferior kind is obtained from the wool and hairs of sheep and goats which feed on the plants, either by combing or after shearing, by boiling with water.

Description.—Labdanum is met with in two forms—either as blackish or dark-brown masses, which soften and become glutinous in the hands, and are gray upon the fresh fracture, the color soon becoming darker, or as cylindrical rolls about the thickness of a finger and rolled spirally into flat pieces. Sometimes it is also in cylindrical sticks somewhat of the shape of liquorice. Good labdanum is insoluble in water, almost completely soluble in alcohol, fusible, burns when ignited with a bright flame, and has an agreeable balsamic odor and a bitter taste. The roll and stick labdanum are frequently adulterated or artificially made.

Constituents.—According to Guibourt, cake labdanum contains 86 per cent. of resin and volatile oil, 7 of wax, 1 of extractive matter, and 6 per cent. of insoluble impurities. Pelletier found in roll labdanum only 20 per cent. of resin and 72 per cent. of sand.

Action and Uses.—The singularly grateful odor of this resin led to its being made use of in the most ancient times for the fumigation of rooms and clothing, and as a medicine both internally and externally for the same purposes as other aromatic resins. It was prescribed internally and by fumigation for chronic *bronchitis*, and locally in *leucorrhœa* and other uterine affections; it was also prized as a *diuretic*. Later it became an ingredient of various stimulant plasters. Its use is now obsolete.

LABURNUM.—Laburnum.

Golden chain, Bean trefoil, E.; *Faux ébénier, Cytise*, Fr.; *Goldregen, Bohnenbaum*, G.

Cytisus Laburnum, *Linné*.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Description.—This is a tall shrub or low tree indigenous to Southern Europe, and planted in this country for ornament. It grows to the height of 4, 5 or 6 M. (15 or 20

feet), and has a smooth bark. The leaves are on slender petioles, trifoliate, with nearly sessile, oval-oblong, obtuse, and mucronate leaflets, which are about 5 Cm. (2 inches) long, smooth and dark-green above, soft hairy and grayish beneath; they have a somewhat saline, bitterish, and slightly acrid taste. The golden-yellow flowers are in long hanging racemes, and produce linear, obtuse legumes containing glossy, dark-brown, nearly reniform *seeds* of a disagreeable bitter and acrid taste.

Constituents.—Chevallier and Lassaigne obtained the bitter principle of the ripe seed in an amorphous condition and named it *cytisin*. T. Scott Gray (1862) obtained, in addition thereto, *laburnic acid* and two neutral bitter principles, *cystin* (*cytistin?*) and *laburnin*, which are present chiefly in the seed and bark. These principles appear to be the more or less impure alkaloid *citysine* of Husemann and Marmé (1865). This is white, crystallizable, inodorous, of a bitterish and somewhat caustic taste and strong alkaline reaction, easily soluble in water and alcohol, but nearly insoluble in ether, chloroform, benzene, and carbon disulphide; it melts at 154.5° C. (310° F.), and is sublimable in thin needles or scales. Warm nitric acid colors it orange-yellow; sulphuric acid and potassium dichromate, yellow, brown, and green. The salts are mostly deliquescent, and crystallize with difficulty. Its composition is $C_{20}H_{27}N_3O$. The leaves contain only traces of it; it is likewise found in the seeds of other species of Cytisus.

Action and Uses.—In medicinal doses laburnum induces a degree of languor and tendency to sleep, rather confines than relaxes the bowels, and very slightly, if at all, increases the urinary secretion. Larger doses are very apt to produce a somewhat soporific effect, and are sure to excite vomiting, and sometimes purging, as well as some quickness of the pulse and giddiness. The same effects are induced by cytisin, and each of its other alleged proximate principles appears to cause some drowsiness and contraction of the pupils. In cases of poisoning by the bark or berries, which have been very numerous in Europe, the effects observed are remarkably uniform. They comprise the following phenomena: Vomiting; pain in the stomach, which is sometimes excruciating; purging; dryness, heat, and constriction of the throat; faintness, languor, vertigo, drowsiness, or a narcotic sleep, with slow and stertorous breathing, followed by insomnia; the eyes are dull and sunken, the pupils dilated, and the eyelids dusky; the pulse is very weak or fluttering, varying between 90 and 100; thirst is usually marked, and in the worst cases muscular twitching of the neck and face is observed. No headache or other pain, except that in the stomach, is complained of, nor do general convulsions occur. In one or two instances the urine has been temporarily grass-green (*Med. Record*, xii. 696). In no case has death been observed.

Laburnum was recommended by Dr. Gray in *bilious dyspepsia*, with periodical attacks of bilious vomiting, diarrhœa, and constipation in the intervals, to be taken in such small doses as not to sicken the patient, thrice daily before meals and continued for six or eight weeks. He also regarded it as an efficient medicine for children who *vomit* after eating, as a palliative of *whooping cough*, of the *nausea* and sickness of pregnancy, of *asthma* connected with emphysema of the lungs, etc. These recommendations have not, as yet, been confirmed by experience. Their author proposed for use a decoction of laburnum concentrated until it attains a specific gravity of 1.034, to be given in *doses* of from 2 to 40 minims. The dose of the extract is stated to be Gm. 0.006–0.06 (gr. $\frac{1}{10}$–1); of laburnic acid, Gm. 0.06–0.35 (gr j–vj); of laburnin, Gm. 0.30–0.70 (gr. v–xij). Cytisine or its nitrate has been used in congestive *headache* (migraine) in doses of Gm. 0.003–0.005 (gr. $\frac{1}{20}$–$\frac{1}{12}$), hypodermically. Many cases of poisoning by LATHYRUS CICERA are on record. The prominent symptoms are lumbar pain, paresis or abnormal reflexes, spasm of the lower limbs, incontinence of urine, etc. (*Archives gén.*, 1883, ii. 230; *Med. Record*, xxxi. 130; *Therap. Gaz.*, xii. 557).

In cases of *poisoning* by laburnum the stomach should be evacuated by warm water and ammonia, and alcohol administered internally.

LAC, *Br.*—MILK.

Lac vaccinum.—Lait de vache, Fr. Cod.; *Milch*, G.; *Latte*, It.; *Leche*, Sp.

The fresh milk of the cow, Bos Taurus, *Linné*.

Class Mammalia; Order Ruminantia.

Description.—Cow's milk is an opaque white liquid having a faint alkaline or neutral reaction, a slight peculiar odor, and a bland and sweet taste; its specific gravity is about 1.030. Viewed under the microscope, it is seen to be a clear and transparent liquid in which a large number of minute globules are suspended. On standing, these rise to

the surface as a yellowish stratum, the *cream*, which constitutes about 5.0 per cent. of the milk, and consists mainly of fat mixed with some casein and retaining some serum. By churning the globules unite to form *butter*, and the liquid which separates, and is known as *buttermilk*, is essentially a solution of *milk-sugar* and the saline constituents of milk, and contains some casein and butter. The milk from which the cream has been separated is called *skim milk*. If left to itself, it becomes acid and separates the casein in a coagulated condition called *curds;* the same effect is produced by rennet and by acids. The liquid separated from the coagulum is called *whey*, and contains chiefly milk-sugar and some salts. The blue color sometimes observed in milk, according to Reiset (1883), is due to a blue fungus.

Milk possesses great emulsifying capacity, forming permanent emulsions on agitation with ether, chloroform, alcohol, benzin, carbon disulphide, etc., as was shown by Gust. Pile (1883); a mixture of equal volumes of milk and chloroform separates but slightly after several hours. Milk produces a blue color with tincture of guaiacum, unless it had been heated to about 80° C. (176° F.) or a mineral acid or caustic alkali had been added.

Constituents.—The chemical constituents of the milk of mammals are qualitatively alike, but quantitatively vary very much for different species, for different individuals, and even for the same individual, depending in the latter case upon the length of time since the last birth, upon the kind and quantity of food, and upon the exertion or rest of the individual. The following table is compiled from the averages given by Lehmann and others (*Physiol. Chemistry*):

	Milk of					
	Woman.	Cow.	Mare.	Goat.	Sheep.	Sow.
Albuminoids (protein compounds)	2.5	4.1	1.7	5.0	4.5	6.2
Fat (butter)	3.6	4.0	0.8	3.7	4.2	5.8
Milk-sugar	6.5	4.2	8.8	4.5	5.0	5.3
Salts (chiefly phosphates)	0.5	0.7	0.4	0.6	0.7	0.9
Total solids	13.1	13.0	11.7	13.8	14.4	18.2
Water	86.9	87.0	88.3	86.2	85.6	81.8

The albuminoids consist of *casein* and *lactoprotein*. Casein is not coagulated by heat, but on evaporating its aqueous solution it becomes insoluble and separates in the form of a thin skin; acetic and other acids coagulate it; so does rennet, and after this ceases to have any further effect, acetic acid will produce another coagulation. The protein compounds of the different milks, however, vary slightly in their behavior to some reagents. Schmidt-Muehlheim (1883) showed that fresh milk contains between .08 and .19 per cent. of *peptone*, and that this quantity is increased at the expense of the casein by digestion at 40° C. (104° F.). To obtain the peptone the protein is precipitated with table-salt and acetic acid, and afterward the peptone by phosphotungstic acid; this precipitate, dissolved in caustic soda, shows the reactions of peptone. (See Ovum.)

Butter, as obtained by the churning of cream, is a very complex mixture of fats with small quantities of an odorous principle, casein, milk-sugar, salts, and water; the fats are glycerides of butyric, capronic, caprinic, myristic, palmitic, stearic, and oleic acids, some of which are gradually decomposed, whereby the liquid fatty acids are liberated and the butter turns *rancid*.

As stated above, milk left to itself becomes acid; the change takes place in consequence of the fermentation of milk-sugar (see Saccharum Lactis) induced by the casein, whereby *lactic acid* is generated. The change is prevented, for some time at least, by the addition of certain compounds, for which purpose borax has been recommended; but boric acid, in the proportion of 1 to 1000 milk, as recommended by Hirschberg (1871), is preferable, as not altering the taste. Salicylic acid (1 to about 5000 milk) has also been found serviceable. If kept in vessels closed by Appert's method, it separates into several strata, but remains unchanged, provided it had been heated for some time to 120° C. (248° F.). Naegeli, and afterward C. Loew (1882), showed that milk preserved at a lower heat gradually becomes intensely bitter and brown, the albuminoids being peptonized and partly converted into leucin, tyrosin, and ammonia, and the milk-sugar into lactose and glucose. More recently, *concentrated* or *condensed milk* has been introduced, which is simply fresh milk mixed with a certain proportion of sugar and evaporated at a low temperature to the consistence of a thick syrup or soft extract, in which condition it will keep well.

Adulteration.—When milk is mixed with water its specific gravity is lowered; skim milk, on the other hand, has a higher density. To detect adulterations, the quantity of the solids is determined by evaporation to dryness; from this the amount of fat

is ascertained by treating with ether or petroleum benzin, and the residue is either incinerated to determine the amount of mineral constituents and estimate the albuminoids and sugar combined by the loss in weight, or the residue insoluble in ether is treated with alcohol and water, which leave casein and dissolve the sugar and salts. Since the milk residue is dried and afterward exhausted with difficulty, some chemists prefer to evaporate the milk mixed with a known quantity of dry sand, calcium sulphate, or upon filtering-paper.

Various instruments, called *lactometers*, have been constructed with the view of ascertaining rapidly the purity of milk by determining either the density, the degree of opacity, the percentage of cream, or the amount of butter.

Preparations of Milk.—Serum lactis dulce.—Whey, *E.;* Petit-lait, *Fr.;* Molken, *G.;* Siero di latte, *It.;* Suero, *Sp.*—Mix fresh cow's milk 200 parts with rennet wine 1 part; warm to 35° or 40° C. (95° or 104° F.), and after coagulation strain from the curd.

Serum lactis, *F. Cod.* (Serum lactis acidum, *P. A.*).—Acid whey, *E.;* Petit-lait acidule, *Fr.;* Saure Molken, *G.*—Heat skim milk (fresh milk, *P. A.*) 100 parts to boiling, add 0.1 part of citric acid dissolved in 1 part of water (or 1 part of vinegar, *P. A.*), and when completely coagulated strain; mix the strained liquid with white of egg, heat to boiling, and filter.

Serum lactis aluminatum.—Alum whey, *E.;* Petit-lait alumineux, *Fr.;* Alaunmolken, *G.*—Milk 100 parts, powdered alum 1 part; heat to boiling and strain.

Serum lactis tamarindinatum.—Tamarind whey, *E.;* Petit-lait tamariné, *Fr.;* Tamarinden-Molken, *G.*—Milk 100 parts, tamarinds 4 parts; heat and strain. The whey has a brownish color.

Serum lactis D. Weiss (Petit-lait de Weiss, *F. Cod.*).—Senna-pods 2 Gm., magnesium sulphate 2 Gm., St. Johnswort 1 Gm., Galium Mollugo 1 Gm., elder-flowers 1 Gm., boiling whey 500 Gm., digest for half an hour, strain, and filter.

Koumys or Kumiss is fermented mare's milk, which is extensively employed as a beverage and for medicinal purposes by the Kirgheez, Kalmucks, Turkomans, Nogays, and other nomad tribes of the Russian Empire. The process for preparing it differs somewhat with the different tribes, but in all cases consists in inducing fermentation by the addition of yeast to fresh mare's milk, and in stirring this occasionally; the product obtained in about 12 hours is known as *ssaumal* or *staumgal;* on being kept for several days it becomes much stronger, of a more decided acid taste, and very sparkling from the confined carbonic acid gas. For the preparation of *lac fermentatum* or *milk wine* from cow's milk the following directions are given by the *National Formulary*, based upon the formula recommended by Wilckens (1874): Dissolve sugar, 1 troy oz., in fresh cow's milk, 1 quart, contained in a strong bottle, add semi-liquid yeast, 60 minims, cork the bottle securely and keep it at a temperature between 23° and 32° C, (75° to 90° F.) for 6 hours; then transfer it to a cold place. The proportions used by Dr. L. Wolff (1880) are: Grape-sugar ½ ounce, water 4 ounces, compressed yeast 20 grains, cow's milk sufficient for a quart champagne-bottle; ferment for 3 or 4 days at 10° C. (50° F.) or less; this koumys will keep 4 or 5 days. According to Jagielski (1874), the fermentation, once started, will continue in corked bottles and at a low temperature, resulting in an increase of alcohol, carbonic acid, and lactic acid; cow's milk is preferable for the preparation of koumys, this being free from disagreeable odor and taste. For special purposes the milk is somewhat diluted before fermentation or the whey only used in making koumys.

Kephir or Kefir, the milk wine of certain Caucasian tribes, is prepared by them from sheep's and goat's milk with a ferment consisting of yeast and a species of bacteria, Diospora caucasica, *Kern* (1881), possibly a species of *Leptothrix:* the fermentation takes place in leather bags. The peculiarity of kephir, according to Biel (1885), depends mainly upon changes in the casein. According to Kugelmann (1886), a milk wine closely resembling kephir is obtained by fermenting in bottles a mixture of 1 volume of buttermilk with 1 or 2 volumes of sweet milk.

Medical History.—In the Hebrew Scriptures milk is constantly referred to for its precious qualities as food, and no more striking figure could be employed to represent the exuberant riches of a country than that it was a "land flowing with milk and honey;" that is to say, suitable for raising herds and grain. Milk is the most essential article of food for man before his teeth are matured for mastication, as well as in that second childhood when "the grinders cease because they are few," especially when it is associated with wine, which is "the milk of old age." Not less does it become the essential and most salutary food of man when at any period of his life he is enfeebled by disease. The qualities that adapt it to these several states or conditions of life are—the facility of eating it, for it requires no mastication; the rapidity of digesting it, since it needs but little change to convert it into assimilable material; and the small amount of waste which it involves and of digestive power which it requires, since the fecal residue of its digestion is less than is left by any other food.

The ancients used milk from the cow, the camel, the mare, the ass, the goat, and the sheep, and attributed to several of these products special virtues or defects; thus, sheep's milk was considered binding, ass's and goat's milk rather relaxing, and to cow's milk

intermediate qualities were ascribed. A full summary of the subject is furnished by Pliny, who represents human milk as the most nutritious, and goat's milk as next in strength, and he calls to memory the myth that Jupiter was suckled by a goat. The mildest milk, according to Pliny, is the camel's. He very correctly remarks that crude milk is more flatulent and less wholesome than boiled milk. He states that milk is used for all manner of internal inflammations, including those of the kidneys, bladder, bowels, throat, and lungs, and externally for itching and watery eruptions of the skin, and refers to its employment, as Celsus also did, in the cure of phthisis. He speaks of its value in other cachexiæ, and especially of the cure of chronic gout by ass's milk, and also of milk in general in the treatment of dysentery and of poisoning by colchicum, conium, etc. He refers particularly to ass's milk in marasmus and other wasting diseases, and to the use in affections of the spleen of milk from goats that had fed on ivy. He describes the mode of preparing whey, and its uses in epilepsy, melancholy, paralysis, and diseases of the skin. Milk was also applied topically in ophthalmia and in ulcerations of the mouth, throat, and uterus. According to Galen, cows were fed with certain medicinal plants in order to render their milk curative of particular diseases. Arabian physicians used a milk diet in consumption. About the beginning of the eighteenth century the milk treatment enjoyed a great vogue under the influence of F. Hoffmann. Since 1865, when Karell prescribed the systematic use of skim milk as the sole remedy for various chronic diseases, his method has been adopted by prominent physicians in several countries. The secretion with the milk of various drugs and medicines is a subject of much importance, but cannot occupy us here. (See Stumpf, *Deutsches Archiv für klinische Medicin*, Jan. 18, 1882; Dolan, *Practitioner*, xxvi. 85, 165, 251, 331, 477.)

Medical Action and Uses.—According to Randolph and Roussell, and also to Jessen, raw milk is more readily acted upon by rennet than boiled milk, while acids more promptly dissolve the latter. From their numerous observations it also followed that boiled milk is digested more slowly than raw milk (*Med. News*, xliv. 725; Vasilieff, *ib.*, lvi. 100). Reichmann, however, reached an opposite conclusion, finding that raw milk was detained in the stomach longer than boiled milk (*Zeitsch. f. k. Med.*, ix. 565); while Dujardin-Beaumetz contended that boiled and raw milk are equally digestible (*Bull. de Thérap.*, cxi. 15). We cannot doubt that warm is more acceptable to the stomach than cold milk, whether it require a longer or a shorter time to be digested. The latter is a scientific, the former a practical and clinical, question. A capital point has been insisted upon by Hoffmann (*Zeitschrift f. k. Med.*, vii. (Suppl.) 19, viz. that different specimens of pure milk possess very unequal nutritive powers; that they vary with the season of the year and the food, etc. of the cows; that the quantity of the milk which is ample for the child in arms or for the adult confined to bed is insufficient for the child that has learned to walk or for the adult that leads an active or laborious life; and that all rules are worthless that fix beforehand a certain quantity for individual patients. In connection with the use of mother's milk for food, it should be remembered that this secretion may convey certain substances from the mother to the child, among which may be mentioned various purgatives and nearly all narcotics, ferrocyanide and iodide of potassium, several preparations of mercury, salicylate of sodium, iodoform, etc. The special action of milk, considered as a therapeutical agent, is that, while it affords sufficient nutriment, it moderates the stimulating action of the blood and restricts the excrementitious waste derived from the food, thereby enabling the organs which are obstructed by blood, by secretions, or by more or less plastic exudations to purge themselves of these hindrances to a free and normal action. In a word, it gives rest, which is the primary condition of cure, and removes hindrances to a return of that functional activity which is an essential condition of health. The milk treatment is essentially a "hunger treatment," and is analogous to that natural and instinctive abstinence from food which is observed in all acute febrile diseases and in the greater number of chronic disorders, and which is the cry of Nature to be let alone—to be spared that officious assiduity which is as mischievous in dietetics as in medicinal therapeutics. This we conceive to be the simple explanation of the curative powers of milk. Dr. S. Weir Mitchell has stated that during the treatment by skim milk patients always lose weight at first, and that so long as its use is continued uric acid completely disappears from the urine, which becomes pale and whey-like, while the feces grow pale, hard, and odorless. According to Chibret, an exclusive milk diet increases by 60 per cent. the urea excreted (*Boston Jour.*, Nov., 1887, p. 486), while augmenting the secretion of urine. Its diuretic action is attributed by Sée to the sugar it contains (*Journal de Méd.*, Juin, 1889). Tortured as it may be by physiological experiment, milk reveals no special action upon this or that organ or anatomical element, but so modifies

the whole system as to restore its soundness without the aid of drugs, or else enables them to produce results which without its aid they would have been unable to accomplish. It is perhaps not always remembered that milk and alcohol in the form of "milk punch" contain at once the most perfect nutrient and the most efficient condiment that could possibly be used under the circumstances in which this preparation is usually employed.

Of all forms of food that can be used in *fevers* and *inflammations*, there is no doubt that milk is the best whenever the decline of the fever and the process of wasting have begun. Before this period watery preparations of starchy products, especially of barley and rice, are sufficient, but as soon as tissue-waste shows itself a portion of milk should be added to them, and gradually increased until it forms the principal part of the nourishment or is supplemented by the stimulant operation of beef-tea or the nutriment of meat-soup. A theoretical objection has been urged against milk as food in acute articular *rheumatism*, that it tends directly to increase the lactic acid which is assumed to be the morbid material of the disease. But the theory, however plausible, is not proven. The use of milk, either in the form of whey, skimmed milk, or milk diluted with water, is commended by most clinicians in this affection, Bartholow saying (*Times and Gazette*, Mar., 1880, p. 326), "Large draughts of milk are useful in maintaining the free action of the kidneys;" and Howard (Pepper's *System of Medicine*, ii. 69), that "the diet in the early actively febrile stage should consist of panada, ... milk and barley-water, or even pure milk." In less acute affections, and especially in those attended with suppuration or an excessive discharge of blood, serum, or mucus, nothing so well as milk maintains the strength without tending to excite fever. When inflammatory or ulcerative lesions exist in the stomach or bowels, the use of milk can hardly be dispensed with. With regard to the former, it may be remarked that a milk diet is almost a matter of necessity, and is the surest means of nourishing the patient while nature gradually restores the normal condition of the stomach. In *simple gastric ulcer* it is the one remedy which may be depended upon for a permanent cure; and in *cancer* of the stomach or bowels it is infinitely the best palliative, and the only one by means of which life may with any certainty be prolonged. But in these and similar cases the quantity of the milk employed must be carefully adjusted to the tolerance of the digestive organs, and, if necessary, its retention favored and its assimilation promoted by the addition of lime-water or by preceding the administration of each portion with a dose of bismuth; but along with these articles must be given, according to circumstances, the more nutritious articles already indicated. The same remarks apply to *diarrhœa* and *dysentery*, both in their acute and chronic forms, provided that in the acute disease whey or milk-and-water or buttermilk is employed rather than pure milk. The last is most efficient in the chronic affection, if it be administered with a due regard to its tolerance by the patient. In *cirrhosis of the liver* a diet largely composed of skimmed milk renders an important service both as a nutrient and a diuretic and depurant (Bartholow). Semmola says that as long as the hepatic lesion is limited to an embryonal neo-formation a good result may be hoped for from a rigorous milk diet (*Therap. Gaz.*, xiii. 644). In almost all of the gastric disorders in which vomiting depends upon irritability of the stomach lime-water and milk in equal proportions, and in *small doses*, form one of the most efficient remedies. M. Debove has proposed that in order to introduce into the stomach the largest necessary quantity of milk there should be added to the skim milk to be given a proportion of desiccated milk in pulverulent form, so that the percentage of nutritive matter in the mixture shall be much greater than in milk alone. When feeding by the stomach is no longer possible, milk may be given by enema with some, even if small, advantage, provided it has added to it sodium bicarbonate and pancreatic emulsion. In not a few cases *albuminuria* due to desquamative nephritis has been cured by the persistent use of an exclusive milk diet, and in others by an association with it of ferruginous-saline mineral waters or of officinal preparations of iron. Even in those less curable cases of interstitial nephritis associated with hepatic and cardiac lesions there can be no doubt that this method tends to remove the dropsy, and at the same time to quiet the morbid violence of the heart's action, while it greatly improves the nutrition of the system. (Compare Robinson, *Therap. Gaz.*, xiii. 101; Senator, *Therap. Monatsch.*, iv. 351.) Some years ago several physicians announced the cure of *diabetes* by a skim-milk diet, but others found that this mode of treatment aggravated the disease (*Bull. de Thérap.*, cxvi. 509). Nevertheless, prolonged experience has proved, however contrary it may be to scientific prevision, that this method sometimes causes a complete disappearance of sugar from the urine, and in a majority of cases reduces it greatly, moderating, of course and at the

same time, the thirst, dryness of the skin, etc. It seems probable also that skimmed is much more salutary than unskimmed milk. Through a somewhat similar mode of action a milk diet becomes a palliative or a cure of *gall-stones* and of *urinary calculi*. In regard to a milk diet in *chronic diseases of the lungs*, whether tuberculous or bronchitic, with their associated affections pleurisy and emphysema, it suffices to say that, as a rule, it is contraindicated, as affording too little nutriment when there is need of all that can be assimilated. In point of fact, a milk diet, as such, never cured, or even ameliorated, any one of them; but its use has been followed by favorable results, even in consumption, when it has been associated with other favorable hygienic influences, such as a pure, dry atmosphere, active and regular exercise, a complete change in the habits of living, abstention from the use of perturbative drugs, and a nutritious diet fitted to compensate for the defects of the milk regimen in this respect. In *diseases of the heart*, and especially in mitral obstruction, a milk diet goes far to palliate the effects of that mechanical obstruction of the circulation; that is to say, it relieves dyspnœa, lessens palpitation, pain, and dropsy, and increases the urine, and, in a word, lessens all the consequences of passive congestion, whether in brain, lungs, stomach, bowels, kidneys, etc. (Hoegerstedt, *Zeitsch. klin. Med.*, xvi. 16). In almost every cachectic condition milk is the most reliable article of food. Different kinds of milk, and especially ass's and goat's milk, have been reputed to be remedies for consumption and *scrofula;* and beyond a doubt a milk diet, with an appropriate regimen in other respects, is a very efficient means of invigorating the strumous constitution. Lime-water, which has always had a similar reputation, should be associated with the milk. A milk-and-vegetable diet has long been used in the treatment of *epilepsy*, and its operation is intelligible by analogy when we consider that every remedy that has been most useful in this disease, from the time of Aretæus, who declared, "from flesh in particular the patient is to be entirely restricted," down to the introduction of the bromides, has been a sedative of the nervous and circulatory systems. Milk is one of the most convenient and efficient antidotes for nearly all corrosive *poisons*, acids, alkalies, and metallic salts, because with some of them it forms compounds that are not readily soluble, and all of them it envelopes in its curd, and thus tends to prevent inflammation or absorption until proper emetics can be administered.

The close analogies of milk and chyle led to the use of the former by its injection into the veins, which was tried by Donné in 1842, and without causing any alarming symptoms. Later it was employed fruitlessly by Bovell and by Herepath in *cholera*, and about 1860 by Hodder of Toronto in a case of complete collapse, in which reaction and recovery followed. Subsequently, Dr. Howe, and then Dr. Thomas of New York, made use of the same method, the one in *phthisis*, the other in *traumatic hæmorrhage*, and in no case did any threatening symptoms arise when the milk employed was perfectly fresh. The latter physician pronounced it a safe and legitimate remedy, expressing his conviction that the intravenous injection of milk will answer nearly as good a purpose as that of blood, and predicting for it a brilliant and useful future. Subsequently, however, Dr. Howe performed a number of experiments upon dogs, depleting the animals, and then injecting into the veins or the arteries a less amount of milk than that of the blood abstracted. Thus he removed by depletion from 8 to 16 ounces of blood, and replaced it with from 6 to 10 ounces of milk. All of the animals died, but two dogs bled in the same manner, and not injected, recovered. Certain experiments of Brown-Séquard proved that much smaller quantities of milk, such as 95 Gm. (℥iij), might, under similar circumstances, be tolerated. Afterward, Wolfsberg found that animals would bear the injection of milk to the extent of three-fourths of 1 per cent. of the quantity of blood abstracted, but that more than this speedily destroyed them. He also was unable to preserve the life of dogs by this treatment; their weight declined, and they died of inanition without obvious disease. Meanwhile, attempts were made to preserve or prolong life by this treatment in patients affected with various diseases by Hunter and Pepper in America and Macdonnell and Meldon in Europe, with results which did not sustain the favorable anticipations referred to above, and which had led Dr. Thomas to state that intravenous injection of milk should be used not only in hæmorrhage, but also in Asiatic cholera, pernicious anæmia, typhoid fever, and puerperal convulsions. Dr. Howe, who was the first in this country to employ it, declares not only that his own experience gives him little faith in its utility, but that "it is a dangerous operation, and one that should only be resorted to when blood cannot be obtained." In several cases the patient was attacked with vertigo, dimness of vision, twitching of the eyeballs, and dyspnœa. In other cases it conferred no sensible or lasting advantage, but only postponed the fatal result. Dr. Pepper, who employed it in a case of progressive organic anæmia, effected no material relief, and was

of opinion that in cases of intense anæmia connected with serious but curable disease, although doubtless of much service, the severe symptoms following the operation and its more immediate dangers render it improper until all other remedies have failed. Jennings claimed that the intravenous injection of "a small quantity of newly-drawn milk is harmless" (*Brit. Med. Jour.*, June, 1885). It is difficult to conceive on what rational grounds such an operation should ever have been undertaken. Its proposers would seem to have considered that the elaborate mechanism provided by nature for the digestion of milk in infancy is useless or superfluous—that the casein which requires the action of the gastric juice, and the butter which needs the bile and pancreatic secretions, to fit them for absorption and nutrition, need not be subjected to any such preparation, but might at once be mixed with the blood and converted directly into tissue! That the water and salts, and possibly even the sugar, may, when so introduced, be capable of sustaining life for a short time, is rendered probable by the results of saline injections into the veins in epidemic cholera; but in regard to milk as a whole experience has confirmed the plainest deductions from physiological law, and proved the operation to be dangerous as well as irrational. These conclusions have been confirmed by the more recent experiments of Moutard-Martin and Richet, and of Demètre Culcer (*Bull. de Thérap.*, xcvii. 136; xcviii. 89), who found that death was caused by caseous emboli in the medulla oblongata; and by Béchamp and Baltus, who conclude that the operation cannot form a substitute for the transfusion of blood (*Archives gén.*, Aôut, 1879, p. 228). It should perhaps be added that Dr. Meldon of Dublin claims to have rescued a phthisical patient from death for at least 6 months by a single intravenous injection of 3½ ounces of milk. He performed the operation, only as a last resort, in ten cases, four of which were cured, and were all of them cases of "pernicious anæmia" (*Med. News and Abstract*, xxxviii. 265). Such a result was unparalleled when it was announced in 1880, and has not been matched since then. In 1885 this treatment was suggested and employed in a case of *opium and chloral poisoning*. The patient at first seemed to revive, but afterward died (*Med. Record*, xxvii. 679).

Milk may be used topically as an emollient and demulcent. It is a popular remedy for *ophthalmia* in infants, and especially in nursing infants, to instil the mother's milk in the eyes, and human as well as cow's milk is applied to various local cutaneous inflammations, such as *erythema*, *intertrigo*, *otorrhœa*, etc. A poultice made by stirring bread-crumb in hot milk is in common use to promote suppuration in *abscesses*. If its application is long continued, it is apt to render the skin sodden and wrinkled. It should be prevented from adhering by the addition of a little lard or glycerin.

Administration.—According to Karell, a chief apostle of the "milk cure," it is essential that the patient abstain from all other food but milk, and that he should take it at fixed hours and in determinate quantities. The milk, we are told, must be skimmed, but that degree of exaction is not required by others who employ the method. It should be warmed, not hot, in winter, cool, but not iced, in summer, and should be swallowed by small mouthfuls and slowly. If the stools are consistent, the quantity of milk may be gradually increased until from 4 to 6 pints a day are taken. Almost always a primary effect of the treatment is to produce constipation, which may be overcome by a little castor oil or rhubarb or by a roasted apple or stewed prunes. Sometimes much more energetic modes of treatment are called for. If, on the other hand, the milk food undergoes decomposition, producing flatulence or diarrhœa, a certain proportion of lime-water should be mixed with it, or the milk should not be taken unless it has been boiled. When its use is attended with a coated tongue and dyspeptic symptoms, the cause is generally a febrile condition, originating in the imperfectly-digested milk contained in the alimentary canal. If the patient is thirsty, he may drink pure water or carbonated water. Toward the third week of this process, if he grows weary of it, he may be allowed a little stale bread once a day, or grits or other analogous preparations may be added to the milk. To carry out this discipline requires the patient to be endowed with a degree of courage approaching heroism; but in certain cases it brings a due reward: the flesh and strength, which had before been declining under the combined influence of pain, indigestion, and scanty nourishment, begin to improve, and thus persons of resolution are encouraged to endure their martyrdom.

It may be stated here that *condensed milk* is in many cases a valuable substitute for fresh milk in all cases of sickness calling for the use of milk, and especially when good milk cannot be procured from the cow. This is notoriously the case at most of our seaside resorts, and it occurs also where the drinking-water is unduly mineralized.

Serum lactis, *Whey*. This preparation, which contains little else than sugar of milk

and a fractional percentage of salts, and is nutritious chiefly through its watery element, has been used from time immemorial as a drink in fevers. It is agreeable to the taste, or may be rendered so by lemon-juice or by tamarinds, as was the custom in Sydenham's day, and is also more or less diuretic and laxative. Taken copiously and hot, it was at that time the favorite diaphoretic at the commencement of febrile attacks due to cold. When whey is drunk to the extent of a pint or two every day and for several weeks together, it tends to derange the stomach, impair the appetite, and produce diarrhœa, and is therefore improper in all chronic diseases in which the digestive organs are already enfeebled. On the other hand, it may, as far as it goes, prove useful in chronic blood disorders like *gout*, *rheumatism*, and *gravel*, with congestion of the brain or of the portal circulation, owing to its depurative and somewhat diuretic qualities, which it owes to the salts which it contains. But in Germany, where alone the "whey cure" is systematically employed, it is pursued in localities in which pure air and exercise and the change of food, to say nothing of the mineral waters usually taken at the same time, doubtless have much more to do with the cure of disease than the systematic drinking of whey. *Wine-whey* is made by adding to a pint of milk, at a boiling heat, from 2 to 8 ounces of sherry wine, straining off the whey, and sweetening it. It is a mildly stimulant and nutritive drink, much used in the *typhoid state* of febrile diseases.

Buttermilk, or the thin sour milk separated from the cream by churning, contains casein, but very little butter. Even by many persons in health it is considered a most refreshing drink, and there is no form of *fever* in which it is not apt to be relished, probably on account of its acidulous taste. It is one of the very best remedies that can be employed in acute and even in chronic *dysentery*, promptly allaying the tenesmus and modifying the bloody and mucous stools of the acute form, and lessening the frequency of the evacuations in the chronic disease. Dr. Young of Chester, Pa., introduced this treatment in 1842, allowing his patients to drink even a gallon of buttermilk daily if they desired it. It was afterward used by Dr. Jackson (of Northumberland) and others with emphatic approval (*Philad. Med. Exam.*, v. 717). Its effects in *typhoid fever* are striking. It renders the discharges less numerous and moderates the tympanites. It should be given in doses of from 2 to 4 ounces every three or four hours, and always as fresh as possible. In many of those cases of *vomiting* for which milk in very small and repeated doses is a familiar remedy buttermilk is even more acceptable to the stomach; and it is one of the best forms in which milk can be given in either form of *kidney disease*.

Koumys is a drink imitated from the Tartars, and which may be considered a peculiar form of milk punch, since it contains the saline and protein constituents along with the sugar, fat, and lactic acid of the milk, together with carbonic acid and alcohol, the latter constituents varying with the time employed in the fermentation. It is therefore a nourishing and stimulating drink, sometimes even an intoxicating one, since the longer it is kept the more alcohol it contains. One analysis states that at the end of 16 days it yields upward of 20 parts of alcohol in 1000. The effects of drinking 2 or 3 glasses of koumys are identical with those of alcohol—a general diffusive glow, a quickening of the pulse, a pleasurable excitement of mind and body. Like alcohol, indulged in overmuch it impairs the appetite for food, tends to constipate the bowels, renders one dull and sleepy, and augments the urinary solids. Moderately used, it promotes digestion and nutrition, or at least increases the weight by augmenting the fat, precisely like milk punch. Like that familiar drink, it is of more or less use in various wasting diseases, including *consumption* and *nervous exhaustion*, chronic *dyspeptic* disorders, chronic *diarrhœa*, *anæmia*, *chlorosis*, *malarial cachexiæ*, etc. In the second edition of the Dispensatory we made use of the following words: "It is not to be wondered at that in Germany a counterfeit koumys is prepared with milk, lemon, and rum. There is good reason to fear that the general fondness for sparkling wines and other effervescing drinks may tend to render fashionable a draught which, under the disguise of a medicine, partakes more or less of their inebriating qualities, and may become the prime cause of a baleful habit of intoxication. There is much danger also lest its votaries overlook the essential conditions of its utility—active exercise in the open air and the various hygienic measures upon which the utility of alcohol and other hydrocarbons in all chronic wasting diseases essentially depends." More recently, as we learn from Stange (*Von Ziemssen's Handbuch der Allgemeinen Therapie*, 1883, i. 403), "favorable results from the koumys treatment can be expected only in the steppes of Russia, where not only is the preparation properly made, but a dry, hot climate exists, which is essential to the success of the method. The proper koumys can only be prepared from the milk of a special race of mares fed on the peculiar grasses of the steppes alone and subjected to no labor." And

Dr. Carrick of St. Petersburg stated to the Medico-Chirurgical Society of Edinburgh that "the best effect of the koumys cure was to be got not only by taking the remedy itself, but by going to the Russian steppes to partake of it there" (*Edinb. Med. Jour.*, xxvii. 167).

Kephir, a drink made by the action of a peculiar ferment (a species of mushroom) upon cow's milk by the mountaineers of the Caucasus, was brought into notice in 1881. It was said to be nutritious as well as remedial in *anæmia*, *scrofula*, *phthisis*, and in *pulmonary* and *gastro-intestinal catarrh*—*i. e.* in *dyspeptic* disorders due either to general debility, or to various diseases of the alimentary canal, or to either of the enumerated affections. In a word, its uses are identical with those of koumys. It contains less alcohol than that preparation, and is therefore less stimulating. By some it is represented as less agreeable, and is indeed apt to excite aversion. Others state it to be more palatable than the similar beverage. It renders the urine more watery, and improves the digestion, assimilation and strength, while palliating or removing the special disease for which it is given. It is recommended to be taken in the morning, fasting, beginning with two glasses and gradually increasing to ten or twelve.

LACCA.—Lac.

Resina lacca.—Laque, Gomme lacque, Fr.; *Lack, Gummilack*, G.; *Goma laca*, Sp.

A resinous exudation produced by the puncture of Coccus Lacca, *Kerr.*

Origin.—The hemipterous insects thus named congregate in large numbers upon the tender branchlets of various East Indian (mostly laticiferous) trees, and become surrounded with the resinous exudation, which gradually hardens. The impregnated, much-enlarged female insects, imbedded in the resin, in which the young larvæ are developed, contain a red coloring matter. These finally eat a passage through the incrustating material and escape. The branches are collected with the incrustation, which is considered more valuable if still containing the red coloring matter. Among the trees yielding lac are the following: Aleurites laccifera, *Willdenow* (Croton, *Linné*) (Nat. Ord. Euphorbiaceæ); Ficus indica, *Roxburgh*, F. bengalensis, *Linné*, F. religiosa, *Linné*, F. Tsjela, *Hamilton* (Nat. Ord. Urticaceæ); Schleichera trijuga, *Willdenow* (Nat. Ord. Sapindaceæ); Butea frondosa, *Roxburgh*, s. Erythrina monosperma, *Lamarck* (Nat. Ord. Leguminosæ). According to Stillman (1880), lac may also be collected from Acacia Greggii, *Gray*, and from the *creasote-bush* or *stinkweed*, Larrea mexicana, *Moricand*, s. L. glutinosa, *Engelmann*, which plants grow from Western Texas to Mexico and Southern California.

Description.—The thin branches, almost completely covered with numerous small resin-nodules, constitute the *stick-lac*. The separate nodules or tears are red-brown, and contain in the interior a dark blackish-red powder; after the escape of the young insects the resin if brown. The same resin, after having been detached from the twigs, constitutes the *seed-lac* or *grain-lac*. It is in irregular fragments of the size of a pea and smaller, yellowish-brown or reddish, somewhat shiny, and nearly tasteless. After boiling the stick-lac or seed-lac with water, fusing the resin, and congealing it upon a smooth surface, *shellac* is obtained; it comes in thin, glossy, and more or less transparent fragments. Sometimes *grape-lac* and *lump-lac* have been distinguished, the former of which consists of agglutinated incrustations separated from the twigs; the latter is identical with shellac, except that it has not been congealed in thin layers. When chewed, sticklac softens and colors the saliva purplish-red, a slight bitterish and astringent taste being perceived; when burned, it gives off a strong and agreeable odor. The water in which red stick-lac has been boiled on being treated with alum yields *lac-dye*.

Shellac is soluble in potassa, soda, borax, and hydrochloric and acetic acids, and when digested with ammonia in close vessels swells to a gelatinous mass. By treating the alkaline solution with chlorine or sulphurous acid bleached shellac is obtained.

Constituents.—Lac is a complex body, containing, according to Unverdorben, five distinct resins, besides wax, fat, and coloring and extractive matter. The resins which may be separated by their different behavior to alcohol, ether, and alkalies are present in seed-lac, according to Hatchett and John, to the amount of 66 or 68 per cent., but shellac contains fully 90 per cent. of resin. The wax has been found to vary in amount between about 2 and 6 per cent.

Uses.—Shellac is used in the preparation of *varnish* and of *sealing-wax*, the latter by fusing from 5 to 8 parts of it with 1 part of turpentine and coloring the mixture with a suitable pigment. *Varnish* suitable for blackboards is made by digesting and intimately

mixing shellac, mastic, sandarac, white turpentine, emery-flour, and lampblack, of each 1 ounce, and alcohol 2 pints. A solution, made without heat, of 1 part of powdered bleached shellac in 2 or 3 parts of a saturated solution of borax is recommended by Geissler (1880) as an excellent *starch-gloss*, also as a *varnish* for maps and prints. An *ink* useful for laboratory purposes is obtained by mixing lampblack with a solution of 100 grains of shellac and 20 grains of borax in 4 ounces of water.

Action and Uses.—Having in a slight degree some of the qualities of the resins, lac has been used in combination with astringents as an application to indolent *ulcers*, especially of a scrofulous and scorbutic sort. It is rarely employed in medicine.

ERYTHRINA CORALLODENDRON is reported to be sedative, anodyne, and soporific. In Brazil its flowers are used in pulmonary affections; the leaves are diuretic and laxative, and externally emollient; the bark is expectorant and narcotic. It is employed in coughs, asthma, neuralgia, etc., and its alkaloid is stated by Rey to be useful in mental disorders (*Centralblatt f. Therapie*, iii. 431). *Erythrina Mulungu* is used in Brazil as an anodyne and sedative. In large doses it produces sleep without causing excitement. It is also employed in cases of hypertrophy (? of the heart), and in baths for rheumatism (*Am. Jour. Phar.*, Dec. 1884, p. 626.)

LACMUS.—LITMUS.

Lacca cærulea, Lacca musica.—Tournesol, Laque bleu, Fr,; *Lackmus*, G.

A blue pigment obtained from Lecanora tartarea, *Acharius*, Roccella tinctoria, *Ach.*, R. fusiformis, *Ach.*, and from other lichens.

Preparation.—The lichens are powdered, mixed with some potash and urine or other ammoniacal liquid, and exposed to the air. The liquid acquires gradually a red, purple, and finally blue color, and is mixed with sufficient chalk to be formed into small rectangular cakes. It is manufactured in Holland.

Description.—Litmus is in earthy, friable cakes of a deep-blue or purplish-blue color and a slight saline and somewhat pungent taste. It effervesces with acids, and is partly soluble in water with a blue, and in dilute alcohol with a purplish-blue color, which is changed to red by acids. The aqueous solution kept in a closed vessel becomes mouldy and colorless, but on exposure to the air turns blue.

Constituents.—Besides the earthy matter, Kane (1841) separated from litmus four coloring matters—namely, *erythrolein*, a purplish-red fatty matter, soluble in ether, fusible at 38° C. (100° F.), and yielding with ammonia a purple-colored solution; *erythrolitmin*, red, crystalline, insoluble in ether, soluble in alcohol, and changed to blue by alkalies; *azolitmin*, brown-red, amorphous, insoluble in alcohol, turned blue by ammonia; and *spaniolitmin*, present in minute quantity only, light-red, soluble in water.

Pharmaceutical Uses.—Litmus is employed as a reagent for acids and alkalies. Litmus-paper is made by making a strong aqueous solution of the coloring matter (*tincture of litmus*), and dipping white unsized paper into it. To make *red litmus-paper*, dilute hydrochloric acid is carefully added to the blue solution until the color has just changed to red, carefully avoiding excess of the acid. When litmus is used for testing by gaslight the change of color is best observed through a green glass. By treating litmus with alcohol, afterward with water, purifying the aqueous extract with alcohol acidulated with acetic acid, and removing every trace of the acid by dissolving in water and evaporating repeatedly with alcohol, nearly pure brown-red azolitmin is obtained, from which test-paper extremely sensitive to both acids and alkalies may be prepared.

Allied Pigments.—Archil or orchil, *E.*, Orseille, *Fr.*, *G.*, is made from the same lichens which yield litmus. The lichens are heated for a week with diluted ammonia, when sulphuric acid and table-salt are added. Archil is a pasty mass of a deep-purple color.

Cudbear, *E.*, Orseille de terre, *Fr.*, Persio, *G.*, is made in precisely the same manner, except that, instead of adding acid and salt, the mixture is dried and powdered.

The lichens which are used for the production of the above pigments contain a number of chromogenes, which are ternary compounds, and in the presence of water and ammonia are converted into various nitrogenated red pigments. The most important of these chromogenes, as far as they have been investigated, are—*erythric acid*, $C_{20}H_{22}O_{20}$, *alphaorsellic acid*, $C_{32}H_{28}O_{14}$, *betaorsellic acid*, $C_{34}H_{32}O_{15}$, and *evernic acid*, $C_{34}H_{32}O_{14}$. On being boiled for a long time with water or baryta they yield *lecanoric acid*, $C_{16}H_{14}O_7$, afterward *orsellic acid*, $C_8H_8O_4$, and finally *orcin*, $C_7H_8O_2$, which crystallizes in large colorless needles, has a sweet taste, turns red in contact with air, and yields with ammonia *orcein*, $C_7H_7NO_3$; this is brown, and dissolves in alkalies with a beautiful red color. Orcin is also obtained from aloes by fusing it with caustic potassa.

Uses.—The only use of litmus in medicine is to determine the acidity or alkalinity

of the animal fluids. Litmus-paper is a necessary adjunct of all apparatus for examining the urine.

LACTUCA, *Br.*—Lettuce.

Herba lactucæ, s.; *lactucæ virosæ.—Laitue vireuse*, Fr. Cod.; *Giftlattich*, G.; *Lechuga*, Sp.

The flowering herb of Lactuca virosa, *Linné*. Bentley and Trimen, *Med. Plants*, 160, 161.

Nat. Ord.—Compositæ, Ligulifloræ.

Description.—This biennial herb, which grows to the height of .9–1.8 M. (3 to 6 feet), has a cylindrical, somewhat prickly, pale-green, and often purplish-spotted stem. The large radical leaves are petiolate, obovate-oblong, obtuse, irregularly spinously toothed, wavy or nearly entire at the margin, pale-green beneath, and prickly on the midrib. The stem-leaves are smaller, alternate, horizontal, sessile, with a sagittate amplexicaul base and an acute spinous apex, otherwise resembling the radical leaves, the floral ones reduced to small pointed bracts. The flower-heads form a loose terminal panicle and are on short axillary peduncles; the involucre is oblong or conical, and composed of imbricated lanceolate bracts in about three rows; the florets are neutral, pale-yellow, ligulate; the akenes are oval, flattened, black, and prolonged into a long whitish beak, bearing at its apex a pappus consisting of numerous soft white capillary bristles. The plant has a disagreeable rather narcotic odor and a bitter and saline taste.

It is indigenous to Western and Southern Europe, is less frequent in Central Europe, and has been naturalized in some parts of New England. It is closely allied to L. Scariola, *Linné*, which is indigenous to Europe, but is found more frequently in the central part, and is distinguished from the preceding mainly by its spinescent, deeply-cut, toothed or pinnatifid vertical leaves, but possesses the same disagreeable odor and taste, though in a rather milder degree.

Constituents.—The older analyses by Pfaff, Dublanc, and others have demonstrated the presence of principles common in herbs; among the inorganic constituents potassium nitrate was found by Pfaff and Bley. More recently, the investigations have been confined to lactucarium, which is partly obtained from this plant.

Action and Uses.—The ancients ascribed to strong-scented lettuce soporific and anaphrodisiac properties, and its juice was even used by them for adulterating opium. It was held to be peculiarly adapted to allay wakefulness produced by over-stimulation of the mind. Whatever may have been the virtues of lettuce in ancient Greece, they are certainly very faintly represented by the plant which grows in this country and in Western Europe. They are contained in their most concentrated and available form in lactucarium.

LACTUCARIUM, *U. S., Fr. Cod.*—Lactucarium.

Lactucarium, Fr., G.; *Giftlattichsaft*, G.; *Lactucario*, Sp.

The concrete milk-juice of Lactuca virosa, *Linné*, obtained by incision and spontaneous evaporation.

Origin and Collection.—Lactuca virosa and L. Scariola, *Linné*, have been described above. L. sativa, *Linné*, is the common garden lettuce. L. altissima, *Bieberstein*, a tall Caucasian herb, is cultivated in Auvergne in France for lactucarium; Planchon regards it as a variety of L. Scariola, *Linné*. We prepared (1867) very efficient lactucarium from several varieties of L. canadensis, *Linné*, of this country, but found the milky juice, which yielded from 22 to 32 per cent. of air-dry residue, to congeal rapidly and to dry into irregular tears. Commerce is supplied with lactucarium almost exclusively from Germany and Great Britain from plants cultivated for the purpose; a small quantity is also produced in Austria. Thomas Fairgrieve, who described the preparation in 1873, states that he cultivates L. virosa, var. montana. The collection of the milky juice is commenced about the middle of July or beginning of August, when the flowers are just appearing, and is continued for 6 or 8 weeks (until the latter part of September). The collectors proceed over the field, cutting the head of each stalk and scraping the juice into their vessels, one person who cuts being followed by two who collect the juice. This process is repeated six or seven times a day, a new cut being made each time a little lower down the stalk. In the evening, when the juice has thickened into a viscous mass, it is turned out of the vessels, suitably divided, and dried by the aid of heat, about 5 days being required for it.

In Germany, near the town of Zell on the Mosel, the collection lasts from May to September; the milky juice is taken up by the finger and transferred to hemispherical earthen cups, in which it quickly hardens, so that it can be turned out. It is then dried in the sunshine until it can be cut into four pieces, when the drying is completed by exposure to the air for some weeks on frames (*Pharmacographia*).

The lactucarium prepared in France by Aubergier is rarely if ever met with in this country. Fairgrieve obtained 1 pound of lactucarium from 4 pounds of juice, and estimates the average yield of each plant to be between 40 and 50 grains. By frequently puncturing the stems, Schütz (1823) obtained from L. sativa, scariola, and virosa, respectively, 17, 25, and 56 grains of lactucarium. The extract of lettuce-leaves was medicinally employed by Dr. H. J. Collin of Vienna (1780), but lactucarium was first introduced into medicine by Dr. J. R. Coxe of Philadelphia (1799).

Description.—German lactucarium generally comes in sections of plano-convex circular cakes which are of a gray-brown color externally, usually white or yellowish, and of a waxy lustre internally. English or Scotch lactucarium is met with in irregular-sized angular pieces of a brown color and earthy appearance. Both kinds have a strongly bitter taste and a strong narcotic odor, suggesting that of opium; they are powdered with difficulty, and on trituration with water are not emulsionized, except after the addition of gum-arabic. When lactucarium is prescribed in mixtures, A. Vogeler (1881) recommends triturating it with a little spirit of nitrous ether before adding the water, when it is readily divided in the liquid.

What is usually sold here as French lactucarium is EXTRACTUM LACTUCÆ (see p. 683).

Tests.—Lactucarium on being treated with boiling water should become soft without melting, and yield a bitter filtrate, which while hot should be clear, and on cooling become turbid; this liquid should not be colored blue by iodine (absence of starch), but should become clear on the addition of ammonia or of alcohol; the ammoniacal liquid should yield a copious precipitate with solution of calcium sulphate (presence of oxalic acid), and the alcoholic solution should not be affected by ferric chloride (absence of tannin, etc.)—*P. G.*

Constituents.—Lactucarium has been analyzed by Walz (1840), Aubergier (1842), Wackenroder (1844), Lenoir (1847), Ludwig (1847), Kromayer (1861), and O. Schmidt (1875, 1879). Nearly one-half the weight of lactucarium is soluble in alcohol, but dilute alcohol dissolves only between 36 and 44 per cent. 50 to 60 per cent. of lactucarium consists of *lactucerin* or *lactucon*, $C_{16}H_{26}O$, which was obtained crystallized by Lenoir (1847) by exhausting lactucarium with boiling alcohol and recrystallizing the product; it forms thin colorless needles, which are inodorous and tasteless, insoluble in water, soluble in alcohol, and more freely so in ether, chloroform, benzin, and fixed and volatile oils; it appears to vary somewhat in different lactucariums. The bitter taste of lactucarium is due to three principles, two of which are usually amorphous and freely soluble in water, while the crystallizable *lactucin*, $C_{11}H_{12}O_3.H_2O$, requires over 60 parts of cold water for solution, but dissolves more readily in hot water and in alcohol. Kromayer (1861) obtained only 0.3 per cent., which does not perhaps represent the whole amount present, but the much larger yields (18 to 28 per cent.) previously observed by Buchner and Ludwig must be due to impurities. Lactucin forms pearly scales or rhombic plates when crystallized from very dilute alcohol, has a neutral reaction, turns red and brown with alkalies, and is deprived of bitter taste; it is not a glucoside, but reduces from alkaline cupric solutions cuprous oxide. *Lactucic acid* and *lactucopicrin* have been found in the mother-liquor of lactucin; the former is light-yellow, amorphous, crystallizes on long standing, is colored red by alkalies, reduces alkaline copper solutions, is precipitated by lead subacetate, and is insoluble in carbon disulphide, petroleum benzin, ether, and chloroform. Lactucopicrin is brown, amorphous, insoluble in ether, soluble in alcohol, not precipitated by lead subacetate, and appears to be produced by oxidation of lactucin.

The other constituents of lactucarium which have been observed by different investigators are—a trace of volatile oil, asparagin, mannit, sugar, albumen, gum, caoutchouc, resin, oxalic, citric, and malic acids, and between 8 and 10 per cent. of ash. Flückiger obtained from German lactucarium, by means of carbon disulphide, an amorphous mass which is fusible below 100° C. and separates from alcohol as a syrupy liquid.

Hiland Flowers (1879) noticed that the milk-juice of L. canadensis does not possess a bitter taste until the plant is in bloom, when the lactucarium collected from it has the same constituents as European lactucarium.

Action and Uses.—The utility of retaining lactucarium as an officinal medicine is very doubtful. It may possibly be desirable as a hypnotic for very impressionable

persons, with whom faith in a remedy supplies its want of intrinsic efficiency. If it have any virtues of the sort ascribed to it, they would peculiarly adapt it to cases of infantile disease. The *dose* of lactucarium is indefinite. Gm. 0.10 (gr. ij) may be given to an infant.

LAMELLÆ, *Br.*—Discs, Gelatin-discs.

Laminæ gelatinosæ.—Disques de gélatine, Fr.; *Gelatinplatten*, G.

The preparation of gelatin-discs or *medicated gelatin* has been briefly described on page 725. They are usually made about 1 Mm. ($\frac{1}{25}$ inch) thick, and a small quantity of glycerin is added to the mixture to prevent the discs from becoming hard and brittle on keeping. The British Pharmacopœia has admitted three kinds of medicated gelatin-discs, but does not give formulas for their preparation. In each case the discs are to be of gelatin, with some glycerin, and each is to weigh about 1.3 Mgm. ($\frac{1}{50}$ grain).

Lamellæ atropinæ, *Br.* Discs of atropine, *E.;* Disques d'atropine, *Fr.;* Atropin-plättchen, *G.*—Each disc is to contain 0.00013 Gm. = 0.13 Mgm. ($\frac{1}{500}$ grain) of atropine sulphate.

Lamellæ cocainæ, *Br.* Discs of cocaine, *E.;* Disques de cocaïne, *Fr.;* Cocain-plättchen, *G.*—Each disc is to contain 0.00032 Gm. = 0.32 Mgm. ($\frac{1}{200}$ grain) of cocaine hydrochlorate.

Lamellæ physostigminæ, *Br.* Discs of physostigmine, *E.;* Disques d'ésérine, *Fr.;* Physostigmin-plättchen, *G.* Each disc is to contain 0.000064 Gm. = 0.064 Mgm. ($\frac{1}{1000}$ grain) of physostigmine.

LAMINARIA.—Laminaria.

Laminaire digitée, Fr.; *Laminaria, Riementang*, G.

Laminaria Cloustoni, *Edmonston*, s. L. digitata, *Lamouroux.*

Nat. Ord.—Algæ, Fucoideæ.

Origin.—The Linnæan name, *Fucus digitatus*, has, according to Ferd. Cohn (1864), been applied to two different algæ of the North Atlantic Ocean. Laminaria flexicaulis, *Le Jolis* (s. L. stenophylla, *Harvey*), has a glossy, dark-brown, flexible stem, which on drying becomes thin like a fibre. Laminaria Cloustoni, however, has an erect, rigid, light-brown stem, 0.9 to 1.8 M. (3–6 feet) long, at the base 5 Cm. (2 inches) thick, divided below into spreading root-like branches, and at the apex prolonged into a flat and digitately divided, leathery, and olive-green frond. The plant grows upon rocks at a depth of 10 to 15 fathoms in the Atlantic and Pacific oceans and northward in the Arctic Sea. The lower cylindrical portion only is employed.

Description.—Laminaria is met with in commerce in irregular cylindrical pieces, which are 12 Mm. ($\frac{1}{2}$ inch) or less thick, deeply wrinkled, of a brown or gray-brown color externally, lighter and darker brown internally, of a horn-like texture, and breaking with a smooth and horny fracture. Immersed in water, it becomes softer and swells to from four to six times its usual diameter. Two layers are readily distinguished, the central one being whitish and composed of large cells, while the outer one is formed of smaller cells, has a brownish color, and contains a zone of axially somewhat elongated large mucilage-cells. For medical use it is turned into cylindrical or conical pieces.

Constituents.—Laminaria contains the usual constituents of marine Algæ. (See Chondrus.) Stenhouse isolated from it mannit.

Allied Plants.—Laminaria saccharina, *Lamouroux*, has a flattish stem and linear or oblong entire fronds. After having been washed with water it acquires a sweet taste, and, like Lam. esculenta, *Lamouroux*, is eaten. The ash of all these species may be used for obtaining iodine.

For some years past the soft root of one or two species of *tupelo*, *Nyssa* (Nat. Ord. Cornaceæ), has been used in Europe for tents. The species adapted for this purpose are Nyssa grandidentata, *Michaux filius*, and N. capitata, *Walter* (N. candicans, *Michaux*); both grow in the Southern United States not far from the sea-coast. The first species is known as *cotton-gum, large tupelo*, and, in Louisiana, *olivier à larges feuilles:* the second species is called *tupelo-gum, sour-gum*, and *Ogeechee lime.* The wood is light, white, of a spongy texture, and when dry swells to about double its usual thickness from the absorption of water.

Action and Uses.—The porosity of its stalks and the quality they possess, when dried, of absorbing water, and thereby increasing in bulk even as much as fourfold, have rendered laminaria a very convenient substitute for compressed sponge. The following summary of the qualities of sea-weed tents, applied particularly to the uterus, was made by Dr. J. Braxton Hicks: 1, they may be made of any size, but much

smaller than sponge tents; 2, they have more distending power; 3, they do not retain the secretions so as to produce much offensiveness; 4, by their greater rigidity they can be more readily applied, especially in a tortuous canal. On the other hand, their rigidity makes them less suitable in cases where the uterus readily bleeds or is very tender, and in cases where the os is somewhat dilated by a polypus or growth distending it. These tents have sometimes perforated the uterine walls. For *dilatation of the os uteri* in its natural state, and for the induction of premature labor, these tents are less suitable than sponge tents or the India-rubber bag. In cleanliness, certainty of action, ease of introduction, and small size they are not equalled by those made of any other material. By fastening several together the physician is enabled to effect any degree of dilatation he may desire. They are, however, no less likely than other uterine tents to produce metritis. According to Landau, the *tupelo* tents recommended by Tiemann are superior to any other for the same reasons above assigned in favor of laminaria tents (*Times and Gaz.*, Mar. 1881, p. 327). Bougies of laminaria have been employed to dilate *strictures* of the *urethra*. For this purpose they were covered with several coats of varnish or with glycerin before introduction, and allowed to remain in place for several hours. Similar instruments have been made use of for dilating the Eustachian tube.

LAPPA, *U. S.*—Burdock.

Radix bardanæ, P. A.—*Bardane, Glouteron*, Fr.; *Klettenwurzel*, G.; *Bardana*, It., Sp.

The root of Arctium Lappa, *Linné;* Lappa officinalis, *Allioni*, s. L. vulgaris, *Neilreich. Nat. Ord.*—Compositæ, Cynaroideæ.

Origin.—Several forms of these plants are often regarded as distinct, and described as Arctium, *Schkuhr*, s. Lappa major, *Gærtner*, L. tomentosa, *Lamarck*, and L. minor, *De Candolle*. They are found in waste places and along roadsides in Northern Asia and throughout Europe, and have been naturalized in North America, where the variety tomentosum is rather scarce. They are coarse-looking biennial weeds, with branching stems 1 to 1.8 M. (3–6 feet) high, and cordate-oblong, nearly entire or toothed, rough, petiolate leaves. The globose involucre has the numerous scales appressed at the base and contracted to a recurved sharp point above. The numerous tubular florets are purplish, or, rarely, whitish; the akenes are flattened and have a pappus of numerous short bristles. The variety major has rather large heads with a smoothish involucre; var. tomentosum has the involucre and peduncles woolly; var. minor has the heads much smaller, the involucre at first cottony, finally smooth, and the leaves usually unequally rounded or tapering at base. They bloom from July to September.

Fig. 170

Burdock-root: transverse section.

The root should be collected in the autumn of the first year's growth or early in the succeeding spring; 6 or 7 parts of the fresh yield 1 part of air-dry root.

Description.—The root is nearly simple, 25 to 50 Cm. (10–20 inches) long, about 25 Mm. (1 inch) thick, fusiform, gradually tapering, fleshy, and when dry longitudinally wrinkled, rounded at the top, and often with a tuft of white, soft-hairy leaf-stalks. It has a grayish-brown color externally, pale-brownish internally, the cross-section displaying a thickish bark, which in the inner layer is radially striate and by a dark cambium-line separated from the meditullium; this is about four times thicker, has finely porous ligneous rays, and the medullary rays of about the same width. The latter, as well as the parenchyma of the bark, are frequently partly destroyed, leaving merely the white dead tissue, which is spongy and full of holes. Burdock has a rather disagreeable but weak odor, and a mucilaginous afterward sweetish and bitterish taste.

Constituents.—Burdock-root is free from starch, but contains in its stead *inulin*. (See Inula.) Mucilage, sugar, albuminoids, and little resin, tannin, fat, and wax, have been observed in it. Weckler (*Am. Jour. Phar.*, 1887, p. 393) found also 3.7 per cent. of ash and indications of a glucoside.

Allied Drugs.—Fructus lappæ, s. Semen bardanæ. Burdock-fruit is about 6 Mm. (¼ inch) long, obovate-oblong, somewhat curved, angular, and flattened, roughish wrinkled, brown-gray mottled with black, mostly deprived of the setaceous pappus, the short base of the style projecting from the centre of the apical scar; inodorous; taste oily and bitter. The fruit contains,

according to Trimble and Macfarland (*Am. Jour. Phar.*, 1885, p. 127; 1888, p. 79), 15.4 per cent. of drying oil, 5.5 of resins, and a small quantity of the crystalline glucoside *lappin*, which is very bitter, and soluble in water, alcohol, and chloroform. *Tinctura lappæ fructus* has been proposed to be made from 4 troyounces of the ground fruit by percolating with a mixture of alcohol 3 parts and water 1 part until a pint of percolate is obtained.

Fructus silybi, s. Semen cardui mariæ.—Mary thistle, *E.*; Chardon Marie, *Fr.*; Stechkörner, Frauendistel, *G.*—from Silybum marianum, *Gærtner*, s. Carduus marianus, *Linné*, a syngenesious biennial of Southern Europe. The akenes are 4 or 5 Mm. ($\frac{1}{6}$ or $\frac{1}{5}$ inch) long, not curved, obovate, flattened, smooth, glossy, light-brown with black or blackish striæ, oblique at the apex, and crowned by a yellowish margin, from the centre of which the base of the style projects; inodorous; taste mucilaginous, oily, and somewhat bitter.

Xanthium strumarium, *Linné*, tribe Helianthoideæ.—Cocklebur, *E.*; Lampourde, Petit glouteron, *Fr.*; Spitzklette, Knopfklette, *G.*—This coarse-looking weed is common in waste places throughout North America, Europe, and Northern Asia. The leaves are alternate, long-petiolate, triangular heart-shaped, and rough-hairy. The sterile flowers are in short terminal spikes. The fertile flowers are numerous, in axillary clusters, and produce flat, oblong akenes, without pappus and enclosed in the enlarged involucre, which is oval or oblong in shape, nearly 25 Mm. (1 inch) long, and densely beset with hooked prickles. The indigenous species and variety, X. canadense, *Miller*, and variety echinatum, *Gray*, have also the two stout beaks hooked. Zander (1881) obtained from 100 parts of the fruit 5.2 ash, 38.6 fat, 36.6 albuminoids, 1.3 xanthostrumarin and organic acids, besides sugar, resin, etc. *Xanthostrumarin* seems to be a glucoside, is yellow, amorphous, soluble in water, alcohol, ether, benzol, and chloroform, and yields precipitates with group reagents for alkaloids and with ferric chloride, lead acetate, and salts of other metals, but not with tannin or gelatin. M. V. Cheatham (1884) obtained only 14.5 per cent. of fixed oil, and a principle which was precipitated by tannin.

Xanthium spinosum, *Linné*, Spiny clotbur. It is indigenous to Southern Europe, but has become somewhat naturalized in waste places of the United States and most civilized countries. It has shortly petiolate, lanceolate, or ovate-lanceolate leaves, which are either cut-toothed or the upper ones entire, and have at the base sharp, three-forked, yellowish, stipulate spines, nearly 25 Mm. (1 inch) long. The fertile axillary burs are crowned with one inconspicuous beak. The alkaloid, the presence of which was announced by Guichard (1877), is regarded by Yvon as a little resin, soluble both in alcohol and ether.

Pharmaceutical Preparation.—Extractum bardanæ; Extrait de bardane, *Fr. Cod.*; Extract of burdock, *E.*, is prepared by exhausting the root with cold distilled water.

Action and Uses.—Burdock has had the reputation in Europe and in this country of being a depurative through its diaphoretic and diuretic virtues, and by a gradual and insensible modification of nutrition. It has been in vogue for the cure of *rheumatism*, *gout*, chronic *cutaneous diseases*, and chronic *pulmonary catarrhs*; it has been reputed to be diuretic (especially its seeds), and to promote the discharge of *urinary deposits*; to be alterative also, and beneficial in constitutional *syphilis* and *scrofula*. These virtues, if they are real, would indicate that the medicine operates by promoting all the secretions, much as sarsaparilla is supposed to do. But, like that medicine, burdock is seldom given unless associated with more active agents. Externally, the expressed juice of the leaves, the fresh leaves bruised, and liniments made by boiling the leaves or the roots with oil have been much used as popular remedies for *burns*, *wounds*, *ulcers*, and *eruptions*. Although an agent of secondary value, it is not quite just, as has been done, to call it "one of the illusions of the materia medica." Burdock is generally given in a decoction prepared by boiling Gm. 64 (℥ij) of the recent bruised root in Gm. 500 (Oij) to a reduction of one-third. At least Gm. 500 (1 pint) of this decoction should be taken daily. Possibly the concentrated syrup or fluid extract, equally diluted, would answer quite as well. According to Dr. Squibb, a tincture made with 1 pound of the ground seed to a gallon of whiskey, and allowed to stand for two weeks before decanting, may be taken in *doses* of two or three teaspoonfuls immediately after meals. He cites a case in which a similar preparation cured an inveterate *psoriasis* (*Ephemeris*, Sept., 1882, p. 115). The fluid extract is reported to have cured this disease, and also *epilepsy* (*Therap. Gaz.*, viii. 108, 552). *Mary thistle* was formerly used as an expectorant and tonic, but has become obsolete in medicine.

Xanthium spinosum. In some parts of Germany the powder or infusion of this plant has a popular reputation for the cure of *intermittent fever*. In Russia it is held to be a prophylactic against *hydrophobia*. Its efficacy is attested by Dr. Grzymala of Podolia, who states that when several animals or men had been bitten by a rabid dog, those only escaped who were treated with this medicine, and that such results are usual, not exceptional. These statements, made in 1876, have not been confirmed. The physiological effects of the plant are said to resemble those of jaborandi, in being sudorific, sialagogue, and slightly diuretic. The dose of the dried powder of the leaves, repeated three times a day and continued for three weeks, is about Gm. 0.66 (gr. x).

LARICIS CORTEX, *Br.*—Larch-Bark.

Écorce de mélèze, Fr.; *Lärchenrinde*, G.; *Corteza de alerce*, Sp.

The bark, deprived of its outer rough portion, of Larix europæa, *De Candolle* (Abies Larix, *Lamarck*, Pinus Larix, *Linné*). Bentley and Trimen, *Med. Plants*, 260.

Nat. Ord.—Coniferæ, Abietineæ.

Origin.—The European larch is a forest tree of Southern and Central Europe, where it grows chiefly in mountainous localities up to an altitude of about 1500 M. (5000 feet). It is often cultivated in Europe, and has been introduced into North America as an ornamental tree. It attains a height of 24 to 30 M. (80–100 feet), has the narrow linear deciduous leaves in fascicles of twenty to forty, and oblong ovoid erect cones which are about 25 Mm. (1 inch) long. The bark is collected in spring from the trunk and the branches. The tree yields Venice turpentine and Briançon manna.

Description.—After the removal of the reddish-brown, fissured, corky layer, the bark forms flattish or quilled pieces, having the outer surface dark red or rosy, and the inner surface smooth, yellowish white or pinkish red, according to age. It breaks with a short somewhat fibrous fracture, having a deep carmine-red color except internally, and displaying rather indistinct medullary rays and some resin-ducts. Larch-bark has a slightly balsamic and terebinthinate odor and an astringent taste.

Constituents.—Stenhouse (1861) found larch-bark to contain a peculiar *tannin*, which yields olive-green precipitates with salts of iron, turns red on being boiled with dilute sulphuric acid, but does not yield any *sugar*, which, however, is contained in the decoction of the bark, together with a considerable quantity of *mucilage* and *resinous matter*. By evaporating the warm infusion of the bark to a syrupy consistence and then distilling it, *larixinic acid*, $C_{10}H_{10}O_5$, crystallizes partly in the neck of the retort, the remainder being obtained by carefully concentrating the distillate and purifying the product by sublimation. The bark of the branches and of trees not over thirty years old yields the largest proportion. It forms long colorless crystals resembling those of benzoic acid, sublimes at 93° C. (199.4° F.), fuses at 150° C. (302° F.), and has a bitterish and astringent taste and a camphoraceous odor. Its combinations with alkalies are red-brown and decomposed by carbonic acid; baryta solution causes a bulky precipitate; ferric salts produce a purple color, and on boiling it with silver salts the metal is separated; nitric acid oxidizes it to oxalic acid. It is sparingly soluble in ether and freely soluble in alcohol and hot water. It is allied to pyrogallol and pyrocatechin.

Allied Products.—The bark of the American larch, Larix americana, *Michaux*, which is more slender and has shorter leaves and smaller cones, deserves to be investigated.

Hemloek-bark is the inner layer of the bark of Tsuga (Abies, *Michaux*) canadensis, *Carrière*; it resembles larch-bark, but the surfaces are orange-brown or brownish-red, the inner one having a yellowish and paler tint; the short-fibrous fracture is mottled whitish and brownish; the taste strongly astringent.

Action and Uses.—Its action does not differ from that of other terebinthinate and balsamic remedies, but its flavor is less disagreeable. With the inner bark a saturated tincture has been prepared, and highly recommended in *chronic bronchitis* and in chronic inflammation of the *urinary* mucous membrane. It has also been used in *passive hæmorrhages* and in *purpura hæmorrhagica*. The *dose* of the tincture is from Gm. 1.30 to 2 (℥ xx–xxx).

LAUROCERASI FOLIA, *Br.*—Cherry-Laurel Leaves.

Laurier-cerise, Fr. Cod.; *Kirschlorbeerblätter*, G.; *Lauroceraso*, F. I.; *Laurel cerezo*, Sp.

The fresh leaves of Prunus Laurocerasus, *Linné* (Cerasus Laurocerasus, *Loiseleur*). Steph. and Church, *Med. Bot.*, plate 117; Bentley and Trimen, *Med. Plants*, 98.

Nat. Ord.—Rosaceæ, Pruneæ.

Origin.—The cherry-laurel is a small evergreen tree, or is frequently a shrub 3 to 6 M. (9–20 feet) high, with a smooth brownish bark and pale-green branches, and produces pendulous racemes of dark-purple, shining, cherry-like drupes. It is a native of Western Asia from Northern Persia to Asia Minor, but it has been naturalized in Southern Europe, and is cultivated in the open air as an ornamental shrub northward to Southern Germany and England.

Description.—The leaves are leathery, glossy, and dark-green above, pale-green beneath, oblong in outline, narrowed above to an obtuse point and below to a short petiole. They are about 15 Cm. (6 inches) long and 5 Cm. (2 inches) wide, somewhat revolute

on the margin, with distant and small but sharp serratures. The midrib is quite prominent on the lower surface, and has near its base one or two pairs of depressed glands. The unbroken fresh leaves are inodorous, but when broken they have a strong bitter-almond odor; their taste is aromatic, bitter, and somewhat astringent.

Constituents.—Cherry-laurel leaves contain some sugar, tannin, wax, fat, and, according to Stange (1823), an acid allied to, if not identical with, malic acid. The same author recognized also the production of *benzoic acid* from the volatile oil in the presence of oxygen. Liebig and Wöhler did not succeed in isolating amygdalin. F. L. Winckler (1839) obtained the bitter principle as a soft, transparent, wine-yellow mass, which, when treated with dilute sulphuric acid and manganese dioxide, yielded a distillate of a very agreeable odor which did not contain hydrocyanic acid. When treated with emulsion of sweet almonds the taste became gradually less bitter, and the odor of bitter almonds was developed. The leaves seem to contain a compound from which amygdalin must be first produced before the volatile oil can be obtained, which has the same composition as oil of bitter almonds. Broeker (1867) observed that the watery distillate is strongest in hydrocyanic acid if the leaves were collected in the summer. Schoonbroodt (1869) obtained from the aqueous extract, on treatment with ether, some bitter crystals which reduced cupric oxide.

Action and Uses.—Cherry-laurel leaves are official in the British Pharmacopœia, chiefly as the source from which cherry-laurel water is obtained. Their medicinal virtues depend upon the hydrocyanic acid which they furnish, and are treated of under AQUA LAUROCERASI and ACIDUM HYDROCYANICUM. The bruised fresh leaves are used as anodyne applications to *painful parts*.

LAURUS.—LAUREL.

Bay, Sweet bay, E.; *Laurier commun*, Fr. Cod.; *Lorbeer*, G.; *Alloro*, It.; *Laurel*, Sp.

European pharmacopœias recognize the leaves, fruit, and expressed oil of Laurus nobilis, *Linné*. Bentley and Trimen, *Med. Plants*, 221.

Nat. Ord.—Laurineæ, Litseaceæ.

Origin.—The bay tree is indigenous to the Levant, grows wild in the countries bordering the Mediterranean, and is cultivated in Mexico. It is a small tree or large shrub with umbellate clusters of yellowish flowers.

Description.—1. FOLIA LAURI. They are 7 to 10 Cm. (3–4 inches) long, 25 Mm. (1 inch) or more broad, shortly petiolate, coriaceous, smooth, pellucid-punctate, oblong or oblong-lanceolate, rather acute at both ends, entire, glossy above and veined beneath. The veins form, with the midrib, an acute angle, send off numerous lateral branches forming a network of small meshes, and disappear near the margin of the leaf without prominently anastomosing. The dry leaves are of a yellowish- or brownish-green color. They have a pleasant aromatic odor and an aromatic and bitterish taste.

2. FRUCTUS (BACCÆ) LAURI, *P. A.*, *P. G.* The so-called *bay-berries* are oval or subglobular drupes about 13 Mm. (½ inch) long. When dry, they are greenish-black or blackish-brown, slightly wrinkled, and fragile, the integuments, including the reddish-brown endocarp, being thin and brittle. The large oval seed is easily separated into the two plano-convex brownish cotyledons, which have an aromatic oily and bitter taste.

3. OLEUM LAURI (S. LAURINUM, S. LAURI EXPRESSUM, S. LAURI UNGUINOSUM), *P. A.*, *P. G.*; Oleum e fructu lauri, *Fr. Cod.*; Olio di lauro, *F. It.* It is obtained in Southern Europe by expressing the bruised fruit between warm plates after steeping it in hot water. It has the consistence of lard, a granular appearance, a green color, and an aromatic odor and taste. It melts near 40° C. (104° F.) to a clear dark-green liquid, is soluble in 1½ parts of ether, partly soluble in alcohol, and does not yield its coloring matter to water. When agitated with warm alcohol the alcoholic solution should not become red on the addition of ammonia (absence of turmeric). Fictitious oils, if colored with curcuma and indigo, leave these behind when dissolved in ether.

Constituents.—The leaves and fruit contain volatile oil, of the spec. grav. 0.91 to 0.924. Bley (1834) obtained from old berries .22 per cent. Gladstone (1863) found eugenol, while Blas (1865) could not detect this, but proved the presence of a little lauric acid. Wallach (1883) showed both oils to yield *pinene* and *cineol* below 180° C., while the higher-boiling fraction of the leaf oil has the odor of anethol. The seeds contain, according to Bonastre (1824), about 20 per cent. of fat, 2 per cent. of volatile oil, and 1.5 per cent. of resin. The expressed fat was analyzed by A. Staub (1879), who determined, besides volatile oil and chlorophyll, the presence of a little acetic acid and the

glycerides of oleic, linoleic, lauric, myristic, palmitic, and stearic acids. *Lauric acid*, $C_{12}H_{24}O_2$, discovered by Marsson (1842), has been found in many vegetable and a few animal fats; it melts at 43.5° C. (110.3° F.), and volatilizes with the vapors of boiling water (Goergey, 1848). Schmidt and Roemer found little free acid in the freshly-expressed oil, but the fruit contained 2 to 3 per cent. of fatty acids.

Allied Plants.—Lindera (Laurus, *Linné*) Benzoin, *Blume* (Benzoin odoriferum, *Nees*); *Spicebush*, *wild allspice*, *feverbush*, E.; *Laurier-benzoin*, Fr.; *Benzoelorbeer*, G. This shrub grows in damp woods from Canada southward to Florida and westward to Kansas, and produces in March and April lateral clusters of four or five yellow inconspicuous flowers. The *bark* forms thin quills, is yellowish or pale-brown and smooth upon the inner surface, blackish-brown and minutely dotted with corky warts upon the outer surface, breaks with a short granular fracture, has an agreeable though not very strong odor, and an aromatic somewhat pungent and astringent taste. Older bark has a brown-gray or dark-ash color and more prominent corky warts. The *fruit* is an obovate red drupe about 8 Mm. (⅓ inch) long, after drying blackish and granular upon the surface, and contains a single large white seed having an oily taste, while the fragile integuments of the fruit have a spicy taste, and when bruised an agreeable odor.

The bark yields 0.43 per cent. of volatile oil of spec. grav. 0.923 (Schimmel & Co., 1890). T. Morris Jones (1873) observed that oxidizing agents, acting upon the oil, develop a bitter-almond odor; a little tannin, starch, sugar, fat, and tasteless resin are also present in the bark. The berries contain nearly 50 per cent. of fat, and yield about 5 per cent. of very fragrant volatile oil, spec. grav. 0.855 (Gleim, 1875; A. W. Miller, 1878; Schimmel & Co.). The volatile oil of the leaves has an agreeable lavender odor.

Lindera sericea, *Blume*, L. triloba, *Bl.*, and several other species of Japan possess tonic and stimulating properties; and the former yields a fragrant volatile oil which has been introduced under the Japanese name of *kuromoji* oil.

Persea gratissima, *Gærtner* (Laurus Persea, *Linné*); Avocado, *E., G.*; Avocatier, *Fr.*; Aguacata, *Sp.*—A small tree indigenous to South America, and cultivated in the tropics. The leaves are about 12 Cm. (5 inches) long, elliptic or obovate, entire, obtuse, nearly glabrous, coriaceous and dark-green above. The fruit, known as *alligator pear*, is of the size and shape of a pear, dark purplish or brownish, internally green, butyraceous, has an agreeable taste, and is eaten like butter with other aliments; hence the name *beurre végétal* or *vegetable butter*. The globose seed is of the size of a walnut, and contains a milk juice which becomes red on contact with air, and is used like indelible ink. According to Betancourt (Thesis, Mexico), the principal constituents of the fruit pulp are fixed oils, malates, sugar, gum, etc.; and the seed contains starch, mannit, sugar, fat, etc., also amygdalin and a ferment yielding hydrocyanic acid.

Action and Uses.—Bay leaves and berries were anciently held in high esteem as stimulant, stomachic, and astringent, and in substance or decoction were much used for the stings of insects, eruptions of the scalp, and vaginal relaxation with leucorrhœa; a decoction of the root-bark was given internally in diseases of the urinary organs and in dropsy, and was regarded as a powerful emmenagogue. More efficient medicines have supplanted it, and it is now seldom prescribed except in the form of its volatile and fixed oils for relieving *local rheumatic* and other *pains*. In Europe the fresh leaves continue to be employed for flavoring pastry and rendering it more digestible.

Benzoin odoriferum depends for its stimulant and diaphoretic virtues upon its volatile oil, which has been used in the forming stage of acute *pulmonary inflammations* and *rheumatism*, and in chronic forms of the latter affection. It has also been employed as a *vermifuge*. The bark has been used in *intermittent fever*. During the Revolutionary War the berries are said to have been employed as a substitute for allspice, and in the late Civil War a similar use was made of them in the Southern States. The oil has served as an ingredient of embrocations for *rheumatism*, *contusions*, and other local painful affections, and internally to relieve *flatulent colic*. It has also been applied in *scabies*. The bark and the berries are usually administered in decoction; the oil may be prescribed in alcoholic solution or suspended in water by magnesia.

Alligator pear, in the form of a fluid extract of the seeds, has had anthelmintic virtues ascribed to it, but upon insufficient grounds. It has also been employed, as a fluid extract, both internally and topically, for *neuralgia* and muscular *rheumatism*.

LAVANDULA.—Lavender.

Flores lavandulæ, P. G.; *Flores lavendulæ.—Lavender-flowers*, E.; *Lavande officinale*, Fr. Cod.; *Lavendelblüthen*, G.; *Alhucema*, *Espliego*, Sp.

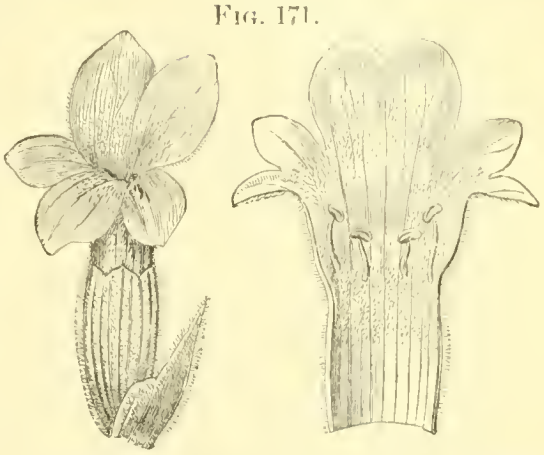
The flowers of Lavandula vera, *De Candolle* (L. Spica, var. *α*, *Linné*; L. angustifolia, *Ehrhart*; L. officinalis, *Chaix*). Bentley and Trimen, *Med. Plants*, 199.

Nat. Ord.—Labiatæ, Ocymoideæ.

Origin.—Lavender is a native of Southern Europe from Italy to Spain, and of North-

western Africa, growing upon sunny hillsides and mountains. It is extensively cultivated as an ornamental garden-plant, and in Europe also for the purpose of distilling the volatile oil. (For an account of the cultivation of lavender at Hitchin, England, see *Proc. Amer. Phar. Assoc.*, 1876, pp. 819–821.) The plant is shrubby, about 2 feet (60 Cm.) high, has a brown-gray bark, which is much cleft when old, opposite, sessile, entire, and linear leaves, with revolute margins and long-stalked terminal spikes, with the lower whorls of flowers remote from the others. The flowers are collected in June and July before fully expanded, and require to be carefully dried.

Fig. 171.



Lavender-flower, with bract and corolla cut open; magnified 1 diameters.

Description.—The flowers grow in the axil of rhombic-obovate, pointed, brownish, and glandular bracts of nearly the length of the calyx. The latter is about ⅛ inch (4 Mm.) long, tubular, thirteen-nerved, contracted and naked at the mouth, with the upper tooth roundish-rhomboid and the remaining four teeth obsolete, densely covered with short hairs and minute glands, and of a blue-gray color. The corolla exceeds the calyx, and is violet-blue, tubular, enlarged above, hairy and glandular on the outside, and two-lipped, the upper lip being erect and two-lobed, and the smaller lower lip spreading and three-lobed. The four stamens are quite short and inserted in the middle of the hairy corolla-tube. Lavender-flowers have an agreeable aroma, which becomes more apparent on bruising and rubbing them, and a bitterish aromatic somewhat camphoraceous taste.

Constituents.—Besides some tannin, resin, and other widely-diffused principles, lavender-flowers contain volatile oil, when fresh yielding about 1 per cent. (See Oleum Lavandulæ.)

Allied Plants.—Lavandula spica, *Chaix*, s. L. latifolia, *Ehrhart.*—Spike lavender, *E.*; Spic, Lavande commune, *Fr. Cod.*; Spiklavendel, *G.*—The plant has spatulate leaves, rather short and dense spikes, and lance-linear bracts. The calyx is finely velvety-hairy, not blue, and about the same length as the calyx-tube. The plant is cultivated in Southern France and Northern Africa, and volatile oil is distilled from it.

Lavandula stœchas, *Linné.*—Arabian or French lavender, *E.*; Stœchas, *Fr.*; Schopflavendel, *G.*; Cantuesa, *Sp.*—This small shrub grows near the Mediterranean, where the flowering spikes are used. These are short-stalked, and have the small dark-purple flowers in the axil of conspicuous rhombic or obovate, sometimes three-lobed, purple-colored bracts; the odor is strongly aromatic, camphoraceous.

Ocymum Basilicum, *Linné.*—Sweet basil, *E.*; Basilic, *Fr. Cod.*; Basilienkraut, *G.*; Albahaca, *Sp.*—This annual herb is indigenous to tropical Asia and Africa, and is frequently cultivated in gardens. The stem is branching and more or less pilose; the long petiolate leaves are oblong-ovate, somewhat toothed, smooth, and beneath glandular-punctate; the flowers are in somewhat interrupted spikes, the calyx short and ciliate, and the corolla white or reddish, with a short tube, a broad four-lobed upper lip, and a descending spatulate lower lip. The herb has a strong and agreeable aromatic odor and a balsamic and cooling taste; it contains volatile oil and a little tannin.

Action and Uses.—Lavender is a stimulant aromatic, remarkable for its refreshing perfume. It is seldom used internally, unless in the form of oil or spirit, and then associated with other medicines. The infusion (Gm. 4 to 60 = 3j to Oj) is said, when too freely taken, to occasion colic. Fomentations made with lavender enclosed in bags allay *local pains*, like other plants of the Labiate family.

Ocymum basilicum (basil or sweet basil) is a well-known potherb used for seasoning certain kinds of food, and has the same general qualities as thyme, sage, etc. It has long been a popular remedy for mild nervous or hysterical disorders, and in Buenos Ayres its fresh juice is said to be used as an *anthelmintic*, and to possess the advantage of not tending to produce unpleasant symptoms. Its essential oil was formerly in vogue as a carminative and nervine (*Med. Record*, xvi. 325).

LEONURUS.—Motherwort.

Agripaume, Cardiaire, Fr.; *Herzgespann, Wolfstrapp*, G.

Leonurus Cardiaca, *Linné.*

Nat. Ord.—Labiatæ, Stachydeæ.

Description.—Motherwort is a perennial herb growing in waste places and near dwellings throughout Europe, Northern Asia, and North America. It is .9 or 1.2 M. (3 or 4 feet) high, and has a quadrangular rather rough stem. The lower leaves are roundish, often heart-shaped at the base, and palmately five- to seven-lobed; the upper ones are oblong, acutely three-lobed, and have a wedge-shaped base. The pale-purplish flowers have awl-shaped or spiny-toothed calyx-teeth, and are in dense axillary cymules. The plant has a rather unpleasant aromatic odor and a bitter taste.

Constituents.—It evidently contains volatile oil; the bitter principle has not been isolated.

Allied Plants.—Of the numerous plants belonging to the tribe Stachydeæ, the following seem to deserve a brief notice (see also Marrubium and Scutellaria):

Stachys palustris, *Linné.*—Hedge nettle, *E.;* Ortie rouge, *Fr.;* Stinknessel, Sumpfziest, *G.*—Grows in wet places in Europe and North America, is stiff-hairy, and has nearly sessile, ovate lanceolate, somewhat heart-shaped leaves. Other species of Stachys have been used; all have subulate calyx teeth and purplish corollas with a large middle lobe of the lower lip, and have a rather unpleasant odor. They are known as hedge-nettle, *E.*, épiaire, *Fr.*, Ziest, *G.*, and yerba de la feridura, *Sp.*

Betonica officinalis, *Linné.*—Wood-betony, *E.;* Bétoine, *Fr. Cod.*—Is a native of Southern Europe and grows sparingly in Massachusetts. It is rough-hairy, has cordate-oblong leaves, the cauline ones few, and purplish or whitish soft-hairy flowers in whorls of six to ten.

Galeopsis tetrahit, *Linné.*—Hemp nettle, *E.;* Chanvre batard, Galeopside, *Fr.;* Hanfnessel, Hohlzahn, *G.*—Introduced from Europe into North America. The stem is densely bristly, hairy below the joints; the leaves are ovate, usually acute, rather rounded at the base, coarsely serrate. The flowers are in dense axillary clusters, have long spiny-toothed calyx-teeth, and a white or yellowish corolla, with a purple spot on the lower lip.

The allied species, Gal. ochroleuca, *Lamarck*, and G. grandiflora, *Roth*, at one time attracted attention in Europe as the principal ingredients of a nostrum sold as *Blankenheim tea* or *Lieber's consumption herbs;* the former species is the Herba galeopsidis of European pharmacopœias.

Ballota nigra, *Linné.*—Black horehound, *E.;* Marrube noir (fétide), *Fr.;* Schwarzer Andorn, *G.*—Sparingly naturalized in New England. The stem is hairy, often red-brown; the leaves are wrinkled, hairy, ovate, slightly heart-shaped, acute, and crenately toothed. The reddish-purple flowers are in axillary clusters of five to nine.

Lamium album, *Linné.*—Dead nettle, *E.;* Ortie blanche, *Fr. Cod.:* Taubnessel, *G.* It has likewise been introduced from Europe; has ovate, heart-shaped, and coarsely serrate, petiolate leaves, and white or whitish flowers in dense axillary clusters. Lamium amplexicaule, *Linné*, and L. purpureum, *Linné*, are more frequent in the United States; they have roundish leaves and smaller purplish flowers.

Many other species of the above genera have been employed in Europe and Asia, and, like the above, contain volatile oil and a bitter principle.

Action and Uses.—A decoction of motherwort is sometimes used in Europe to promote digestion and quicken the functions of the skin. There also L. lanatus is regarded as a vascular stimulant and diuretic, and as a general tonic; it is employed in *dropsy*, especially of hepatic origin, and is stated to impart to the urine a dark-brown color; it is also used in chronic *gout* and *rheumatism* and to relieve *uterine obstructions*. A hot infusion may be prepared with Gm. 16–32 in Gm. 500 (℥ss–i in Oj) of water.

The several species of *Stachys* have been used as local and general stimulants; *Betonica officinalis* and *Galeopsis* were employed for the cure of *intermittent fever* and *chronic* bronchitis; *Ballota nigra* was esteemed a stimulant and antispasmodic and prescribed as a vermifuge, and *Lamium album*, which is bitter and astringent, was thought to be a valuable remedy for chronic diarrhœa and leucorrhœa, passive hæmorrhages, etc.

LEPTANDRA, *U. S.*—Leptandra.

Culver's Root, Culver's Physic, Black-root, E.; *Racine de leptandra, s. de véronique de Virginie*, Fr.; *Leptandra-Wurzel*, G.

The rhizome, with the rootlets, of Veronica virginica, *Linné* (Leptandra virginica, *Nuttall.* Bentley and Trimen, *Med. Plants*, 196.

Nat. Ord.—Scrophularineæ.

Origin.—Leptandra is indigenous to Canada, and to the United States as far west as the Mississippi Valley; in its southern locations it grows in mountain-valleys, and farther north in low grounds and rich woodlands. It sends up an obtusely-angular stem 0.9–1.8 M. (3 to 6 feet) high, has the short-petioled, lanceolate, and serrate leaves in verticils of four or five, and the white flowers with the two much-exserted stamens in panicled spikes 7–15 Cm. (3 to 6 inches) long. It flowers in July and August, and produces ovate, two-celled, and many-seeded capsules.

Description.—The rhizome is 10–15 Cm. (4 to 6 inches) long, and about 6 Mm. ($\frac{1}{4}$ inch) thick, horizontal, somewhat bent, and branched, blackish-brown to brown-black, nearly free from wrinkles, but the bark is sometimes transversely fissured. The upper side has short remnants of the stems or cup-shaped scars 2–5 Cm. ($\frac{3}{4}$ to 2 inches) apart; the numerous rootlets, which are chiefly attached to the lower side, are blackish, about 1.5 Mm. ($\frac{1}{16}$ inch) thick, longitudinally wrinkled, quite fragile, and therefore usually detached and much broken. The rhizome is hard, and breaks with a woody fracture, showing a large purplish-brown pith and a few medullary rays dissecting the yellowish wood, which is eight to ten times thicker than the blackish-gray bark. The ligneous cord of the rootlets is of about the same thickness as the bark. Leptandra has no odor; its taste is bitter and feebly acrid.

Fig. 172.

Leptandra virginica: transverse sections of rhizomes and rootlets.

Constituents.—According to the analysis of Prof. Wayne (1856), leptandra contains, besides widely-diffused principles, like tannin, gum, resin, and a trace of volatile oil, a principle having the nauseous bitter taste of the drug, and therefore deserving to be called *leptandrin*. It is soluble in water, alcohol, and ether, and was obtained by precipitating the infusion with lead subacetate, removing the excess of lead from the filtrate, by sodium carbonate, and passing the liquid through a column of animal charcoal; this was washed with water and then treated with boiling alcohol, and the extract left on evaporation treated with ether; on evaporating the ether spontaneously a portion of leptandrin crystallized; the remainder was contaminated with coloring matter, which prevented it from crystallizing. The so-called *leptandrin* of the eclectics, which is obtained by precipitating the concentrated tincture with water, appears to owe its efficacy to the accidental presence of the principle described. From the mother-liquor of this eclectic preparation Wayne (1859) obtained *mannit*. F. F. Mayer (1863) observed the bitter principle to be at least partly precipitated by tannin, and that portion to be a glucoside; he also found *saponin*, some *citric acid*, and a small quantity of a *volatile alkaloid*. Prof. Lloyd (1880) reported the presence of a considerable amount of glucose, and that the bitter taste of the tincture is destroyed by boiling with dilute sulphuric acid.

Action and Uses.—Although this medicine has long been in use and is officinal, we do not learn that it has commended itself to educated physicians by its peculiar virtues, although they are sufficiently marked to merit greater attention. The root, when fresh or recent, acts violently as an emeto-cathartic, and the impure resin obtained from it, and ignorantly called leptandrin, as if it were itself the proximate active principle of the plant, produces similar effects when the dose is excessive. Like all gastro-intestinal irritants, it probably promotes the secretions of the mucous glands, the pancreas, and the liver, but has no specific influence upon the last-named organ, as has been confidently assumed. According to Rutherford, its stimulant action on the liver is "very feeble," and it resembles podophyllin in its operation. The *dose* of the powder is stated to be Gm. 1.30–4 (gr. xx–lx), and of leptandrin Gm. 0.10–0.20 (gr. ij–iv). It has also been given in tincture and fluid extract.

LEVISTICUM.—Lovage.

Radix levistici, P. G.; *Livèche*, Fr. Cod.; *Ache de montagne*, Fr.; *Liebstöckel*, G.

The root of Levisticum officinale, *Koch*, s. Ligusticum Levisticum, *Linné*.

Nat. Ord.—Umbelliferæ, Seselineæ.

Origin.—Lovage is indigenous to the mountainous districts of Southern Europe, and has a stem about 1.2 M. (4 feet) high, terminal umbels of yellow flowers, and elliptical or oval fruits with winged ribs, and one or more oil-tubes in each groove. The plant is sometimes cultivated in gardens.

Description.—The root is altogether about 40 Cm. (16 inches) long, 25–38 Mm. (1 or 1½ inches) thick, several-headed, indistinctly annulate, longitudinally wrinkled, somewhat branched below, and is yellowish-brown externally and pale-yellowish internally. It has a thick bark, which is radially striate from the medullary rays, fissured in the outer portion, and contains numerous orange-yellow resin-cells arranged in irregular concentric circles. The meditullium is denser, but soft, and has narrow medullary rays and in the upper portion a central pith. It has a strong balsamic odor, somewhat resembling that of angelica, and a mucilaginous, aromatic, and pungent taste.

Constituents.—Lovage was analyzed by Trommsdorff (1836), Riegel (1840), and others, and found to yield a thickish volatile oil containing much stearopten, various

resins, some soft, others hard (one having a bitter and pungent taste), sugar, mucilage, and other common principles.

Allied Drugs.—Ligusticum filicinum, *Watson*.—It grows in the Rocky Mountains and has a root resembling lovage in appearance and properties, which is known as *Colorado cough-root*, and to the Indians as *osha*. Lig. actæifolium, *Michaux*, is indigenous to the Southern states and has similar properties.

Pimpinella Saxifraga and P. magna, *Linné*, Radix pimpinellæ, *P. G.*—Small burnet saxifrage, *E.*: Grand boucage, *Fr.*: Pimpinell, Bibernell, *G.*—Indigenous to Europe and Asia. The root resembles the preceding, but is brown-yellow or blackish, usually one-headed, not over 15 Mm. ($\frac{3}{5}$ inch) thick, finely annulate above and wrinkled and verrucose below; the bark is very thick, spongy, either white or yellowish, contains numerous resin-cells (in the medullary rays), and encloses a porous radiate yellow wood. The constituents are similar to those of the preceding.

Tinctura pimpinellæ, *P. G.*, is made with 1 part of the root to 5 parts of alcohol sp. grav. 0.892.

Laserpitium latifolium, *Linné*. The root was formerly known as *Radix gentianæ albæ*, from its resemblance in shape to that of gentian-root, but it is externally brownish-white, internally white, and contains yellow resin-cells in the thick spongy bark. Kütz (1883) isolated from it bitter *laserpitin*, $C_{15}H_{22}O_4$, which separates from hot benzin in monoclinic crystals, and is easily soluble in chloroform, ether, benzol, and carbon disulphide.

Peucedanum officinale, *Linné*. The root is externally blackish, internally brownish-yellow, and enclosing a soft porous wood, with resin-cells in the medullary rays. (For *peucedanin*, see p. 864.

Action and Uses.—Levisticum belongs to the large class of plants containing an essential oil and a resin, which have always been employed as carminatives, diuretics, emmenagogues, and digestive stimulants. It has been much used in flatulent *dyspepsia*, *amenorrhœa*, and *dropsy*, especially in Germany, where it is prescribed as a substitute for angelica. It is administered in decoction or infusion (Gm. 5–10 in Gm. 100), in tablespoonful doses. *Pimpinella saxifraga* is endowed with similar properties, and was formerly much used to expel the mercury remaining in the system after the treatment of syphilis. The root of *Laserpitium latifolium* is an active cathartic. *Peucedanum officinale* was in ancient, and even in modern times, employed as a diuretic, aromatic, and nervine medicine.

LIATRIS.—Liatris.

Nat. Ord.—Compositæ, Eupatorieæ.

Description.—The genus Liatris embraces principally North American perennial herbs with tuberous roots, simple and erect stems, alternate and entire leaves, and handsome rose-purple flower-heads with an oblong imbricate involucre, naked receptacle, and a pappus composed of many bristles. The flowers are usually in terminal spikes or racemes.

Liatris spicata, *Willdenow*. The tuberous rhizome is known as *Button snake-root*, *Devil's bit*, and *Colic-root*. It is ½ inch (12 Mm.) or more in diameter, somewhat tuberculate from short branches, and marked with several cup-shaped stem-scars. It is slightly wrinkled and of a brown color externally, and internally of a dingy white, with streaks of brown. Its odor is somewhat balsamic and its taste warm and bitterish.

L. squarrosa, *Willdenow*, and L. scariosa, *Willdenow*, are known as *Rattlesnake's master*. The rhizomes resemble the preceding, but are more elongated, irregularly ovate, and beset with a few wiry rootlets. Internally they are of a brownish color.

L. odoratissima, *Willdenow*, *Vanilla-plant* or *Deer's tongue*. The radical leaves are obovate-spatulate, obtuse, about seven-veined, narrowed below; the stem-leaves are oval or oblong, and clasping at the base. All the leaves are rather fleshy, pale-green, and smooth, and after drying have a very agreeable odor.

Constituents.—The rhizomes appear to contain volatile oil and resin. The leaves of the deer's tongue were found by Procter (1859) to contain coumarin, which is frequently separated upon the surface in crystals.

Pharmaceutical Uses.—Their agreeable and persistent odor renders deer's tongue leaves serviceable in the preparation of sachet powders, etc., as suggested by Dr. A. W. Miller (1875).

Action and Uses.—L. spicata is one of the numerous "snake-roots," which owe whatever virtue they possess to being diaphoretic when administered in hot decoction in consequence of the acrid or stimulant principles they contain. Its qualities adapt it to

relieve flatulent *colic*. It is also diuretic, and is used in *nephritic complaints*. L. odoratissima has an odor resembling that of vanilla, for which reason it is sometimes mixed with smoking tobacco and introduced into cigars. Other species, L. scariosa and L. squarrosa, are especially high in popular esteem as antidotes to the *rattlesnake's bite*, both internally and locally, and are employed in *gonorrhœa* and also to prepare gargles for *sore throat*. Liatris is administered in decoction and tincture.

LIMON, *Fr. Cod.*—Lemon.

Citron, Fr.; *Citrone*, *Limone*, G.; *Limon*, Sp.

Citrus Limonum, *Risso* (C. medica, var. *β*, *Linné*). Bentley and Trimen. *Med. Plants*, 54.

Nat. Ord.—Rutaceæ.

Official Parts.—1. Limonis cortex, *U. S.*, *Br.*; Cortex fructus citri, *P. G.*; Lemon-peel, *E.*; Écorce (Zeste) de citron (de limon), *Fr.*; Citronenschale, Limonenschale, *G.*

The rind of the recent fruit.

2. Limonis succus, *U. S.*, *Br.*; Succus citro, Lemon-juice, Lime-juice, *E.*; Suc de citron (de limon), *Fr.*; Citronensaft, Limonensaft, *G.*

The freshly-expressed juice of the ripe fruit.

Origin.—The lemon is a native of the north-western part of India, where it is found in the forests up to an altitude of about 1200 M. (4000 feet). It is extensively cultivated in the basin of the Mediterranean, and the culture has also been introduced into the southern parts of the United States, into Australia, and into most tropical and subtropical countries. Several varieties have been produced from the original stock, of which, besides the lemon, the following are quite distinct:

C. medica, *Risso*, *Citron* or *Cedrat* (Bentley and Trimen, *Med. Plants*, 53). Its flowers are purplish externally; the fruit is 10–15 Cm. (4 to 6 inches) long, ovate-oblong, has a rugged and thick rind, and contains an acid juice.

C. limetta, *Risso*, *Sweet lime*. Its flowers are white; the fruit is smaller than the lemon, oval or roundish, has a smoother and thin rind, and contains an insipidly sweet juice.

C. Lumia, *Risso*, has likewise a sweet pulp. The *sour lime* is the fruit of Citrus acida, *Roxburgh*, C. acris, *Miller*, and perhaps other varieties.

The *lemon tree* is 3.5–4.5 M. (12 to 15 feet) high, irregularly branched, and spiny in the leaf-axils; the leaves are oval or ovate-oblong, somewhat serrate, leathery, glossy above, and articulated with the wingless or slightly-winged petiole. The flowers are mostly solitary, have a small calyx, five petals, which are purplish-pink externally, and numerous stamens. The fruit, 50–75 Mm. (2 to 3 inches) long, varies in shape between oval and obovate, has a nipple-shaped apex, a yellow nearly smooth but glandular pericarp, and is divided into eight to twelve cells, each with two or three seeds.

Description.—*The Peel.*—Lemon-peel forms either narrow bands or oblong and curved sections with little of a spongy, white inner layer adhering to them; the outer surface has a deep lemon-yellow color, and is somewhat uneven from numerous oil-glands imbedded in the tissue. This portion has an agreeable odor and an aromatic slightly bitter taste; it is the only part which possesses any medicinal value. The white spongy tissue underneath, which is inodorous and nearly tasteless, should be rejected. The Pharmacopœia now directs that the spongy white inner layer adhering to the segments should be removed before use.

The Juice.—Lemon-juice is a slightly turbid, yellowish liquid, which has the agreeable odor of lemon and an acid taste. The odor is usually due to the presence of a little volatile oil from the rind, but even without the latter lemon-juice has a slight odor distinct from that of the peel. Stoddard determined its usual specific gravity to be 1.044, and each fluidounce to contain 44 grains of citric acid (about 9¼ per cent. = 42.5 grains in 1 Imperial fluidounce); its acid strength, however, is subject to variation. The U. S. P. requires it to contain about 7 per cent. of citric acid, and to have a specific gravity not less than 1.030 at 15° C. (59° F.). According to H. M. Witt (1854), lemon-juice yields from 0.2 to 0.7 per cent. of ash; W. W. Stoddart (1868) obtained between 0.26 and 0.6 per cent., and the Pharmacopœia accepts a juice with 0.5 per cent. Lemon-juice speedily undergoes decomposition, the citric acid decreasing in quantity, at first slowly, afterward rapidly, as shown by Stoddard. Various methods for its preservation have been suggested, most of which, however, fail to preserve the juice in condition for

medicinal use. It has been proposed to concentrate it by evaporation or freezing before bottling it, or to exclude the air by a stratum of fixed oil; the flavor, however, is considerably modified. A better method is to clarify the juice by adding half its volume of strong alcohol; the decanted liquid is then freed from alcohol at a very moderate heat, and the remaining liquid put into suitable bottles, which are heated to near the boiling-point for about an hour, and then hermetically sealed. The juice may be preserved by the same method without the previous treatment with alcohol, but the flavor will be impaired on keeping.

Constituents.—The principal constituent is volatile oil. (See OLEUM LIMONIS.) The bitter taste is probably due to hesperidin (see page 312). The white portion is colored black by ferric salts; the principle which gives rise to this color has not yet been isolated.

Lemon-juice contains from 7 to 10 per cent. of citric acid and 0.5 to 1 per cent. of gum and sugar. Witt found the principal constituents of the ash to be potassa 44.34 lime 7.61, and phosphoric acid 7.56 per cent. Cossa (1872) obtained 15 per cent. of phosphoric acid.

Uses. Lemon-peel is used in medicine, as in cookery, for the sake of its flavor.

LINARIA.—TOAD FLAX.

Herba linariæ.—Snapdragon, Ramsted, Butter-and-Eggs, E.; *Linaire commune*, Fr.; *Leinkraut, Flachskraut, Löwenmaul*, G.; *Linaria*, Sp.

Linaria vulgaris, *Miller*, s. Antirrhinum Linaria, *Linné*.

Nat. Ord.—Scrophulariaceæ.

Description.—The toad flax is a European perennial, now extensively naturalized in North America. It is 30–45 Cm. (1 or 1½ feet) high, has alternate, sessile, lance-linear, almost three-nerved, smooth, and light-green leaves, 25–38 Mm. (1 or 1½ inches) long; and terminal racemes of showy yellow flowers, which have a personate corolla and at the base continued into a curved spur of the same length. When fresh the herb has a slight disagreeable odor and a bitterish somewhat acrid taste.

Constituents.—The flowers were analyzed by Riegel (1843); they contain a yellow coloring matter, mucilage, sugar, and tannin. Walz obtained an acrid principle, resin, and volatile *linarosmin* and *antirrhinic acid*.

Pharmaceutical Preparation.—UNGUENTUM LINARIÆ. 2 parts of the dry plant are macerated with 1 part of alcohol, and then digested with 10 parts of lard until the alcohol has evaporated; the fat is expressed, strained, and stirred until congealed.

Action and Uses.—Common toad flax is used in Germany for *jaundice, dropsy*, and *diseases of the skin*, and an ointment is made with it for the cure of *hæmorrhoids*. A decoction is prepared with Gm. 15–30 in water, Gm. 250–500 (℥ss–j in f℥viij–xvi.)

LINIMENTA.—LINIMENTS.

Embrocations, E., Fr.; *Liniments, Einreibungen*, G.

Liniments are liquid or semi-liquid preparations which are intended for external use and are applied to the skin by friction. The vehicle may be oil or alcohol, or sometimes water; many are perfect solutions, others mechanical mixtures which should be well agitated before they are used; a few are of a soft solid consistence at the ordinary temperature, but become liquid when applied to the skin. The U. S. Pharmacopœia since 1880 uses cotton-seed oil in place of olive oil, formerly directed.

LINIMENTUM ACONITI, *Br.*—LINIMENT OF ACONITE.

Liniment d'aconite, Fr.; *Akonitliniment*, G.

Preparation.—Take of Aconite-root, in No. 40 powder, 20 ounces; Camphor 1 ounce; Rectified Spirit a sufficiency. Moisten the aconite with 20 fluidounces of spirit, and macerate in a closed vessel for three days; then transfer to a percolator, and, when the liquor ceases to pass, continue the percolation with more of the spirit, allowing the liquor to drop into a receiver containing the camphor until the product measures 30 fl. oz.—*Br.*

This liniment is one-third weaker than the fluid extract, and differs also in containing

camphor. With proper manipulation the aconite-root is practically exhausted by the above process. Procter (1853) had suggested an aconite liniment which has been dropped from the Pharmacopœia since 1880, but may be prepared from the fluid extract of aconite-root by mixing 4 fluidounces of it with ½ fluidounce of glycerin and evaporating the mixture to 4 fluidounces.

Uses.—This liniment is convenient for using aconite locally and as an addition to other anodyne applications. It is chiefly employed for the relief of *neuralgia* by saturating it with disks or pledgets of cloth, which are then applied to the painful part. Mixed with an equal quantity of soap liniment, it is said effectually to remove the pain of *dry gangrene*.

LINIMENTUM AMMONIÆ, *U. S., Br.*—Ammonia Liniment.

Linimentum ammoniatum, P. G.; *Linimentum volatile*, *Linimentum ammoniacale*.—*Volatile liniment*, E.; *Liniment ammoniacal* (*volatil*), *Savon ammoniacal*, F.; *Flüchtiges Liniment*, *Flüchtige Salbe*, G.

Preparation.—Ammonia water 350 Cc.; Alcohol 50 Cc.; Cotton-seed oil 600 Cc.; to make 1000 Cc. Mix them.—*U. S.*

Take of solution of ammonia 1 fluidounce; olive oil 3 fluidounces. Mix together with agitation.—*Br.*

The German Pharmacopœia directs 3 parts of olive oil and 1 part of poppy-seed oil, and the French Codex 9 parts of expressed oil of almonds to 1 part of ammonia water. The fixed oil is partly decomposed, with the formation of an ammonia soap, by means of which the water and oil are kept well mixed forming an opaque emulsion. Ammonia liniment may be prepared by shaking together in a bottle 3½ fluidounces of ammonia water, ½ fluidounce of alcohol, and 6 fluidounces of cotton-seed oil. When made by the present official formula ammonia liniment is sure to separate into two distinct layers; in our experience more satisfactory results will be obtained if about one-sixth of the volume of cotton-seed oil be replaced by a like quantity of common olive oil. Old cotton-seed oil will also give better results than the fresh oil. The addition of alcohol in the official formula is intended to preserve the fluidity of the liniment, as the latter has a tendency to thicken considerably if kept on hand for some time. On being kept, the liniment becomes thicker, and finally forms a stiff and even granular mass, which Rother prevents by the addition of a minute quantity of oleic acid.

Linimentum ammoniæ camphoratum.—Camphorated volatile liniment, *E.*; Liniment ammoniacal camphré, *Fr.*; Flüchtiges Kampher-liniment, *G.*—The French Codex and German Pharmacopœia direct it to be made precisely like volatile liniment, except that camphor liniment is substituted for the almond and olive oil.

Uses.—This preparation represents the stimulant rather than the counter-irritant virtues of ammonia. It is used to relieve local pains of a *neuralgic* or *rheumatic* nature, and to palliate both pain and congestion in the forming stage of various inflammations, as *sore throat*, *laryngitis*, *bronchitis*, and *pleurisy*. If prevented from evaporating it may vesicate the skin.

LINIMENTUM BELLADONNÆ, *U. S., Br.*—Belladonna Liniment.

Liniment de belladone, Fr.; *Belladonna-Liniment*, G.

Preparation.—Camphor, 50 Gm.; Fluid Extract of Belladonna, a sufficient quantity to make 1000 Cc. Dissolve the camphor in about 200 Cc. of the fluid extract, and then add enough of the latter to make the product measure 1000 Cc.—*U. S.*

To make 1 pint of the official liniment dissolve 365 grains of camphor in 4 ounces of fluid extract of belladonna-root, and add enough fluid extract to bring the volume up to 16 fluidounces.

Take of belladonna-root, in No. 40 powder, 20 ounces; camphor 1 ounce; rectified spirit a sufficiency. Moisten the belladonna with 20 fluidounces of spirit, and macerate in a closed vessel for three days; then transfer to a percolator, and, when the liquor ceases to pass, continue the percolation with more of the spirit, allowing the liquor to drop into a receiver containing the camphor until the product measures 30 fluidounces.—*Br.*

Considering the belladonna-root used in both formulas to be of equal efficiency, the second liniment is one-third weaker.

Uses.—Belladonna liniment is a convenient and efficient preparation for allaying the local pains which belong to *neuralgia*, *rheumatism*, *sprains*, etc. It is advantageously associated with aconite liniment.

LINIMENTUM CALCIS, *U. S., Br.*—Lime Liniment.

Liniment of lime, Carron oil, E.; *Liniment calcaire, Savon calcaire*, Fr.; *Kalkliniment*, G.

Preparation.—Solution of Lime, Linseed Oil, each 1 volume. Mix them.—*U. S.*

Take of solution of lime, olive oil, each 2 fluidounces. Mix together, with agitation.—*Br.*

A lime soap is formed by this process, which keeps the excess of the oil emulsionized for a short time, the two separating together from the aqueous liquid.

The French Codex directs the separation of the soft saponaceous mass resulting from the agitation of 9 parts of lime-water with 1 part of expressed oil of almonds, and its preservation for use.

Uses.—This liniment is much employed in the treatment of *burns*, both those which are recent and superficial and those which involve the skin, in their ulcerative stage. It is not only a protective, but, as an astringent of a special kind, it hastens the restoration of the injured tissues. It may be used to prevent pitting in confluent *small-pox*. It is applied most efficiently on cloths, which should not be allowed to get dry.

LINIMENTUM CAMPHORÆ, *U. S., Br.*—Camphor Liniment.

Oleum camphoratum, P. G.; *Linimentum camphoratum.—Camphorated oil*, E.; *Liniment camphré, Huile camphré*, Fr.; *Kampherliniment*, G.

Preparation.—Camphor, in coarse powder, 200 Gm.; Cotton-seed oil, 800 Gm.; to make 1000 Gm. Introduce the camphor and the cotton-seed oil into a suitable flask, and apply a gentle heat, by means of a water-bath, loosely stoppering the flask during the operation. Agitate from time to time, until the camphor is dissolved.—*U. S.*

To make about 1 pint of camphor liniment dissolve 2 av. ozs. of camphor in 14½ fluidounces of cotton-seed oil.

Take of camphor 1 ounce; olive oil 4 fluidounces. Dissolve the camphor in the oil.—*Br.* Dissolve camphor 1 part in olive oil 9 parts.—*F. Cod., P. G.*

A simple solution of camphor in oil, which is best obtained by employing the camphor as a fine powder or by digesting the mixture in a closed bottle at a moderate heat.

Souley's *carbolized camphor liniment* is made by dissolving pure carbolic acid 9 parts and camphor 25 parts in absolute alcohol 9 parts and adding oil 35 parts.

Uses.—It is used as an anodyne and discutient for *sprains, bruises*, and *glandular swellings* and for the relief of *rheumatic pains*. It is also serviceable in preventing the ill effects of pressure by surgical apparatus and by decubitus.

LINIMENTUM CAMPHORÆ COMPOSITUM, *Br.*—Compound Liniment of Camphor.

Liniment ammoniacal camphré anglais, Fr.; *Ammoniak- und Kampher-Liniment*, G.

Preparation.—Take of camphor 2½ ounces; Oil of Lavender, 1 fluidrachm; Strong Solution of Ammonia, 5 fluidounces; Rectified Spirit, 15 fluidounces. Dissolve the camphor and oil of lavender in the spirit; then add the solution of ammonia gradually, shaking them together until a clear solution is formed.—*Br.*

Uses.—The characteristic of this preparation, as distinguished from simple liniment of camphor, is that it is rendered stimulant, and even rubefacient, by the strong water of ammonia it contains. It is a convenient liniment in cases of local *rheumatic, neuralgic*, and *traumatic pains*.

LINIMENTUM CHLOROFORMI, *U. S., Br.*—Chloroform Liniment.

Liniment au chloroforme, Fr.; *Chloroform-Liniment*, G.

Preparation.—Chloroform, 300 Cc.; Soap Liniment, 700 Cc.; to make 1000 Cc. Mix them.—*U. S.*

Take of chloroform, liniment of camphor, each 2 fluidounces. Mix.—*Br.*

Chloroform 1 part, expressed oil of almond 9 parts.—*F. Cod.* The preparation bearing the same name in the three pharmacopœias differs essentially in composition as well as in the proportion of chloroform.

Uses.—The purpose of this preparation was probably to prolong, and at the same time mitigate, the local anæsthetic action of chloroform. But the object is better accomplished by a mixture of chloroform and soap liniment, to which tincture of aconite-root may be added.

LINIMENTUM CROTONIS, *Br.*—Liniment of Croton Oil.

Liniment crotoné, Fr.; *Krotonöl-Liniment*, G.

Preparation.—Take of Croton Oil 1 fluidounce; Oil of Cajeput, Rectified Spirit, each 3½ fluidounces. Mix.—*Br.*

This is simply a solution of croton oil in alcohol and oil of cajeput, and has the odor of the latter.

Uses.—There is an apparent incongruity in associating a prompt but transient irritant, like oil of cajeput, with one whose operation is slow and is scarcely active until the characteristic croton pustulation is produced. Possibly, the rubefaction of the skin by the one oil was intended to hasten the more permanent action of the other. But the preparation has little to recommend it before an extemporaneous solution of croton oil in olive oil, with or without the addition of oil of cajeput, cloves, or cassia.

LINIMENTUM HYDRARGYRI, *Br.*—Liniment of Mercury.

Linimentum mercuriale.—Liniment mercuriel, Fr.; *Quecksilber-Liniment*, G.

Preparation.—Take of Ointment of Mercury 1 ounce; Solution of Ammonia, Liniment of Camphor, each 1 fluidounce. Rub the ointment of mercury with one-half of the liniment of camphor; mix the solution of ammonia with the other half; then mix them together.—*Br.*

This may be prepared in a wide-mouthed vial if the ointment and liniment are digested together and frequently agitated until the lumps have disappeared, when the second mixture should be added and well incorporated by shaking. The liniment has a gray color from the finely-divided mercury.

Uses.—The camphor and ammonia in this preparation are intended by their stimulant action to promote the discutient and absorbent action of the mercury. As it must be applied with friction, there is great danger of its causing salivation. It is less efficient in promoting the resolution of enlarged and indurated *glands*, etc., than are mercurial ointments and plasters, especially those containing the iodides of mercury.

LINIMENTUM IODI, *Br.*—Liniment of Iodine.

Liniment ioduré, Fr.; *Jodliniment*, G.

Preparation.—Take of Iodine 1¼ ounces; Potassium Iodide, ½ ounce; Glycerin, ¼ ounce; Rectified Spirit, 10 fluidounces. Dissolve the iodine, potassium iodide, and glycerin in the spirit.—*Br.*

This is much stronger than the Tinctura iodi, from which it also differs in containing about 2½ per cent of glycerin. The potassium iodide adapts the liniment for use with a small quantity of aqueous liquids by preventing the precipitation of the iodine.

Uses.—As it is probable that a very minute proportion, if any, either of iodine or of potassium iodide is absorbed by the sound skin, it must be concluded that this liniment will be less efficient as a local application than either the simple or compound iodine ointment, in both of which the active ingredients are kept longer in contact with the integument than they can be in a liniment.

LINIMENTUM OPII, *Br.*—Liniment of Opium.

Anodyne liniment, E.; *Liniment opiacé*, Fr.; *Opiumliniment*, G.

Preparation.—Take of Tincture of Opium, Soap Liniment, each 2 fluidounces. Mix.—*Br.*

The *liniment savonneux opiacé* of the French Codex was made by triturating 5 parts of powdered soap with 90 parts of expressed oil of almonds, and adding 5 parts of tincture of opium; it must be well agitated.

Uses.—Being merely a mixture of laudanum and soap liniment, its fixed proportions are rather embarrassing than convenient. The quantity of laudanum used should vary with the condition of the affected part as to delicacy, the degree of pain, etc.

LINIMENTUM POTASSII IODIDI CUM SAPONE, *Br.*—Liniment of Potassium Iodide and Soap.

Liniment savonneux ioduré, Fr.; *Jodkalium-Seifenliniment*, G.

Preparation.—Take of Curd Soap, cut small, 2 ounces (16 parts); Potassium Iodide, 1½ ounces (12 parts); Glycerin, 1 fluidounce (8 fluid parts); Oil of Lemon, 1

fluidrachm (1 fluid part); Distilled Water, 10 fluidounces (80 fluid parts). Reduce the soap to fine shreds, and mix this with the water and glycerin in a porcelain dish over the water-bath. When the soap is dissolved pour the liquid into a mortar in which the potassium iodide has previously been powdered. Mix briskly, and continue the trituration until the mixture is cold. Set aside for an hour; then rub well the oil of lemon into the cream-like product.—*Br.*

Uses.—This liniment is even more objectionable than liniment of iodine, since it contains only the iodic salt, and no iodine, as the latter preparation does. The clinical evidence of any real benefit being derived from it through its potassium iodide has never been furnished. If cutaneous absorption of the potassium iodide be desired, it will be secured much more readily by the prolonged application of compresses saturated with strong solution of the iodide and their protection by a waterproof covering.

LINIMENTUM SAPONIS, *U. S.*, *Br.*—Soap Liniment.

Linimentum saponato-camphoratum liquidum, P. G.—*Spiritus nervinus camphoratus; Liquid opodeldoc*, E.; *Liniment savonneux camphré*, Fr.; *Flüssiger Opodeldok*, G.

Preparation.—Soap, in fine powder, 70 Gm.; Camphor, in small pieces, 45 Gm.; Oil of Rosemary, 10 Cc.; Alcohol, 750 Cc.; Water, a sufficient quantity, to make 1000 Cc. Introduce the camphor and the alcohol into a graduated bottle, and shake this until the camphor is dissolved. Then add the soap and oil of rosemary, and shake the bottle well for a few minutes. Lastly, add enough water to make 1000 Cc., and agitate until a clear liquid results. Set the bottle aside, in a cool place, for twenty-four hours, then filter.—*U. S.*

To prepare 2 pints of soap liniment will require soap, in fine powder 1022 grains, camphor 663 grains, oil of rosemary 154 minims, alcohol 24 fluidounces, and finally enough water to make the solution measure 32 fluidounces.

The present formula is an improvement over that of 1880, and the liniment will keep better, because a larger proportion of water is present; the amount of soap now used will be uniform, as it is ordered in fine powder and must therefore be dry.

Take of hard soap, in fine shavings, 2 ounces; camphor 1 ounce; oil of rosemary 3 fluidrachms; rectified spirit 16 fluidounces; distilled water 4 fluidounces. Mix the water with the spirit, and add the oil of rosemary, the soap, and the camphor. Macerate for seven days at a temperature not exceeding 70° F., with occasional agitation, and filter. —*Br.*

Both Pharmacopœias use soap made with olive oil and soda, which is more soluble in the alcohol than soap made with animal fat, but the Br. omits to state whether or not the soap is to be dried before being weighed. If white Castile soap is used, the liniment will have a pale-yellowish color, and is at once ready for use, but if mottled soap is employed the preparation will be turbid, and should be filtered, when it will have a brownish color, due to the iron held in solution. Barckhausen (1872) suggested the use of a potassa soap made of rape-seed oil, which has the advantage of not separating from the alcohol even at the freezing temperature; and a soap made from castor oil has been suggested by C. H. Clark and L. E. Sayre in 1872. To accomplish the same result, the German Pharmacopœia uses a potassa soap of olive oil.

Allied Preparations.—Linimentum saponato-camphoratum, s. Balsamum opodeldoc.—Opodeldoc, Steer's opodeldoc, *E.*; Baume opodeldoch, Baume de savon, *Fr.*; Opodeldok, *G.*—Digest, in a suitable vessel, of tallow soap 30 parts, camphor 24 parts, and 90 per cent. alcohol 250 parts; when dissolved add oil of thyme 2 parts, oil of rosemary 6 parts; agitate with 10 parts of animal charcoal, add ammonia-water 10 parts; filter rapidly by means of a well-covered funnel, collect the filtrate in suitable wide-mouthed vials, and allow it to congeal.—*F. Cod.*

The German Pharmacopœia uses soap 8 parts, camphor 2 parts, alcohol 84 parts; the warm solution is filtered; then it adds oil of thyme 0.4 part, oil of rosemary 0.6 part, and ammonia-water 5 parts. The liniment is solid at the ordinary temperature, but readily liquefies at the temperature of the body, and is white or yellowish, opalescent, and somewhat translucent.

Action and Uses.—An anodyne and discutient preparation, used for the same purposes as camphor liniment, but more efficient because more stimulant than that preparation. The *opodeldoe balsam*, the liniment, and the spirit (P. G.) are more stimulant than the official preparation.

LINIMENTUM SAPONIS MOLLIS, *U. S.*—Liniment of Soft Soap.

Tinctura saponis viridis, U. S. 1880. *Spiritus saponis kalinus Hebra.—Teinture de savon vert*, Fr.; *Hebra's Seifenspiritus*, G.

Preparation.—Soft Soap, 650 Gm.; Oil of Lavender, 20 Cc.; Alcohol, 300 Cc.; Water, a sufficient quantity, to make 1000 Cc. Mix the oil of lavender with the alcohol, dissolve in this the soft soap by stirring or agitation, and set the solution aside for twenty-four hours. Then filter it through paper, and pass enough water through the filter to make the product measure 1000 Cc.—*U. S.*

To make 1 pint of liniment of soft soap will require soft soap 10¾ av. ounces, oil of lavender 3 fluidrachms, alcohol 4¾ fluidounces, and water enough to make the solution measure 16 fluidounces.

Uses.—This solution of green soap is more convenient than the soap itself, because its smell is not offensive and because it is free from the gritty particles often contained in the soap. It is used chiefly in the treatment of *psoriasis*, *lichen*, *eczema*, and *prurigo*.

LINIMENTUM SINAPIS COMPOSITUM, *U. S.*, *Br.*—Compound Liniment of Mustard.

Liniment sinapisé composé, Fr.; *Zusammengesetztes Senfliniment*, G.

Preparation.—Volatile Oil of Mustard, 30 Cc.; Fluid Extract of Mezereum 200 Cc.; Camphor 60 Gm.; Castor Oil 150 Cc.; Alcohol a sufficient quantity; to make 1000 Cc. Dissolve the camphor in 500 Cc. of alcohol; then add the fluid extract of mezereum, the oil of mustard, and the castor oil, and finally enough alcohol to make the product measure 1000 Cc.—*U. S.*

To make 8 fluidounces 220 grains of camphor should be dissolved in 4 fluidounces of alcohol, then add 13 fluidrachms of fluid extract of mezereum, 115 minims of volatile oil of mustard, 9½ fluidrachms of castor oil, and finally enough alcohol to bring the volume of the solution up to 8 fluidounces.

Take of oil of mustard 1 fluidrachm; ethereal extract of mezereon 40 grains; camphor 120 grains; castor oil 5 fluidrachms; rectified spirit 4 fluidounces. Dissolve the extract of mezereon and camphor in the spirit, and add the oil of mustard and castor oil.—*Br.*

The solution is readily effected by agitation in a vial.

Action and Uses.—It was doubtless intended in this compound to provide a powerful counter-irritant and revulsive, and it is described as a useful embrocation. We should hesitate to employ it without feeling more assured than at present of its being safe. The sores made by mezereon or by mustard are very intractable. Moreover, if the oil of mustard is in such proportion as to produce its proper effect, it will do so long before the mezereon has begun to act. Hence one or the other ingredient of the liniment would seem to be superfluous.

LINIMENTUM TEREBINTHINÆ, *U. S.*, *Br.*—Turpentine Liniment.

Linimentum terebinthinatum, P. G.—*Liniment térébenthiné*, Fr.; *Terpentinliniment*, G.

Preparation.—Resin Cerate 650 Gm.; Oil of Turpentine 350 Gm.; to make 1000 Gm. Add the oil to the cerate, previously melted, and mix them thoroughly.—*U. S.*

To make about 1 pint of this liniment it will require 10¾ av. ozs. of resin cerate and 6½ fluidounces of oil of turpentine.

Take of soft soap 2 ounces; camphor 1 ounce; oil of turpentine 16 fluidounces. Dissolve the camphor in the oil of turpentine; mix the soap with 2 fluidounces of water; then rub these fluids together until they are thoroughly mixed.—*Br.*

Oleol of chamomile, oil of turpentine, equal parts.—*F. Cod.*

The first formula yields what is known as *Kentish liniment*; the cerate should be melted at a low heat, and then the oil gradually added, with continued stirring. The second process is a considerable modification of the former, and requires continued trituration of the soap in a mortar, with the gradual addition of the oil, in order to obtain a uniform mass. The liniment of the French Pharmacopœia differs from the foregoing.

Action and Uses.—This preparation was originally employed in the treatment of *burns* and *scalds*, which it protects from the irritating influence of the air, while it maintains a moderate stimulation which tends to prevent the ulterior effects of those injuries in which the vitality of the tissues is more or less impaired. It is essential for its successful use that the primary dressing should not be removed for twenty-four hours, and

that the liniment should not be continued longer than is necessary to establish a healthy action in the part. This preparation is also serviceable in superficial *erysipelas* or *erythema* arising from traumatic causes, and in *frost-bite* without active inflammatory phenomena.

LINIMENTUM TEREBINTHINÆ ACETICUM, *Br.*—Liniment of Turpentine and Acetic Acid.

Liniment térébenthiné acétique, Fr.; *Terpenthin- und Essig-Liniment*, G.

Preparation.—Take of Oil of Turpentine 4 fluidounces (4 fluid parts); Glacial Acetic Acid 1 ounce (1 part); Liniment of Camphor 4 fluidounces (4 fluid parts). Mix.—*Br.*

Action and Uses.—This preparation is essentially "St. John Long's liniment," which name it derived from a quack who professed to cure almost every painful local disease by its application. It is particularly efficient in *neuralgia* when applied over the points of exit of the trunks or the terminal distribution of the affected nerves. It should then be employed so as to vesicate the part superficially and over a small area. It may also be applied to relieve other local pains and inflammations, such as limited *muscular rheumatism*, and to the epigastrium to allay *vomiting* depending on inflammation of the stomach.

LINTEUM.—Lint.

Linteum carptum.—Charpie, Fr., G.

Preparation and Description.—Lint was originally made from bleached linen cloth by scraping it until it became soft and woolly. At the present time it is almost exclusively prepared by means of machinery from a fabric woven for this purpose, and is known as *patent lint* in distinction to the hand-made lint. It is in rather thick but very soft and fleecy sheets, and when viewed under the microscope shows the bast-cells of flax as long cylindrical tubes, which are slightly thickened in a few places and somewhat pointed toward both ends. The cell-walls are very thick by concentric deposits, leaving only a small central cavity. Immersed in an ammoniacal solution of copper, they swell considerably, and are ultimately dissolved without leaving any residue. These cells resemble the bast-fibres of hemp, but the latter are thinner, blunt at the ends, with a still smaller cavity in the centre, and adhere more firmly together, hence the coarser appearance of hemp fabrics.

Cotton is now often more or less substituted for linen, and lint made in this way is known as *cotton lint*. The fibre of cotton is described on page 791, and may be readily distinguished from linen fibre by the microscope.

Tests for Linen and Cotton.—Boiled with a concentrated solution of potassa, the linen fibre turns bright yellow within 2 minutes, while cotton fibre remains white or becomes pale-yellowish. Dipped in a solution of *rosolic acid*, which is known in commerce as aurin or yellow corallin, and afterward in a concentrated solution of sodium carbonate, linen fibre is dyed rose-red, while cotton fibre remains white. When immersed in a tincture of *madder*, linen fibre acquires a yellowish-red, but cotton fibre a light-yellow, color. Cold concentrated *sulphuric acid* does not materially alter linen fibre within 1 or 2 minutes, while cotton fibre is destroyed in the same time. When rubbed with a *fixed oil*, linen fabric remains white and opaque, but cotton becomes translucent.

Action and Uses.—The purpose of lint is to provide a soft and unirritating covering for *wounds;* to protect them from the air and the foreign particles floating in it; to moderate and graduate the pressure of bandages and other surgical apparatus; to absorb the more liquid discharges, and to be introduced into wounds which are not intended to heal immediately. Of the different forms of lint, that which is made of old linen by picking apart its threads is the most elastic and absorbent, and by far the most comfortable to the patient; that which is made by scraping old linen is very suitable for small wounds and abrasions; and the so-called patent lint is the least eligible unless its threads are unravelled so as to form a soft mass. But the last-mentioned lint, when made of cotton, as it usually is, does not absorb discharges nearly as well as that derived from linen, chiefly on account of the oil which adheres to it. Of late years cotton lint has been prepared entirely free from oil, and therefore possessing a greater absorbent power, and is at the same time impregnated with carbolic acid, so as to render it disinfectant. But a defect of all cotton lint is, that as soon as it becomes saturated with liquids it entirely loses its elasticity, which is not the case with old linen lint or charpie.

A substance analogous to charpie is oakum, which consists of tarred ropes picked into shreds. Its value, derived from the tar impregnating it and the greater looseness of its texture, is counterbalanced by the harshness of the material. It was first suggested by Surgeon Ruschenberger, U. S. N., in 1862. Several kinds of wood-fibre have been converted into a spongy tissue known as wood-wool or wood-cloth, and which is very absorbent. It is sometimes impregnated with corrosive sublimate or other antiseptic solution. Peat-moss and Spanish moss have been similarly applied.

LINUM, *U. S.*—Flaxseed.

Lini semina, Br.; *Semen Lini*, P. G.—*Linseed*, E.; *Semence (Graine) de lin*, Fr.; *Leinsamen, Flachssamen*, G.; *Linaza*, Sp.

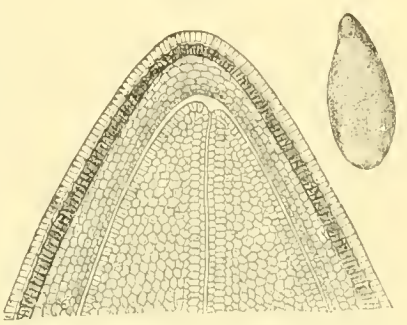
The seed of Linum usitatissimum, *Linné*. Bentley and Trimen, *Med. Plants*, 39.
Nat Ord.—Linaceæ.

LINI FARINA, *Br.*—Flaxseed Meal.

Linseed meal, E.; *Farine de lin*, Fr.; *Leinsamenmehl, Leinmehl*, G.; *Polvo (Harina) de linaza*, Sp.

Origin.—Flax is probably indigenous to the Mediterranean basin, but has been cultivated for a long period, and grows so spontaneously wherever it has been introduced, that it is difficult to determine its native country. It has an annual stem about 60 Cm. (2 feet) high, alternate linear-lanceolate leaves, and terminal flowers with five ovate, pointed and three-nerved sepals and five fugacious blue-veined and short-clawed petals. The fruit is an ovate five-celled and ten-seeded capsule, each cell being again imperfectly divided. As cultivated in the various tropical and temperate countries, several varieties have been observed, differing in the shape and size of the seeds and more markedly in other characters. The seeds are principally imported from Russia and Germany. (See Oleum Lini).

Fig. 173.



Flaxseed, magnif. a diam., and transverse section near edge, magnif. 65 diam.

Description.—Flaxseed is 4–6 Mm. ($\frac{1}{6}$ to $\frac{1}{4}$ inch) long, oblong-ovate, considerably flattened, but the sides convex and the edges obtuse, rounded below and oblique at the apex, beneath which the hilum is located in a slight depression. The testa is of a yellowish-brown color, glossy, and covered with a transparent epithelium, which swells very considerably in water; the kernel consists of a very thin endosperm and two large plano-convex oily greenish or yellowish cotyledons having the shape of the seed, with the radicle projecting into the pointed end. The brown coloring matter is contained in the inner cell-row of the testa; the albumen and cotyledons are composed of thin-walled parenchyma, the cells being filled with proteids and oil, but are free from starch. The seed is inodorous, and has a mucilaginous, bitterish, and oily taste.

Placentæ seminis lini, *P. G.*, are the press-cakes obtained in preparing linseed oil, and on grinding yield the so-called *cake meal*. These press-cakes are of a dingy-gray color, and their powder shows under the microscope fragments of the brown-yellow testa of linseed, but none of the blackish-brown testa of rape-seed, and yields with boiling water and on filtering an insipid mucilaginous liquid, which when cold is not colored blue by iodine. But cake meal is not recognized by the U. S. Pharmacopœia, which requires that "ground linseed, for medicinal purposes, should be recently prepared, free from unpleasant or rancid odor, and, when extracted with carbon disulphide, should yield not less than 25 per cent. of fixed oil." The Br. P. and F. Cod. likewise order the ground seeds.

Constituents.—The most important constituents of flaxseed are the *mucilage* and *fixed oil*, the latter (see Oleum Lini), according to Chevallier (1844), being contained in the embryo to the extent of about 30 to 37 per cent., the former in the epithelium to the extent of about 15 per cent. The mucilage is $C_{12}H_{20}O_{10}$, and by nitric acid is converted into mucic acid. Besides the above, Leo Meyer (1826) found protein compounds, a small portion of wax, resin, sugar, malates, acetates, and other salts, which are dissolved with the mucilage. The ash amounts to about 3 per cent., and consists of phosphates, with some sulphates and chlorides of potassium, calcium and magnesium.

Action and Uses.—The union of oil and mucilage in flaxseed adapts it for external application in the many cases in which an emollient is required, and the ready absorption of at least the water in its infusion has led to its internal use as a diluent and diuretic. Flaxseed tea is universally employed in *inflammations* of the mucous membranes of the *respiratory*, *digestive*, and *urinary* organs. It serves as the basis of numerous ptisans, and is injected into the rectum, vagina, and bladder in irritations of those organs. It forms an ordinary drink in *renal* and *vesical* irritations. The tea is made with ½ an ounce of flaxseed to a pint of boiling water, macerated for two hours and strained. It may be taken in any convenient quantity. The compound infusion (U. S. P. 1870) contains liquorice, which adapts it to bronchial affections. Flaxseed mucilage is prepared by boiling the seed. It is commonly used to cover *erysipelatous* and other inflammations of the skin, *burns*, etc., but is objectionable if allowed to get dry, by rendering the skin stiff; it is also apt to become sour and irritating. For the purposes last mentioned lead acetate is sometimes dissolved in it. It precipitates the solution of lead subacetate.

The flaxseed poultice is prepared by gradually pouring boiling water upon flaxseed meal and stirring the mixture until it acquires the proper consistence. As it tends to render the skin white, wrinkled, and sodden, and to excite a pustular eruption, the part to which it is applied should first be covered with sweet oil, fresh lard, or glycerin; or, as directed officially (British Pharmacopœia), olive oil should be mixed with the meal of which the poultice is made. Wherever applied, it should be kept in close contact with the skin. It may be medicated by the addition of narcotic tinctures or watery solutions, of astringents, stimulants, etc.

LIQUIDAMBAR.—Sweet Gum.

A balsamic exudation from Liquidambar styraciflua, *Linné*.

Nat. Ord.—Hamamelaceæ, Balsamifluæ.

Origin.—The sweet-gum tree, also called *bilsted* and *copalm*, is a handsome North American tree, from 12–18 M. (40 to 60 feet) high, growing from Connecticut and Illinois southward to Florida and westward to Mexico. It has a reddish, fine-grained, and compact wood, and a thick gray deeply-furrowed astringent bark, that of the branches being usually furnished with thick wing-like ridges of cork. The leaves are dark-green, round in outline, palmately five- to seven-lobed, and the lobes serrate. The fruit is capsular, beaked, aggregated in globular heads, together with the indurated scales. The leaves, fruit, and bark when bruised have an agreeable odor; the taste of the bark is balsamic and astringent, and that of the other parts mentioned aromatic and acidulous. In its southern locations the tree yields a balsamic exudation from incisions made in the bark.

Description.—Sweet gum, also called, *gum wax* (*Bálsamo de liquidámbar*, Sp.), exudes in the form of a thick liquid having the density of syrup and a yellowish color. On standing it thickens, becomes darker in color, and finally hard at the ordinary temperature, and breaks with a resinous fracture, which is of a variegated appearance, the color being brown, with lighter (and even white) spots and streaks. It softens somewhat by the warmth of the hand, and when heated fuses to a yellowish-brown liquid. It has a very pleasant balsamic odor and taste, the latter being followed by pungency. It dissolves completely, fragments of bark excepted, in alcohol, ether, and chloroform, the alcoholic solution having a slight acid reaction.

Constituents.—A pretty complete analysis of sweet gum was made by William L. Harrison (1874). He obtained, by distillation with a solution of sodium carbonate in water, 3½ per cent. of an aromatic oily hydrocarbon, having the properties of *styrene*, but which was found by Flückiger to be not converted into metastyrene; the aqueous liquor in the retort, on being supersaturated with acid, yielded 5½ per cent. of *cinnamic acid*. The portion insoluble in the alkaline liquor was partly dissolved in hot petroleum benzin, the solution yielding *styracin* on cooling, and finally left a dark-brown nearly tasteless and inodorous resin. The sweet gum examined contained 9 per cent. of impurities. On treating sweet gum with warm petroleum benzin, cinnamic acid and styracin are taken up, and crystallize together on cooling; they may then be separated with weak ammonia, which dissolves the cinnamic acid only. Harrison observed also that by heating sweet gum with a small quantity of water and stirring frequently a gray-colored mixture is obtained resembling storax. The presence of cinnamic acid in sweet gum was previously proved by Hanbury (1857) and Procter (1866). It will be observed that sweet gum

agrees in composition with storax, which in addition contains water mechanically mixed with it.

Pharmaceutical Uses.—A *syrup of sweet gum* is made by the official process for syrup of tolu, and is much employed in some parts of the Southern States. A *syrup of sweet-gum bark* is likewise used and prepared by the official process for syrup of wild cherry (Dr. C. W. Wright, 1856). According to L. Hughes (1876), an ethereal solution of sweet gum is very serviceable for extinguishing the mercury in preparing mercurial ointment.

Action and Uses.—These appear to be identical with those of storax; and indeed the latter is defined by the United States Pharmacopœia to be "a balsam prepared from the inner bark of Liquidambar orientalis." Its action is that of an aromatic resin, operating particularly upon the respiratory and urinary mucous membranes. It is employed in the treatment of chronic profluvia of these parts, such as *bronchitis*, *cystitis*, *pyelitis*, and *gleet*. Externally, it was used formerly in an ointment for the treatment of *scabies* (as storax now is), and for various purposes to which resin cerate is applied, including *frost-bite*, indolent *ulcers*, and *burns*. A decoction, and also a syrup prepared from the bark, are said to be employed in the Western and Southern States in the treatment of infantile *diarrhœa* and *dysentery*. The former is sometimes made with milk. The bark, like the leaves, is astringent.

LIQUORES.—Solutions.

Solutés, Fr.; *Lösungen*, G.

With the exception of infusions, decoctions, and syrups, and of those aqueous liquids containing volatile oils or gases, all aqueous solutions are, by the U. S. Pharmacopœia, designated *Liquores;* the British and some other pharmacopœias embrace under the same head also aqueous solutions of gases. The German Pharmacopœia is inconsistent in its designation, lime-water, chlorine-water, and lead-water being placed among *Aquæ*, while ammonia-water is regarded as a *liquor*. Gutta-percha solutions and blistering liquids alone have a menstruum other than water. Many saline solutions develop a cryptogamic vegetation altering the nature and properties of the dissolved compounds, this is particularly the case with phosphates in the presence of organic substances, through the rapid growth of an alga, Hygrocrocis phosphaticus, which, according to Jacquemaire (1888), is prevented by the presence of carbon dioxide in excess.

LIQUOR ACIDI ARSENOSI, *U. S.*—Solution of Arsenous Acid.

Liquor arsenici chloridi, U. S. 1870.—*Liquor arsenici hydrochlorici*, Br.—*Solution of arsenic chloride, Hydrochloric solution of arsenic*, E.; *Liqueur arsénicale hydrochlorique*, Fr.; *Chlorarsenik-Lösung*, G.

Preparation.—Arsenous Acid, in small pieces, 10 Gm.; Diluted Hydrochloric Acid 50 Cc.; Distilled Water a sufficient quantity, to make 1000 Cc. Boil the arsenous acid with the hydrochloric acid and 250 Cc. of distilled water, until solution has been effected. Filter the liquid, and pass enough distilled water through the filter to make the solution measure 1000 Cc.—*U. S.*

To make one pint of the official solution of arsenous acid, boil 73 grains of arsenous acid and 384 minims of diluted hydrochloric acid with 4 ounces of distilled water until dissolved; filter and add enough distilled water to make 16 fluidounces.

Arsenous acid in powder 87 grains: hydrochloric acid 2 fluidrachms; distilled water sufficient to make 1 pint (Imperial).—*Br.*

Arsenous and hydrochloric acids, when heated together, and then distilled, unite to form volatile *arsenous chloride*, As_2Cl_6, which, on being dissolved in water, is decomposed again into the compounds from which it was prepared. The official solutions, therefore, contain simply the two acids.

Properties.—The solution is colorless, has an acid reaction, and an acidulous taste. Hydrogen sulphide yields at once a bright-yellow precipitate of arsenic sulphide. In arsenic strength it corresponds with Fowler's solution, containing 1 per cent. of arsenous acid, or 4.56 grains to the fluidounce, or 4.35 grains (4 grains, *Br.* 1867) to the Imperial fluidounce; Valangin's solution contained 0.38 per cent. of arsenous acid, or 1¾ grains to the fluidounce. The pharmacopœial solutions have the specific gravity 1.009 *U. S.*, 1.010 Br.

The strength is determined as follows: "If 24.7 Cc. of solution of arsenous acid be boiled for a few minutes with 2 Gm. of sodium bicarbonate, the liquid, when cold, diluted with water to 100 Cc. and mixed with a little starch test-solution, it should require from 49.4 to 50 Cc. of decinormal iodine volumetric solution, until the blue tint of iodide of starch makes its appearance (corresponding to 1 per cent. of arsenous acid of the required degree of purity)."—*U. S.* "442 grains boiled for five minutes with 20 grains of sodium bicarbonate, and then diluted with 6 fluidounces of distilled water, to which a little mucilage of starch has been added, does not give with the volumetric solution of iodine a permanent blue color until 875 grain-measurers have been added."—*Br.*

Allied Preparation.—Liquor arsenici bromidi. Clemens' formula (1876), somewhat modified in the manipulation, is as follows: Mix 1 part each of powdered arsenous acid and pure potassium carbonate, and dissolve in about 10 parts of boiling water; then add 80 parts of water and 2 parts of bromine, set aside at a moderate temperature until the liquid has become colorless, and add sufficient water to make the solution weigh 100 parts. It is said to improve by age. *Arsenic bromide*, $AsBr_3$, is crystalline, melts near 25° C. (77° F.), boils and volatilizes without decomposition near 220° C. (428° F.), and is decomposed by water, with the formation of arsenous and hydrobromic acids. The above solution probably contains potassium bromide and arsenate.

Action and Uses.—The advantages of this preparation, which contains the same proportion of arsenic as Fowler's solution, are far from being apparent. Indeed, its action has been pronounced very uncertain. It may be given in *doses* of from 3 to 5 drops, largely diluted and after meals.

LIQUOR AMMONII ACETATIS, *U. S.*, *Br.*—Solution of Ammonium Acetate.

Liquor ammoniæ acetatis, *Liquor ammonii acetici*, P. G.; *Acetas ammonicus liquidus*, *Spiritus Mindereri.*—*Spirit of Mindererus*, E.; *Acetate d'ammoniaque liquide*, *Esprit de Mindérérus*, Fr.; *Ammoniumacetat-Lösung*, *Essigsaure Ammonium-Lösung*, G.

An aqueous solution of ammonium acetate, containing about 7 per cent. of the salt, together with small amounts of acetic and carbonic acids.

Preparation.—Ammonium Carbonate, 5 Gm.; Diluted Acetic Acid, 100 Cc. Add the ammonium carbonate (which should be in translucent pieces, free from white, pulverulent bicarbonate) gradually to the cold diluted acetic acid, and stir until it is dissolved. This preparation should be freshly made when wanted.—*U. S.*

Each fluidounce of diluted acetic acid U. S. P. would require about 23 grains (22.84) of official ammonium carbonate in the preparation of spirit of Mindererus, as directed above.

Strong solution of ammonium acetate 4 fl. oz., distilled water sufficient for 20 fluidounces.—*Br.* Spec. grav. 1.022.

Liquor ammonii acetatis fortior.—Add crushed ammonium carbonate 17½ oz. gradually to 45 oz. of acetic acid; then add more of the acid (about 5 oz.) until a neutral liquid results, and add sufficient water to yield 60 fluidounces of product. Preserve in bottles free from lead.—*Br.* Spec. grav. 1.073.

The present official formula is greatly to be preferred to former ones, a definite amount of ammonium acetate is assured, together with an excess of acetic acid; in following the pharmacopœal directions the dispenser will be sure that no excess of alkali can possibly be present, which latter frequently happened heretofore, when it was impossible to ascertain the exact point of neutrality and the operator's experience and sense of taste were his only guides. The 100 Cc. of diluted acetic acid ordered in the above formula contain 6.048 + Gm. of absolute acetic acid, of which 5.727 + Gm. will be required to neutralize the 5 Gm. of official ammonium carbonate (consisting of ammonium acid carbonate and carbamate), as may be see from the equation, $NH_4HCO_3NH_4NH_2CO_2 + 3HC_2H_3O_2 = 3NH_4C_2H_3O_2 + H_2O + 2CO_2$—156.77 : 179.58 : : 5 : x, $x = 5.7274$ +.

Solution of ammonium acetate should never be kept on hand for dispensing purposes, as it absorbs ammonia from the air, and finally acquires an alkaline reaction.

Properties.—It is a "clear, colorless liquid, free from empyreuma, of a mildly saline taste and acid reaction. It is wholly volatilized by heat. When heated with potassa it evolves vapors of ammonia, and when heated with sulphuric acid it gives out vapor of acetic acid.—*U. S.*

The British Pharmacopœia directs the preparation of a neutral solution which is somewhat stronger: the undiluted acetic acid being used, less carbonic acid is retained by the liquid, and may be expelled by trituration or stirring at first, and toward the close of the

reaction by warming the liquid until it has no effect upon test-paper, after which it is to be properly diluted. In place of ammonium carbonate, ammonia-water may be used to effect the neutralization, as directed by the German Pharmacopœia, which requires the neutralized liquid to be heated to boiling for a short time, in order to expel traces of empyreumatic matter likely to be present in the ammonia-water. The description corresponds with the one given above, but the solution is to have the specific gravity 1.032–1.034, to contain 15 per cent. of ammonium acetate, and to be not rendered turbid by barium nitrate (absence of sulphate), nor, after acidulation with nitric acid, by silver nitrate (absence of chloride).

Action and Uses.—It is generally held to be efficient in the forming stage of *catarrh*, *sore throat*, and *muscular rheumatism*, and in the *eruptive fevers* when the eruption is slow to appear. It is the best diaphoretic in epidemic catarrh or *influenza*. In low forms of *fever* it often of signal advantage, helping to sustain the powers of life until the crisis is past. In this way it is peculiarly valuable in *typhus*, in which, like other appropriate stimulants, it lowers the pulse and temperature, moistens the dry tongue, and moderates the delirium. It is reported to have been peculiarly efficacious in the treatment of epidemic *pseudo-membranous bronchitis*.

In *sick headache* few remedies are so successful as a teaspoonful or two of this solution repeated every hour. In *alcoholic intoxication* it frequently dissipates at once the signs of drunkenness. It is reported to be an efficient remedy in *dysmenorrhœa* and *menorrhagia*. It is an adjuvant in the treatment of scarlatinous *dropsy*, and is perhaps not without advantage in chronic *eruptions of the skin*.

Externally, it is a valuable discutient in *contusions*, *glandular swellings*, *mammary engorgements*, *commencing abscesses*, *hydrarthrosis*, and even acute *hydrocele*. It has been found beneficial in *impetigo capitis*.

The *dose* of the official solution is from Gm. 8–16 (2 to 4 fluidrachms), diluted with sweetened water.

LIQUOR AMMONII CITRATIS, *Br.*—Solution of Citrate of Ammonium.

Citrate d'ammoniaque liquide, Fr.; *Ammoniumcitrat-Lösung*, G.

Preparation.—Strong Solution of Ammonium Citrate 5 fl. oz.; Distilled Water sufficient for 20 fluidounces.—*Br.* Spec. grav. 1.062.

Liquor ammonii citratis fortior.—Neutralize citric acid 12 oz. with ammonia 11 fluidounces or sufficient, and add distilled water sufficient to yield 20 fluidounces of product. Store in bottles free from lead.—*Br.* Spec. grav. 1.209.

Citric acid combines with ammonia, forming ammonium citrate and water. The two solutions are clear and colorless, have a saline taste, and should not change either litmus- or turmeric-paper.

Action and Uses.—This solution is perhaps more palatable than solution of ammonium acetate, but its medicinal effects are not perceptibly different. *Dose*, from Gm. 8–16 (2 to 4 fluidrachms).

LIQUOR ANTIMONII CHLORIDI, *Br.*—Solution of Antimony Chloride.

Liquor stibii chlorati, *Antimonium muriaticum liquidum*, *Butyrum antimonii* (*s. stibii*), *Chloridum* (*s. Chloruretum*) *stibicum.*—*Liquid butter of antimony*, E.; *Chlorure* (*Beurre*) *d' antimoine liquide*, *Huile d' antimoine*, Fr.; *Spiessglanzbutter*, G.

A solution of $SbCl_3$ (molecular weight 225.71) in hydrochloric acid.

Preparation.—Purified Black Antimony 1 pound; Hydrochloric Acid 4 pints. Place the black antimony in a porcelain vessel, pour upon it the hydrochloric acid, and constantly stirring, apply to the mixture, beneath a flue with a good draught, a gentle heat, which must be gradually augmented as the evolution of gas begins to slacken, until the liquid boils. Maintain it at this temperature for fifteen minutes; then remove the vessel from the fire, and filter the liquid through calico into another vessel, returning what passes through first, that a perfectly clear solution may be obtained. Boil this down to the bulk of 2 pints (Imperial), and preserve it in a stoppered bottle.—*Br.*

Hydrochloric acid decomposes antimony sulphide with the product of antimonous chloride, which dissolves in the acid liquid, and hydrogen sulphide, which escapes; $Sb_2S_3 + 6HCl$ yields $2SbCl_3 + 3H_2S$. Provision must be made to carry off the offensive gas

either through a flue or by working in the open air. The powdered sulphide and the acid may be left in contact for several hours, during which time the reaction will partly take place; the mixture should afterward be slowly heated until the boiling-point is reached and the disengagement of hydrogen sulphide ceases. The insoluble mineral impurities are then filtered off, either through calico, or, preferably, through a material which is not corroded by the acid liquid, such as gun-cotton, asbestos, or glass-wool. The arsenic naturally contained in the antimony is partly evolved, and the remainder is removed as arsenous chloride by boiling the filtered liquid and concentrating it as directed, this arsenic compound being much more volatile than the antimonous chloride. The French Codex directs the liquid to be concentrated by evaporation, and the residue to be distilled—an operation requiring great care in case notable quantities of lead chloride be present.

Properties.—It is a yellowish or yellowish-red liquid having the spec. gr. 1.47, and yielding with water a white precipitate of antimonous oxychloride (*powder of Algaroth*), $2SbCl_3.5Sb_2O_3$. This precipitate is completely soluble in an aqueous solution of tartaric acid, and the solution, when treated with hydrogen sulphide, yields an orange-brown precipitate of antimony sulphide, which, when dried at 100° C., should weigh about 22 grains for every fluidrachm of the official solution. When free from other metals the solution is colorless; as prepared from the crude sulphide, however, it always contains ferric chloride.

Antimonium chloride of the French Codex is a soft white, translucent, crystalline, and very caustic mass, which melts to a clear liquid at 73° C. (163.5° F.) and boils at 223° C. (433.5° F.). On exposure to the air it fumes and absorbs moisture, deliquescing to a clear oily liquid, which is precipitated by more water. The salt is soluble in cold alcohol, and this solution, when boiled, precipitates antimonous oxychloride.

Impurities.—*Lead*, if present, will mostly crystallize from the cold liquid; what remains dissolved may be recognized by a drop of dilute sulphuric acid, which will cause a white precipitate. *Copper* is recognized by the blue color obtained on treating the liquid with an excess of ammonia. *Arsenic* is detected by rendering the liquid strongly alkaline with potassa, adding a little pure zinc, and heating to boiling. The vapors, on coming in contact with filtering-paper moistened with a drop of solution of silver nitrate, will then color the latter black.

Action and Uses.—Butter of antimony is one of the most powerful caustics employed in surgery, and from its readily penetrating into *wounds* has been used to cauterize those inflicted by rabid animals and venomous serpents. It has also been applied to *malignant pustule*, *warts*, *condylomata*, and *chancres*. "Pure chloride of antimony has been used as an application to *staphyloma* by some German surgeons; a camel's-hair pencil or a point of lint is dipped in the deliquescent salt and applied to the tumor until a whitish crust is perceived, when the whole is washed away by means of a large camel's-hair pencil dipped first in milk and afterward into milk and water" (Neligan).

Several instances of poisoning by this preparation are on record in which, besides abrasions of the mouth and throat, or even a charred appearance of these parts, there was more or less complete general collapse. In one case recovery took place after 4 or 5 drachms, and in another after an ounce had been taken. In a fatal case the dose was 3 ounces, and on inspection after death the interior of the alimentary canal from the mouth down to the jejunum presented a black appearance, as if the parts had been charred (Taylor).

The proper *antidotes* for poisoning by chloride of antimony are chalk and magnesia or their carbonates, followed by demulcent drinks. Tannic acid and the substances containing it are also recommended.

LIQUOR ARSENI ET HYDRARGYRI IODIDI, *U. S.*, *Br.*—Solution of Arsenic and Mercuric Iodide.

Solutio Donovani.—Donovan's solution, E.; *Soluté d'iodo-arsénite de mercure, Liqueur de Donovan*, Fr.; *Jodquecksilber-Arsenik-Lösung, Donovansche Tropfen*, G.

Preparation.—Arsenic Iodide 10 Gm.; Red Mercuric Iodide, 10 Gm.; Distilled Water, a sufficient quantity, to make 1000 Cc. Triturate the iodides with 150 Cc. of distilled water until they are dissolved. Filter the liquid, and pass enough distilled water through the filter to make the solution measure 1000 Cc.—*U. S.*

A fluidounce of Donovan's solution contains 4.56 grains each of arsenic iodide and red

mercuric iodide; the liquid should be kept in a dark place, and should not be dispensed if the color has changed to yellowish-red and the odor of iodine become apparent.

Iodide of arsenium, mercuric iodide, each 45 grains; distilled water sufficient for 10 fluidounces (Imperial).—*Br.*

This is a solution of the two iodides in very nearly the proportion of their molecular weights, and containing them mixed, but not chemically combined. The present preparation contains about the same quantity of each of the two iodides as that of 1880.

Properties.—It is of a light-yellow color, has a metallic taste, and gives precipitates with solutions of silver, alkalies, and salts of the alkaloids.

Action and Uses.—The combination of arsenic and mercury in this preparation was proposed for the treatment of *syphilitic* diseases of the skin, and was thought to be especially useful in those of the squamous form, although mercury alone is apt to aggravate them. Yet many consider that in these cases the compound is more injurious than useful. The efficacy of Donovan's solution is shown in cutaneous affections apparently free from syphilitic taint when they have become chronic and have resisted arsenic alone. Among these may be mentioned *impetigo* and *sycosis;* in the latter it should be associated with epilation. The best authorities deny that it has any curative influence in *lupus.* The *dose* is Gm. 0.30 (gtt–v), gradually increased and taken after meals, well diluted.

LIQUOR ATROPINÆ SULPHATIS, *Br.*—Solution of Atropine Sulphate.

Soluté de sulfate d'atropine, Fr.; *Schwefelsaure Atropinlösung,* G.

Preparation.—Take of Atropine Sulphate 9 grains (1 part); Camphor-water 16½ fluidrachms (99 fluid parts). Dissolve.—*Br.*

This solution is best prepared in small quantity only, that decomposition, which is likely to result from long keeping, may be prevented. Combining the atropine with benzoic or boracic acid does not, in the experience of Tichborne (1877), prevent the appearance of fungoid growth, but *solution of atropine salicylate* made of 2.7 grains of atropine and 1.3 grains of salicylic acid to 1 ounce of distilled water, was found to keep indefinitely. Camphor-water prevents decomposition better than distilled water.

Action and Uses.—This preparation is identical with solution of atropine in its strength, action, uses, dose, and mode of application. For acting upon the iris disks of paper or gelatin impregnated with either solution may be introduced between the eyelid and the eyeball.

LIQUOR BISMUTHI ET AMMONII CITRATIS, *Br.*—Solution of Bismuth and Ammonium Citrate.

Liquor bismuthi.—Solution of ammonio-citrate of bismuth, E.; *Soluté de citrate de bismuth ammoniacal,* Fr.; *Wismuth-Ammoniak-Citrat-Lösung,* G.

Preparation.—Take of Bismuth Citrate 806 grains; Solution of Ammonia, Distilled Water, of each a sufficiency. Rub the Bismuth citrate to a paste with a little of the water; add the solution of ammonia, gradually and with stirring, until the salt is just dissolved. Dilute with distilled water to form 1 pint (Imperial).—*Br.*

In the former edition of the Br. P. a concentrated solution of bismuth nitrate in nitric acid was mixed with double the quantity of citric acid theoretically necessary for the formation of bismuthous citrate; and this acid liquid was neutralized with ammonia. Thus prepared, the solution contained ammonium citrate and bismuthous citrate, or a double salt of these two compounds, and in addition thereto a notable quantity of ammonium nitrate. N. G. Bartlett (1865), however, showed—and his observations were corroborated by Méhu (1873)—that the neutral bismuthous citrate dissolves in ammonia, and that on evaporation a dry salt is obtained which is again soluble in water, and for which Rother (1876) gives the formula $(NH_4)_3C_6H_5O_7.BiOOH$. These observations have led to several modifications of the former formula, by which contamination with ammonium nitrate is at the same time avoided. These modifications are based upon the preparation of *bismuth citrate*—1, by double decomposition between bismuth nitrate and potassium or sodium citrate; or 2, by first preparing bismuthous hydroxide or subcarbonate, and treating this with the equivalent quantity of citric acid; or 3, as suggested by Rother, by boiling for a short period equivalent quantities (10 parts) of bismuth subnitrate and (7 parts) of citric acid with some water. This latter process has been adopted by the

U. S. P. (see page 339), while the Br. P. prepares its *Bismuthi citras* from a solution of bismuthous nitrate in nitric acid, diluted with water as much as possible, by precipitating it with sodium citrate. These precipitated citrates frequently contain small quantities of bismuthous chloride and sulphate as impurities, and these two salts remain insoluble on treating the citrate with ammonia, which should be added merely until it remains permanently in slight excess. By filtering, weighing the dried undissolved residue, and deducting it from the original weight of the bismuthous citrate, the actual weight of the latter is readily ascertained, and the strength of the solution may thus be adjusted.

Bismuthi et ammonii citras, *Br.*, is prepared from the above solution (see p. 339), the heat for drying in scales being limited to 37.8° C. (100° F.) to avoid loss of ammonia.

Properties.—The solution of the British Pharmacopœia is colorless, and has a saline slightly styptic taste and the specific gravity 1.07. It is neutral or slightly alkaline to test-paper, and mixes with water without change. Potassa yields a precipitate of bismuth hydroxide and liberates ammonia; hydrochloric acid produces a precipitate of basic salt, which is redissolved by an excess of acid. 2 fluidrachms of the official solution, treated with hydrogen sulphide yield a black precipitate, which after drying weighs about 7 grains. Each fluidrachm represents 3 grains of bismuthous oxide.

Action and Uses.—If, as we have endeavored to show elsewhere, the action of bismuth is entirely local and depends upon its insolubility, the use of its soluble salts is irrational. Yet the solubility of this preparation is set forth as a ground of its superiority over the oxide and the subnitrate! As an astringent it is quite superfluous, although it seems to have been employed in cases of flaccidity of the *vagina*, *rectum*, etc. The official *dose* is stated to be from Gm. 2–4 (fʒss–j).

LIQUOR CALCIS, *U. S., Br.*—Solution of Lime.

Aqua calcariæ, P. G.; *Aqua calcariæ ustæ*, *Aqua calcis*, *Calcaria soluta*, *Oxydum calcicum aqua solutum.*—*Lime-water*, E.; *Eau (Liqueur) de chaux*, Fr.; *Kalkwasser*, G.

A saturated, aqueous solution of calcium hydroxide.

The percentage of calcium hydroxide varies with the temperature, being somewhat over 0.17 per cent. at 15° C. (59° F.), and diminishing as the temperature rises.

Preparation.—Lime 12 Gm., Distilled Water a sufficient quantity. Slake the lime by the gradual addition of 70 Cc. of the water, then add 360 Cc. of water, and stir occasionally during half an hour. Allow the mixture to settle, decant the liquid, and throw this away. Now add to the residue 3600 Cc. of distilled water, stir well, wait a short time for the coarser particles to subside, and pour the liquid, holding the undissolved lime in suspension, into a glass-stoppered bottle. Pour off the clear liquid when wanted for use.—*U. S.*

Wash slaked lime 2 oz. with distilled water until the filtrate acidulated with nitric acid is not rendered turbid by silver nitrate. Put the washed lime into a stoppered bottle containing 1 gallon of distilled water, and shake well for two or three minutes. After 12 hours the excess of lime will have subsided, and the clear solution may be drawn off with a siphon as it is required for use, or transferred to a green glass bottle furnished with a well-ground stopper.—*Br.*

When water is added to burned lime or calcium oxide, this is converted into *calcium hydroxide*, $Ca(OH)_2$ which dissolves in the excess of water. If used for this purpose, the lime should be prepared from marble, when it will be nearly pure: but if made from ordinary limestone it usually contains alkalies which are readily soluble in water, hence it should be treated with a portion of the water, and this rejected to remove the impurities mentioned. The water should be kept, at a low temperature, upon the lime to retain the solution saturated, and this should be drawn off as needed.

Properties.—Lime-water is a clear, colorless, inodorous solution of a slight alkaline disagreeable taste, but of a strong alkaline reaction to test-paper; its specific gravity is 1.0015 at 15° C. (59° F.) When exposed to air it becomes covered with a pellicle of calcium carbonate; the same compound is formed with the loss of the alkaline reaction if carbon dioxide is passed through the solution and the solution heated to expel the excess of the gas (absence of alkalies or alkali carbonates). If lime-water is heated to boiling, it becomes turbid from the separation of some calcium hydroxide, which dissolves again on cooling. On the addition of test-solution of oxalic acid, lime-water yields a white precipitate of calcium oxalate, which is insoluble in acetic, but soluble in hydrochloric, acid.

Tests.—Since at 15° C. (59° F.) lime requires about 780 parts of water for solution,

1 fluidounce (U. S. measure) of lime-water contains 0.57 grain of lime or 0.75 grain of calcium hydroxide, which is equal to 0.125 and 0.165 per cent. respectively. At 21° C. (70° F.) 800 parts of water are required for solution, indicating 0.125 per cent. of calcium oxide or 0.166 per cent. of calcium hydroxide; a solution of lime of this strength is obtained at 32° C. (89.6° F.). According to Thomas Maben (1883), 1 part of CaO is soluble

at	10°	20°	30°	40°	60°	80°	99°C.
in	770	791	862	932	1136	1362	1650 parts of water.
equal to	0.129	0.126	0.116	0.107	0.088	0.073	0.06 per cent. CaO.

On mixing 100 Cc. of lime-water with 40 Cc. of decinormal volumetric solution of oxalic acid, the liquid should not acquire an acid reaction, indicating at least 0.148 per cent. of $Ca(OH)_2$.—*U. S.* "10 ounces require for neutralization at least 180 grain-measures of the volumetric solution of oxalic acid, which corresponds to 5 grains of calcium oxide (CaO)."—*Br.*

Action and Uses.—Lime-water is destitute of caustic qualities, but is astringent and styptic, diminishing more or less the secretion of parts to which it is directly applied and of the mucous membranes and glands when taken internally. It is a valuable lotion in various diseases of the skin, especially in *eczema capitis*, and *ulcers*. In the former the affected part should be thoroughly cleansed with warm water and soap before the lime-water is applied. In all cases of chronic *mucous* or *purulent discharges* from the nostrils, fauces, auditory canal, vagina, urethra, or rectum, it is one of the simplest and best washes. It is said to destroy *ascarides of the rectum*. With flaxseed oil or sweet oil it forms the official liniment so useful in the treatment of *burns*. Equal parts of lime-water and cod-liver oil have been given with great advantage in teaspoonful doses in a case of *scalded throat* produced by hot steam.

Internally, as already indicated, it appears to escape in part the neutralizing influence of the gastric acids, for it has long been used to diminish the mucous secretion in *chronic bronchitis*, and to modify the urine and the lining membrane of the urinary passages in *calculous* and other disorders of the urino-genital organs. In vesical diseases lime-water is sometimes injected into the bladder through a catheter after properly cleansing the organ. It would seem, whether employed in the one or the other manner, to act by diminishing the irritability of the vesical mucous membrane. Lime-water is one of the most useful remedies for excessive *vomiting* produced by irritability or ulcer of the stomach, especially when the matters rejected are very acid. In the vomiting of tubercular phthisis and of simple and cancerous gastric ulcer milk with lime-water is sometimes the only nutriment that can be retained. The constipation that results from the internal use of lime-water, as well as its beneficial operation in chronic bronchitis, proves that it is not fully acidified in the stomach. In *diarrhœa* attended with acid stools and the associated colic and tympanites belonging to acid gastro-intestinal fermentation, and which is so prevalent during hot seasons, especially among infants, lime-water added to milk in the proportion of from one-fourth to one-half is a very efficient remedy. The *aphthous* condition of the mouth and fauces, and the *thrush* fungus that forms there under these circumstances, are often removable by lime-water. In *chronic diarrhœa*, dependent on whatever cause, this solution, given with milk as the almost exclusive food, will usually mitigate, and in appropriate cases cure, the disease. The most signal triumphs of this simple method are achieved in *chronic dysentery* and in cases of *typhoid fever* protracted by the persistence of the intestinal ulcers. Even in tubercular *phthisis* it sometimes suspends the discharges for a considerable time. In all these affections it diminishes *tympanites*, and in certain cases in which that symptom appears to be the result of intestinal fermentation, lime-water is one of the best remedies. This preparation has been extolled as a remedy for *diabetes*, and the highest testimony in its favor exists, so far as relates to its power of lessening the secretion of sugar. It in like proportion diminishes thirst and voracious appetite. It should be given with milk, or, if that is contraindicated, with cream, and in quality not less than 1 or 2 pints daily. In *hydruria* or diabetes insipidus it is more efficacious still. It has been recommended in *rachitis* and *osteomalacia*, and is very useful in gouty (acid) *dyspepsia*, especially when taken during the first stages of digestion. The *cutaneous eruptions* so often associated with gouty disorders are usefully treated by the internal use of lime-water.

The demonstration that false membranes are soluble in lime-water led to the use of gargles and the spray of this liquid and the vapors of slaked lime in *pseudo-membranous pharyngitis* (diphtheria) and in *laryngitis* and *bronchitis* of the same type. The result has been the cure of a large number of cases in which the nature of the disease was

abundantly demonstrated by inspection or by the rejection of false membranes. To be successful the gargle or inhalation should be frequently repeated. As often as possible the patient should be confined in a dense vapor of slaking lime, and with this the use of atomized lime-water should be alternated, while the room is kept filled with the vapor. Other treatment, except stimulants, is of little use. It may perhaps be questioned whether the good results of this method are due to the solvent action of the lime or to the softening influence of the watery vapor which holds it in solution. Possibly, both influences contribute to the result, but the latter is probably the most efficient.

Lime-water is an appropriate antidote to *arsenous acid*, with which it forms an innocuous compound.

The *dose* of lime-water is Gm. 16–120 (f℥ss–iv) given from one to four times a day with an equal quantity of milk or weak animal broth.

LIQUOR CALCIS CHLORINATÆ, *Br.*—Solution of Chlorinated Lime.

Chlorure de chaux liquide, Fr.; *Chlorkalk-Lösung*, G.

Preparation.—Take of Chlorinated Lime 1 pound; Distilled Water 1 gallon. Mix well the water and the chlorinated lime by trituration in a large mortar, and, having transferred the mixture to a stoppered bottle, let it be well shaken several times for the space of 3 hours. Pour out now the contents of the bottle on a calico filter, and let the solution which passes through be preserved in a stoppered bottle.—*Br.*

The solution has the odor, taste, and general properties of chlorinated lime (see page 382). The Br. P. requires the solution to contain at least 1.9 (about 2) per cent. of available chlorine, which is ascertained by the following test: 80 grains by weight, mixed with 20 grains of potassium iodide dissolved in 4 fluidounces of water, when acidulated with 2 fluidrachms of hydrochloric acid give a red solution, which requires for the discharge of its color 450 grain-measures of the volumetric solution of sodium thiosulphate.

Action and Uses.—This solution is convenient as a *deodorizer* of decomposing organic matter, as an *excitant* of the skin in low fevers, as a stimulant of chronic *cutaneous eruptions*, and for the various purposes enumerated under Chlorinated Lime.

LIQUOR COCAINÆ HYDROCHLORATIS, *Br. Add.*—Solution of Cocaine Hydrochlorate.

Preparation.—Cocaine Hydrochlorate 33 grains; Salicylic Acid ½ grain; Distilled Water, sufficient to produce 6 fluidrachms. Boil the water, add the salicylic acid, and then the cocaine hydrochlorate; cool, and add water if necessary, to produce the required volume.—*Br. Add.*

This is a very strong solution of cocaine hydrochlorate, and therefore should be used with care. Each fluidrachm contains 5.5 grains of the salt, or each minim about $\frac{1}{11}$ of a grain. The dose is stated to be 2 to 10 minims. The salicylic acid is added as a preservative.

LIQUOR EPISPASTICUS, *Br.*—Blistering Liquid.

Linimentum cantharidis, Br. 1864.—*Liqueur vésicant*, Fr.; *Blasenziehende Flüssigkeit*, G.

Preparation.—Take of Cantharides, in powder, 5 ounces; Acetic Ether a sufficiency, Mix the cantharides with 3 fluidounces of acetic ether; pack in a percolator, and at the expiration of 24 hours pour acetic ether over the contents of the percolator, and allow the solution to pass slowly through until 20 fluidounces are obtained. Keep the liquid in a stoppered bottle.—*Br.*

As formerly made with acetic acid and ether, the blistering liquid contained the entire amount of cantharidin in solution. Tichborne preferred to use in place of acetic acid an equivalent amount of glacial acetic acid, as thereby less water is introduced into the powder. Brady has shown that when spontaneously evaporated from the skin the film left is not uniform, but thickest at the circumference. Deane (1876) recommended the discarding of the official solvents, and the substitution of acetic ether, which dries more uniformly and takes up a larger amount of cantharidin.

Uses.—This liquid is intended to produce a rapid vesication, which is effected chiefly by the acetic acid, although the irritation is maintained by the cantharides. It should

be well rubbed into the skin with a small mop or piece of sponge attached to a handle, until redness is produced, and should be used only on limited portions of the skin.

LIQUOR FERRI ACETATIS, *U. S., Br.*—Solution of Ferric Acetate.

Liquor ferri acetici, P. G.—*Solution of ferric acetate*, E.; *Acétate ferrique liquide*, Fr.; *Ferriacetat-Lösung*, G.

An aqueous solution of ferric acetate $Fe_2(C_2H_3O_2)_6$; molecular weight 464.92—containing about 33 per cent. of the anhydrous salt and corresponding to about 7.5 per cent. of metallic iron.

Preparation.—Solution of Ferric Sulphate, 1000 Gm.; Glacial Acetic Acid, 260 Gm.; Ammonia-water, 850 Cc.; Water, Distilled Water, each a sufficient quantity to make 1000 Gm. Mix the ammonia-water with 3000 Cc. of cold water, and the solution of ferric sulphate with 10,000 Cc. of cold water. Add the latter solution slowly to the diluted ammonia-water, stirring constantly. Let the mixture stand until the precipitate has subsided as far as practicable, and then decant the supernatant liquid. Add to the precipitate 6000 Cc. of boiling water, mix well, and again set the mixture aside, as before. Repeat the washing with successive portions of boiling water, in the same manner, until the washings are no longer affected by sodium cobaltic nitrite test-solution (showing the removal of ammonia and its salts). Transfer the mixture to a wet muslin strainer, allow the precipitate to drain completely, and press it, folded in the strainer, until its weight is reduced to 700 Gm. or less. Now add the precipitate gradually to the glacial acetic acid contained in a jar provided with a glass stopper, stirring the mixture after each addition until each portion added is nearly dissolved before adding another portion. Finally, add enough distilled water to make the product weigh 1000 Gm., mix thoroughly, allow it to become clear by subsidence, and decant the clear solution. Keep the product in well-stoppered bottles, in a cool place, protected from light.—*U. S.*

To make 1 pint of this solution 14 fluidounces of solution of ferric sulphate should be diluted with 10 pints of water, and then poured slowly into a mixture of 15¼ fluidounces of ammonia-water and 4 pints of water. The well-washed and drained precipitate, free from ammonium salts, should be dissolved in 4 fluidounces of glacial acetic acid, as directed above, and finally enough distilled water added to bring the volume of finished product up to 16 fluidounces.

This formula is modelled after that of the German Pharmacopœia for 1872, but yields a product differing from it not only in strength, but also in composition. The first step is the precipitation of ferric hydroxide, which must be accomplished at a low temperature, the iron solution being poured slowly, and with continued stirring, into the ammoniacal liquid, which must remain in slight excess, and the precipitate being washed with boiling water by decantation until ammonium salts can no longer be detected. After draining the precipitate upon a strainer this is folded and pressure applied to it very gradually—an operation which requires patience to avoid bursting of the press-cloth. The pressure should be very slowly increased until the residue no longer adheres to the cloth as a soft pulpy mass, but may be readily removed in the form of a somewhat firm cake.

The change in the directions for washing the precipitate from cold to boiling water will prove of great benefit, as it is almost impossible to remove the alkali salts by the former treatment, and the presence of these has been shown to be the cause of the instability of the solution. If carefully prepared by the present official formula, the liquid will keep perfectly, and can even be exposed to a temperature of 100° Cc. (212° F.) without undergoing decomposition. Some years ago Oldtmann recommended the removal of water and alkali by freezing, but the washing by hot water is far less troublesome and has been found by us thoroughly satisfactory.

Liquor ferri acetatis fortior, *Br.*—Strong solution of ferric acetate. Take of solution of persulphate of iron 5 fluidounces; glacial acetic acid 3 fluidounces; solution of ammonia, distilled water, of each sufficient. Mix 8 fluidounces of solution of ammonia with 1 pint of distilled water; to this gradually add the solution of persulphate of iron, previously diluted with about a pint of distilled water; stir the whole thoroughly, taking care that the ammonia is, even finally, in slight excess, as indicated by the odor of the mixture. Let the whole stand for two hours, stirring occasionally; then put it on a calico filter, and when the liquid has drained away, wash the precipitated ferric hydroxide with distilled water until the liquid which passes through the filter ceases to give a precipitate with solution of barium chloride. Let the ferric hydroxide drain; squeeze to remove superfluous moisture; dissolve it in the glacial acetic acid; and make the volume

up to 10 fluidounces with distilled water. Allow any insoluble matter to subside, and pour off the clear solution.

The strong solution of the Br. P. is somewhat weaker than the liquor of the U. S., and contains a larger excess of acetic acid. Its specific gravity is 1.127, and it contains 6.4 per cent. of metallic iron or 9.2 per cent. of Fe_2O_3. 1 fluidrachm of it, diluted with water, yields with ammonia 5.7 grains of ferric oxide.

LIQUOR FERRI ACETATIS, *Br.*—This is made by mixing 5 fluidounces of strong solution of ferric acetate with sufficient distilled water to make 20 fluidounces. It has the specific gravity 1.031.

Properties.—Solution of ferric acetate is "a dark red-brown, transparent liquid, of an acetous odor, a sweetish, faintly styptic taste, and a slightly acid reaction; sp. gr. 1.160 at 15° C. (59° F.) The diluted solution forms a brown-red precipitate with ammonia-water, and a blue precipitate with test-solution of potassium ferrocyanide. When heated with sulphuric acid the solution evolves acetous vapors."—*U. S.* If the solution be largely diluted with water until it has a mere yellowish color, the addition of solution of potassium sulphocyanate will occasion a blood-red color. On exposure to the light a partial reduction to ferrous salt takes place. As prepared by the pharmacopœial directions, and provided the acetic acid be of the proper strength, the liquid will be a solution of normal ferric acetate having the composition given above. The ferric hydroxide, however, will completely dissolve in two-thirds the quantity of acid ordered, the salt then dissolved having the composition $Fe_2(OH)_2(C_2H_3O_2)_4$; and this is the compound which has been largely employed in Europe. It is more readily affected than the preceding by the influence of light and heat, and is more easily decomposed, even in the dark, with the formation of a brown precipitate, if the ferric hydroxide had not been thoroughly washed; precipitates which have been produced under the circumstances indicated are not dissolved on the addition of acetic acid.

The German Pharmacopœia recognizes a solution of the basic acetate, mixed with about 12 per cent. of the normal acetate; this solution has the specific gravity 1.087–1.091, and contains between 4.8 and 5 per cent. of iron.

Tests.—The tests of purity are in both pharmacopœias substantially alike. If a few drops of the liquid be added to freshly-prepared test-solution of potassium ferricyanide, the mixture should acquire a pure brown color without a trace of green or greenish-blue (absence of ferrous salt). If the iron be completely precipitated from the solution by an excess of ammonia, a portion of the filtrate should not yield a white or a dark-colored precipitate with hydrogen sulphide (zinc, copper); another portion should leave no fixed residue on evaporation and gentle ignition (fixed alkalies, alkaline earths, zinc, copper); and a third portion of the filtrate on being acidulated with nitric acid should not be rendered turbid by test-solution of barium nitrate (sulphate) or of silver nitrate (chloride). "If 1.12 (1.1176) Gm. of the solution be introduced into a glass-stoppered bottle (having a capacity of about 100 Cc.), together with 15 Cc. of water and 2 Cc. of hydrochloric acid, and, after the addition of 1 Gm. of potassium iodide, the mixture be kept for half an hour at a temperature of 40° C. (104° F.), and then allowed to cool and mixed with a few drops of starch test-solution, it should require about 15 Cc. of decinormal sodium thiosulphate volumetric solution to discharge the blue or greenish color of the liquid (each Cc. of the volumetric solution consumed representing 0.5 per cent. of metallic iron."—*U. S.*

Pharmaceutical Uses.—Solution of ferric acetate, diluted with water, may be used as a test for free mineral acids, which change the color from red to brown.

FERRI ACETAS. The clear solution obtained in the cold by saturating acetic acid with ferric hydroxide, decanting instead of filtering from the insoluble matter, and evaporated at a temperature of about 60° C. (140° F.), leaves a scaly basic salt, which is again soluble in cold water.

Uses.—Besides possessing the special virtues of chalybeate preparations, this compound is astringent, and indeed may be used as a styptic, both internally and topically. The *dose* of the German preparation after which this one is formed is Gm. 0.03–1 (gr. v–xv) as a tonic or internal astringent. In much larger doses and well diluted with water it has been given as an antidote to *arsenous acid.*

The *dose* of Liq. Ferri Acetatis, Br. P. is from Gm. 0.3 to 2 (5–30 minims) and that of the stronger solution Gm. 0.06–0.5 (1–8 minims).

LIQUOR FERRI CHLORIDI, *U. S.*—Solution of Ferric Chloride.

Liquor ferri perchloridi fortior, Br.; *Liquor ferri sesquichlorati*, P. G.; *Liquor ferri muriatici oxydati*, *Ferrum sesquichloratum solutum.—Solution of chloride of iron*, *Strong solution of perchloride of iron*, E.; *Solution de perchlorure de fer*, *Chlorure ferrique liquide*, Fr.; *Eisenchloridlösung*, *Flüssiges Eisenchlorid*, G.

The specific gravities of the official solutions of ferric chloride are—1.387 *U. S.*, 1.42 *Br.*, 1.280 to 1.282 *P. G.*, 1.26 *E. Cod.*, and they contain 37.8 per cent. *U. S.* (with some free hydrochloric acid), about 39 per cent. *Br.*, 29.8 per cent. *P. G.*, and 26 per cent. *E. Cod.*, of anhydrous ferric chloride.

Preparation.—Iron, in the form of fine wire and cut into small pieces, 150 Gm.; Hydrochloric Acid, 870 Gm.; Nitric Acid, Distilled Water, each a sufficient quantity, to make 1000 Gm. Put the iron wire into a flask capable of holding double the volume of the intended product. Pour upon it 540 Gm. of hydrochloric acid previously diluted with 250 Cc. of distilled water, and let the mixture stand until effervescence ceases; then heat it to the boiling-point, filter through paper, and, having rinsed the flask and iron wire with a little boiling distilled water, pass the washings through the filter. To the filtered liquid add 280 Gm. of hydrochloric acid, and pour the mixture, slowly and gradually, in a stream, into 80 Gm. of nitric acid contained in a capacious porcelain vessel. After effervescence ceases apply heat, by means of a sand-bath, until the liquid is free from nitrous odor. Test a small portion with freshly-prepared test-solution of potassium ferricyanide. Should this reagent produce a blue color, add a little more nitric acid, drop by drop, as long as effervescence is observed, and evaporate off the excess. Finally, add the remaining 50 Gm. of hydrochloric acid and enough distilled water to make the whole weigh 1000 Gm.—*U. S.*

To prepare 1 pint of solution of ferric chloride would require 1550 grains of iron wire, 134 fluidrachms of hydrochloric acid (divided into three portions of 82.5, 44, and 7½ fluidrachms respectively) and 8½ fluidrachms of nitric acid. The first portion of hydrochloric acid should be diluted with 6 fluidounces of distilled water.

Liquor ferri perchloridi fortior, *Br.*—Mix iron wire 4 oz., hydrochloric acid 12½ fl. oz., and water 7 oz.; when effervescence ceases, heat to boiling, filter, rinse the flask and contents with a little water, and pour this over the filter; add to the filtrate hydrochloric acid 7 fl. oz.; then pour the solution in a slow, continuous stream into 1½ fl. oz. of nitric acid, the evolution of red fumes being promoted, if necessary, by a slight application of heat. Evaporate the product until no more nitrous fumes escape and a precipitate begins to form; then add hydrochloric acid 1 fl. oz. and sufficient water to produce 17½ fl. oz. of the solution.—*Br.*

Liquor ferri perchloridi, *Br.* Mix strong solution of perchloride of iron 1 fluidounce with distilled water sufficient for 4 fluidounces. Its spec. grav. is 1.11.

The reactions which take place in the preparation of ferric chloride and the proper manipulations to ensure success have been described. (See Ferri Chloridum, page 719.) The solution of the U. S. Pharmacopœia differs from the similar solutions of the other pharmacopœias in containing about 1.6 per cent. uncombined HCl, or 500 grains of official hydrochloric acid, to the pint; the difference in density has been stated above.

Properties.—Solution of ferric chloride is a reddish-brown liquid, which has a faint odor of hydrochloric acid, an acid reaction, and a strongly styptic taste. It may be mixed with water and alcohol in all proportions without producing a precipitate. Diluted with water, it gives a brown precipitate with ammonia or potassa, a white one with silver nitrate (chloride), and a dark-blue precipitate of Prussian blue with potassium ferrocyanide. It is not altered by exposure to the sunlight, except in the presence of various organic matters, by which the salt is partly reduced to ferrous chloride; and it remains clear when heated to boiling unless ferric oxychloride be present, when it becomes turbid, a slight turbidity being best observed in reflected light. On being evaporated to dryness a reddish-brown salt is left, which at a red heat is partly decomposed and partly volatilized.

Tests.—The same reactions which are used for determining the purity of the salt (see Ferri Chloridum, page 719) are likewise employed for this solution. On adding a crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and a moderately dilute portion of the solution, a black color should not be produced near the crystal (absence of nitric acid). A freshly-prepared solution of potassium ferricyanide should color the solution olive-brown, but not blue (ferrous salt). Diluted with water and boiled, it acquires a darker color, but remains clear (oxychloride).

Test-solution of barium chloride should not cause a precipitate (sulphate). Mixed with excess of ammonia-water and filtered, the liquid should be colorless (copper); a portion of the filtrate, tested with hydrogen sulphide or acidulated with acetic acid and tested with potassium ferrocyanide, should not be precipitated (copper, zinc); another portion of the filtrate, evaporated to dryness and ignited, should leave no residue (alkalies, alkaline earths, zinc, copper). Paper saturated with solution of starch and zinc iodide on being held near the surface of the solution should not acquire a blue color (free chlorine). "If 1.12 (1.1176) Gm. of the solution be introduced into a glass-stoppered bottle (having a capacity of about 100 Cc.), together with 15 Cc. of water and 2 Cc. of hydrochloric acid, and, after the addition of 1 Gm. of potassium iodide, the mixture be allowed to stand for half an hour at a temperature of 40° C. (104° F.), and then allowed to cool, and mixed with a few drops of starch test-solution, it should require about 26 Cc. of decinormal sodium thiosulphate solution to discharge the blue or greenish color of the liquid (each Cc. of the volumetric solution consumed corresponding to 0.5 per cent. of metallic iron).—*U. S.* 2 fluidrachms of the solution, diluted with water, and mixed with an excess of ammonia-water, yield a reddish-brown precipitate which, when washed and ignited, weighs between 30 and 32 grains.—*Br.*

Pharmaceutical Uses.—Martin's hæmostatic, which is used in France, consists of selected pieces of spunk which are saturated with ferric chloride.

Adrian's hæmostatic is made by dissolving 15 Gm. of sodium chloride in 60 Gm. of water, and adding 25 Gm. of solution of ferric chloride, specific gravity 1.26.

Ferrum dialysatum, Liquor ferri dialysatus, *Br.*; Liquor ferri oxychlorati, *P. G.*; Dialyzed iron, *E.*; Fer dialysé, *Fr.*; Flüssiges Eisenoxychlorid, *G.*

Dialyzed iron is made by saturating an aqueous solution of ferric chloride with ferric hydroxide, putting the liquid into a dialyzer and suspending this in water, which is often renewed—as long, indeed, as it acquires an acid reaction. Very little iron will pass through the parchment septum; when dialysis is completed the ferric solution is diluted, so that 100 grains of it, when evaporated and dried at a temperature not exceeding 100° C. (212° F.), will leave a solid residue weighing 5 grains. In France the following process has been adopted: 100 Gm. of solution of ferric chloride of 30° B. are mixed in small quantities with 35 Gm. of ammonia-water of 22° B. The precipitate dissolves at first rapidly, afterward very slowly. When the liquid has become transparent it is introduced into a dialysator and treated as stated before; eight to ten days are required in the preparation.

Similar solutions were obtained by Ordway (1858) and Béchamp (1859) by leaving pure ferric hydroxide in contact with ferric chloride for a prolonged time. Th. Graham (1861) subjected this to dialysis, and succeeded in removing the acid until chlorine corresponding to 1.5 per cent. of HCl was left. Such a solution, however, which would correspond to $Fe_2Cl_6.95Fe_2O_3$, gelatinized ultimately. Hager (1868) found dialyzed iron to have the composition $Fe_2Cl_6.12Fe_2O_3$; Ordway's oxychloride was $Fe_2Cl_6.23Fe_2O_3$. H. Trimble (1878) has analyzed six samples met with in commerce, and found the saline portion to vary in amount between 2.51 and 4.83 per cent., and in composition between $Fe_2Cl_6.11Fe_2O_3$ and $Fe_2Cl_6.31Fe_2O_3$.

Prof. E. Schefler (1878) showed that by precipitation with ammonia very basic oxychlorides of iron may be obtained, which, after having been thoroughly washed, will slowly dissolve in distilled water. The limits at which a soluble precipitate is obtained appear to have been reached on mixing 150 volumes of the official solution of ferric chloride with 91.5 volumes of ammonia-water. The washed precipitate contained 97.83 per cent. Fe_2O_3 to 2.17 per cent. Fe_2Cl_6, and required over 7 weeks for effecting solution in distilled water. The preparation known in some parts of Europe as *Ferrum catalyticum* is probably made by a similar process. The German Pharmacopœia has adopted the following process: Dilute solution of ferric chloride (spec. grav. 1.281) 35 parts with water 160 parts, and pour the mixture slowly into ammonia-water 35 parts, previously diluted with water 320 parts; wash the precipitate, express, and add hydrochloric acid (spec. grav. 1.124) 3 parts; agitate occasionally for 3 days, then warm gently until solution has been effected, and dilute with water until the liquid has the spec. grav. 1.050.

According to the Br. P., 6 fl. oz. of strong solution of iron perchloride are precipitated with ammonia; the washed and squeezed ferric hydroxide is dissolved in 1 fl. oz. of the perchloride solution, the liquid filtered, dialyzed, and made to measure 28 fl. oz.

Owing to the retention of ammonia by ferric hydroxide, solutions of the latter in acid or ferric chloride must vary somewhat in character, and therefore are properly subjected

to dialysis for separating ammonium chloride and increasing the basic character of the ferric oxychloride.

Liquid oxychloride or dialyzed iron is perfectly transparent in thin layers of a deep brown-red color, inodorous, and almost destitute of styptic taste. It is miscible with alcohol, glycerin, syrup, and distilled water, but not with spring water or other, even dilute saline, solutions. A small quantity of tannin merely darkens the liquid; a larger quantity causes a deep-brown gelatinous precipitate. A minute quantity of silver nitrate will not disturb the liquid; a larger quantity will cause a gelatinous brown precipitate, which is again soluble in distilled water; but on adding first a slight excess of ammonia, filtering from the ferric hydroxide, acidulating with nitric acid, and then testing with silver nitrate, a white precipitate of silver chloride is formed. "If to 1 Cc. of the liquid, diluted with 19 Cc. of distilled water, 1 drop of nitric acid be added and 2 drops of volumetric (decinormal) solution of silver nitrate, the mixture should be clear in transmitted light.—*P. G.* This test indicates the thorough washing of the ferric hydroxide and the absence of ammonium chloride from the solution; a few drops more of either the acid or test-solution will cause a turbidity or precipitate. Prepared by the P. G. process, it has the specific gravity 1.050, and contains nearly 3.5 per cent. of iron or about 7 per cent. of oxychloride, having approximately the composition $Fe_2Cl_6.8Fe_2(OH)_6$. A solution which, when evaporated on a water-bath until the residue is pulverulent and weighs 5 per cent., has, according to E. B. Shuttleworth (1877), the spec. grav. 1.034. If 5 per cent. of residue is left after completely drying in a water-bath, the spec. grav. is 1.040, and if the same amount of residue is left after ignition, the spec. grav. of the solution is 1.046. The British Pharmacopœia requires the spec. grav. 1.047.

Ferrum albuminatum, albuminate of iron, is a compound of ferric chloride and albumen largely used in Europe, and for which J. Biel (1878) has given the following process: 10 Gm. of dry soluble egg-albumen are dissolved in 100 Gm. of distilled water; the clear solution is mixed with 1.75 Gm. of crystallized ferric chloride (see page 719) previously dissolved in 24 Gm. of distilled water; 20 Gm. of 90 per cent. alcohol are now added, and sufficient water to make 200 Gm. This concentrated solution will keep in the dark without alteration; for dispensing, to obtain the *Liquor ferri albuminati*, 1 part of it is diluted with 4 parts of distilled water, and then contains 0.033 per cent. of metallic iron, the strength generally adopted in Europe. It is more convenient, however, to evaporate the concentrated solution at a temperature not exceeding 40° C. (104° F.), when the compound is obtained in golden-yellow transparent scales containing 3.34 per cent. of iron, and yielding the solution by dissolving them in one hundred times their weight of distilled water.

Liquor ferri albuminati, *P. G.*, is prepared as follows: 35 parts of dry egg-albumen are dissolved in 1000 parts of water, the solution strained and poured slowly and in a thin stream, under constant stirring, into a mixture of 120 parts of oxychloride-of-iron solution and 1000 parts of water; the precipitate is well washed with water until all chlorine is removed, and then dissolved in a mixture of 3 parts of soda solution, spec. grav. 1.170, and 50 parts of water. To the solution are added 150 parts of alcohol, 100 parts of cinnamon-water, 2 parts of aromatic tincture, and sufficient water to make the finished product weigh 1000 parts. It contains about 4 per cent. of metallic iron.

Ferrum peptonatum, peptonate of iron, is best prepared according to E. Dietrich (1888) as follows: 10 Gm. of dried or 75.0 Gm. of fresh egg-albumen are dissolved in 1000 Cc. of distilled water; to this are added 18 Gm. of hydrochloric acid (sp. gr. 1.124) and 0.5 of pepsin, and the mixture digested at 40° C. (104° F.) until a portion produces only a faint turbidity with nitric acid; allow to cool, neutralize with soda-solution, strain and mix the liquid with 120 Gm. of solution of ferric oxychloride (sp. gr. 1.050) and 1000 Cc. of distilled water. The fluid is now *exactly* neutralized with soda-solution and the precipitate washed by decantation with distilled water until the washings are no longer affected by silver nitrate. The precipitate is drained on a well-wetted calico strainer, transferred to a porcelain dish, 1.5 Gm. hydrochloric acid added and heat applied with stirring on a water-bath until a clear solution results, which is concentrated, spread on plates of glass, and dried between 20° and 30° C. (68° and 86° F.) to yield a scale preparation. *Liq. Ferri Peptonati* is made by dissolving the whole scale product, or the clear solution before drying, in sufficient distilled water to make 900 Gm. of solution to which add 100 Gm. of brandy.

These so-called *indifferent iron preparations* are very sensitive to carbonic acid and sodium chloride and hence they must be prepared as rapidly as possible and with distilled water previously boiled and cooled again.

Action and Uses.—The action of a poisonous dose of ferric chloride is described by Beranger-Féraud and Porte as follows: An acrid and styptic taste in the mouth is followed by epigastric distress, vomiting, colic, diarrhœa with bloody stools, diminution or suppression of urine, cramps and paresis of the legs, cerebral congestion with delirium or collapse, labored breathing, and general cyanosis. It is employed chiefly for the styptic and astringent qualities which it possesses in a high degree. Its efficiency as an internal medicine is displayed in various *passive hæmorrhages*, particularly of the stomach, bowels, uterus, and urinary passages. It is useful in several profluvia, as *leucorrhœa*, *hydruria*, nocturnal *incontinence of urine*, and *vesical catarrh*. It is reported to control *seminal emissions* due to irritability of the urethra or spermatic ducts. In chronic *dysentery* it is one of the best of the astringent medicines appropriate in that affection; it may be prescribed internally and by enema. This preparation is more frequently employed locally as a styptic and astringent in *epistaxis*, hæmorrhage from *leech-bites*, from the jaw after the *extraction of teeth*, from the *tonsils*, from *cancer of the uterus*, from the *umbilical* cord, from the rectum in *hæmorrhoids*, from the uterus after *abortion*, and from *vascular growths* in the cavity of that organ. It is of interest to learn, if possible, in what manner the solution acts in arresting hæmorrhage. Undoubtedly it coagulates the blood itself. If a small artery is allowed to bleed into saucer containing a mixture of 2 parts liq. ferri perchlor. (*B. P.*) and 1 of water, this mixture converts almost instantaneously six or eight times its bulk of blood into a tough, hard clot, and for a long time preserves it from putrefaction (Connel). But Broca has shown that this coagulating action is not instantaneous, but needs about half a minute for its completion; so that if the liquid is applied to a part from which the blood is flowing freely, its styptic influence cannot be exerted upon the vessels from which the blood escapes. But such an influence is essential to an arrest of the hæmorrhage. Hence in applying it with this object every effort must be made by pressure and otherwise to suspend for a time the escape of blood.

One of its most valuable applications is that for the arrest of *post-partum hæmorrhage* caused by uterine inertia. Dr. Barnes, who first brought it into vogue, made use of a mixture of ½ pint of the stronger solution of the chloride (*B. P.*) with 1½ pints of water. He directed that a tube about 9 inches long should be carried by the hand to the fundus of the uterus, previously freed from coagula, and that the liquid should be very slowly injected, care being taken that no air accompanied it. Basing his judgment on clinical observation alone, he declared that his conviction of the utility of this operation was too deep to permit him to hesitate to pursue it or to urge others to do the same. Such appears to have been the general estimate of the operation by the gynæcologists of London, although even in that city several cases of death were attributed to its use by Drs. Bantock, Protheroe Smith, and Snow Beck. Indeed, the last-named gentleman stated that he had seen nine or ten cases in which death resulted from the injection of solution of chloride of iron into the uterus to arrest hæmorrhage. In Edinburgh the great majority of leading obstetrical practitioners agreed that its employment for this purpose is either useless or worse than useless. Some of those who condemn the injection into the uterus of a solution of chloride of iron advocate the introduction into the organ of the hand containing a sponge saturated with a solution of equal parts of the tincture and water, and the expression there of the liquid after the removal of the clots as far as possible. Pollard ascribes the grave consequences of the injection of the solution into the uterus to its escaping into the peritoneal cavity through the Fallopian tubes, or to its entering the uterine veins and causing either embolism or phlegmasia alba dolens (*British Med. Jour.*, Apr. 24 and May 1, 1880). In *pulmonary hæmorrhage* a weak solution of the chloride has been successfully used in the form of an atomized spray. It may be employed to check *gastric hæmorrhage* in any of the various conditions in which that accident occurs. This powerful styptic has been used to cure *aneurism*, varicose, sacculated, and others; but, although the operation is successful in coagulating the blood in the tumor, it has so often happened either that the tumor suppurated, or that purulent infiltration took place around it, or that fatal embolism occurred, that the operation is no longer considered warrantable. (Compare *Med. Record*, xxiii. 672.) It has been most successful in erectile tumors of the scalp, and safest when the tumors, previously blistered or not, have been covered with compresses wet with the astringent solution. *Varicose veins* have been treated by injections of this preparation, pressure being maintained between the point operated upon and the heart. In chronic *ophthalmia* with varicose enlargement of the blood-vessels it affords probably the best chance of cure. As a local application in pharyngeal *diphtheria* it appears to excel all other stimu-

lants and caustics. Goldschmidt recommends that every two hours should be given about 5 ounces of water holding in solution Gm. 1 (20 drops) of solution of perchloride of iron (at 20 degrees), followed by a mouthful or two of cold milk (*Bull. de Thérap.*, cxv. 19), and that milk should be the only food allowed. In the same manner it cures *chilblains* and is advantageous in *zona*. It is useful in repressing fungous granulations everywhere, but especially in cases of *ingrown toe-nail* and in ulceration of the *gums*. It forms one of the best dressings for *hospital gangrene*, hardening the tissues and correcting the fetor, and has a like effect in *sweating of the feet*. A solution of 1 part of the chloride in 2 of water has been applied with alleged curative effects in certain *scrofulous ulcers* that had resisted all other treatment (*Bull. de Thérap.*, xcix. 190). A weak solution (one-sixteenth) has been used as an injection for the radical cure of *hydrocele*. In *prolapsus of the rectum* it has been efficiently employed, the protruding bowel being well painted with the solution and then reduced, after which it is retained by means of a tampon moistened with a diluted solution of the medicine. *Dose*, Gm. 0.06–0.60 (ɱj–x), mixed with syrup and largely diluted.

As the teeth are very actively and injuriously attacked by this preparation, they should be carefully guarded against its action by administering the liquid through a glass tube and by thoroughly washing the mouth after its use.

Albuminate of iron has been used by Donitz in Japan, both internally and hypodermically, in the treatment of "kakke" (*Medical Record*, xvi. 515). The preparation does not seem to have been approved elsewhere.

Ferrum Dialysatum.—The merits of dialyzed iron are claimed to be that it has no styptic taste, mixes well with water in any proportion, and does not stain the teeth or cause constipation. On pharmaceutical grounds "the action of dialyzed iron upon animal products forbids us to suppose *a priori* that it acts like other ferruginous preparations" (Depaire). A very competent judge (Bouchardat) has declared that, "theoretically, dialyzed iron must be regarded as an inert, or at least a very feeble, preparation of iron." Personne has said concerning it, "It is completely insoluble in the gastric juices. When it was injected into a dog's stomach during active digestion, and an examination was made two hours later, flakes of oxide of iron adhered to the undigested food, and not a trace of iron was discoverable either in the gastric liquids or on the surface of the alimentary canal. Its inactivity may be inferred from its insolubility" (*Archives gén.*, 7 sér., iv. 491). We have found it utterly to fail in cases for which iron appeared to be the proper remedy, and which other preparations of the metal caused to speedily improve. Dr. R. V. Mattison has shown that dialyzed iron is probably insoluble in the gastric secretions, for he attempted unsuccessfully to dissolve the precipitate of ferric hydrate in an artificial gastric juice. Neither could he find a trace of iron in the urine of patients who were taking dialyzed iron. On the other hand, Dr. Gowers of London ascertained, by counting the red corpuscles of the blood before and after the use of the medicine in *anæmia*, that they rose from 46 to 102 per cent. of the normal proportion in 34 days in one case, and in a second case from 26 per cent. of the normal proportion to 92 per cent. in 63 days. So Dr. Robert Amory of Boston reports that he also counted the red corpuscles in anæmic cases treated by this preparation, and found the proportion increased in them severally as follows: No. 1, from 83 to 97 per cent.; No. 2, from 80 to 90 per cent.; No. 3, from 74 to 92 per cent.; No. 4, from 76 to 90 per cent.; and No. 5, from 76 to 83 per cent. In 1878, Dr. DaCosta used hypodermic injections of dialyzed iron in a case of *chlorotic anæmia:* 15 minims of the pure liquid were given without any unpleasant after-effects, and with a very rapid restoration of the patient to health (*Phila. Med. Times*, viii. 251). In one or two cases Dr. Lamadrid also reported the success of this treatment (*Med. Record*, xiv. 17). In 1879, Luton stated that 25 or 30 drops of the solution may be injected without producing the slightest disturbance; that it causes a diffusive sense of warmth, a determination of blood to the face, a sort of intoxication, in fine: and he compared its effects to those of transfusion of blood (*Mouvement méd.*, Juin, 1879). In 1881, Neuss classed this preparation of iron among those unsuited to hypodermic use (*Zeitsch. f. klin. Med.*, iii. 9), and Kemp found alarming symptoms immediately following its use, and the subsequent formation of abscess at the point of puncture (*Med. Record*, xiii. 481). We cannot learn that any later experience has confirmed the very favorable judgment originally expressed of the hypodermic use of dialyzed iron. The observations on which that judgment rests would be conclusive of the hæmatogenous virtues of dialyzed iron had we not the positive declaration of Hayem, who pursued the very same method of investigation (see Ferrum), that, at least in saturnine anæmia, "iron does not influence the number, but only the development, of the red corpuscles." But in Dr.

Prosser James's opinion, "The testimony of physicians to the activity of dialyzed iron is so abundant that it is unnecessary to add to it" (*Times and Gaz.*, Dec. 1882, p. 659). In relation to the value of iron employed hypodermically, it may be added that Glaevecke found the citrate of iron very efficient in *anæmia* when used in this manner in the *dose* of Gm. 0.10 (2 grains) (*Arehiv f. Exper. Pathol., etc.*, xvii. 466).

Numerous cases have been published which appear to prove that dialyzed iron is an efficient antidote to the poisonous action of *arsenic* in the stomach. Dr. Mattison, having performed some experiments to determine the conditions of its efficacy, found—1, that a solution of dialyzed iron to be of value as an arsenical antidote must be precipitated by the action of some neutral or alkaline salt; 2, that such precipitation, and the consequent production of ferric hydrate, are accomplished when this preparation is taken into the stomach; and 3, that, therefore, the solution of dialyzed iron is a valuable antidote in arsenical poisoning; 4, that to ensure the formation from it of ferric hydrate its administration should be followed by that of a teaspoonful of common salt.

Dialyzed iron may be given internally in doses of Gm. 0.30–2.0 (gtt. v–xxx) several times a day, simply diluted with water or in some sweetened and aromatic vehicle.

LIQUOR FERRI CITRATIS, *U. S.*—Solution of Ferric Citrate.

Liquor ferri citrici, Citras ferricus liquidus.—Citrate de fer liquide, Fr.; *Eisencitrat-Lösung, Flüssiges Eisencitrat*, G.

An aqueous solution of ferric citrate, corresponding to about 7.5 per cent. of metallic iron.

Preparation.—Solution of Ferric Sulphate, 1050 Gm; Citric Acid, 300 Gm.; Ammonia-water, 880 Cc.; Water, a sufficient quantity, to make 1000 Gm. Mix the ammonia-water with 3000 Cc. of cold water, and the solution of ferric sulphate with 10,000 Cc. of cold water. Add the latter solution slowly to the diluted ammonia-water, constantly stirring. Pour the mixture on a wet muslin strainer, and allow the liquid to run off and the precipitate to drain. Then remove the moist mass from the strainer, mix it well with 6000 Cc. of cold water, again pour it on the strainer, and let it drain. Repeat this washing with several successive portions of cold water in the same manner, until the washings cease to produce more than a slight cloudiness with barium chloride test-solution. Then allow the precipitate to drain completely, transfer it to a porcelain dish, add the citric acid, and heat the mixture, on a water-bath, to 60° C. (140° F.), stirring constantly, until the precipitate is dissolved. Lastly, filter the liquid, and evaporate it at the above-mentioned temperature, until it weighs 1000 Gm.—*U. S.*

To prepare 1 pint of solution of ferric citrate the following quantities should be used: 16 fluidounces of solution of ferric sulphate diluted with 12 pints of water, 17½ fluidounces of ammonia-water diluted with 4 pints of water, and 6¼ av. ozs. of citric acid.

The first part of the process consists in preparing ferric hydroxide; the reaction has been explained (see page 734). The hydroxide retains a considerable quantity of water, so that on the addition of citric acid the mixture becomes liquid as the acid is dissolved and ferric citrate is formed. The solution is aided by the application of heat, which should never exceed 66° C. (151° F.), but is best kept at 60° C. (140° F.) to prevent decomposition. The digestion must be continued for several hours until the acid has taken up as much iron as can combine with it, when it is filtered and evaporated as directed.

Properties.—The solution is inodorous, has a dark-brown color, a slightly ferruginous taste, an acid reaction, and the specific gravity 1.250 at 15° C. (59° F.). When evaporated spontaneously or at a moderate heat in thin layers it forms transparent, garnet-red scales, which are readily detached from the glass or porcelain plate; 100 parts of the solution should yield 42.5 to 43 parts of scales. The solution is rendered darker, but is not precipitated, by alkalies in the cold, but when boiled with potassa or soda a red-brown precipitate of ferric hydroxide is produced, and the filtrate, if neutralized with acetic acid and then boiled with test-solution of calcium chloride, yields a white granular precipitate of calcium citrate. The solution gives with potassium ferrocyanide a greenish-blue precipitate, which becomes dark-blue on the addition of hydrochloric acid.

Tests.—On boiling the solution with potassa or soda, ammoniacal vapors should not be given off. On the addition of a few drops of hydrochloric acid, followed by a concentrated solution of potassium acetate, a crystalline precipitate should not be produced (absence of tartrate). On evaporating the solution to dryness and igniting the residue, the ash left should not have an alkaline reaction (alkalies). If 1.12 (1.1176) Gm. of

the solution be introduced into a glass-stoppered bottle (having a capacity of about 100 Cc.), together with 15 Cc. of water and 2 Cc. of hydrochloric acid, and after the addition of 1 Gm. of potassium iodide the mixture be kept for half an hour at a temperature of 40° C. (104° F.), then cooled, and mixed with a few drops of starch test-solution, it should require about 15 Cc. of decinormal sodium thiosulphate solution to discharge the blue or greenish color of the liquid (each Cc. of the volumetric solution indicating 0.5 per cent. of metallic iron).—*U. S.*

Action and Uses.—This solution forms a convenient mode of dispensing citrate of iron. *Dose*, Gm. 0.60 (ℳx) or Gm. 0.30 (gr. v) of the salt.

LIQUOR FERRI ET AMMONII ACETATIS, *U. S.*—Solution of Iron and Ammonium Acetate.

Mistura ferri et ammonii acetatis, *U. S. P.*, 1880.—*Basham's Mixture.*

Preparation.—Tincture of Ferric Chloride, 20 Cc.; Diluted Acetic Acid, 30 Cc.; Solution of Ammonium Acetate, 200 Cc.; Aromatic Elixir, 100 Cc.; Glycerin, 120 Cc.; Water, a sufficient quantity, to make 1000 Cc. To the solution of ammonium acetate (which should not be alkaline) add, successively, the diluted acetic acid, the tincture of ferric chloride, the aromatic elixir, and the glycerin, and lastly, enough water to make the product measure 1000 Cc. This preparation should be freshly made when wanted.—*U. S.*

To prepare 1 pint of Basham's mixture would require 154 minims of tincture of ferric chloride, 230 minims of diluted acetic acid, 3 fluidounces and 96 minims of solution of ammonium acetate, 13 fluidrachms of aromatic elixir, 2 fluidounces of glycerin, and sufficient water to bring the volume up to 16 fluidounces.

This preparation has been the cause of much annoyance to the pharmacist on account of its instability as prepared by the formula of 1880. As now made it keeps perfectly; although the Pharmacopœia directs that it shall be freshly made when wanted, this is scarcely necessary: we have found it to remain unchanged for a period of seventy-five days, exposed to diffused light at summer temperature. The use of glycerin in place of simple syrup was first suggested by H. R. LeValley (*Drugg. Circ.*, 1887).

Ferric chloride and ammonium acetate mutually decompose each other, forming ferric acetate and ammonium chloride, some of the ammonium acetate remaining unchanged. The deep-red color of the liquid is due to the newly-formed ferric acetate.

Action and Uses.—This preparation has long been used in the treatment of various forms of *albuminuria*, but chiefly in that which attends tubular nephritis. Its recommendations are its agreeable appearance, its not unpleasant taste, its acceptability by the stomach, and its diuretic action. *Dose*, from 15–30 Cc. (½ to 1 fluidounce).

LIQUOR FERRI NITRATIS, *U. S.*—Solution of Ferric Nitrate.

Liquor ferri pernitratis, Br.—*Solution of pernitrate of iron*, E.; *Azotate* (*Pernitrate*) *de fer liquide*, Fr.; *Eisennitrat-Lösung*, *Ferrinitrat-Lösung*, G.

An aqueous solution of ferric nitrate, $Fe_2(NO_3)_6$; molecular weight 483.1—containing about 6.2 per cent. of the anhydrous salt, and corresponding to about 1.4 per cent. of metallic iron.

Preparation.—Solution of Ferric Sulphate, 180 Gm.; Ammonia-water, 160 Cc.; Nitric Acid, 71 Gm.; Distilled Water, Water, each, a sufficient quantity to make 1000 Gm. Mix the ammonia-water with 500 Cc. of cold water, and the solution of ferric sulphate with 1500 Cc. of cold water. Add the latter solution slowly to the diluted ammonia-water, constantly stirring. Let the mixture stand until the precipitate has subsided as far as practicable, and then decant the supernatant liquid. Add to the precipitate 1000 Cc. of cold water, mix well, and again set the mixture aside, as before. Repeat the washing with successive portions of cold water, in the same manner, until the washings produce but a slight cloudiness with barium chloride test-solution. Transfer the washed ferric hydroxide to a wet muslin strainer, and let it drain thoroughly. Then put it into a porcelain dish, add the nitric acid, and stir with a glass rod until a clear solution is obtained. Finally, add enough distilled water to make the finished product weigh 1000 Gm. Filter, if necessary—*U. S.*

To prepare 1 pint of solution of ferric nitrate would require 2¼ fluidounces of solution of ferric sulphate, 2¾ fluidounces of ammonia-water, and 405 minims of nitric acid; the ferric-sulphate solution should be diluted with 1½ pints of water, and the ammonia-water with 8 ounces of water.

Take of fine iron wire, free from rust, 1 ounce; nitric acid 4½ fluidounces; distilled water a sufficiency. Dilute the nitric acid with 16 ounces of the water, introduce the iron wire into the mixture, and leave them in contact until the metal is dissolved, taking care to moderate the action, should it become too violent, by the addition of a little more distilled water. Filter the solution, and add to it as much distilled water as will make its bulk 1½ pints (30 fluidounces).—*Br.*

Both formulas aim at the production of ferric nitrate, $Fe_2(NO_3)_6$. If the directions of the British Pharmacopœia are followed, the iron is taken up, with the evolution of red vapors, the reaction being as follows: Fe_2+8HNO_3 yields $Fe_2(NO_3)_6+2NO+4H_2O$. Considerable heat is produced, and may rise to such a degree that nitric acid is vaporized; the reaction must therefore be closely watched, and, if it should become too violent, moderated by the addition of some cold water. This difficulty was sought to be avoided in the process of the U. S. P. 1870 by first forming ferrous nitrate and converting this into the ferric salt. Berzelius observed that, besides ferrous nitrate, ammonium nitrate is also formed and no gas evolved if a mixture of iron, water, and nitric acid is kept below the temperature of 50° C. (122° F.), when $2Fe_2+10HNO_3$ yields $4Fe(NO_3)_2+NH_4NO_3+3H_2O$. The formation of ammonia is a secondary reaction, and depends upon the action of the nascent hydrogen upon the excess of nitric acid; it is lessened, but not entirely prevented, by a stronger acid and at a higher temperature, and augmented as the temperature and the acid strength are decreased, sometimes to such a degree that considerable ferrous hydroxide is separated. It follows from this that solutions thus prepared are apt to vary in their composition.

The present formula of the U. S. P. is essentially that of F. T. Bower (1876). Ferric hydroxide is first prepared, and, after washing it well, is dissolved in the nitric acid. Care should be taken that the latter has the proper specific gravity; weaker acids will yield darker-colored basic compounds, some of which are insoluble or sparingly soluble in water.

Ordway (1865) found that weak solutions of *ferrous nitrate*, which are free from excess of acid, may be concentrated at 60° C. (140° F.), but must then be evaporated at a lower temperature to prevent oxidation. The green crystals obtained in the cold cannot be dried without decomposition. *Ferric nitrate* has been obtained in deliquescent colorless or purplish crystals, which are cubes when containing $12H_2O$, or prisms with $18H_2O$.

Properties.—The solution has a reddish-brown, or, if the acid is somewhat in excess, a pale-amber, color, which becomes darker on heating and lighter again on cooling. It is perfectly transparent, inodorous, has a strongly styptic taste and an acid reaction, and remains unaltered on exposure to light and air, except in the presence of organic compounds, by many of which it is deoxidized. It gives a red-brown precipitate with ammonia and other alkalies and alkali carbonates, and a dark-blue precipitate with potassium ferrocyanide. When mixed with a solution of ferrous sulphate, and then with strong sulphuric acid, it assumes a blackish-brown color. The specific gravity is 1.050 *U. S. P.*, 1.107 *Br. P.*

Tests.—Potassium ferricyanide, silver nitrate, and barium nitrate should not disturb the solution, proving the absence of ferrous salt, chloride, and sulphate. If precipitated with an excess of ammonia, the filtrate evaporated to dryness, and the salt heated to redness, no residue should be left (other metals). "If 1.12 (1.1176) Gm. of the solution be introduced into a glass-stoppered bottle (having a capacity of about 100 Cc.), together with 15 Cc. of water and 2 Cc. of hydrochloric acid, and, after the addition of 1 Gm. of potassium iodide, the mixture be allowed to stand for half an hour at a temperature of 40° C. (104° F.), and then allowed to cool and mixed with a few drops of starch test-solution, it should require about 2.8 Cc. of decinormal sodium thiosulphate solution to discharge the blue or greenish color of the liquid (each Cc. of the volumetric solution consumed corresponding to 0.5 per cent. of metallic iron)." *U. S.* The ferric oxide obtained from a fluidrachm of the solution by precipitating with ammonia, washing, and igniting, is required to weigh 2.6 grains.—*Br. P.*

Action and Uses.—Solution of the nitrate differs in its properties from the other acid compounds of iron. It is much more astringent than the vegetable acid salts or than the iodide of iron, and less harsh than the sulphuric and muriatic acid compounds. It is used chiefly in chronic *diarrhœa* dependent upon debility of the system or following dysentery, when no febrile complication exists. It is also profitably employed in *leucorrhœa* affecting feeble and lymphatic females, both internally and locally, and in *menorrhagia* occurring under similar conditions. The *dose* is about Gm. 0.60 (gtt. x), largely diluted. As an injection Gm. 0.60–2 (gtt. x–xxx) in a fluidounce of water may be employed.

LIQUOR FERRI SUBSULPHATIS, *U. S.*—Solution of Ferric Subsulphate.

Solution of basic ferric sulphate, Solution of persulphate of iron, Monsel's solution, E.; *Liqueur hémostatique de Monsel*, Fr.; *Basisch-schwefelsaure Eisenoxydlösung, Monsel's Eisenlösung*, G.

An aqueous solution of basic ferric sulphate (of variable chemical composition), representing about 13.6 per cent. of metallic iron.

Preparation.—Ferrous Sulphate, in clear crystals, 675 Gm.; Sulphuric Acid, 65 Gm.; Nitric Acid, Distilled Water, each, a sufficient quantity to make 1000 Gm. Add the sulphuric acid to 500 Cc. of water in a capacious porcelain dish, heat the mixture to nearly 100° C. (212° F.), and then add 65 Gm. of nitric acid, and mix well. Divide the coarsely powdered ferrous sulphate into four equal portions, and add one of these portions, at a time, to the hot liquid, stirring after each addition until effervescence ceases. When all of the ferrous sulphate has been dissolved, add a few drops of nitric acid and if this causes a further evolution of red fumes, continue to add nitric acid, a few drops at a time, until it no longer causes red fumes to be evolved; then boil the solution until it assumes a ruby-red color and is free from nitrous odor. Lastly, add enough distilled water to make the product weigh 1000 Gm. Keep the product in well-stoppered bottles, in a moderately warm place (not under 22° C. or 71.6° F.), protected from the light.—*U. S.*

Note.—Solution of subsulphate of iron is to be dispensed when solution of persulphate of iron is prescribed by the physician.

To prepare one pint of Monsel's solution would require 1 pound and 650 grains of ferrous sulphate, 736 grains each of sulphuric and nitric acid and a sufficient quantity of distilled water, 12 fluidounces being used to dilute the acids in the first instance.

This process is a slight modification of that proposed by Dr. Squibb (1860). On introducing the ferrous sulphate in small portions into the heated acids a black color is produced from the union of nitric oxide with ferrous sulphate, which disappears with the copious evolution of red nitrous vapors as fast as the sulphate dissolves in the hot liquid. The mixture foams most toward the end of the process, and after the liquid has again subsided a little of it should be tested with nitric acid to ensure its complete oxidation. The amount of sulphuric acid used is insufficient for forming the normal ferric sulphate. A basic or oxysulphate is the result, which has the composition $Fe_4O(SO_4)_5 + Aq$, or $5Fe_2(SO_4)_3.Fe_2(OH)_6$. The mineral *copiapite* is a crystallized hydrate of the same combination. Other more basic ferric sulphates are known, some being soluble, others insoluble in water.

Properties.—Monsel's solution is a deep red-brown liquid, being nearly of a syrupy consistence, and of the spec. grav. 1.550. It is almost inodorous, has a very astringent but not caustic taste, and an acid reaction, and mixes with water and alcohol in all proportions without decomposition. On dropping sulphuric acid into it the color becomes lighter, and with a larger quantity ($\frac{1}{2}$ volume) of the acid a separation of whitish anhydrous ferric sulphate takes place (difference from solution of tersulphate). Diluted with distilled water, it yields a red-brown precipitate with ammonia or potassa, a dark-blue one with potassium ferrocyanide, and a white one insoluble in nitric or hydrochloric acid with barium chloride. When evaporated at a moderate heat upon a glass or porcelain plate, it yields transparent, deliquescent scales, and at a somewhat higher temperature is converted into a yellowish powder which is less deliquescent.

Tests.—The solution, diluted with 5 parts of water, should be colored olive-brown, but not blue, with freshly-prepared solution of potassium ferricyanide, and it should not yield a white precipitate with silver nitrate (absence of ferrous salt and chloride). On adding a clear crystal of ferrous sulphate to a cooled mixture of equal volumes of concentrated sulphuric acid and a diluted portion of the solution, the crystal should not become brown, nor should there be a brownish-black zone developed around it (absence of nitric acid). "If 1.12 (1.1176) Gm. of the solution be introduced into a glass-stoppered bottle (having a capacity of about 100 Cc.), together with 15 Cc. of water and 2 Cc. of hydrochloric acid, and, after the addition of 1 Gm. of potassium iodide, the mixture be allowed to stand for half an hour at a temperature of 40° C. (104° F.), and then allowed to cool, and mixed with a few drops of starch test-solution, it should require about 27.2 Cc. of decinormal sodium thiosulphate solution to discharge the blue or greenish color of the liquid (each Cc. of the volumetric solution consumed corresponding to 0.5 per cent. of metallic iron)."—*U. S.*

Action and Uses.—This preparation is chiefly used as a local styptic in cases of *hæmorrhage* from parts not readily subjected to pressure, as the nasal cavities, the sockets from which teeth have been extracted, the uterus, vagina, rectum, etc. It has the advantage of being less irritating than other acid salts of iron. But its very power of coagulating blood may be mischievous. A child had an aneurism of the palmar arch following a wound. It was injected with about ten drops of Monsel's solution. Gangrene followed, and the hand had to be amputated (Keen, *Med. News*, xl. 298). The solution is generally applied by means of a wooden or glass brush or a fragment of compact sponge. A fluidrachm of the solution in an ounce of water has been used with an ear syringe to arrest *epistaxis*. Where pressure can also be made it should not be omitted. An atomized solution of it has been found successful in some cases of *hæmoptysis*. For this purpose Gm. 0.06–0.60 (♏j–x) should be added to Gm. 32. (a fluidounce) of distilled water. Internally, it may be prescribed in the *dose* of Gm. 0.30–0.60 (♏v–x), properly diluted. The solution may be evaporated to dryness, and the powdered residue given in pills containing about one grain of the salt. It may be used in chronic and in acute watery *diarrhœa*.

LIQUOR FERRI TERSULPHATIS, *U. S.*—Solution of Ferric Sulphate.

Liquor ferri persulphatis, Br.—*Solution of normal ferric sulphate*, *Solution of persulphate of iron*, E.; *Persulfate de fer liquide*, Fr.; *Ferrisulfatlösung*, *Schwefelsaure Eisenoxyd-Lösung*, G.

An aqueous solution of normal ferric sulphate $Fe_2(SO_4)_3$, containing about 28.7 per cent. of the salt, and representing about 8 per cent. of metallic iron.

Preparation.—Ferrous Sulphate, in clear crystals, 400 Gm.; Sulphuric Acid, 78 Gm.; Nitric Acid, Distilled Water, each, a sufficient quantity, to make 1000 Gm. Add the sulphuric acid to 200 Cc. of water in a capacious porcelain dish, heat the mixture to nearly 100° C. (212° F.), then add 55 Gm. of nitric acid, and mix well. Divide the coarsely powdered ferrous sulphate into four equal portions, and add these portions, one at a time, to the hot liquid, stirring after each addition until effervescence ceases. When all of the ferrous sulphate has been dissolved, add a few drops of nitric acid, and, if this causes a further evolution of red fumes, continue to add nitric acid, a few drops at a time, until it no longer causes red fumes to be evolved; then boil the solution until it assumes a reddish-brown color and is free from nitrous fumes. Lastly, add enough distilled water to make the product weigh 1000 Gm. Filter, if necessary.—*U. S.*

To prepare 1 pint of solution of ferric sulphate would require 8¾ av. ozs. of ferrous sulphate, 752 grains of sulphuric acid, 530 grains of nitric acid, and a sufficient quantity of distilled water, of which 4½ fluidounces should be used for dilution of the acids.

Take of sulphate of iron 8 ounces; sulphuric acid, nitric acid, each 6 fluidrachms; distilled water 12 fluidounces or a sufficiency. Add the sulphuric acid to 10 ounces of the water, and dissolve the sulphate of iron in the mixture with the aid of heat. Mix the nitric acid with the remaining 2 ounces of the water, and add to this acid, warmed, the solution of sulphate of iron. Concentrate the whole by boiling, until, by the sudden disengagement of ruddy vapors, the liquid ceases to be black and acquires a red color. A drop of the solution is now to be tested with red prussiate of potash, and if a blue precipitate forms, a few additional drops of nitric acid should be added and the boiling renewed, in order that the whole of the sulphate may be converted into persulphate of iron. When the solution is cold, make the quantity 11 fluidounces (Imperial measure) by the addition, if necessary, of distilled water.—*Br.*

The reaction which takes place in these processes is precisely the same as in making the subsulphate of iron, the only difference being that the sulphuric acid is used in sufficient quantity to form normal ferric sulphate, $Fe_2(SO_4)_3$. The reaction is explained by the equation $6FeSO_4 + 3H_2SO_4 + 2HNO_3 = 3Fe_2(SO_4)_3 + N_2O_2 + 4H_2O$. From 80 parts of ferrous sulphate, 200 parts *U. S.* (160 parts *P. G.*, 158.5 parts *Br.*) of the solution are prepared.

Properties.—Solution of normal ferric sulphate is a dark reddish-brown liquid, having no odor, a very astringent and at the same time acid taste, and an acid reaction. It is miscible in all proportions with alcohol and water without causing decomposition. Its behavior to ammonia, potassium ferrocyanide, and barium chloride is the same as that of the subsulphate, but for the precipitation of the anhydrous salt about 3 volumes (instead of ½ volume) of sulphuric acid is required. The pharmacopœial solution con-

tains 28.76 per cent. *U. S.*, 36.3 per cent., *Br.*, of anhydrous ferric sulphate, and has the spec. grav. 1.320 *U. S.*, 1.441 *Br.* Hager gives the following densities for solutions containing of the anhydrous salt—

25	26	27	28	28.5	29	29.5	30	31	32 per cent.
1.271	1.284	1.297	1.310	1.316	1.323	1.330	1.337	1.351	1.365.

Tests.—The absence of ferrous salt, chloride, nitric acid, and foreign salts is determined in precisely the same manner as for the subsulphate (see above). "If 1.12 (1.1176) Gm. of the solution be introduced into a glass-stoppered bottle (having a capacity of about 100 Cc.), together with 15 Cc. of water and 2 Cc. of hydrochloric acid, and, after the addition of 1 Gm. of potassium iodide, the mixture be allowed to stand for half an hour at a temperature of 40° C. (104° F.), and then allowed to cool, and mixed with a few drops of starch test-solution, it should require about 16 Cc. of decinormal sodium thiosulphate solution to discharge the blue or greenish color of the liquid (each Cc. of the volumetric solution consumed corresponding to 0.5 per cent. of metallic iron)."—*U. S.* 1 fluidrachm of the solution, diluted with water and mixed with an excess of ammonia-water, should yield a precipitate which, when washed and ignited, weighs 11.44 grains.—*Br.*

Action and Uses.—It may be used for the same purpose as the subsulphate, but is not as eligible, because it is more irritating and less astringent.

LIQUOR GUTTA-PERCHÆ, *Br.*—Solution of Gutta-percha.

Liqueur de gutta-percha, Fr.; *Guttapercha-Lösung, Traumaticin*, G.

Preparation.—Gutta-percha, in thin slices, 1 ounce; Chloroform, 8 fluidounces; Lead Carbonate, in fine powder, 1 ounce. Add the gutta-percha to 6 fluidounces of chloroform in a stoppered bottle, and shake them together frequently until solution has been effected. Then add the lead carbonate previously mixed with the remainder of the chloroform, and, having several times shaken the whole together, set the mixture aside, and let it remain at rest until the insoluble matter has subsided. Lastly, decant the clear liquid, and keep it in a well-stoppered bottle.—*Br.*

This preparation has been dismissed from the present edition of the U. S. P.; the formula of 1880 was almost identical with the above, the only difference being in the relative proportions by weight—the U. S. P. 1880 directing 9 parts of gutta-percha to 91 of chloroform, while the Br. Ph. orders 1 to 11.92 or 9 to 107.2 parts.

Crude gutta-percha does not yield a clear solution with chloroform, but on standing the impurities will rise to the surface more rapidly if, according to Maschke (1857), the solution is agitated with 1 or 1½ per cent. of water. Hodgson (1861) proposed lead carbonate with the same object in view, the impurities subsiding with the lead compound. Other heavy and insoluble compounds may be used with the same result, of rendering the solution clear and almost or entirely colorless. Other solvents, which are cheaper than chloroform, are employed for the purification of gutta-percha on the large scale (see page 801).

Action and Uses.—The various applications of this solution are enumerated under Gutta-Percha. They consist, briefly, in the adhesive and protective qualities of the film formed by the rapid evaporation of the solvent, and the faculty with which the solution is applied.

LIQUOR HYDRARGYRI NITRATIS, *U. S.*—Solution of Mercuric Nitrate.

Liquor hydrargyri nitratis acidus, Br.; *Liquor hydrargyri nitrici oxydati, Hydrargyrum oxydatum nitricum solutum.—Acid solution of nitrate of mercury, Solution of pernitrate of mercury*, E.; *Azotate (Nitrate) mercurique liquide, Nitrate acide (Pernitrate) de mercure*, Fr.; *Mercurinitrat-Lösung, Quecksilberoxydnitrat-Lösung*, G.

A liquid containing about 60 per cent. of mercuric nitrate $Hg(NO_3)_2$, together with about 11 per cent. of free nitric acid.

Preparation.—Red Mercuric Oxide 40 Gm.; Nitric Acid 45 Gm.; Distilled Water 15 Gm.; to make 100 Gm. Mix the nitric acid with the distilled water, and dissolve the red mercuric oxide in the mixture. Keep the solution in glass-stoppered bottles. —*U. S.*

The foregoing formula will yield a little over 1½ fluidounces (1.61+) of solution.

Take of mercury 4 ounces; nitric acid 5 fluidounces; distilled water 1½ fluidounces. Mix the nitric acid with water in a flask, and dissolve the mercury in the mixture without the application of heat. Boil gently for fifteen minutes, cool, and preserve the solution in a stoppered bottle.—*Br.*

Mercury 100 parts; nitric acid 150 parts; water 50 parts. Dissolve and evaporate to 225 parts.—*F. Cod.*

The mercury is dissolved in the two last processes by the action of nitric acid, with the extrication of red nitrous vapors to form mercuric nitrate; $3Hg_2 + 16HNO_3$ yields $6Hg(NO_3)_2 + 2N_2O_2 + 8H_2O$. It is necessary to apply some heat, particularly at the close of the reaction, to convert into mercuric any mercurous salt which may be present. The United States process yields the same solution more rapidly, and involves simply a combination of the mercuric oxide with nitric acid, water being liberated; $HgO + 2HNO_3$ yields $Hg(NO_3)_2 + H_2O$. The present pharmacopœial solution is a little weaker than that of 1870, the latter requiring 43.66 parts of mercuric oxide and 48.66 parts of nitric acid to obtain 100 parts; it was nearly identical with that of the French Codex, which represents 43.5 per cent. of mercuric oxide against about 35 per cent. of the British preparation.

Properties.—The solution is colorless, and has a slight odor of nitric acid, a strong acid reaction, and a caustic and metallic taste. Its specific gravity is 2.100 *U. S. P.*, about 2.0 *Br.* A crystal of ferrous sulphate dropped into it soon becomes surrounded with a dark-colored liquid (nitrate). Dropped upon copper, a deposit of mercury is at once produced, and the diluted solution gives a yellow precipitate with soda or potassa solution and a scarlet-red precipitate with potassium iodide; this latter precipitate is soluble in an excess of the precipitant. Nearly one-fourth of the nitric acid is uncombined, and prevents the separation of a basic salt on dilution with water. Evaporated by heat on a glass or porcelain dish, a white salt is left, which on the further application of heat is decomposed, assuming a yellow, red, and brown color, and is finally completely volatilized. The solution, mixed with alcohol and heated, produces *fulminating mercury*, which is very explosive.

If the solution is kept over sulphuric acid until crystals have been separated, the syrupy liquid will have the composition $Hg(NO_3)_2.2H_2O$, and the crystals of mercuric nitrate contain less water, their composition being $2Hg(NO_3)_2.H_2O$. If the liquid is further concentrated by heat, nitric acid is given off, and the solution contains then basic nitrates, which are crystallizable, but when largely diluted with water are converted into more basic insoluble white or yellowish compounds.

Tests.—The characters given are sufficient to determine the quality of the preparation. On the addition of water no precipitation should occur (free nitric acid). Diluted hydrochloric acid should occasion no precipitate, potassa solution a yellow (not black), and potassium iodide a scarlet-red (not yellow or green) precipitate (absence of mercurous salt).

Allied Preparations.—Millon's Test Solution. Dissolve with a gentle heat mercury in an equal weight of strong nitric acid, dilute the solution with twice its bulk of water, and decant from the precipitate; the liquid must contain some free nitric and nitrous acid. A solution of nearly the same mercury strength, but containing no nitrous acid, is obtained by diluting the pharmacopœial (*U. S.*) solution of mercuric nitrate with an equal bulk of water. Millon's reagent is used as a reagent for proteids, the mixture, as well as the precipitate, acquiring a red color on boiling.

Hydrargyri protonitras; Nitras (azotas) hydrargyrosus, *F. Cod.*—Mercurous nitrate, *E.;* Azotate mercureux, *Fr.;* Mercuronitrat, Salpetersaures Quecksilberoxydul, *G.*—Mercury 4 parts, nitric acid 3 parts, water 1 part; after 24 hours collect the crystals, wash them with a little diluted nitric acid, and dry.—*F. Cod.* The salt forms colorless monoclinic plates or prisms having the composition $Hg_2(NO_3)_2 2H_2O$, mol. weight 559.4; it melts at 70° C. (158° F.), is completely soluble in a little warm water, but is by more water decomposed into a soluble acid and an insoluble basic salt; the solution imparts to the skin a purplish-red color, turning black.

Liquor hydrargyri nitrici oxydulati, s. Hydrargyrum oxydulatum solutum, s. Liquor Bellostii.—Solution of mercurous nitrate, *E.;* Liqueur de Belloste, *Fr.;* Mercuronitrat-Lösung, *G.*—Dissolve without heat mercurous nitrate 100 parts in nitric acid 15 parts and water 885 parts. On exposure to the air oxidation to mercuric nitrate takes place.

Action and Uses.—Solution of nitrate of mercury is not used internally. Locally, its action is powerfully caustic, destroying the life of the tissue to which it is directly applied and inflaming the surrounding parts. The slough separates as a yellowish scab. When swallowed by mistake, it produces the effect of a powerful corrosive poison, including intense pain, vomiting, purging, collapse, and speedy death, after which the

fauces have been found vesicated and discolored and the stomach presenting brown eschars. Applied to an ulcerated surface, even of small extent, it has caused salivation, and a weak solution of it used in the treatment of itch has occasioned fatal poisoning, with symptoms of corrosion and salivation also.

This preparation is employed to stimulate sluggish restorative processes and to remove indurated tissues. It is a valuable application in chronic and indurated *ulcers* of the neck of the uterus of whatever nature, but most so, of course, in simple ulcers. Tubercles and ulcers of the skin belonging to *lupus* have sometimes been treated advantageously by this caustic while appropriate internal medicines were administered. It is advised that it should be applied daily. It is an efficient remedy for *acne* by destroying the diseased sebaceous follicles. It has been recommended as the most successful of local applications to all forms of *syphilitic* sores of the skin, tongue, throat, etc. The strength of the solution employed must vary with the object in view. In lupus and acne the pure liquid must be used, and applied by means of a pointed glass rod or brush or a wooden splinter, so as accurately to limit the caustic action to the diseased tissue. When ulcers of the throat are to be treated, 1 or 2 minims of the acid in an ounce of water (Gm. 0.06–0.12 to Gm. 32) may be used as a gargle or with an atomizer, care being taken that the spray is not inhaled; or by means of a sponge-mop a mixture of a fluidrachm of the solution with an ounce of water (Gm. 4 to Gm. 32) may be applied. For cutaneous ulcers a lotion may be made with 30 minims of the solution and an ounce (Gm. 2 to Gm. 32) of water.

LIQUOR HYDRARGYRI PERCHLORIDI, *Br.*—Solution of Perchloride of Mercury.

Liquor hydrargyri bichloridi.—Solution of corrosive sublimate, Solution of mercuric chloride, E.; *Chlorure de mercure et d'ammoniaque liquide, Soluté de sel Alembroth*, Fr.; *Sublimat-Lösung*, G.

Preparation.—Take of Perchloride of Mercury, Chloride of Ammonium, each 10 grains; Distilled Water 1 pint (Imperial). Dissolve.—*Br.*

This is a colorless solution of the *sal Alembroth* of the alchymists, having the saline and metallic taste of the salts from which it is made. It yields white precipitates with alkalies and their carbonates, and is decomposed by vegetable juices and the medicinal extracts. It contains ½ grain of corrosive sublimate to the (Imperial) fluidounce, and is of one-half the strength of the similar solution which was formerly recognized by the Prussian and other European pharmacopœias. By substituting emulsion of bitter almond for the water *Gowland's cosmetic lotion* is obtained.

Liqueur de Van Swieten, *F. Cod.*, is a solution of 1 part of corrosive sublimate in 100 parts of alcohol and 900 parts of water.

Action and Uses.—The object of this preparation appears to be to render the solution of corrosive sublimate more perfect than that in water alone. The average *dose* is Gm. 4 (f℥j), containing Gm. 0.004 (gr. $\frac{1}{16}$) of corrosive sublimate.

LIQUOR IODI COMPOSITUS, *U. S.*—Compound Solution of Iodine.

Liquor iodi, Br.—*Solution of iodine, Lugol's solution*, E.; *Soluté ioduré de Lugol*, Fr.; *Lugol'sche Jodlösung*, G.

Preparation.—Iodine 5 Gm.; Potassium Iodide 10 Gm.; Distilled Water 85 Gm.; to make 100 Gm. Dissolve the iodine and potassium iodide in the distilled water. Keep the solution in well-stoppered bottles.—*U. S.*

To prepare 4 fluidounces of Lugol's solution 108 grains of iodine and 216 grains of potassium iodide should be dissolved in 4 ounces of distilled water.

Take of iodine 22 grains; potassium iodide 33 grains; distilled water 1 fluidounce. Dissolve.—*Br.*

Solutions of potassium iodide dissolve iodine in different proportions, weak solutions taking up 1 atom of I for each molecule of KI, or 76.5 parts for 100 parts of the salt. The dissolved portion, therefore, has the composition KI_2. The proportion of iodine to potassium iodide in the second formula approaches the composition given, but the formula of the United States Pharmacopœia directs a larger amount of the salt, and its iodine strength is greater. Viewed as free iodine held in solution by potassium iodide, 1 part of the former is represented by 20.0 parts (*U. S. P.*) and 22.4 parts (*B. P.*) of the solution.

Properties.—The solution is of a dark brown-red color, having the caustic taste of iodine and imparting to starch-paste a dark-blue color. When boiled, iodine is given off, but the whole of it does not volatilize until the liquid is evaporated to dryness and the residuary mass heated nearly to redness. When agitated with chloroform, ether, or carbon disulphide, the solution is decolorized. "12.66 Gm. of the solution, mixed with a little gelatinized starch, should require for complete decoloration from 49.3 to 50 Cc. of decinormal solution of sodium thiosulphate."—*U. S.*

Allied Preparations.—Liquor iodi causticus, N. F.; Caustic solution of iodine; Churchill's iodine caustic.—Iodine 480 grains, Potassium iodide 960 grains, Distilled water 4 fluidounces.

Causticum iodi, Lugol's caustic.—Iodine and potassium iodide, of each 1 part, water 2 parts. By substituting glycerin for the water, *Hebra's iodine caustic* is obtained.

Action and Uses.—This preparation is considerably stronger in the proportion of its active ingredients than the compound *tincture* of iodine, and is thought to be more efficient, although there is no satisfactory evidence in favor of that opinion. 20 minims (Gm. 1.15) of it contain about 1 grain (Gm. 0.06) of iodine. The average *dose* is Gm. 0.25 (gtt. iv). It should be administered in a large portion of water.

LIQUOR LITHIÆ EFFERVESCENS, *Br.*—Effervescing Solution of Lithia.

Aqua lithiæ effervescens.—Lithia-water, E.; *Eau de lithine*, Fr.; *Lithian-Wasser*, G.

Preparation.—Take of Lithium Carbonate 10 grains; Water 1 pint. Mix in a suitable apparatus, and pass into it as much pure washed carbon dioxide gas, obtained by the action of sulphuric acid on chalk, as can be introduced with a pressure of four atmospheres. Keep the solution in bottles securely closed to prevent the escape of the compressed gas.—*Br.*

This is a solution of lithium carbonate in water rendered more agreeable by the free carbonic acid present. Each fluidounce contains ½ grain of the carbonate, the amount of which is best ascertained by evaporating a known measure of it. The residue should answer to the tests for lithium carbonate.

Medical Uses.—This is merely an agreeable form for the administration of lithia; it may be given in the *dose* of Gm. 120–360 (f ℥iv–xii).

LIQUOR MAGNESII CARBONATIS, *Br.*—Solution of Magnesium Carbonate.

Aqua magnesio-effervescens.—Fluid magnesia, E.; *Eau magnésienne, Magnésie liquide*, Fr.; *Magnesiawasser, Kohlensaure Magnesiulösung*, G.

Preparation.—Take of Magnesium Sulphate 2 ounces; Sodium Carbonate 2½ ounces; Distilled Water a sufficiency. Dissolve the two salts separately, each in ½ pint of water. Heat the solution of magnesium sulphate to the boiling-point, then add to it the solution of sodium carbonate, and boil them together until carbon dioxide ceases to be evolved. Collect the precipitated magnesium carbonate on a calico filter, and wash it with distilled water until what passes ceases to give a precipitate with barium chloride. Mix the washed precipitate with a pint of distilled water, and, putting them into a suitable apparatus, pass into it pure washed carbon dioxide, obtained by the action of sulphuric acid on chalk. Let the mixture remain in contact with excess of carbonic acid, retained there under pressure, for about twenty-four hours; then filter the liquid to remove any undissolved magnesium carbonate, and again pass carbon dioxide into the filtered solution. Finally, keep the solution in a bottle securely closed to prevent the escape of carbon dioxide. The solution contains about 10 grains of magnesium carbonate in a fluidounce.—*Br.*

The first part of the above process embraces the preparation of magnesium oxycarbonate, $4(MgCO_3).Mg(OH)_2$, which is the official Magnesii carbonas. By the subsequent operation this is dissolved in water by the aid of carbon dioxide in excess, whereby magnesium carbonate, $MgCO_3$, and bicarbonate, $MgH_2 2CO_3$, are formed.

Properties and Tests.—It is a colorless solution, which should effervesce on opening the vessel, carbon dioxide escaping, and has a slightly acidulous taste free from bitterness. The white mass left by evaporating a fluidounce and calcining the residue should weigh 5 grains and answer to the tests for magnesia. When the solution is exposed to cold, prismatic crystals of magnesium carbonate, $MgCO_3.5H_2O$, appear, which on exposure to the air lose water and become $MgCO_3.3H_2O$.

Medical Uses.—The intention of this preparation is apparently to provide an agreeable form of magnesia for administration in cases of constitutional *gout* and other disorders attended with an excess of *acid* in the system and acid urinary deposits. An extemporaneous mixture of magnesia with carbonated water answers the same purpose, and so do the granular effervescing vegetable salts of magnesia. The *dose* is Gm. 32–64 (f ℥j–ij).

LIQUOR MAGNESII CITRATIS, *U. S., Br.*—Solution of Magnesium Citrate.

Liquor magnesii citrici.—Limonade au citrate de magnésie, Limonade purgative citro-magnésienne, Fr.; *Magnesiumcitrat-Lösung, Magnesia-Limonade*, G.

Preparation.—Magnesium Carbonate 15 Gm.; Citric Acid 30 Gm.; Syrup of Citric Acid 120 Cc.; Potassium Bicarbonate, in crystals, 2.5 Gm.; Water a sufficient quantity. Dissolve the citric acid in 120 Cc. of water, and, having added the magnesium carbonate, stir until it is dissolved. Filter the solution into a strong bottle of the capacity of 360 Cc., containing the syrup of citric acid. Then add enough of water to nearly fill the bottle, drop in the potassium bicarbonate, and immediately close the bottle with a cork, which must be secured with twine. Lastly, shake the mixture occasionally until the potassium bicarbonate is dissolved.—*U. S.*

Take of magnesium carbonate 100 grains; citric acid 200 grains; syrup of lemon ½ fluidounce; magnesium bicarbonate, in crystals, 40 grains; water a sufficiency. Dissolve the citric acid in 2 ounces of the water, and, having added the potassium carbonate, stir it until it is dissolved. Filter the solution into a strong half-pint bottle, add the syrup and sufficient water to nearly fill the bottle; then introduce the potassium bicarbonate, and immediately close the bottle with the cork, which should be secured with string or wire. Afterward shake the bottle until the potassium bicarbonate has dissolved.—*Br.*

The U. S. Pharmacopœia has increased the quantities of magnesium carbonate and citric acid, but not the relative proportions, and hence it is doubtful whether the official solution will keep any better than that of 1880. Effervescent solution of magnesium citrate has been the source of frequent annoyance to the pharmacist, and it is to be regretted that the pharmacopœia did not prescribe either a formula *for extemporaneous preparation only*, or a formula by which a solution can be prepared which will not deposit even after lapse of some time. When magnesium carbonate and citric acid are brought together in the presence of water, carbon dioxide is eliminated and magnesium citrate is formed; the exact composition of the latter salt depends upon the amount of base or acid present. Normal magnesium citrate of the composition $Mg_3(C_6H_5O_7)_2$ is but slightly soluble in water, and crystallizes from its solutions with 14 molecules of water; it is formed whenever 10 molecules of citric acid are allowed to react with 3 molecules of official magnesium carbonate, as follows: $3[4(MgCO_3).Mg(OH)_2.5H_2O] + 10H_3C_6H_5O_7.H_2O = 5Mg_3(C_6H_5O_7)_2 + 12CO_2 + 43H_2O$. The acid magnesium citrate, $MgHC_6H_5O_7$, is very soluble in water, and is the compound aimed at by the formula of both pharmacopœias; it is produced by the following reaction: $4(MgCO_3).Mg(OH)_2.5H_2O + 5H_3C_6H_5O_7.H_2O = 5MgHC_6H_5O_7 + 4CO_2 + 16H_2O$, which shows that each molecule of official magnesium carbonate requires 5 molecules of citric acid. The 15 Gm. of magnesium carbonate ordered in the official formula require 21.61+Gm. of citric acid to form the normal, or 32.43 Gm. to form the acid salt; the Pharmacopœia orders 30 Gm. of acid, of which only 29.45 Gm. are available for the magnesium salt, as even the large quantity of syrup of citric acid ordered does not contain sufficient acid to decompose the 2.5 Gm. of potassium bicarbonate subsequently added. The official solution must contain, therefore, a mixture of acid and normal salts, to which its instability may be ascribed. If a solution of acid magnesium citrate only is desired which will not deposit in the course of time, the quantity of citric acid in the official formula must be increased to 32.98(32.43+0.55) Gm., which includes the necessary amount of acid to supply the deficiency in the syrup stated above; this, however, produces a very acid liquid, and may be objected to by many persons on that account. The 120 Cc. of syrup ordered will fail to cover the acid taste sufficiently, besides which it is questionable whether it is advisable to combine 102 Gm. (nearly 4 av. ozs.) of sugar with one purgative dose of any medicine. A solution of normal magnesium citrate is admirably adapted for extemporaneous preparation, but it does not keep well for any length of time: the following formula, in which the quantity of magnesium carbonate directed by the Pharmacopœia has been retained, but

the syrup of citric acid has been reduced to one-half, will be found to yield a very satisfactory solution for use within twenty-four hours, and contains just sufficient excess of citric acid (2.24 Gm.) to make the taste agreeably acidulous: Mix 25 Gm. of citric acid in powder with 15 Gm. of magnesium carbonate, and add 180 Cc. of water; stir well until dissolved, and filter the solution into a strong bottle of 360 Cc. capacity containing 60 Cc. of syrup of citric acid. Add enough water to nearly fill the bottle, and drop in 2.5 Gm. of potassium bicarbonate in crystals; the bottle should be immediately closed with a perfect soft cork, which is to be secured with wire or twine. Finally shake the bottle until all crystals are dissolved.

The Pharmacopœia orders plain water to be used, but if the solution is to be kept on hand, distilled, or, better yet, recently boiled and filtered, water will be found preferable, so as to avoid the formation of fungi. The potassium bicarbonate added is converted into neutral potassium citrate, the carbon dioxide, which is eliminated, remaining in solution. Magnesium carbonate is preferable to the oxide, as it is less apt to vary in composition, but if the latter is chosen 6.23 Gm. of magnesium oxide may be used in place of 15 Gm. of the official carbonate.

To prepare the solution, ten times (or any other convenient multiple) of the quantities of citric acid and magnesium carbonate are weighed out and mixed with the corresponding quantity of water; after the magnesia is dissolved the liquid is passed through a paper-filter, equally divided among the requisite number of bottles, each containing the necessary quantity of syrup; sufficient water is then added to each bottle, after which the potassium bicarbonate in crystals is dropped in. The corks are then inserted and securely fastened by twine, and the bottles laid upon their sides in a cool place. Prepared in this way, the crystals will gradually dissolve in the syrup, and this will slowly mix with the lighter saline solution, unless it be wanted for immediate use, when, by slight agitation, the syrup and bicarbonate are dissolved in the aqueous fluid.

The solution is colorless, free from sediment, and of a pleasant acidulous taste free from bitterness. The present formula differs from that of 1880 chiefly in ordering larger quantities of syrup of citric acid and potassium bicarbonate; hence a more effervescent solution is obtained.

Allied Preparations.—Liquor magnesii acetatis.—Solution of magnesium acetate, *E.*; Soluté d'acétate de magnésie, *Fr.*; Magnesiumacetat-Lösung, *G.*—Renaud proposed a solution made by dissolving 40 parts of magnesium carbonate in sufficient acetic acid (137 parts), filtering, and evaporating to 100 parts. It is a colorless syrupy liquid, having a bitterish taste less pleasant than the citrate, and containing nearly 60 per cent. of the dry acetate, $Mg(C_2H_3O_2)_2$ (mol. weight 142.02). The dry salt is white, gum-like, very deliquescent, and freely soluble in water and alcohol.

Elixir magnesii acetatis.—Solution of magnesium acetate 66 parts; alcohol 14 parts; syrup of orange-peel (or of lemon-peel) 70 parts. This contains 25 per cent. of the dry salt, but less alcohol than directed by Garot's formula.

Action and Uses.—This medicine has come into popular use as a purgative, and, if its constitution could be depended upon, would answer a useful purpose. But as it sometimes purges violently, and in other cases fails of any purgative effect, it ought not to be employed where certainty and uniformity of action are important. It should generally be given in divided doses of Gm. 120–190 (f ℥iv–vi) every hour until the desired operation is produced.

Magnesium acetate was introduced as a substitute for magnesium citrate, probably on account of its greater cheapness, it being assumed to possess the same mode of action as the citrate. A committee of the Pharmaceutical Society of Paris reported it to be a purgative whose slight taste and great solubility recommended it. It is, however, less soluble than the citrate and of a less agreeable taste. It does not seem to have been approved by physicians.

LIQUOR MORPHINÆ ACETATIS, *Br.*—Solution of Morphine Acetate.

Soluté d'acétate de morphine, Fr.; *Essigsaure Morphinlösung*, G.

Preparation.—Take of Morphine Acetate 9 grains; Diluted Acetic Acid 18 minims; Rectified Spirit ½ fluidounce; Distilled Water 1½ fluidounces. Mix the acid, the spirit, and the water, and dissolve the acetate of morphine in the mixture.—*Br.*

Uses.—Each fluidrachm contains ½ grain (Gm. 4 contain Gm. 0.03) of morphine acetate, the decomposition of which is prevented by the spirit.

LIQUOR MORPHINÆ BIMECONATIS, *Br.*—Solution of Morphine Bimeconate.

Preparation.—Take of Morphine Hydrochlorate, 9 grains; Solution of Ammonia, a sufficiency; Meconic Acid, 6 grains; Rectified Spirit, ½ fluidounce; Distilled Water, a sufficiency. Dissolve the morphine hydrochlorate in two or three drachms of distilled water, aiding solution by warmth; then add solution of ammonia until morphine ceases to be precipitated; cool; filter; wash the precipitate with distilled water until the washings cease to give a precipitate with silver nitrate; drain; mix the precipitate with sufficient water to produce an ounce and a half; add the rectified spirit and meconic acid; dissolve.—*Br.*

Each fluidounce of this solution contains about 5 grains of morphine bimeconate, and its *dose* is 5 to 40 minims.

LIQUOR MORPHINÆ HYDROCHLORATIS, *Br.*—Solution of Morphine Hydrochlorate.

Soluté de hydrochlorate de morphine, Fr.; *Salzsaure Morphinlösung*, G.

Preparation.—Take of Morphine Hydrochlorate, 9 grains; Diluted Hydrochloric Acid, 18 minims; Rectified Spirit, ½ fluidounce; Distilled Water, 1½ fluidounces. Mix the hydrochloric acid, the spirit, and the water, and dissolve the morphine hydrochlorate in the mixture.—*Br.*

Uses.—Each fluidrachm of this solution contains ½ grain of morphine hydrochlorate, and its *dose* is from 10 to 60 minims. Trousseau recommended, for hypodermic injection, a solution of morphine hydrochlorate in glycerin, which preserves the salt from decomposition

LIQUOR MORPHINÆ SULPHATIS, *Br. Add.*—Solution of Morphine Sulphate.

Soluté de sulfate de morphine, Fr.; *Schwefelsaure Morphinlösung* G.

Preparation.—Take of Morphine Sulphate, 35 grains; Rectified Spirit, 2 fluidounces; Distilled Water, sufficient to produce 8 fluidounces. Dissolve the morphine sulphate in part of the water, add the rectified spirit, and finally the remainder of the water.—*Br. Add.*

This and the preceding solution are about four times as strong as the *Liquor morphiæ sulphatis*, U. S. P., 1870, which was made by dissolving 1 grain of morphine sulphate in 1 fluidounce of water.

In some parts of the United States a much stronger solution is prescribed under the name of *Magendie's solution of morphine*. It is prepared by dissolving 16 grains of morphine sulphate in sufficient water to produce 1 fluidounce, and is therefore sixteen times as strong as the preceding *Magendie's solution* is prepared in France by dissolving 0.8 Gm. (12⅓ grains) of morphine acetate in 30 Gm. (about 1 fluidounce) of water, and is therefore considerably weaker than the solution known by the same name in the United States.

Uses.—Each fluidrachm of this solution contains about ½ grain of morphine sulphate, and the dose is from 10 to 60 minims.

LIQUOR PLUMBI SUBACETATIS, *U. S., Br.*—Solution of Lead Subacetate.

Liquor plumbi subacetici, P. G.; *Acetum plumbicum*, *Acetum saturni*, *Plumbum hydrico-aceticum solutum*, *Subacetas plumbicus liquidus.—Goulard's extract*, E.; *Sous-acétate de plomb liquide*, *Extrait de saturne* (*de Goulard*), *Vinaigre de plomb* (*de saturne*), F.; *Bleiessig*, G.

An aqueous liquid containing in solution about 25 per cent. of lead subacetate (approximately, $Pb_2O(C_2H_3O_2)_2$ 546.48),—*U. S.* Specific gravity 1.195 *U. S.*, 1.275 *Br.*, 1.235 to 1.240 *P. G.*, 1.32 *F. Cod.*

Preparation.—Lead Acetate, 170 Gm.; Lead Oxide, 100 Gm.; Distilled Water, a sufficient quantity; to make 1000 Gm. Dissolve the lead acetate in 800 Gm. of boiling distilled water in a glass or porcelain vessel. Then add the lead oxide, and boil for half an hour, occasionally adding hot distilled-water to make up the loss by evaporation. Remove the heat, allow the liquid to cool, and add enough distilled water, previously

boiled and cooled, to make the product weigh 1000 Gm. Finally, filter the liquid in a well-covered funnel. Solution of lead subacetate should be kept in well-stoppered bottles. —*U. S.*

Lead Acetate, 5 oz. av.; Lead Oxide, 3½ oz. av.; Distilled water, 20 oz. av. Boil as above, and make the filtrate measure 20 Imperial fluidounces.—*Br.*

Lead Acetate, 3 parts; Lead Oxide, 1 part; Distilled Water, 8 parts. Boil and preserve the weight.—*F. Cod.*

Lead Acetate, 3 parts; Lead Oxide, 1 part; Water, ½ part. Mix at the heat of a water bath until the mixture has become white or nearly so; then add 9½ parts of water, set aside to settle and filter.—*P. G.*

Several basic lead acetates, soluble or insoluble in water, are known, which may be obtained by treating solutions of the neutral acetate with the requisite quantity of lead oxide. The exact composition of the pharmacopœial solutions depends, therefore, upon the proportion of the two compounds named. Döbereiner, Berzelius, and others suggested to use them in the proportion of their molecular weights, so as to form $Pb(C_2H_3O_2)_2.Pb(OH)_2$. This proportion is closely adhered to by the U. S. and Br. Pharmacopœias, both authorities using nearly 6 molecules of the oxide to 5 of the acetate, so that the solutions must contain chiefly the acetate named, and in addition thereto a small quantity of the triplumbic acetate, $2Pb(C_2H_3O_2)_2.Pb(OH)_2$. On the other hand, the French and German preparations are made with very nearly 3 molecules of acetate to 2 of lead oxide and contain, therefore, about equal molecules of the two basic acetates. Both these salts are crystallizable from alcohol, in which solvent they are less freely soluble than in water. A still more basic triplumbic acetate, $Pb(C_2H_3O_2)_2.2Pb(OH)_2$, may also be obtained in white needles, but is insoluble in strong alcohol. In preparing these compounds a nearly insoluble sexplumbic acetate, $Pb(C_2H_3O_2)_2.5Pb(OH)_2$, is formed in variable proportions, and is filtered off. This insoluble compound is included in the total weight directed by three of the above formulas, while that of the British Pharmacopœia orders the filtrate to be brought to a definite measure. The filtered product, *U. S. P.*, weighs about 950 Gm. (about 27 fluidounces).

The combination of the chemicals may be effected at the ordinary temperature by macerating the finely-levigated litharge with the solution of lead acetate in a corked bottle, and agitating occasionally until the sediment has become white; from two to four days are usually required. By boiling all the ingredients the same result is obtained in a much shorter time, and the process is preferable to that of the German Pharmacopœia.

Properties.—Solution of lead subacetate is a colorless liquid having a sweet, astringent taste and an alkaline reaction to test-paper; the specific gravity has been given above. On exposure to air, or on being mixed with water containing air in solution, the solution yields a white precipitate of lead carbonate. It unites readily with liquid and solid fats, and may be mixed with an equal bulk of alcohol without precipitating. Added to a solution of gum-arabic, a dense white precipitate is produced; otherwise it has the reactions of lead acetate.

Tests.—After acidulating the solution with acetic acid, potassium ferrocyanide should produce a white precipitate free from any blue (iron) or red (copper) tint. When completely precipitated by an excess of sulphuric acid the filtrate, on being evaporated to dryness, should leave no residue or only a very slight one (absence of other salts). When precipitated by an excess of ammonia the filtrate should not have a blue color (absence of copper). "13.67 Gm. of the solution diluted with 50 Cc. of water should require for complete precipitation 25 Cc. of the normal volumetric solution of sulphuric acid."—*U. S.* 284.5 grains of the solution and 500 grain-measures of the volumetric solution of oxalic acid, *Br.*

Linimentum plumbi subacetatis, *U. S.*, 1880.—Mix 4 parts of solution of lead subacetate with 6 parts of cotton-seed oil (all by weight), and shake well together.

Action and Uses.—This solution has occasioned violent toxical symptoms when taken internally, which it never should be for medicinal purposes. It is employed whenever an astringent and local sedative action is required to allay pain or inflammation, to constringe flaccid tissues, or to lessen secretion. When applied to the denuded cutis its use should not be continued long, lest acute poisonous effects be developed. It is of common use, diluted, in the treatment of *contusions*, *sprains*, *excoriations*, *fractures*, *burns*, *wounds*, *abscesses*, *hernia*, *hæmorrhoids*, and various cutaneous *eruptions* of an inflammatory sort. It is best applied on soft cloths, lint, etc., which should be covered with a waterproof tissue. Spongio-piline is a convenient vehicle for its use. The mucilage of slippery elm or of quince-seeds causes a precipitation of the lead from this solution;

flaxseed and sassafras-pith mucilages are less objectionable. For practical use the diluted solution is in most cases preferable.

LIQUOR PLUMBI SUBACETATIS DILUTUS, *U. S., Br.*—Diluted Solution of Lead Subacetate.

Aqua plumbi, P. G.; *Aqua plumbica (vel saturnina).—Lead-water*, E.; *Eau de saturne, Eau blanche*, Fr.; *Bleiwasser, Kühlwasser*, G.

Preparation.—Solution of Lead Subacetate 30 Cc.; Distilled Water 970 Cc.; to make 1000 Cc. Mix the solution of lead subacetate with the distilled water, previously boiled and cooled. Keep the liquid in well-stopped bottles.—*U. S.*

To prepare a pint of lead-water, 230 minims of solution of lead subacetate should be mixed with sufficient distilled water, previously boiled, to make 16 fluidounces.

Take of solution of lead subacetate, rectified spirit, each 2 fluidrachms; distilled water 19½ fluidounces. Mix, and filter through paper. Keep the clear solution in a stoppered bottle.—*Br.*

The use of distilled water does not prevent the mixture from becoming turbid at once, the carbonic acid held in solution or contained in the atmosphere producing some lead carbonate; this gas is therefore expelled by the previous boiling of water. Since, however, the decomposition will again take place when exposed to the atmosphere, it is best to prepare lead-water only in small quantities; for preparing 4 fluidounces of it 56 minims of Goulard's extract are required; the French and German Pharmacopœias order 2 per cent.

Aqua plumbi Goulardi, Aqua vegeto-mineralis Goulardi vel Lotio plumbea.—Goulard's lead-water, *E.;* Eau de Goulard, *Fr.;* Goulardsches Wasser, *G.*—This contains a little alcohol (*Br.*) or vulnerary spirit (*F. Cod.*), the latter being an aromatic alcohol.

Uses.—It is this rather than the stronger solution of subacetate of lead that is commonly employed for the various purposes above indicated. When it is used as a lotion merely, and is not confined by dressings, it is rendered more efficient by the addition of alcohol, in the proportion of 3 or 4 drachms to a pint (Gm. 12–16 in Gm. 500) of the solution, as in Goulard's lead-water.

LIQUOR POTASSÆ, *U. S., Br.*—Solution of Potassa.

Liquor kali caustici, P. G.; *Kali hydricum solutum, Lixivium causticum.—Solution of potash*, E.; *Potasse caustique liquide, Lessive caustique*, Fr.; *Aetzkalilauge, Kalilauge*, G.

An aqueous solution of potassium hydroxide, KOH; molecular weight 55.99—containing about 5 per cent. *U. S.*, 5.84 per cent. *Br.*, 15 per cent. *P. G.*, of the hydroxide. Specific gravity 1.036 *U. S.*, 1.058 *Br.*, 1.126 to 1.130 *P. G.*

Preparation.—Potassium Bicarbonate 85 Gm.; Lime 40 Gm.; Distilled Water a sufficient quantity. Dissolve the potassium bicarbonate in 400 Cc. of distilled water; heat the solution until effervescence ceases, and then raise it to boiling. Slake the lime and make it into a smooth mixture with 400 Cc. of distilled water, and heat it to boiling. Then gradually add the first liquid to the second, and continue the boiling for 10 minutes. Remove the heat, cover the vessel tightly, and when the contents are cold add enough distilled water to make the whole mixture weigh 1000 Gm. Lastly, strain it through linen, set the liquid aside in a well-stoppered bottle until it is clear, and remove the clear solution by means of a siphon.

Solution of potassa may also be prepared in the following manner: potassa 56 Gm.; distilled water 944 Gm.; to make 1000 Gm. Dissolve the potassa in the distilled water.

The potassa used in this process should be of the full strength directed by the Pharmacopœia (90 per cent.). Potassa of any other strength, however, may be used if a proportionately larger or smaller quantity be taken, the proper amount for the above formula being ascertained by dividing 5000 by the percentage of absolute potassa (potassium hydroxide) contained therein. Solution of potassa should be kept in well-stoppered bottles.—*U. S.*

To prepare 1 pint of solution of potassa 423 grains of the official potassium hydroxide may be dissolved in sufficient distilled water to obtain 16 fluidounces of finished product.

Take of potassium carbonate 1 pound; slaked lime 12 ounces; distilled water 1 gallon (Imperial). Dissolve the potassium carbonate in the water, and, having heated the solution to the boiling-point in a clean iron vessel, gradually add the washed slaked lime, and

continue the ebullition for ten minutes with constant stirring. Then remove the vessel from the fire, and when, by the subsidence of the insoluble matter, the supernatant liquor has become perfectly clear, transfer it by means of a siphon to a green glass bottle furnished with an air-tight stopper, and add distilled water if necessary to make it correspond with the tests of specific gravity and neutralizing power.—*Br.*

On bringing together potassium carbonate and slaked lime in the presence of water a double decomposition is effected, resulting in the formation of potassium hydroxide and calcium carbonate; $K_2CO_3 + Ca(OH)_2$ yields $2KOH + CaCO_3$. This reaction cannot be completed in concentrated solutions, but occurs promptly in diluted liquids. The smallest quantity necessary for 1 part of potassium carbonate, according to Watson, is 8 parts of water; Mohr, however, prefers to use not less than 12 parts, and to concentrate the caustic liquor, if necessary, by evaporation. The decomposition may be effected in the cold by frequent agitation, but the resulting calcium carbonate is then light and retains much of the liquor, while at the same time silica, if present in the carbonate, is not completely removed. The British Pharmacopœia uses potassium carbonate and water in the proportion of 1 to 10; the United States Pharmacopœia, nearly in the proportion of 1 to $12\frac{1}{2}$, having substituted the much purer bicarbonate for the carbonate. 1 part of slaked lime is sufficient to decompose 2.5 parts of potassium carbonate, containing 81 per cent. of the pure anhydrous salt, and for 1.8 parts of potassium bicarbonate if in boiling the solution of the latter carbon dioxide was not given off, or for 3.6 parts of the latter salt if previously converted into normal carbonate by boiling. An excess of lime is, however, preferable to ensure complete decomposition; but the employment of an unnecessarily large quantity may be avoided by following the directions of the Pharmacopœia to add the milk of lime gradually in small portions to the boiling alkaline liquid; when this addition amounts to a quantity of lime equal to about one-half the weight of the potassium salt, a little of the boiling mixture may be poured upon a small moistened filter, and the filtrate collected in a test-tube containing some hydrochloric acid. Should effervescence occur, the boiling must be continued and more lime added, until on testing as before, a new filter being used each time, no effervescence is observed. The removal of the caustic liquor may be effected either by filtering it at once through muslin, or, better still, we think, by allowing the insoluble matter to subside, drawing off the clear liquor by means of a siphon, and transferring the sediment before it has become hard upon a muslin strainer, and washing the potassa out by means of distilled water. In all cases the liquid should be brought to the proper density by the addition of water, or, if necessary, by evaporation; if largely diluted by washing, the potassa solution may be employed for various chemical operations. A well-cleaned iron vessel is best adapted for the above operation.

Other methods for obtaining potassa solution adapted for special purposes have been recommended. Schubert decomposed potassium sulphate accurately by a hot solution of baryta. Hunter (1866) arrived at the same result by substituting lime for the baryta, and by boiling and filtering under a pressure of about 40 pounds to the square inch. F. Schulze (1861) heated a mixture of 1 part of pure potassium nitrate with 3 parts of ferrous oxalate to dull redness while hydrogen gas was being conducted to the bottom of the crucible. Wöhler's process (1853), to heat a mixture of 1 part of potassium nitrate and 2 of copper to dull redness, is apt to yield a product containing potassium nitrite if the mixture has not been intimate or if the heat is not continued long enough; Polacci (1872) found the solution in water to contain a little copper.

The table on page 977, computed by Gerlach (1869), gives the specific gravity of potassa solution at 15° C. (59° F.), containing from 1 to 60 per cent. of potassium oxide, and the same percentage of potassium hydroxide:

Properties.—Potassa solution is a clear and colorless liquid of the specific gravity stated above, and has a strong alkaline reaction and a very caustic taste. The slight peculiar odor which it usually has is due to its action upon organic bodies which may have been derived from the atmosphere. It dissolves wool, skin, and other animal and many vegetable substances, and decomposes fats, forming therewith soluble soaps. It attracts carbon dioxide from the air with great avidity, and must therefore be preserved in well-stoppered bottles. Green glass, free from lead, is best adapted for the purpose, but is likewise somewhat decomposed by alkalies, which cause the stopper to become firmly fastened into the bottle unless protected by a thin layer of paraffin. Potassa solution decomposes the salts of ammonium, of the metals, and of all the alkaloids, and induces the decomposition of tannin and its derivatives; a drop taken by a platinum loop and held in a non-luminous flame imparts to it a violent tint. As a test of identity, and con-

sidering the strong yellow color given by sodium compounds, the flame may be examined through a blue glass to cut off the color of sodium. It differs from soda solution in yielding a white crystalline precipitate with excess of concentrated solution of tartaric acid, and a yellow one on the addition of hydrochloric acid and platinic chloride.

Per-centage.	K_2O.	KHO.	Per-centage.	K_2O.	KHO.	Per-centage.	K_2O.	KHO.
1	1.010	1.009	21	1.230	1.188	41	1.522	1.425
2	1.020	1.017	22	1.242	1.198	42	1.539	1.438
3	1.030	1.025	23	1.256	1.209	43	1.554	1.450
4	1.039	1.033	24	1.270	1.220	44	1.570	1.462
5	1.048	1.041	25	1.285	1.230	45	1.584	1.474
6	1.058	1.049	26	1.300	1.241	46	1.600	1.488
7	1.068	1.058	27	1.312	1.252	47	1.615	1.499
8	1.078	1.065	28	1.326	1.264	48	1.630	1.511
9	1.089	1.074	29	1.340	1.276	49	1.645	1.527
10	1.099	1.083	30	1.355	1.288	50	1.660	1.539
11	1.110	1.092	31	1.370	1.300	51	1.676	1.552
12	1.121	1.101	32	1.385	1.311	52	1.690	1.565
13	1.132	1.111	33	1.402	1.324	53	1.705	1.578
14	1.143	1.119	34	1.418	1.336	54	1.720	1.590
15	1.154	1.128	35	1.431	1.349	55	1.733	1.604
16	1.166	1.137	36	1.445	1.361	56	1.746	1.618
17	1.178	1.146	37	1.460	1.374	57	1.762	1.630
18	1.190	1.155	38	1.475	1.387	58	1.780	1.641
19	1.202	1.166	39	1.490	1.400	59	1.795	1.655
20	1.215	1.177	40	1.504	1.411	60	1.810	1.667

Tests.—The solution should not effervesce, or at most should give off only isolated bubbles, when dropped into an excess of dilute hydrochloric acid (limit of carbonate). Carbonic acid is limited to about $\frac{1}{3}$ per cent. by the following test: Mix 1 part of potassa solution with 4 parts of lime-water; boil, and filter into nitric acid, when no effervescence should be observed.—*P. G.* When acidulated with nitric acid, potassa solution should give not more than a very slight turbidity with barium nitrate (sulphate), silver nitrate (chloride), or sodium carbonate (alumina, lime); and when the acidulated solution is evaporated to dryness the residue should form a clear or merely a slightly turbid (from presence of silica) solution in water, which should not be disturbed by test solution of magnesium (absence of phosphate). If neutralized with sulphuric acid, and then mixed with half its bulk of concentrated sulphuric acid and allowed to cool, the addition of ferrous sulphate should not produce a black or blackish-brown color (nitrate). Potassa solution should not be precipitated or colored black by hydrogen sulphide, either before or after being acidulated (absence of metals). The British Pharmacopœia demands that 462.9 grains (1 fluidounce Imperial) should require for neutralization 482 grain-measures of the volumetric solution of oxalic acid, which corresponds to 5.84 per cent. by weight of potassium hydrate, or 27 grains in 1 (Imperial) fluidounce. The solution of the United States Pharmacopœia should require for 28 Gm. not less than 25 Cc. of the normal volumetric solution of sulphuric acid, and the (*U. S.*) fluidounce should contain about 26.5 grains of pure potassium hydroxide.

Pharmaceutical Uses.—By evaporating the solution it yields Potassa (Potassa caustica), *U. S.*, *Br.*

Action and Uses.—Solution of potassa possesses in a degree the caustic properties of the pure alkali, since it contains nearly 6 per cent of the latter. The soapy feel which it gives to the fingers is due to its combination with the unctuous secretion of the skin. In medicinal doses and taken during or after a meal it speedily combines with the acids then abundantly secreted by the stomach, but if properly diluted and used when the stomach is empty it is absorbed, and tends to neutralize the acid secretions, especially the urine, along with which it is chiefly eliminated. Used habitually, it lessens the coagulability of the blood and dissolves out the hæmatin from the red corpuscles, giving rise to paleness and puffiness of the skin, passive hæmorrhages, general emaciation, and, in a word, to the ordinary phenomena of scurvy. Its poisonous effects are treated of under Potassa. This aplastic operation explains its efficacy in moderating a tendency to plastic exudations, in promoting the absorption of those already existing, and in modifying nutrition generally.

Solution of potassa limits or suspends the formation of *acid urinary deposits* and *concretions* by neutralizing the free acids through which they are formed, while it spares the urinary passages the irritation of their contact. But since these acids always pro-

ceed from some defect of primary assimilation, the mere neutralization of them when formed does not necessarily effect a radical cure, which must be sought by the use of remedies tending to bring the digestive powers and the work of digestion into due proportion and harmony. For this purpose dietetic and hygienic measures are the most efficient. The *dyspeptic symptoms* which call for solution of potassa and other antacid medicines are heartburn, sour eructations, aphthæ, œsophageal spasm, vomiting, cramp in the stomach, colic, and irregular diarrhœa. It is probable that such medicines, by correcting acidity, tend to promote the due digestion of food, and thereby indirectly to remove the debility of the system upon which *acid dyspepsia* depends. Certain it is that in cases of "uric-acid diathesis," as it has been called, the alkaline treatment, duly carried out, will sometimes suspend the faulty secretions for an indefinite period. It is true that this result is more usual after the liberal use of diuretic mineral waters, which probably cleanse the urinary channels of accumulated deposits, than from the use of solution of potassa or of any other alkali alone. The *tympanites* incident to this form of dyspepsia is best palliated by the medicine when it is given in a bitter infusion. *Strangury* from cantharides is said to be both prevented and relieved by 20 minims of solution of potassa, largely diluted. In *acne* of the face (gutta rosacea) the internal use of the medicine is sometimes very efficient, and it has been equally recommended for the prevention and cure of *boils* when they occur in successive crops. *Scrofulous glandular swellings* are doubtless diminished during a course of this medicine, but its debilitating effects upon the system should at the same time be counteracted by appropriate food and cod-liver oil. It is injurious in *phthisis*, but, on the other hand, useful in *chronic bronchitis*, especially when associated with emphysema and when expectoration is difficult and the sputa are scanty and tenacious. The mode of action implied in some of the preceding statements receives a further support from the successful use of solution of potassa in moderate *obesity*. The hypothesis invoked to explain its action is that "it increases the vital powers of metamorphosis, by saponifying in part the fat contained in the blood and enabling it to be burnt off as carbonic acid." We should incline to the opinion that it acts by slowly poisoning the victim, radically disorganizing his blood, and hindering his nutrition. For the purpose intended it has been given in the dose of 1 or 2 fluidrachms three times a day—a dose which probably no stomach could long receive with impunity. Experiments and observations in India furnish some reason for thinking that solution of potassa is an antidote to *serpents' bites*. They are not, however, conclusive. Nor is the statement more probable that if used to cauterize the bites of rabid animals it will prevent *hydrophobia*. The power of this solution to dissolve organic products has been used to soften the nail in cases of *ingrown nail*, and gradually to permit its removal, leaving the fungous granulations free from its irritation. In like manner it softens the callosities of *corns*, *bunions*, and similar effects of local pressure. It has been recommended to add solution of potassa to the lime-water used for atomized inhalations in *diphtheritic* affections of the throat and larynx, in the proportion of 10 or 15 drops to 5 or 6 ounces of lime-water diluted one-half with pure water. When swallowed in poisonous doses the proper antidote against its effects is vinegar or lemon-juice, followed by some bland oil.

Solution of potassa may be administered internally in the *dose* of Gm. 0.60–4 (♏x–fʒj), largely diluted with a mucilaginous or sweetened aromatic or a bitter infusion. It should not be prescribed along with henbane, belladonna, or stramonium, whose medicinal properties it destroys.

LIQUOR POTASSÆ EFFERVESCENS, *Br.*—Effervescing Solution of Potash.

Aqua potassæ effervescens.—Potash-water, E.; *Eau alcaline gazeuse*, Fr.; *Alkalisches Mineralwasser*, G.

Preparation.—Take of Potassium Bicarbonate 30 grains; Water 1 pint (Imperial). Dissolve the bicarbonate in the water and filter the solution; then pass into it as much pure washed carbon dioxide gas, obtained by the action of sulphuric acid on chalk, as can be introduced with a pressure of four atmospheres. Keep the solution in bottles securely closed to prevent the escape of the compressed gas.—*Br.*

Properties and Tests.—The solution effervesces strongly when the containing vessel is opened, carbon dioxide escaping; it is clear and sparkling, and has an agreeable acidulous taste. 10 fluidounces, after being boiled for five minutes, require for neutralization 150 grain-measures of the volumetric solution of oxalic acid. 5 fluidounces,

evaporated to one-fifth, and 12 grains of tartaric acid added, yield a crystalline precipitate which, when dried, weighs not less than 12 grains.

Uses.—The remarks made under LIQUOR MAGNESIÆ CARBONATIS are applicable to this preparation.

LIQUOR POTASSII ARSENITIS, *U. S.*—SOLUTION OF POTASSIUM ARSENITE.

Liquor arsenicalis, Br.; *Liquor kalii arsenicosi*, P. G.; *Solutio arsenicalis Fowleri, Kali arsenicosum solutum.—Arsenical solution, Fowler's solution*, E.; *Liqueur (solution) arsenicale de Fowler*, Fr.; *Fowler'sche Tropfen*, G.

The official solutions contain 1 Gm. of arsenous acid in 100 Cc., *U. S.;* 1 part in 100 by weight, *Br., F. Cod., P. G.*

Preparation.—Arsenous Acid, in fine powder 10 Gm.; Potassium Bicarbonate 20 Gm.; Compound Tincture of Lavender 30 Cc.; Distilled Water, a sufficient quantity to make 1000 Cc. Boil the arsenous acid and potassium bicarbonate with 100 Cc. of distilled water, until solution has been effected. Then add enough distilled water to make the solution, when cold, measure 970 Cc., and lastly, add the compound tincture of lavender. Filter through paper.—*U. S.*

To prepare ½ pint of Fowler's solution 37 grains of arsenous acid and 74 grains of potassium bicarbonate should be boiled with 6 fluidrachms of distilled water until dissolved; when cool, sufficient distilled water should be added to bring the volume up to 7¾ fluidounces, and finally ¼ fluidounce of compound spirit of lavender is to be added.

Take of arsenous acid, in powder, potassium carbonate, each 87 grains; compound tincture of lavender 5 fluidrachms; distilled water a sufficiency. Place the arsenous acid and the potassium carbonate in a flask with 10 ounces of the water and apply heat until a clear solution is obtained. Allow this to cool. Then add the compound tincture of lavender and as much distilled water as will make the bulk 1 pint (Imperial).—*Br.*

The United States Pharmacopœia very properly directs the mixture of potassium salt and arsenous acid to be boiled in a small quantity of water, whereby a combination and solution is readily effected. When arsenous acid and potassium bicarbonate are boiled together with water in the proportion directed by the U. S. P., the following reaction probably takes place: $4\ KHCO_3 + As_2O_3 + 3H_2O = 2\ K_2HAsO_3 + 4H_2O + 4CO_2$. Since the Br. and G. P. order equal weights of arsenous acid and normal potassium carbonate to be used, a different reaction must ensue, and potassium meta-arsenite is probably present in the solution, according to the equation $As_2O_3 + K_2CO_3 = 2\ KAsO_2 + CO_2$; an excess of potassium carbonate is also present, as 1 part of arsenous acid requires less than ¾ part of potassium carbonate to form the meta-arsenite. Some authorities even claim that the solution is not that of a definite arsenical compound at all, but simply a solution of the arsenous acid in the alkaline liquid, and that the U. S. P. solution will likewise be changed to this condition by the absorption of carbon dioxide from the atmosphere.

Observations made by Fresenius, Dannenberg, and others indicate that in partially filled bottles the arsenous acid is gradually oxidized to arsenic acid, which is considered to be far less poisonous than the former. It is evident, therefore, that Fowler's solution cannot be kept unchanged for an indefinite period, and it is advisable that it be prepared in no larger quantities than will be sufficient for a few months or a year, or that it be kept in small well-sealed bottles, whereby oxidation is prevented, as well as the appearance of a fungous growth which often takes place in Fowler's solution on exposure to the air. Delahaye (1882) regards the excess of alkali used as favoring this growth, and recommends reducing the potassium to the quantity absolutely necessary for retaining the arsenic in permanent solution, or, better still, replacing it by sodium bicarbonate, 2 parts of which will be sufficient for 3 parts of arsenous acid; these changes, however, do not prevent the development of mould, though they may possibly retard it.

Properties.—Fowler's solution is a reddish liquid, at first somewhat opalescent, having an alkaline reaction to test-paper and the odor of lavender; that of the French and German Pharmacopœias is colorless, and is flavored with compound spirit of melissa. Its specific gravity is 1.009. It gives the usual reactions of arsenic, and requires to be acidulated with hydrochloric acid before it will be precipitated by hydrogen sulphide.

Tests.—On being acidulated with hydrochloric acid the solution should not acquire a yellow color or deposit a yellow precipitate (absence of arsenic sulphide).

The amount of arsenous acid contained in it is conveniently ascertained with iodine.

with starch-paste as an indicator, which is not permanently colored blue until the arsenous has all been oxidized to arsenic acid, hydriodic acid being formed at the same time; $As_2O_3 + 5H_2O + 2I_2$ yields $2H_3AsO_4 + 4HI$. "If 24.7 Cc. of the solution are boiled with 2 Gm. of sodium bicarbonate, the liquid, when cold, diluted with 100 Cc. of water, and some gelatinized starch added, it should require from 49.4 to 50 Cc. of decinormal solution of iodine until the blue color ceases to disappear on stirring (corresponding to 1 Gm. of arsenous acid in 100 Cc. of the solution."—*U. S.* Or, "5 Gm. of solution, mixed with 20 Gm. of water, 1 Gm. of sodium bicarbonate, and a few drops of starch solution, should decolorize 10 Cc. of the volumetric solution of iodine, and on the further addition of 0.1 Cc. of the latter should acquire a blue color."—*P. G.* "442 grains (1 fluidounce), 10 grains of sodium bicarbonate, and 6 fluidounces of distilled water containing a little mucilage of starch, treated as described, require 875 grain-measures of the volumetric solution of iodine, indicating 4⅓ grains of arsenous acid."—*Br.*

The addition of sodium bicarbonate in the official tests is for the purpose of neutralizing the newly-formed arsenic and hydriodic acids, thus preventing decomposition of the latter by the former, which would vitiate the results by constantly liberating iodine.

Uses.—The action and uses of this medicine have been sufficiently discussed elsewhere. (See ACIDUM ARSENOSUM.) It is sufficient in this place to state that its efficacy is most conspicuous in *squamous diseases of the skin*, *intermittent fever*, *neuralgia*, especially the trifacial nerve, and in *nervous asthma*. The commencing *dose* should not exceed Gm. 0.30 (gtt v), nor should it be given when the stomach is empty, nor unless greatly diluted.

LIQUOR POTASSII CITRATIS, *U. S.*—SOLUTION OF POTASSIUM CITRATE.

Mistura potassii citratis; Liquor kali citrici.—Citrate de potasse liquide, Fr.; *Kalium-citrat-Lösung*, G.

Preparation.—Citric Acid 6 Gm.; Potassium Bicarbonate 8 Gm.; Water a sufficient quantity. Dissolve the citric acid and the potassium bicarbonate each in 40 Cc. of water. Filter the solutions separately, and wash the filters with enough water to obtain in each case 50 Cc. of solution. Finally, mix the two solutions, and when effervescence has ceased transfer the liquid to a bottle. This preparation should be freshly made when wanted for use.—*U. S.*

To make 4 fluidounces of the official solution use 111 grains of citric acid and 148 grains of potassium bicarbonate, dissolving each separately in 2 ounces of water.

This solution of potassium citrate differs from Mistura potassi citratis U. S. 1880, in the absence of the yellowish color and the agreeable lemon flavor. It contains about 9 per cent. of anhydrous potassium citrate and small amounts of citric and carbonic acids, which latter impart to the liquid a pleasant acidulous taste.

The direction to make the solution fresh as wanted is a commendable one, since aqueous solutions of citric acid undergo decomposition (see page 51).

POTIO RIVERI, *P. G.*, is less than one-third the strength of the preceding; it is made from citric acid 4 parts, water 190 parts, and crystalized sodium carbonate 9 parts.

POTIO DE RIVIERE, *F. Cod.* Dissolve citric acid and potassium bicarbonate, of each 2 Gm., separately in water 50 Gm. and syrup 15 Gm.; the solutions are often dispensed in separate vials.

Action and Uses.—This preparation is nearly identical in its action with Liq. potassii effervescens, *Br. P.*, and with the effervescing draught prepared extemporaneously. When the intention is solely to affect the system after the absorption of the salt, either of the first two will lessen the tension of the capillaries and promote *diaphoresis;* but when it is intended at the same time to make an impression upon the stomach itself, the carbondioxide extricated during effervescence becomes an important part of the dose. The primary action of the gas is to stimulate organically, while it perhaps anæsthetizes, the gastric mucous membrane, as may be inferred from the many cases of gastric hyperæmia and irritation in which it allays *nausea* and *vomiting*. It may therefore be sometimes used with advantage when the stomach is disordered, although fever may be absent. Either solution may have its diaphoretic power increased by the addition of spirit of nitrous ether, of solution of morphine, or of antimonial wine or tartar emetic, in very small, non-nauseating doses.

The *dose* of the neutral mixture is a tablespoonful (Gm. 16); of the effervescing mixture, a tablespoonful (Gm. 16) of each of the two solutions should be mixed, and swal-

lowed while effervescing. The dose should be repeated every hour until the object in view is attained or defeated.

LIQUOR POTASSII PERMANGANATIS, *Br.*—Solution of Potassium Permanganate.

Liquor potassæ permanganatis.—Soluté de permanganate de potasse, Fr.; *Kalium-permanganat-Lösung* G.

Preparation.—Take of Potassium Permanganate 88 grains; Distilled Water 1 pint (Imperial). Dissolve.—*Br.*

The solution contains 1 per cent. of potassium permanganate, and has the purple color and the chemical behaviour of the salt.

Uses.—The official solution, of 4 grains of the salt to an ounce of distilled water, appears unnecessary, since it is too weak for many purposes and too strong for others. (For its uses and doses, see Potassii Permanganas.)

LIQUOR SODÆ, *U. S., Br.*—Solution of Soda.

Liquor natri caustici, P. G.; *Natrum hydricum solutum.—Soude caustique liquide, Lessive des savonniers*, Fr.; *Aetznatronlauge*, G.

An aqueous solution of sodium hydroxide, NaOH; molecular weight 39.96—containing 5 per cent. *U. S.*, 4.1 per cent. *Br.*, 15 per cent. *P. G.*, 23 per cent. *F. Cod.*, of the hydroxide. Specific gravity of the official solutions: 1.059 *U. S.*, 1.047 *Br.*, 1.33 *F. Cod.*, 1.168 to 1.172 *P. G.*

Preparation.—Sodium Carbonate 170 Gm.; Lime 50 Gm.; Distilled Water a sufficient quantity. Dissolve the sodium carbonate in 400 Cc. of boiling distilled water. Slake the lime, and make it into a smooth mixture with 400 Cc. of distilled water, and heat it to boiling. Then gradually add the first liquid to the second, and continue the boiling for ten minutes. Remove the heat, cover the vessel tightly, and when the contents are cold add enough distilled water to make the whole mixture weigh 1000 Gm. Lastly, strain it through linen, set the liquid aside in a well-stoppered bottle until it is clear, and remove the clear solution by means of a siphon.

Solution of Soda may also be prepared in the following manner: Soda 56 Gm.; distilled water 944 Gm.; to make 1000 Gm. Dissolve the soda in the distilled water. The soda used in this process should be of the full strength directed by the Pharmacopœia (90 per cent.). Soda of any other strength, however, may be used if a proportionately larger or smaller quantity be taken, the proper amount for the above formula being ascertained by dividing 5000 by the percentage of absolute sodium hydroxide contained therein. Solution of soda should be kept in well-stoppered bottles.—*U. S.*

To prepare 1 pint of solution of soda 432 grains of the official sodium hydroxide may be dissolved in sufficient distilled water to obtain 16 fluidounces of finished product.

Take of carbonate of soda 28 ounces; slaked lime 12 ounces; distilled water 1 gallon. Dissolve the carbonate of soda in the water, and, having heated the solution to the boiling-point in a clean iron vessel, gradually add the washed slaked lime, and continue the ebullition for 10 minutes, with constant stirring. Then remove the vessel from the fire, and when, by the subsidence of the insoluble matter, the supernatant liquor has become perfectly clear, transfer it by means of a siphon to a green glass bottle furnished with an air-tight stopper, and add distilled water, if necessary, to make it correspond with the tests of specific gravity and neutralizing power.—*Br.*

The process is quite analogous to that for the preparation of caustic potassa, and what has been said about the manipulation (see Liquor Potassæ) applies equally well in this case. 1 part of burned lime, if pure, is sufficient to decompose 5 parts of crystallized sodium carbonate; in both the above formulas the quantity of the former ordered may without disadvantage be reduced.

Properties.—Soda solution is a clear and colorless liquid of the density given above, and has a strong alkaline reaction and a very caustic taste; the peculiar slight odor which it usually has is solely due to the accidental presence of organic matters, which are likely to impart also a yellowish color. It dissolves various organic matters and tissues, and decomposes fats, forming soaps. It has a great affinity for carbonic acid, and should be preserved in well-stopped bottles made of glass free from lead, the stopper being protected by a thin layer of paraffin. In its chemical behavior it closely resembles potassa solution, but, unlike the latter, it does not yield a crystalline precipitate with excess of tartaric acid, except in concentrated solutions; with hydrochloric acid and platinum

chloride it does not yield a yellow precipitate, and when, by means of a platinum wire, a drop of it is held in a non-luminous flame, an intense yellow color is imparted to the latter.

Tests.—Soda solution should not effervesce, or at most should evolve only isolated bubbles of carbon dioxide, on being dropped into an acid. "If 1 part of it be boiled with 4 parts of lime-water, the liquid filtered into nitric acid should not cause any effervescence (not over $\frac{1}{3}$ per cent. carbonic acid as carbonate)."—*P. G.* The solution acidulated with nitric acid should not cause more than a slight cloudiness with barium nitrate (sulphate), silver nitrate (chloride), or sodium carbonate (alumina, earths), and when evaporated to dryness and redissolved in water should leave only a minute quantity of insoluble matter (silica), and furnish a liquid which is not precipitated by test solution of magnesium (phosphate). The absence of nitrate and of heavy metals is shown as described for LIQUOR POTASSÆ. "To neutralize 20 Gm. of solution of soda should require not less than 25 Cc. of the normal solution of sulphuric acid."—*U. S.* 458 grains (1 fluidounce) of the solution require 470 grain-measures of the volumetric solution.—*Br.*

The following table by Gerlach (1869) gives the specific gravity at 15° C. (59° F.) of soda solution containing from 1 to 60 per cent. of sodium oxide and the same percentage of sodium hydroxide.

Per-centage.	Na_2O.	NaOH.	Per-centage.	Na_2O.	NaOH.	Per-centage.	Na_2O.	NaOH.
1	1.015	1.012	21	1.300	1.236	41	1.570	1.447
2	1.029	1.023	22	1.315	1.247	42	1.583	1.456
3	1.043	1.035	23	1.329	1.258	43	1.597	1.468
4	1.058	1.046	24	1.341	1.269	44	1.610	1.478
5	1.074	1.059	25	1.355	1.279	45	1.623	1.488
6	1.089	1.070	26	1.369	1.290	46	1.637	1.499
7	1.104	1.081	27	1.381	1.300	47	1.650	1.508
8	1.119	1.092	28	1.395	1.310	48	1.663	1.519
9	1.132	1.103	29	1.410	1.321	49	1.678	1.529
10	1.145	1.115	30	1.422	1.332	50	1.690	1.540
11	1.160	1.126	31	1.438	1.343	51	1.705	1.550
12	1.175	1.137	32	1.450	1.351	52	1.719	1.560
13	1.190	1.148	33	1.462	1.363	53	1.730	1.570
14	1.203	1.159	34	1.475	1.374	54	1.745	1.580
15	1.219	1.170	35	1.480	1.384	55	1.760	1.591
16	1.233	1.181	36	1.500	1.395	56	1.770	1.601
17	1.245	1.191	37	1.515	1.405	57	1.785	1.611
18	1.258	1.202	38	1.530	1.415	58	1.800	1.622
19	1.270	1.213	39	1.543	1.420	59	1.815	1.633
20	1.285	1.225	40	1.558	1.437	60	1.830	1.643

Allied Preparation.—SODIUM ETHYLATE, C_2H_5NaO, or *caustic alcohol*, was recommended by Dr. B. W. Richardson (1870). Half a fluidounce of absolute alcohol is put into a two-ounce test-tube, immersed in water of 10° C. (50° F.), and metallic sodium is added in small pieces until the evolution of hydrogen ceases, when the temperature is raised to 37.8° C. (100° F.), and the addition of sodium continued until hydrogen ceases to be given off; the compound is then dissolved in half a fluidounce of absolute alcohol. According to Liebig (1837), the action is rapidly completed at 50° C. (122° F.), and on cooling the sodium ethylate crystallizes in large colorless laminæ. It may be rubbed into powder and preserved in well-stoppered vials.

LIQUOR SODII ETHYLATIS, *Br.*, is made by dissolving metallic sodium 22 grains in ethylic (absolute) alcohol 1 fluidounce, contained in a flask and kept cool by water. It is a colorless, syrupy liquid, of spec. grav. 0.867, becomes brown by keeping, and contains 19 per cent of NaC_2H_5O.

Action and Uses.—Solution of soda is seldom used therapeutically, and then chiefly in cases of "torpor of the liver." *Dose*, Gm. 0.60–4 (gtt. x–lx), largely diluted.

SODIUM ETHYLATE.—According to Dr. Richardson, the following are the results of applying *sodium ethylate* to living tissues: 1, a removal of water from the tissue; 2, the destructive action of the resulting caustic soda; 3, coagulation from the alcohol that is reproduced; 4, prevention of decomposition in the resulting dead tissue. It was employed by Dr. Brunton in the treatment of *nævus* in 1871. He describes its action as follows: "Laid on dry parts of the body, the sodium ethylate is comparatively inert, creating no more change than the redness and tingling caused by common alcohol; but as soon as the part to which the substance is applied gives up a little water, the transformation described above occurs, caustic soda is produced in contact with the skin in proportion as water is eliminated, and there proceeds a gradual destruction of tissues which may be moderated so as hardly to be perceptible or may be so intensified as to act

almost like a cutting instrument." "Applied direct to the unbroken skin, the destructive action is less painful than would be expected, and when pain is felt it may be checked quickly by dropping upon the part a little chloroform, which decomposes the alcohol, converting it into a chloride salt and ether." "The caustic alcohols may be used in combination with local anæsthesia from cold. A part rendered quite dead to pain by freezing with ether spray may be directly destroyed by the subcutaneous injection of caustic alcohol—a practice very important in the treatment of *poisoned wounds*. It is by no means improbable that *cystic tumors* may be cured by the simple subcutaneous injection of a little of those fluids after destruction of their sensibility by cold. Potassium and sodium alcohol, added to the volatile hydride of amyl, dissolve the hydride and produce a caustic solution." Dr. Brunton states that, compared with the action of nitric acid, there is but little destruction of the epidermis, and he considers that sodium ethylate acts as an astringent, and that the pain is not so severe as that caused by nitric acid. In his cases hardly any scarring ensued. The ethylate affects but little the healthy skin; it restricts its action to the spot on which it is applied. Dr. Richardson (*London Lancet*, Feb. 12, 1881) has reported cases of *tattoo* and *mother's marks*, *hypertrichosis*, nasal *polypus*, *ozæna*, and *lupus* in which the caustic produced good results, as well as in minor affections, such as *warts*, small *melanotic growths*, *ringworm*, and *hæmorrhoids*. (Compare Welsh, *British Med. Jour.*, Aug. 22, 1885; Taylor, *ibid.*, Oct. 6, 1888; Startin, *Practitioner*, xxxiv. 370; Jamison, *ibid.*, xliii. 1, 81.)

Dr. Richardson states that the liberated alcohol coagulates the albuminous compounds in its neighborhood, and thus limits the caustic action of the soda. The red corpuscles become disintegrated, and then crystalline, while the white are for a time left unaffected. The risk of too great hæmorrhage from the rapid action of the ethylate in cases of pendent vascular tumors may be met by diluting the ethylate with alcohol, so as to promote coagulation; and the pain caused by it may be mitigated by mixing it with laudanum. It should be applied with a camel's-hair brush.

LIQUOR SODÆ CHLORATÆ, *U. S.*—Solution of Chlorinated Soda.

Liquor sodæ chlorinatæ, Br.; *Liquor natri chlorati*, *Liquor natri hypochlorosi.—Labarraque's solution*, E.; *Chlorure de soude liquide*, *Liqueur de Labarraque*, Fr.; *Chlornatronlösung*, *Bleichflüssigkeit*, G.

An aqueous solution of several chlorine compounds of sodium, chiefly NaClO and NaCl, and containing at least 2.6 per cent. by weight of available chlorine.

Preparation.—Sodium Carbonate 150 Gm.; Chlorinated Lime 75 Gm.; Water, a sufficient quantity; to make 1000 Gm. Triturate the chlorinated lime with 200 Cc. of water, gradually added, until a uniform mixture results. Allow the heavier particles to subside, and transfer the thinner, supernatant portion to a filter. Then triturate the residue again with 200 Cc. of water, transfer the whole to the filter, and when the liquid has drained off, wash the filter and contents with 100 Cc. of water. Dissolve the sodium carbonate in 300 Cc. of hot water, and add this solution to the previously obtained filtrate contained in a suitable vessel. Stir or shake the mixture thoroughly, and, if it should become gelatinous, warm the vessel until the contents liquefy. Then transfer the mixture to a new filter, and, when no more liquid drains from it, wash the filter and contents with enough water to make the product weigh 1000 Gm. Keep the solution in well-stoppered bottles, protected from the light.—*U. S.*

To prepare 1 gallon of Labarraque's solution 21 av. ozs. of sodium carbonate, dissolved in 44 fluidounces of hot water, should be added to a solution of 10½ av. ozs. of chlorinated lime in 64 fluidounces of water (prepared as directed above); after the mixture has been well shaken and filtered enough water should be passed through the filter to bring the volume of the solution up to 8 pints.

Take of chlorinated lime 16 ounces; sodium carbonate 24 ounces; distilled water 1 gallon. Dissolve the sodium carbonate in 2 pints of the distilled water; thoroughly triturate the chlorinated lime with 6 pints of the water and filter; mix well the solutions; again filter. Keep the solution in a stoppered bottle in a cool and dark place.—*Br.*

Dry chlorinated lime 100 Gm.; crystallized sodium carbonate 200 Gm.; distilled water 4500 Gm. Triturate the chlorinated lime in a porcelain mortar with a portion of the water, and separate by decantation the finest portion; triturate the residue, add more of the water, and decant as before; repeat this operation until two-thirds of the water have been used. Dissolve the sodium salt in the remaining water, mix the two liquids, let settle, and filter.—*F. Cod.*

The process of the U. S. Pharmacopœia yields the chlorinated soda by double decomposition of chlorinated lime with sodium carbonate, whereby calcium carbonate is precipitated, the chlorinated soda remaining in solution, together with the sodium chloride resulting from the decomposition of calcium chloride present in the lime compound and with the excess of sodium carbonate employed. The solution of sodium carbonate is now directed to be boiling hot when added to the mixture of chlorinated lime and water, the object being the precipitation of a dense calcium corbonate. If no heat is employed, the precipitate will be very light and retain a very large proportion of the liquid. But heat should not be applied after the mixture has been made, since the solutions of chlorinated alkalies are decomposed thereby into chloride and chlorate, oxygen being at the same time evolved; in the presence of much free alkali the decomposition takes place less readily. The French Codex directs the same process, the liquids being mixed without heating. For 75 parts of chlorinated lime, 150 parts *U. S.*, *F. Cod*, of crystallized sodium carbonate are used, and sufficient water to make a total weight of 1000 parts *U. S.*, 3375 parts *F. Cod.*; the chlorine strength of the former is therefore nearly 3½ times that of the latter. The liquid which remains mechanically enclosed in the precipitate may be washed out upon a strainer by water and utilized for bleaching purposes, but owing to its uncertain strength is not adapted for medicinal use.

The Br. P. process differs from the preceding ones mainly in this, that although the solution of chlorinated lime is filtered, an uncertain quantity of this liquid remains with the insoluble portion. The former directed chlorine gas to be passed into the dissolved sodium carbonate, whereby one-half of the salt is acted upon, resulting in the production of sodium chloride and hypochlorite and the liberation of carbon dioxide, which unites with the other half of the salt to form sodium bicarbonate; $2Na_2CO_3 + Cl_2 + H_2O$ yields $NaCl.NaClO + 2NaHCO_3$. If the action of chlorine is continued, the sodium hypochlorite is decomposed, sodium chloride and hypochlorous anhydride being formed; $NaClO + Cl_2$ yields $NaCl + Cl_2O$. The last-mentioned compound, which has a yellowish color, seems to decompose the bicarbonate with difficulty.

Properties.—The solution is clear and colorless, not pale-greenish, as described by the U. S. Pharmacopœia, a yellowish color being imparted only when the process of the British Pharmacopœia has been followed and an excess of chlorine has been used. Its specific gravity is 1.052. It has a feeble odor of chlorine, and a saline somewhat styptic and sharp alkaline taste, and bleaches indigo, litmus, and vegetable colors like chlorine, but less energetically. With solution of ferrous sulphate it produces a brown precipitate of ferric hydroxide, and with solution of lead salt a brown one of lead dioxide; the color of both precipitates is lighter, from carbonate present, if an excess of the metallic salts be used. On the addition of hydrochloric acid effervescence takes place, the gas consisting of carbon dioxide and chlorine, the latter resulting from the mutual reaction of the hydrochloric and hypochlorous acids; thus: $NaCl.NaClO + 2HCl = 2NaCl + HCl + HClO$, and $HCl + HClO = Cl_2 + H_2O$. It is upon the amount of this *available chlorine* that the value of this preparation depends.

Tests.—Solution of chlorinated soda is not precipitated by ammonium oxalate (absence of calcium). "If 6.7 (6.74) Gm. of the solution be mixed with 50 Cc. of water, then 2 Gm. of potassium iodide and 10 Cc. of hydrochloric acid added, together with a few drops of starch test-solution, it should require not less than 50 Cc. of decinormal sodium thiosulphate solution to discharge the blue or greenish tint of the liquid (each Cc. of the volumetric solution corresponding to 0.052 per cent. of available chlorine)."—*U. S.* The chlorine set free liberates an equivalent quantity of iodine, which imparts a blue color to the solution containing starch, and this color disappears on the addition of the thiosulphate. The same process, but without starch, is used by the British Pharmacopœia, 70 grains of the chlorinated solution being mixed with a solution of 20 grains of potassium iodide in 4 fluidounces of water and acidulated with 2 fluidrachms of hydrochloric acid; the brown color should be discharged by 500 grain-measures of the volumetric solution of sodium thiosulphate (2½ per cent. Cl).

A preparation analogous to the preceding in composition and identical in bleaching effects is *Liquor potassæ chloratæ*, *Chlorinated potassa solution* (Chlorure de potasse, *Fr.*; Chlorkalilösung, *G.*), which is perhaps better known by its French designation, *Eau de javelle*. It is obtained by substituting equivalent quantities of potassium carbonate for the sodium carbonate ordered in the above processes.

Action and Uses.—Under the impression that its antiseptic qualities fitted it to counteract morbid processes which were theoretically supposed to depend upon putridity, it has been largely employed in *typhoid* fever and typhoid diseases generally, but without

obvious advantage. But as a topical application to *gangrenous sores* and to other *unhealthy ulcers*, such as affect the mouth in *mercurialization*, in *diphtheria*, *scarlatina*, and *scurvy*, the nostrils in *ozæna*, the *uterus*, the *vagina*, and the *auditory canal*, it corrects the offensive odor of the secretions and stimulates the parts to separate dead tissue and assume a healthy action. For *simple ulcers* of an indolent aspect, especially such as result from *burns*, or which affect the *nipples* and the *genital organs* of females, this liquid generally acts as a wholesome stimulant.

It may be given internally in *doses* varying from Gm. 2–4 (gtt. xxx–lx) in water or some mild liquid, and repeated every two or three hours. As a gargle it should be diluted with 8 or 10 parts of water, and used of the same strength for an injection into the vagina, uterus, or bladder, and as a lotion for burns, excoriations, and cutaneous eruptions.

LIQUOR SODÆ EFFERVESCENS, *Br.*—Effervescing Solution of Soda.

Aqua sodæ effervescens, Aqua alcalina effervescens.—Soda-water, E.; *Eau alcaline gazeuse*, Fr.; *Sodawasser*, G.

Preparation.—Take of Sodium Bicarbonate 30 grains; Water 1 pint. Dissolve the sodium bicarbonate in the water and filter the solution; then pass into it as much pure washed carbon dioxide gas, obtained by the action of sulphuric acid on chalk, as can be introduced with a pressure of four atmospheres. Keep the solution in bottles securely closed to prevent the escape of the compressed gas.—*Br.*

This corresponds to the effervescing solution of potash, and has the same physical properties. 10 fluidounces, after being boiled for five minutes, require for neutralizing 178 grain-measures of the volumetric solution of oxalic acid.—*Br.*

The corresponding solution of the French Codex is made by dissolving 3.12 Gm. (48 grains) of sodium bicarbonate, 0.23 Gm. (3½ grains) of potassium bicarbonate, 0.35 Gm. (5½ grains) of magnesium sulphate, and 0.08 Gm. (1¼ grains) of sodium chloride in 650 Gm. (21 troyounces) of water, and impregnating the solution with carbon dioxide gas.

Action and Uses.—This preparation appears to be superfluous. The quantity of sodium bicarbonate required in any particular case can be administered in carbonated water, or can be supplied by Soda or Seidlitz powders.

LIQUOR SODII ARSENATIS, *U. S.*—Solution of Sodium Arsenate.

Liquor sodii arseniatis, Br.—*Solution of arseniate of sodium*, E.; *Liqueur (Soluté) d'arseniate de soude*, Fr.; *Arsensaure Natronlösung*, G.

Preparation.—Sodium Arsenate, deprived of its water of crystallization by a heat not exceeding 149° C. (300° F.), 1 Gm.; Distilled Water a sufficient quantity, to make 100 Cc. Dissolve the sodium arsenate in the distilled water.—*U. S.*

The above formula yields nearly 3½ fluidounces of solution, and hence each fluidrachm contains about ½ grain of the anhydrous salt.

Take of sodium arsenate (rendered anhydrous by a heat not exceeding 300° F.) 9 grains; distilled water 2 fluidounces. Dissolve.—*Br.*

The *Liqueur arsenicale de Pearson* of the French Codex is made by dissolving 1 part of crystallized sodium arsenate in 600 parts of distilled water, and is, therefore, only about one-tenth the strength of the above. 1 part of the exsiccated salt is contained in 100 *U. S.*, *Br.*, and about 1000 *F. Cod.* parts.

The solutions are colorless, and give the reactions of Sodium Arsenate, which see.

Action and Uses.—This preparation does not appear to possess any demonstrable advantages over the solution of potassium arsenate. It may be employed in similar *doses*, or from Gm. 0.15–0.30 (gtt. iij–vj), largely diluted and after meals.

LIQUOR SODII SILICATIS, *U. S.*—Solution of Sodium Silicate.

Liquor natrii silicici, P. G.; *Natrum silicium solutum, Vitrium solubile.—Liquid glass, Soluble glass*, E.; *Silicate de soude liquide, Verre soluble, Verre liquide*, Fr.; *Natriumsilikat-Lösung, Wasserglas, Natronwasserglas*, G.

Origin.—The element *silicon* or *silicium* (Si; atomic weight 28.3) is an important constituent of many minerals and rocks. *Rock-crystal* is pure silica or silicic oxide, SiO_2, and *quartz*, *sand*, *amethyst*, *chalcedony*, *agate*, *flint*, and other minerals are chiefly composed

of the same oxide. A combination of this oxide with alkali and other bases became known at an early date with the discovery of glass; and about 1640, Van Helmont noticed that the compound of silex and salt of tartar (potassium carbonate) would liquefy in a damp atmosphere. This liquid became known as *Liquor silicum*—Liquor of flints, *E.;* Liqueur des cailloux, *Fr.;* Kieselfeuchtigkeit, *G.* The usefulness of such a solution for rendering inflammable substances incombustible was proved by J. N. Fuchs (1818). In its preparation soda was soon substituted for potash, and the designation "liquid" or "soluble glass" applied indiscriminately to both compounds, which are used in calico-printing, as an addition to cheap soaps, in fresco-painting, for manufacturing artificial stone, for cements, and for other purposes. In 1880 the United States imported over 1,000,000 pounds, in 1882 only 106,101 pounds, of sodium silicate.

Preparation.—Sodium silicate is usually made by fusing together a mixture of 1 part of fine sand or powdered flint and 2 parts of exsiccated sodium carbonate dissolving the product in boiling water, filtering, and evaporating; or 8 parts of exsiccated sodium carbonate, 15 parts of fine sand, and 1 part of charcoal are used, the latter merely serving as a means for facilitating the decomposition of the carbonate, the gas evolved being partly carbonic oxide. L. Buchner recommended as a cheap material for its preparation 10 parts of powdered quartz, 6 parts of calcined sodium sulphate, and 1½ or 2 parts of charcoal. A mixture of soda and potash with silica is more rapidly fusible than the former. The proportion of the ingredients, however, is varied according to the use to be made of the compound, and a more glass-like and less-readily soluble mass is obtained by the fusion of 2 parts of silica and 3 parts of calcined soda.

Properties.—Sodium silicate is a transparent glass-like mass, which may be obtained in crystals, Na_2SiO_3, with variable amounts of water of crystallization. On exposure the salt becomes superficially opaque, and it is slowly soluble in boiling water; but the alkaline solution may be evaporated to a thick syrupy consistence without separating a deposit on cooling. The solution, as met with in commerce, usually contains about 10 to 12 per cent. of soda $(NaOH)_2$ and 20 to 24 per cent. of silica (SiO_2), and is a transparent or semi-transparent colorless or yellowish viscid liquid, which is inodorous, and has a saline and sharp alkaline taste and an alkaline reaction to test-paper. Its specific gravity varies between 1.30 and 1.40. On acidulating the solution with hydrochloric acid the mixture remains transparent, but the colorless silicic acid forms gradually a dense jelly. If the solution be previously diluted with 10 to 15 parts of water, the silicic acid liberated by the hydrochloric acid will remain dissolved or suspended until the liquid is boiled or evaporated. Alcohol added to the solution produces a gelatinous precipitate of sodium silicate. A drop of the liquid held in a non-luminous flame by means of a loop of platinum wire burns with the intense yellow color of sodium compounds.

Solution of sodium silicate should be preserved in glass or stone vessels, securely stoppered with cork or caoutchouc to prevent access of air and decomposition by carbon dioxide gas. Stoppers of glass or stone may be used, but should be well coated with paraffin to prevent their becoming cemented to the neck of the vessel.

Tests.—When mixed with an equal bulk of alcohol any caustic alkali present will remain in solution, and may be recognized by test-paper or estimated by volumetric solution of oxalic acid. On adding excess of hydrochloric acid to the solution, only a moderate effervescence should take place, showing that it has not been injuriously affected by exposure; and on evaporating the acid mixture to dryness a residue partly soluble in water should be left, which is not colored dark by hydrogen sulphide. Should the solution of sodium silicate be strongly alkaline, it may be boiled with gelatinous silicic acid, which will be dissolved by the free alkali.

Other Silicates.—Potassium silicate is obtained by fusing a mixture of 10 parts of potassium carbonate, 15 parts of fine sand, and 1 part of charcoal. It closely resembles sodium silicate in all its properties, but is more easily fusible.

Magnesium Silicate. This is found native, and constitutes several well-known minerals, such as *soapstone* or *stealite*, which consists of magnesium and aluminum silicate; *talc*, or *French chalk* (Talcum, *P. G.*), also called steatite, having the composition $4MgSiO_3.SiO_24H_2O$; *Meerschaum*, having the formula $2MgO.3SiO_2$; and several others. These minerals are insoluble, tasteless, and yield a soft, slippery powder. *Asbestos* is likewise magnesium silicate.

Pulvis salicylicus cum talco, *P. G.* An intimate mixture of finely-powdered salicylic acid 3 parts, wheat starch 10 parts, and talc 87 parts.

Action and Uses.—Sodium silicate is remarkable for its power of arresting the putrefaction of organic matter. This salt has been applied to correcting the odor and preventing the consequences of putrefactive fermentation. But Löwenhaupt asserts

that the preparation has no influence upon putrefaction (*Therap. Gaz.*, xiii. 466). Its solutions have been injected into the vagina in certain cases of *leucorrhœa* and *uterine ulceration*, into the urethra in *gonorrhœa*, into the bladder in chronic *cystitis*, and into the nostrils in *ozæna;* but for all these purposes it is inferior to other stimulant antiseptics and astringents. Solutions containing the salt in the proportion of ½ of 1 per cent. are employed. It has been applied in the same manner as collodion to the treatment of *erysipelas* of the face and other parts, care being taken that the preparation is neutral in its reaction. It has also been used, like starch and other substances whose solutions harden in drying, to prepare the so-called immovable bandages used in treating *fractures* and other surgical injuries. Potassium silicate has been employed for the same purpose, and the solutions of both have been known as soluble glass. It is brushed over the part, previously covered with a dry bandage, and then bandages saturated with the solution are rapidly applied in as many layers as may be necessary. The part should remain at rest for an hour to two. Owing to the risk of strangulating the limb by the contraction of the solution in drying, it has been advised to use only washed bandages, and also to apply a thin layer of carded cotton over the roller that lies next the skin. The bandage may be easily removed with scissors when it has been softened with warm water.

Sodium fluosilicate was in 1887 proposed by Mr. Thomson (*Amer. Jour. Phar.*, lix. 606) as an antiseptic and deodorizer which was not poisonous and had no smell. The experiments of Mr. Robson, however, showed (*Brit. Med. Jour.*, May 19, 1888) that the undiluted preparation is an irritant, and may act as a caustic upon raw tissues, and that a solution of 1 grain to the ounce, although antiseptic without being irritant, corrodes steel instruments. In 1888, Dr. Berens (*Therap. Gaz.*, xii. 443) performed with it a number of experiments, and found it superior to corrosive sublimate as a deodorizer and an antiseptic. He took three times a day for a week doses of ten grains without noticeable effect, and found that as an obstetrical and surgical deodorizer and antiseptic, and in various catarrhal affections of the eye, ear, throat, nose, larynx, vagina, urethra, etc., it acted promptly and efficiently when applied in solutions of 1–2 : 1000. The germicide powers of this compound have been questioned by Foote, who found it inferior to bichloride of mercury, carbolic acid, thymol, creolin, and hydronaphtol (*Amer. Jour. of Med. Sci.*, xcviii. 243); the latter judgment is confirmed by the observations of Bokenham (*Brit. Med. Jour.*, 1890, i. 356).

Talc in powder has been used by Debove to counteract chronic *diarrhœa*, especially when of tuberculous origin. It was given in enormous doses diffused in milk (*Therap. Gaz.*, xii. 489). As it is insoluble and can only act mechanically and in mass, the inconveniences and probable dangers of such a treatment are palpable.

LIQUOR STRYCHNINÆ HYDROCHLORATIS, *Br.*—Solution of Strychnine Hydrochlorate.

Liquor strychninæ.—Soluté de strychnine, Fr.; *Strychninlösung*, G.

Preparation.—Take of Strychnine in crystals 9 grains; Diluted Hydrochloric Acid 14 minims; Rectified Spirit ½ fluidounce; Distilled Water 1½ fluidounces. Mix the hydrochloric acid with 4 drachms of the water, and dissolve the strychnine in the mixture by the aid of heat. Then add the spirit and the remainder of the water.—*Br.*

Action and Uses.—This solution, being stable, is convenient for medical prescription. The *dose* is from 5 to 10 minims, *i. e.* from Gm. 0.002–0.005 = $\frac{1}{24}$ to $\frac{1}{12}$ grain of strychnine hydrochlorate.

LIQUOR ZINCI CHLORIDI, *U. S., Br.*—Solution of Zinc Chloride.

Chlorure de zinc liquide, Solution de Burnett, Fr.; *Chlorzink-Lösung, Flüssiges Chlorzink*, G.

An aqueous solution of zinc chloride, $ZnCl_2$—containing about 50 per cent. by weight of the salt.

Preparation.—Zinc, granulated, 240 Gm.; Hydrochloric Acid, 840 Gm.; Nitric Acid, 12 Gm.; Precipitated Zinc Carbonate, 12 Gm.; Distilled Water, a sufficient quantity. To the zinc, contained in a glass or porcelain vessel, add 150 Cc. of distilled water; then gradually add the hydrochloric acid, and digest, until the acid is saturated. Pour off the solution, add the nitric acid, evaporate the solution to dryness, and heat the dry mass to fusion at a temperature not exceeding 115° C. (239° F.). Let it cool, and dis-

solve it in a sufficient amount of distilled water to make the product weigh 1000 Gm. Then add the precipitated zinc carbonate, agitate the mixture occasionally during twenty-four hours, and then set it aside until it has become clear by subsidence. Finally, separate the clear solution by decantation or by means of a siphon.—*U. S.*

The above formula will yield about 22 fluidounces of solution.

Take of granulated zinc 1 pound; hydrochloric acid 44 fluidounces; solution of chlorine a sufficiency; zinc carbonate ½ ounce or a sufficiency; distilled water 1 pint. Mix the hydrochloric acid and water in a porcelain dish, add the zinc, and apply a gentle heat to promote the action until gas is no longer evolved. Boil for half an hour, supplying the water lost by evaporation, and allow the product to cool. Filter it into a bottle, and add solution of chlorine by degrees, with frequent agitation, until the fluid acquires a permanent odor of chlorine. Add the zinc carbonate in small quantities at a time and with renewed agitation until a brown sediment appears. Filter the liquid into a porcelain basin, and evaporate until it is reduced to the bulk of 2 pints.—*Br.*

Zinc dissolves in hydrochloric acid with the evolution of hydrogen gas, $Zn_2 + 4HCl$ yields $2ZnCl_2 + 2H_2$. The iron contained in the solution is first oxidized in the one case by nitric acid, and in the other by chlorine gas. To avoid contamination with nitrate, the former solution is evaporated to dryness, redissolved in water, and then treated with zinc carbonate, whereby ferric oxide is precipitated. The process of the British Pharmacopœia arrives at the same result in a similar manner, except that an evaporation of the liquid to dryness is not necessary. 1 pound of zinc yields about 33½ ounces of zinc chloride, which are contained in 40 (Imperial) fluidounces of the solution. The spec. grav. is stated to be 1.535 *U. S.*, 1.460 *Br.*

Properties.—The solution is a colorless and inodorous liquid which has the disagreeable metallic taste of zinc salts, and an acid reaction, and is miscible with alcohol and water without producing a precipitate. Its reactions and tests are those of ZINCI CHLORIDUM which see.

The French Codex directs 1 part of fused zinc chloride to be dissolved in 2 parts of water, the solution to be of specific gravity 1.33. Sir William Burnett's liquid contained 200 grains of zinc in the Imperial fluidounce, and was stated to have the specific gravity 2.0 and to contain about 50 per cent. of $ZnCl_2$.

Action and Uses.—Rohe states that zinc chloride, in the proportion of 5 per cent., added to the material to be disinfected, can be relied upon for the destruction of micro-organisms in the absence of spores. To destroy the vitality of anthrax spores a 20 per cent. solution is necessary (*Med. News*, xlvii. 346). Under the name of *Burnett's disinfecting fluid* a solution of chloride of zinc was extensively employed, and its utility probably suggested an officinal preparation for similar purposes. That liquid has in numerous cases produced fatal mischief by being taken internally, occasioning all the phenomena due to a violent irritant poison. The chief application of this solution is to *deodorize* and *disinfect* sinks, sewers, water-closets, dissecting-rooms, hospitals, etc. It has been made use of to preserve dead bodies by injecting it into the blood-vessels, but owing to its corrosive action upon steel such bodies are not suitable for dissection. Largely diluted, Gm. 0.60–1.30 in Gm. 120 (gtt. x to gtt. xx in water f℥iv), it has been used as an injection for *gonorrhœa* in both sexes and for *leucorrhœa;* also as a collyrium in *gonorrhœal* and in *diphtheritic ophthalmia*. It should be employed, if at all, with extreme caution, the weakest solution being first applied to test the susceptibility of the parts. (For the use of zinc compounds as caustics see ZINCI CHLORIDUM).

LITHII BENZOAS, *U. S.*—LITHIUM BENZOATE.

Lithium benzoicum, Benzoas lithicus.—Benzoate de lithine, Fr.; *Lithiumbenzoat, Benzoesaures Lithion*, G.

Formula, $LiC_7H_5O_2$. Molecular weight 127.72.

Preparation.—This salt is made by decomposing lithium carbonate with benzoic acid, and according to Shuttleworth (1875), it is most advantageous to add the acid to the carbonate. 100 grains of the latter are heated with 900 grains (2 fluidounces) of distilled water, when 330 grains of benzoic acid or a sufficient quantity of it is added in small portions until effervescence is no longer produced. The filtrate is evaporated to dryness with constant stirring, and the salt rubbed to powder, or the hot somewhat concentrated solution may be set aside to crystallize on spontaneous evaporation. The yield will be 346 grains.

Properties.—Lithium benzoate is a white salt, forming either a light crystalline

powder or small glistening pearly scales, which feel greasy to the touch and are sometimes aggregated to moss-like forms. Berzelius stated the salt to be hygroscopic, but Shuttleworth, and afterward Raskowsky (1886), showed it to be permanent in the air. It has a slight odor, like that of medicinal benzoic acid, or if free from aromatic compounds is inodorous; its taste is alkaline, somewhat cooling and sweetish; its reaction to test-paper is slightly acid. It dissolves at 15° C. (59° F.), in 4 parts (*U. S.*), 3½ parts (Shuttleworth), 3 parts (Raskowsky), of water, and in 12 parts (*U. S.*), 10 parts (Shuttleworth), of alcohol, and at the boiling temperature in 2.5 parts (*U. S.*), 2 parts (Raskowsky), of water, and in 10 parts of alcohol (*U. S.*). When heated the salt melts, and at a higher temperature chars and emits aromatic inflammable vapors of benzene and other decomposition-products of benzoic acid, a portion of the latter subliming unaltered; the black residue left behind contains charcoal and lithium carbonate. The aqueous solution of the salt is decomposed by mineral acids, but not by carbon dioxide, and yields with ferric chloride a flesh-colored precipitate soluble in hydrochloric acid and in alcohol.

Tests.—"If 1 Cc. of diluted nitric acid be added to 0.2 Gm. of lithium benzoate, dissolved in 2 Cc. of water, and the precipitated benzoic acid removed by filtration, the clear filtrate should not be rendered turbid on addition of silver nitrate test-solution (absence of chloride), or of barium nitrate test-solution (absence of sulphate). If a concentrated solution of the salt be mixed with hydrochloric acid, a white precipitate of benzoic acid will be formed, which, after being separated from the liquid and thoroughly washed and dried, should conform to the tests of purity given under Acidum Benzoicum. If the filtrate from this precipitate be evaporated to dryness and ignited, 1 part of the residue should be soluble in 5 parts of absolute alcohol. If to this solution an equal volume of ether be added, no precipitate or turbidity should appear (limit of other alkalies). The aqueous solution (1 in 20) should remain unaffected by hydrogen sulphide test-solution or ammonium sulphide test-solution (absence of arsenic, lead, iron, aluminum, etc.), or by ammonium oxalate test-solution (absence of calcium), or by sodium-cobaltic nitrite test-solution (limit of potassium); nor should silver nitrate test-solution or barium nitrate test-solution produce in it more than a very slight turbidity (limit of chloride and sulphate). If 1 Gm. of dry lithium benzoate be thoroughly ignited in a porcelain crucible, so as to destroy most of the carbonaceous matter, and the residue be mixed with 20 Cc. of water, it should require, for complete neutralization, not less than 7.8 Cc. of normal sulphuric acid (corresponding to not less than 99.6 per cent. of the pure salt), methyl-orange being used as indicator."—*U. S.*

Action and Uses.—The medicinal effects of this compound rest upon theoretical expectation rather than clinical observation, in so far as they depend upon the lithia it contains. In 1874, Dalkiewicz and Mallez (*Practitioner*, xiii. 274) reminded the profession of the well-known doctrine that benzoic acid is converted into hippuric acid in the system, forming soluble salts, whereas the urates of the same bases are more or less insoluble. Undoubtedly, this view explained the efficacy of benzoic acid and of the sodium benzoate in various *calculous disorders*. Lithium was then substituted for sodium in the compound on account of its greater solubility. There is not, however, a shadow of proof that this substitution is advantageous, or that the merits of the medicine, whatever they may be, are not due to the benzoic acid it contains. So far as laboratory experiments may have weight in such a question, it should be stated that the solvent power of lithium benzoate has been found far inferior to that of magnesium borocitrate upon uric-acid calculi (Madsen, *Bull. de Thérap.*, xcviii. 68).

LITHII BROMIDUM, *U. S.*—Lithium Bromide.

Lithium bromatum, *Bromuretum lithicum.*—*Bromure de lithium*, Fr.; *Bromlithium*, *Lithiumbromid*, G.

Formula LiBr. Molecular weight 86.77.

Lithium bromide should be kept in well-stoppered bottles.

Preparation.—Yvon (1875) prepared the salt by dissolving lithium carbonate in hydrobromic acid and evaporating; or, 37 Gm. of the carbonate are converted into neutral sulphate, dissolved in a small portion of water, and mixed with a concentrated aqueous solution of 119 Gm. of potassium bromide; the mixture is well stirred, the liquid separated by filtration, evaporated to dryness, and treated with alcohol, which leaves potassium sulphate undissolved; the alcoholic solution is evaporated to dryness. A convenient method for preparing the salt consists in forming, first, ferrous bromide by gradu-

ally adding 399 grains of bromine to 300 grains of iron and 900 grains (2 fluidounces) of water; the green solution is filtered, heated, and in a flask agitated with 186 grains of lithium carbonate; when cool the liquid is filtered and evaporated, yielding 434 grains of lithium bromide. Lithium bromide may be obtained in crystals by evaporating its syrupy solution over sulphuric acid. The anhydrous salt contains nearly 92 per cent. of bromine.

Properties.—Lithium bromide is a very deliqueseent salt, and on this account not readily obtainable in crystals, but usually kept in the form of a white powder more or less granular. It is inodorous, and has a somewhat pungent (sharp, *U. S.*) and bitterish taste and a neutral reaction. It imparts a crimson color to flame, melts at a dull red heat, and at a white heat is slowly volatilized. It is freely soluble in alcohol, also in ether, and dissolves at 15° C. (59° F.) in 0.6 part and at 100° C. (212° F.) in 0.3 part of water (*U. S.*). The concentrated, but not the largely diluted, aqueous solution yields a white precipitate with ammonium carbonate. On the addition of a few drops of chlorine-water bromine is liberated, which dissolves in carbon disulphide with a brown-yellow or yellowish-brown color without a violet tint (absence of and difference from iodide).

Tests.—"1 part of the salt should be completely soluble in 5 parts of absolute alcohol, and the addition of an equal volume of stronger ether to the alcoholic solution should produce no precipitate (limit of other alkalies). If 0.5 Cc. of sodium-cobaltic nitrite test-solution be added to 5 Cc. of the aqueous solution, no precipitate or turbidity should occur within ten minutes (limit of potassium). The aqueous solution (1 in 20) should not be affected by hydrogen sulphide test-solution, either before or after acidulation with a drop of hydrochloric acid (absence of arsenic, lead, copper, etc.), nor by ammonium sulphide test-solution (absence of iron, aluminum, etc.) In the aqueous solution no turbidity should be produced by the addition of barium chloride test-solution (absence of sulphate). If a few drops of starch test-solution be added to 5 Cc. of the aqueous solution, and then a drop or two of chlorine water, no blue color should appear (absence of iodide). If 0.3 Gm. of dry lithium bromide be dissolved in 10 Cc. of water and 2 drops of potassium chromate test-solution be added, it should require 35.3 Cc. of decinormal silver nitrate solution to produce a permanent red color of silver chromate (corresponding to at least 98 per cent. of the pure salt)."—*U. S.*

Allied Salts.—Lithii iodidum, Lithium iodide, LiI; mol. weight 133.54. It is obtained by dissolving lithium carbonate in hydriodic acid or by digesting a solution of calcium iodide or ferrous iodide with lithium carbonate in slight excess, filtering, and evaporating to dryness. It is a white crystalline salt, crystallizing with $3H_2O$ in deliquescent prisms, and on exposure acquires a yellow tint from liberated iodine. 1 Gm. of the dry salt requires for complete precipitation 1.27 Gm. of silver nitrate.

Lithii chloridum, Lithium chloride, LiCl; mol. weight 42.38. The process for preparing it from lepidolite is given below. It crystallizes in anhydrous cubes or octahedrons having a saline taste and melting at a red heat, and is freely soluble in alcohol and in spirit of ether. Exposed to the atmosphere, it forms prisms or needles containing $2H_2O$, and then deliquesces; at 0° C. (32° F.) it requires 1.6 parts, at 20° C. (68° F.) 1.24 parts, and at 100° C. (212° F.) 0.77 part, of water for solution. 1 Gm. of the dry salt requires 4 Gm. of silver nitrate for complete precipitation.

Action and Uses.—In 1870, Dr. S. Weir Mitchell accidentally found that lithium bromide seemed to cause a more rapid and intense sleepiness than the other bromides. He observed, moreover, that it was the most soluble salt of its class, that it contained a larger proportion of bromine than any other, and that, clinically, it excels them all as a hypnotic, and is efficient in smaller doses than the potassium bromide as an anti-epileptic. In 1877 he declared of this salt that it stood the test of his own experience, as well as that of many French and German therapeutists, who had come to regard it as the most valuable of the bromides. According to Levy, its action, compared with that of potassium bromide, is as follows: It acts with greater force and rapidity upon the spinal cord and nerves; the anæsthesia it produces begins in the nerves and is propagated to the cord; in other words, it is a sedative of morbid excitement in the spinal cord. It does not appear to act upon the heart.

Lithium bromide was used in the treatment of *epilepsy*, as already stated, and apparently with very remarkable advantages, but its efficiency was differently estimated by some other physicians, of whom Echeverria regarded it as inferior to the potassium bromide, and Sée prescribed it without any favorable results. The *dose* has been variously stated at Gm. 0.30–0.60 (gr. v–x) and Gm. 0.60–1.30 (gr. x–xx) three times a day in a simple bitter infusion. But much larger doses may be prescribed. It has also been used in *gout* with no demonstrable advantage.

This preparation has been proposed and used by Martineau (*Lancet*, Mar. 26, 1887) as a remedy for *diabetes*, in conjunction with arsenic, and was tried by the late Dr. Austin Flint without any marked effects upon the disease (*Med. News*, li. 29).

LITHII CARBONAS, *U. S., Br.*—Lithium Carbonate.

Lithiæ carbonas; Lithium carbonicum, P. G.; *Carbonas lithicus.—Carbonate of lithia*, E.; *Carbonate de lithine, Carbonate lithique*, F.; *Lithiumcarbonat, Kohlensaures Lithion*, G.

Formula Li_2CO_3. Molecular weight 73.87.

Origin and Preparation.—Lithium was discovered by Arfvedson (1817) in petalite and other Swedish minerals, and by Berzelius (1822) in the mineral waters of Carlsbad, Marienbad, and Franzensbrunn. It is met with as phosphate in *montebrasite* and several other minerals, and as fluoride or silicate in *lepidolite*, *spodumene*, and others. It is found in minute quantities in the ashes of some plants and in many minerals springs, often as carbonate; the waters of the Mur spring at Baden-Baden and of a hot spring at Wheel-Clifford in Cornwall are the richest known, the latter, according to W. A. Miller (1864), containing 26.05 grains LiCl in the Imperial gallon. To prepare the carbonate, lepidolite is heated with sulphuric acid; the aqueous solution, containing impure lithium sulphate, may be freed from most of the sulphates of aluminum and the alkalies by crystallizing them as alum, or it is treated with lime to separate metallic oxides and earths, and then precipitated by barium chloride to remove sulphate, and by ammonium oxalate to remove calcium. After evaporating to dryness, lithium chloride is dissolved by a mixture of alcohol and ether, and thus freed from the chlorides of rubidum, cæsium, sodium, and potassium, with which metals it is associated in the lepidolite. The concentrated aqueous solution of lithium chloride, treated with ammonium carbonate, yields a precipitate of lithium carbonate, which is washed with alcohol; the filtrate from the precipitate on being evaporated to dryness and ignited yields as chloride the lithium which had remained in solution.

Properties.—Lithium carbonate is a light white amorphous powder or is in minute crystalline grains. It has the specific gravity 2.11, is permanent in the air, inodorous, has a mild alkaline taste and a distinct alkaline reaction, and imparts a carmine color to flame. It is insoluble in alcohol, but soluble in 140 parts of boiling water and in 80 parts at 15° C. (59° F.); much more soluble in water saturated with carbon dioxide (*U. S., P. G.*), 150 parts of cold water (*Br.*). The solution has an alkaline reaction, precipitates the salts of the heavy metals, and on boiling decomposes ammonium salts. On heating the salt to dull redness it melts to a transparent liquid, loses a portion of its carbon-dioxide, and congeals on cooling to pearly oxycarbonate, which is permanent in the air; the fused salt corrodes glass, silver, and platinum. It dissolves with effervescence in dilute hydrochloric acid, and the solution, evaporated to dryness, leaves a residue of lithium chloride, which is soluble in spirit of ether, and the neutral solution of which yields a white precipitate with sodium phosphate.

Tests.—"If 1 Gm. of lithium carbonate be dissolved in 40 Cc. of diluted acetic acid, no insoluble residue should remain. Portions of this solution should not be rendered turbid by hydrogen sulphide test-solution (absence of arsenic, lead, etc.); nor by ammonium sulphide test-solution (absence of iron, aluminum, etc.); nor by ammonium oxalate test-solution (absence of calcium); nor by silver nitrate test-solution (absence of chloride) nor by barium chloride test-solution (absence of sulphate); nor by sodium-cobaltic nitrite test-solution (limit of potassium). If 0.5 Gm. of lithium carbonate be dissolved in 2 Cc. of hydrochloric acid, and the clear solution evaporated to dryness, the residue should completely dissolve in 3 Cc. of absolute alcohol, and an addition of 3 Cc. of ether should not render the solution turbid (limit of other alkalies). If 0.5 Gm. of the dry salt be mixed with 20 Cc. of water, it should require, for complete neutralization, not less than 13.4 Cc. of normal sulphuric acid solution (corresponding to at least 98.98 per cent. of the pure salt), methyl-orange being used as indicator."—*U. S.*

Chemical Action.—When a calculus composed of uric acid and oxalate of lime is suspended in a warm solution of lithium carbonate, it loses sensibly in weight; and when a portion of bone infiltrated with gouty concretions is placed in a solution of the salt, after two or three days the whole of the deposit disappears. In fact, the urate of lithium is the most soluble salt formed with uric acid. Garrod (*Times and Gaz.*, June, 1883, p. 691) and Jahns (*Amer. Jour. of Med. Sci.*, Jan. 1884, p. 262) show that, in laboratory experiments at least, lithium carbonate is a much better solvent of uric acid concretions than sodium or magnesium salts. These facts have been adduced to explain

the efficacy in chronic gout of numerous mineral springs in Europe and of the Gettysburg Spring in Pennsylvania.

Action and Uses.—Opinions are by no means uniform in regard to the value of lithium carbonate in removing *uric acid deposits* and *gouty concretions*. On the one hand, it is asserted that when patients are voiding uric acid gravel it causes the deposit to diminish or to cease altogether, and that in *gout* it often diminishes the frequency of the attacks. At the same time it is stated to be powerfully diuretic. On the other hand, some authorities confidently affirm that they have seen no benefit arise from its use. Others, again, declare that it is suitable only for the treatment of chronic gout, that the daily dose of it should be small, and that its good effects become apparent only after several weeks' use. On the whole, there appears to be no substantial ground for a belief in its alleged virtues in gout and calculous diseases. Of late years sundry mineral waters have been vaunted as efficacious in these affections because they contained from $\frac{6}{10000}$ grain to 1 grain in a pint of the spring water. Such pretentions tend to bring the art of therapeutics into discredit. When the physicians who have professed faith in natural mineral waters because they contained so minute a proportion of lithium, have compared their curative effects with those of non-mineralized spring waters, they will perhaps be disposed to attribute their therapeutic results rather to the diuretic and detergent action of the waters than to the lithium salt they held in solution.

Lithium carbonate is said to exhibit extraordinary powers in the solution of *false membrane.*

This medicine may be given in the *dose* of Gm. 0.06–0.20 (gr. i–iij) three times a day, dissolved in 3 or 4 ounces of hot water or preferably in carbonated water. Externally, it has been applied in an ointment or glycerite containing 1 part of the salt to 8 of the excipient.

Poulet (1885), having convinced himself that hippuric acid is the real gastric juice, readily found that the hippurates of lime and of lithia are specifics for all digestive disorders and gouty affections, and their dependencies, including the so-called *rheumatic gout.* He published the following formula: ℞ Lithium carbonate, 8 parts; hippuric acid, 35 parts; tepid water, 1000 parts; sugar, 1200 parts. Add the acid to the carbonate dissolved in a small part of the water, producing an alkaline solution, from which prepare a syrup. Each dose should contain about 5 grains of the salt (*Bull. de Thérap.*, cix. 153; 273).

LITHII CITRAS, *U. S., Br.*—Lithium Citrate.

Lithiæ citras, Lithium citricum.—Citrate of lithia, E.; *Citrate de lithine*, Fr.; *Lithiumcitrat, Citronsaures Lithion*, G.

Formula $Li_3C_6H_5O_7$. Molecular weight 209.57.

Lithium citrate should be kept in well-stoppered bottles.

Preparation.—Take of Lithium Carbonate 50 grains; Citric Acid, in crystals, 90 grains; warm Distilled Water 1 fluidounce. Dissolve the citric acid in the water, and add the lithium carbonate in successive portions, applying heat until effervescence ceases and a perfect solution is obtained. Evaporate by steam- or sand-bath until the product has a specific gravity of about 1.230, and set aside for crystals to form. Dry the crystals and preserve them in a stoppered bottle.—*Br.* Thus prepared the salt is crystalline, contains $4H_2O$, and has the molecular weight 281.41.

On adding lithium carbonate to a solution of citric acid, carbon dioxide is given off and lithium citrate remains in solution, the reaction being explained by the equation: $3Li_2CO_3 + 2H_3C_6H_5O_7$ yields $2Li_3C_6H_5O_7 + 3CO_2 + 3H_2O$. The yield is equal to the weight of citric acid used. The U. S. P. 1870 directed a slight excess of citric acid, while the above formula orders a slight excess of lithium carbonate, for 50 grains of the latter require 90.46 grains of the acid. For dispensing in solution the salt may well be prepared extemporaneously, the proportion of citric acid to lithium carbonate being 1000 : 528.6 (or 10 : 5.3), with a yield of 1000 (or 10) parts; on triturating in a mortar with a small quantity of hot water the decomposition is readily effected. Hager recommends precipitation of the concentrated slightly acid solution with alcohol, when the normal salt, containing two molecules or 14.63 per cent. of water, is precipitated.

Properties and Tests.—Lithium citrate is a white amorphous powder which dissolves in 2.5 parts of water and at 15° C. (59° F.), in 0.5 parts of boiling water (*U. S.*), and may be obtained crystallized from a concentrated solution on standing. According to C. Umney (1876), this salt contains $4H_2O$, three of which are given off

at 100° C. and the fourth molecule at 115° C.; the crystallized as well as the anhydrous salt is fairly permanent in the air, and not deliquescent, as stated by the Pharmacopœia. The salt has a neutral reaction to test-paper, is inodorous, has a saline somewhat cooling taste, is soluble in glycerin, and insoluble or nearly so in alcohol. When heated it blackens, gives off the odor of burning citric acid, inflammable gases are evolved, and finally a white residue is left, which, if neutralized with hydrochloric acid, is soluble in alcohol, and the solution, ignited, burns with a carmine color. The salt is recognized as a citrate by mixing its aqueous solution with calcium chloride, filtering if necessary, and heating the clear liquid, when a precipitate of calcium citrate will be deposited. "The aqueous solution, slightly acidulated with acetic acid, should not be rendered turbid by hydrogen sulphide test-solution (absence of arsenic, lead, etc.); nor by ammonium sulphide test-solution (absence of iron, aluminum, etc.); nor by ammonium oxalate test-solution (absence of calcium); nor by sodium-cobaltic nitrite test-solution (limit of potassium). With barium nitrate test-solution, or with silver nitrate test-solution, not more than a slight turbidity should appear (limit of sulphate and of chloride). If the residue obtained after calcining the salt at a red heat be dissolved in a slight excess of diluted hydrochloric acid, and the filtrate evaporated to dryness, a portion of the residue, when treated with 5 parts of absolute alcohol, should completely dissolve, and the addition of an equal volume of stronger ether should not render the solution turbid (limit of alkalies). If 1 Gm. of dry lithium citrate be thoroughly ignited in a porcelain crucible, so as to destroy most of the carbonaceous matter, and the residue be mixed with 30 Cc. of water, it should require, for complete neutralization, not less than 14.2 Cc. of normal sulphuric acid solution (corresponding to at least 99.2 per cent. of the pure salt), methyl-orange being used as indicator."—*U. S.*

Other acids besides citric are detected by their several tests. Basylous impurities are recognized by igniting some of the salt, dissolving the residue in hydrochloric acid, evaporating to dryness, and testing as described in the preceding article. "20 gr. lose at 100° C. 3.8 grs., at 115.5° C. additional 1.3 gr., and at a low red heat leave 7.8 gr. of white residue."—*Br.* On heating a mixture of 20 grains of the salt with about 40 grains of sulphuric acid until carbonized, then evaporating to dryness and igniting, a white residue of lithium sulphate should be obtained weighing 15.7 grains.

Allied Salts.—Lithii borocitras. Edmund Scheibe (1880) has prepared three of these compounds, but regards the following two as most suitable for medicinal use. They are prepared by dissolving the ingredients in boiling water, evaporating the solution to dryness, and powdering or spreading the concentrated liquid upon glass for obtaining the salt in scales. For *lithium diborocitrate*, citric acid 20 parts, lithium carbonate 7 parts, and boric acid 12 parts are used; for *lithium monoborocitrate*, citric acid 20 parts, lithium carbonate 4 parts, and boric acid 6 parts.

Action and Uses.—Like the vegetable salts of sodium and potassium, lithium citrate is decomposed in the body and excreted as a carbonate with the urine. Its operation is the same as that of lithium carbonate. Its *dose* may be stated at Gm. 0.30–1.30 (gr. v—xx).

LITHII CITRAS EFFERVESCENS, *U. S.*—Effervescent Lithium Citrate.

Limonade sèche au citrate de lithine, Fr.; *Brauselithioncitrat*, G.

Preparation.—Lithium Carbonate, 70 Gm.; Sodium Bicarbonate, 280 Gm.; Citric Acid, 370 Gm.; Sugar, in fine powder, a sufficient quantity, to make 1000 Gm. Triturate the citric acid with about 200 Gm. of sugar, and dry the mixture thoroughly; then incorporate with it, by trituration, the lithium carbonate and sodium bicarbonate, and enough sugar to make the product weigh 1000 Gm. Keep the product in well-stoppered bottles.—*U. S.*

To prepare 4 av. ozs. of the effervescent salt use 122 grains of lithium carbonate, 490 grains each of sodium bicarbonate and sugar, and 648 grains of citric acid, and proceed as directed above.

In the official formula, of the 370 Gm. of citric acid ordered 127 Gm. will be required for the conversion of the lithium carbonate into the citrate, thus leaving 243 Gm. free to react with the sodium bicarbonate; but since 280 Gm. of the sodium salt require only 233 Gm. of the acid, a slight excess of the latter, equal to 1 per cent. of the total weight of the finished product, will be present. The free citric acid, together with the liberated carbonic acid when the salt is in solution, renders the taste agreeably acidulous.

Dose, Gm. 4 to 8 (ʒi–ij).

LITHII SALICYLAS, *U. S.*—Lithium Salicylate.

Lithium salicylicum.—Salicylate de lithine, Fr.; *Lithiumsalicylat*, G.
Formula $LiC_7H_5O_3$. Molecular weight 143.68.

Preparation.—Heat a mixture of 11 parts of salicylic acid, 3 of lithium carbonate, and 25 of water until effervescence ceases; filter, wash the filter with water, evaporate, and keep in well-stoppered bottles.

Properties.—The salt may be obtained crystallized in needles, but is usually met with as a white powder, deliquescent on exposure to air, odorless or nearly so, having a sweetish taste and a faintly acid reaction; very soluble in water and alcohol. When heated the salt is decomposed, emitting the odor of phenol, and finally leaves a black residue having an alkaline reaction, which imparts a crimson color to a non-luminous flame. On supersaturating the dilute aqueous solution with hydrochloric acid a bulky white precipitate is obtained which is soluble in boiling water, from which it crystallizes on cooling; also soluble in ether, and producing an intense violet color with ferric salts. On adding to a small portion of the salt, in a test-tube, about 1 Cc. of concentrated sulphuric acid, and then, cautiously, about 1 Cc. of methylic alcohol in drops, on heating the mixture to boiling the odor of oil of gaultheria will be evolved.

Tests.—"The aqueous solution should be colorless and not effervesce on the addition of an acid (absence of carbonate). When agitated with 15 parts of concentrated sulphuric acid the salt should not impart any color to the acid within fifteen minutes (absence of foreign organic matters). If a portion of the residue left after ignition be dissolved in diluted acetic acid, portions of the filtrate should not be rendered turbid on addition of a few drops of barium chloride test-solution (absence of sulphate), nor be rendered more than very slightly turbid by silver nitrate test-solution (limit of chloride). Other portions of the same filtrate should not be affected by hydrogen sulphide test-solution (absence of arsenic, lead, etc.), nor by ammonium sulphide test-solution (absence of aluminum, etc.), nor by ammonium oxalate test-solution (absence of calcium), nor by sodium-cobaltic nitrite test-solution (limit of potassium). If another portion of the residue left after ignition be dissolved in diluted hydrochloric acid and the filtrate evaporated to dryness, a portion of the residue, when treated with 5 parts of absolute alcohol, should completely dissolve, and the addition of an equal volume of ether should not render the solution turbid (limit of alkalies). If 2 Gm. of dry lithium salicylate be thoroughly ignited in a porcelain crucible, so as to destroy most of the carbonaceous matter, and the residue be mixed with 20 Cc. of water, it should require for complete neutralization not less than 13.8 Cc. of normal sulphuric acid solution (corresponding to at least 99.13 per cent. of the pure salt), methyl-orange being used as indicator."—*U. S.*

Action and Uses.—There is no reason to believe that this salt possesses any qualities that do not belong equally, if not much more decidedly, to sodium salicylate. The two salts are equally soluble in water, and there is no proof that lithium salicylate displays any peculiar physiological or therapeutical action. Lithium salicylate is richer than the corresponding sodium salt in salicylic acid, and, like it, may produce morbid effects, such as headache, giddiness, dulness of hearing, and noises in the ears. They may last for twenty-four hours, but the headache is the first to cease. Vulpian has also observed persistent colic and diarrhœa as an effect of large doses of the salt. He admits that the salicylic acid in this compound is its most efficient factor. He employed it in acute *articular rheumatism* and *acute gout*, and found that it sometimes completed a cure left incomplete by sodium salicylate, or accomplished one where other preparations failed. He conceived that the relief, even of chronic articular rheumatism with misshapen, stiffened, and painful joints was not entirely unattainable by means of this medicine (*Centralbl. f. d. g. Therap.*, iv. 122). The average *dose* is variously stated at from Gm. 0.30–2.60 (5 to 40 grains). According to Vulpian the maximum efficient dose amounts to Gm. 5 (75 grains) daily, while Gm. 4 (60 grains) are generally sufficient. A single dose may be reckoned at Gm. 0.5 (7 or 8 grains). It is worthy of remark that while the U. S. Pharmacopœia contains no less than six lithium compounds, the German Pharmacopœia (1882) presents but one—the carbonate. It may well be doubted whether even this one be not superfluous.

LOBELIA, *U. S., Br.*—Lobelia.

Herba lobeliæ, P. A., P. G.—*Indian tobacco*, E.; *Lobélie enflée*, Fr. Cod.; *Lobelienkraut*, G.

The leaves and tops of Lobelia inflata, *Linné*, collected after a portion of the capsules have become inflated. Bentley and Trimen, *Med. Plants*, 162.

Nat. Ord.—Lobeliaceæ.

Origin.—The inflated lobelia is an annual herb, native of the North American continent, growing in dry open fields and on the borders of woods from the northern parts of Canada southward throughout the United States to Georgia and Mississippi. It flowers from July to September, and should be collected when some of the capsules have become inflated; the fresh herb, on drying, loses from 75 to 80 per cent. of moisture.

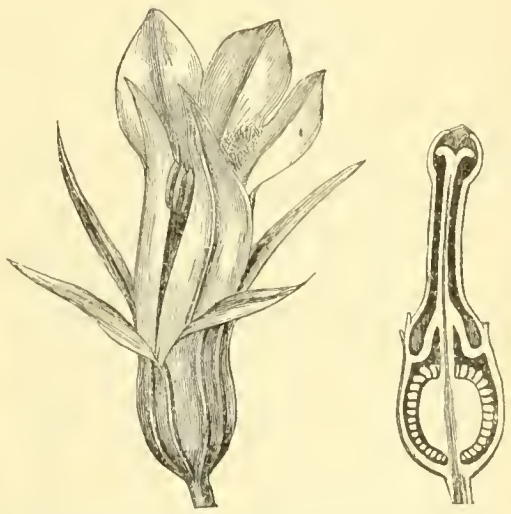
Description.—The herb grows from 20–50 Cm. (12 to 20 inches) high, and has a branching stem, which is somewhat furrowed and beset with spreading hairs. The leaves are alternate, 50–75 Mm. (2 to 3 inches) long, ovate or oblong, irregularly toothed, pubescent, and pale green; the lower ones petiolate, the upper sessile and gradually reduced to bracts. The flowers are in long racemes, terminating the stem and branches. The calyx-tube is adherent to the ovary, has the limb divided into five narrow teeth, and becomes inflated in fruit. The pale-blue corolla is somewhat two-lipped and has the upper side of the tube split to the base. The five stamens are free from the corolla, and by the union of the filaments and anthers form a tube which encloses the single style. The fruit is a thin subglobular capsule which is two-celled, opens at the apex, and contains a large number of minute brown oblong seeds, the surface of which has, under the microscope, a reticulated appearance. It has an herbaceous somewhat irritating odor, and an herbaceous afterward burning and acrid tobacco-like taste.

Constituents.—Lobelia owes its virtues, at least in part, to an alkaloid, *lobeline*, which was first recognized by Calhoun (1833), but isolated by Procter (1838). To obtain it, the tincture made with alcohol containing acetic acid is evaporated to a syrupy consistence, triturated with excess of magnesia, the filtrate agitated with ether, and the ethereal solution evaporated; the impure alkaloid requires purification by combining with an acid, treating with animal charcoal, and again decomposing with magnesia. W. D. Richardson (1872) obtained more alkaloid from the above mother-liquor by precipitation with potassium iodo-hydrargyrate. *Lobeline* is a yellow somewhat aromatic liquid (amorphous solid, Lloyd Bros., 1886) having an acrid taste; it is lighter than water, is soluble in alcohol, ether and fixed oils, and less so in water. Its salts, except the acetate are crystallizable, are freely soluble in water, scarcely so in ether, and not altered at a boiling temperature, whereas the alkaloid is thereby deprived of its acrid taste. Richardson found it even to be altered by simple exposure to air, whereby it became resinified and unable to combine with acids. Bastick (1850) considered it volatile, but to evaporate not entirely unchanged. Lewis (1878) corroborated Richardson's observations, and observed that sulphuric acid and Fröhde's reagent impart a brown-red color, and that on boiling with dilute sulphuric acid or with potassa, glucose is liberated from the alkaloid. V. Rosen (1886) obtained both a liquid and a solid alkaloid from lobelia herb.

Fig. 174.

Lobelia-seed, magnified.

Fig. 175.



Lobelia inflata, *Linné*, and section through stamens and pistil, magnified 5 diameters.

In 1871, Enders obtained the acrid principle *lobelacrin* by concentrating the tincture in the presence of charcoal, washing this with water, and exhausting with boiling alcohol (*Pharmacographia*). It forms warty tufts of a brown color, is soluble in ether and chloroform, slightly so in water, is decomposed by boiling with water, and yields sugar and *lobelic acid* under the influence of acids and alkalies. It is possible that the alkaloid, as heretofore obtained, has been more or less contaminated with this body, which, according to Lewis, is lobelate of lobeline.

The *lobelic acid* of Enders is probably identical with the compound of Pereira (1842),

Procter, and Lewis bearing the same name. Procter obtained it from the decoction of the leaves by precipitating it with copper sulphate and decomposing with hydrogen sulphide. It is crystallizable, soluble in ether, alcohol, and water, and yields with ferric salts an olive-brown, with copper sulphate a light-green, with lead acetate and baryta-water a yellow, and with silver nitrate a white afterward brown precipitate. The barium compound of Enders's acid is soluble in water.

Inflatin, obtained by Lloyd Bros. (1886) from the herb and seeds is a crystallizable, neutral principle, soluble in most simple solvents.

Reinsch (1848) obtained from the herb also waxy, resinous, fatty, and gummy matters, and Procter from the seeds about 30 per cent. of rapidly-drying fixed oil.

Allied Species.—Lobelia syphilitica. *Linné* (*Great lobelia*). It has acute elliptic-oblong, irregularly-serrate leaves, and showy blue flowers in the axils of the upper leaves, forming a terminal raceme: the calyx has a short hemispherical tube, five long acute lobes, and at their base conspicuous deflexed appendages. It is met with in low grounds in the United States.

Lobelia cardinalis, *Linné* (*Cardinal-plant*). It is common in marshy and low grounds throughout the greater portion of the United States, nearly smooth, has oblong-lanceolate, acute, and slightly-toothed leaves, and bears long racemes of large showy scarlet-red flowers on short pedicels in the axils of the leaf-like bracts.

Action and Uses.—The action of lobelia and its alkaloid upon animals is almost identical with that of tobacco and nicotine, but larger doses are required to develop it. Lobelia is ranked as a respiratory poison, and in the cat it greatly reduces the temperature. Dr. Bartholow, using the hydrobromate of lobeline in his experiments, confirmed previous results by showing that it causes death by respiratory failure. He did not find that it depressed the heart (*Amer. Jour. of Med. Sci.*, xciii. 526).

Cases have been published of death from the maladministration of this drug by ignorant persons assuming to be practitioners of medicine. Lobeline sulphate is said to be an emetic after the manner of apomorphine.

The chief medicinal value of lobelia is in the treatment of *asthma*, whether the disease be purely spasmodic or associated with pulmonary emphysema, or chronic bronchitis, heart disease, etc. It eliminates from the attack the bronchial spasm, which in the first-named affection constitutes the whole disease and in the others is a complication only. Gm. 4 (a fluidrachm) of the tincture should be given every hour, or, if the symptoms are urgent, every half hour until relief is obtained or the characteristic effects of the medicine are produced. This dose (for adults) has been greatly exceeded by Nunes (*Bull. de Thér.*, cx. 161) and by Moncorvo (*ibid.*, cxi. 321) who prescribed from Gm. 8–16 (ʒij–iv) of the tincture. It sometimes occasioned vomiting, but no alarming effects. Its efficacy in the other diseases mentioned, as well as in *whooping cough*, will depend mainly upon the predominance of the nervous element in them. Yet, when dyspnœa is due to inflammatory changes in the bronchia, or to the presence in these tubes of secreted matter, rather than to spasm, lobelia displays special virtues that entitle it to be preferred before numerous "expectorants." It is of no more advantage in *inflammatory laryngitis* than various other nauseants and emetics, but it is decidedly more efficacious in *spasmodic laryngitis* than most other remedies of the same class. In almost all cases of distress in breathing arising from a want of proper balance between the lungs and the heart, this medicine affords relief; as, for instance, when the lungs are congested by mitral obstruction and there is a tendency to œdema of those organs; and, again, when the lungs are themselves diseased so as to interfere with the cardiac circulation, as occasionally happens even in tuberculous consumption. Hœmostatic virtues have been ascribed to the tincture of lobelia which probably belonged only to the alcohol of the preparation.

The *dose* of lobelia as an emetic is Gm. 0.60–1.30 (gr. x–xx) but this use of it is unnecessary, and may be dangerous. As an expectorant the dose is from Gm. 0.06–0.30 (gr. i–v). The preparations most frequently employed are the tincture and the vinegar of lobelia, of either of which the dose as an expectorant is from Gm. 0.60–5 (♏ x–lx). In asthmatic attacks Gm. 4–8 (fʒi–ii) should be administered every half hour or hour, according to the urgency of the symptoms. The dose of the fluid extract as a nauseant or expectorant is Gm. 0.06–0.30 (♏ i–v). Moncorvo prescribed lobeline in doses of Gm. 0.01 (gr. $\frac{1}{6}$) gradually increasing it until Gm. 0.40 (6 grains) a day were taken. No toxic action resulted. He also administered it hypodermically (*Therap. Gaz.*, xiii. 466). Bartholow says "the dose of the salts of lobeline will vary from $\frac{1}{100}$ gr. to $\frac{1}{20}$ gr.," which appears to be too small for efficiency.

Lobelia syphilitica was formerly used by the aborigines for the cure of syphilis, probably on account of its diaphoretic action, and at one time its virtues were maintained

by several eminent physicians in Europe. They are not any longer believed in; nevertheless, there can be no doubt that, in so far as diaphoresis tends to cure syphilis, the disease may be palliated by lobelia. Older authorities describe it as being diaphoretic, and hence depurative. *L. cardinalis* possesses similar virtues, but in a less degree. It was used by the American Indians as an anthelmintic.

Acetum Lobeliæ (Pharmacop. 1880).—Vinegar of lobelia is especially indicated in congested states of the *bronchial* mucous membrane, with imperfect secretion and *spasmodic constriction* of the air-tubes. It may be appropriately associated with preparations of antimony, squill, seneka, or ipecacuanha. The dose for an adult is Gm. 2–4 (♏xxx–f℥j) when a merely expectorant operation is desired; but as a nauseant and antispasmodic Gm. 4–8 (f℥j–ii) should be given at intervals of an hour until its characteristic effects are produced.

LOLIUM.—Darnel.

Bearded darnel, E.; *Ivraie*, Fr.; *Lolch, Taumelkorn*, G.

The fruit (caryopsis) of Lolium temulentum, *Linné*, s. L. arvense, *Withering*. Bentley and Trimen, *Med. Plants*, 295.

Nat. Ord.—Gramineæ.

Origin.—The bearded darnel grows on waysides and in grain-fields in Western Asia and throughout Europe, and has been introduced to some extent in most grain-growing countries; it is rare in the United States. It is an annual about 75 Cm. (2½ feet) high, with rather large leaves, and has an elongated inflorescence, the spikelets being nearly 25 Mm. (1 inch) long, about seven-flowered, somewhat suppressed, alternate, sessile, appressed to the concave rachis, and about as long as the glumes.

Description.—The fruit is oblong-ovoid, nearly 6 Mm. (¼ inch) long, enclosed in the paleæ, grooved on the inner and convex on the outer surface, smooth, pale-brown, internally white, inodorous, and of a farinaceous afterward bitterish taste.

Constituents.—The chemical investigations undertaken for the purpose of isolating the poisonous principle have been reviewed by Wittstein (1875). The deleterious properties of the plant, according to Ludwig and Stahl (1864) appear to be due to an acrid fixed oil and to an amorphous yellowish glucoside, which is soluble in water, alcohol and ether, and has a bitter and acrid taste. Bley (1834) and Muratori (1837) ascribed them to an acid body, and Baillet and Fihol (1863) to a non-saponifiable oily compound. Bley (1838) obtained his *loliin* by precipitating the alcoholic solution of the aqueous extract with ether; the yield was only $\frac{1}{30}$ per cent. of a dingy-white powder having an acrid taste. Antze (1891) obtained a volatile alkaloid, *loline*, forming crystallizable salts with acids and *temulentic acid*, crystalline and melting at 234° C. The fruit contains the ordinary constituents of grain, among them from 30 to 50 per cent. of starch, the granules of which, according to Schwerdtfeger (1853) are about one-third the size of wheat starch, circular, with a moderately white margin and a bright, strongly translucent surface without marks. On incineration, darnel fruit leaves about 5 per cent. of ash.

Lolium perenne, *Linné*, *ray-* or *rye-grass*, is a pasture-grass, has a perennial creeping rhizome, the glumes shorter than the spikelets, and awnless or short-awned flowers. It is not poisonous.

Action and Uses.—A large number of persons have at different times been poisoned by bread made with flour containing lolium. Upon different animals it acts differently: it is poisonous to dogs, sheep, and horses, but not to hogs, cows, and ducks, and quails are said to be fond of the seeds as food. Its effects have been known from ancient times to be narcotic and anæsthetic. They comprise the following symptoms: headache, vertigo, disturbed and sometimes yellow vision, ringing in the ears, paresis of the tongue, oppression in breathing, anxiety, vomiting, and sometimes purging, urination, general muscular trembling, cold sweating, and overpowering and deep sleep. In several cases the poisoning has proved fatal. There is reason to suspect that the old custom of using darnel to adulterate malt and distilled liquors is not wholly obsolete. The peculiar intoxication produced by some of these drinks strongly suggests such a fraudulent and wicked addition to them. Lolium has been mixed with poultices applied for the relief of local *pains*, pleuritic, neuralgic, and rheumatic, and, although it has been given internally, neither the grounds of its administration nor its alleged results are entitled to any confidence.

LOTIONES.—Lotions.

Washes, E.; *Lotions*, Fr.; *Waschungen*, G.

Lotions are liquid preparations, usually containing water as their principal vehicle, and are ordinarily applied by wetting lint or muslin with them, and keeping this upon the affected part.

LOTIO HYDRARGYRI FLAVA, *Br.*—Yellow Mercurial Lotion.

Aqua phagedænica.—Yellow wash, E.; *Eau phagédénique, Eau divine de Fernel*, Fr.; *Phagedänisches Wasser, Altschadenwasser*, G.

Preparation.—Take of Perchloride of Mercury 18 grains; Solution of Lime 10 fluidounces. Mix.—*Br.*

A double decomposition takes place, resulting in the formation of calcium chloride and finely-divided yellow mercuric oxide. It should be well shaken when used.

Action and Uses.—This preparation is stimulant, and even caustic. Its use is restricted almost exclusively to the treatment of indolent *chancres* and other *syphilitic ulcers*. It should be applied upon lint.

LOTIO HYDRARGYRI NIGRA, *Br.*—Black Mercurial Lotion.

Aqua phagedænica nigra, Aqua nigra, Aqua mercurialis nigra.—Black wash, E.; *Eau phagédénique noir*, Fr.; *Schwarzes Wasser*, G.

Preparation.—Take of Subchloride of Mercury 30 grains; Solution of Lime 10 fluidounces. Mix.—*Br.*

The chemical reaction between the two substances results in producing calcium chloride and black mercurous oxide. It must be well shaken when used.

Action and Uses.—The action of black wash appears to be mildly stimulant and astringent as well as protective. It may be applied on lint to *syphilitic* ulcers.

LUPINUS.—Lupin.

Lupin, Fr.; *Feigbohne, Wolfsbohne*, G.; *Altramuz, Chochos*, Sp.

The seed of Lupinus albus, *Linné*.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin and Description.—This annual is a native of Southern Europe and Western Asia, and is cultivated in gardens. It is about 50 Cm. (20 inches) high, and has palmately five- or seven-foliate leaves, with the leaflets obovate-oblong, 25–50 Mm. (1 or 2 inches) long, smooth above and white hairy beneath; the flowers are in terminal racemes on short pedicels, white and rather large; the legume is 7–10 Cm. (3–4 inches) long, flattish, and contains three to six white circular and flattened seeds, which are inodorous and have a somewhat bitter taste.

Allied Plants.—L. hirsutus, *Linné*, has spatulate-oblong leaflets and blue or rose-colored flowers.

L. luteus, *Linné*, is distinguished by its yellow flowers; like the preceding, it is of South European origin.

A large number of lupins are indigenous to the Western section and the Pacific coast of the United States, some of which, like L. polyphyllus and densiflorus, *Nuttall*, are cultivated in gardens. These, as well as the blue-flowered L. perennis, *Linné*, which grows in sandy soil in the Eastern portion of the United States, may possess similar properties.

Constituents.—Cassola (1835), and afterward Reinsch (1849), found the bitter principle of lupin to be insoluble in ether. Schulze and Barbieri (1878) obtained it crystalline from Lupinus luteus by preparing a tincture with diluted alcohol, precipitating with lead subacetate, decomposing the precipitate with hydrogen sulphide, and treating with hot water, on the cooling of which the bitter principle crystallizes in yellowish-white fine needles. This *lupinin*, $C_{29}H_{32}O_{16}$, is soluble in alkalies with a dark-yellow color, and on being boiled with dilute acids is split into sugar and *lupigenin*, $C_{17}H_{12}O_6$. Eichhorn (1867) obtained an alkaloid which was further investigated by Beyer, Siewert, Liebscher (1880), and Baumert (1881). *Lupinine*, $C_{21}H_{40}N_2O_2$, prepared from yellow lupin-seed, forms colorless rhombic prisms of a fruit-like odor and intensely bitter taste. Campani and Bettelli (1881) isolated an alkaloid from white lupin-seed. These seeds appear to contain several alkaloids.

Action and Uses.—In recent times they have almost ceased to be employed in medicine, but in 1877, Donnabella (*Practitioner*, xxi. 211) reported that, having thrown into the rectum about 5 ounces of a decoction of lupins he soon began to feel general malaise, uneasiness of the head, obscuration of vision, heaviness of the eyelids, vertigo, excitement of mind, and a sense of constriction of the larynx and pharynx. Several months afterward he repeated the experiment with the same results. It is probable that this reporter used in his experiments some very different seeds from those of white lupin, since none of the ancient writers who treat of them at length make the least allusion to their being poisonous.

LUPULINUM, *U. S., Br.*—Lupulin.

Glandulæ lupuli, P. G.—*Lupuline*, Fr. Cod.; *Hopfenmehl, Lupulin*, G.; *Lupulina*, Sp.

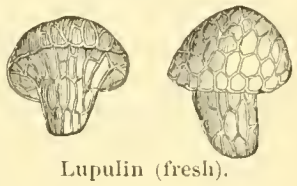
The yellow glandular powder separated from the strobiles of Humulus Lupulus, *Linné.*

Nat. Ord.—Urticaceæ, Cannabineæ.

Origin.—(See Humulus, page 818). On handling dry hops the glandular powder becomes detached, and is freed from fragments of the bracts, etc. by sifting; about 10 per cent. of the weight of the hops may be obtained.

Description.—Lupulin has also been called *lupulite.* When fresh it is a bright, brownish-yellow, afterward yellowish-brown, granular resinous powder, which has the aromatic odor and bitter and aromatic taste of hops. Under the microscope it is seen to consist of two hemispheres, the lower and firmer of which is somewhat obtusely conical or top-shaped, the upper one rounded, the surface of both reticulate. In the dry state the lower one nearly retains its shape, but the more delicate upper part collapses and forms a flattish hood. The glands contain a brown-yellow liquid which dries up to a resinous mass. Lupulin should be free from sand, which readily subsides from it when agitated with water.

Fig. 176.



Lupulin (fresh).

Constituents.—On distilling hops with water, Personne (1854) obtained *valerianic acid* and a *volatile oil*, which boils between 140° and 300° C. (284° and 572° F.), is colorless and neutral, but becomes resinous and acid on exposure, and consists of a lighter portion, $C_{10}H_{16}$, and *valerol*, $C_6H_{10}O$, from which by gradual oxidation valerianic acid is formed. The residue from the distillation when treated with lime yields a distillate of *valeral*, $C_5H_{10}O$. The *resin* of lupulin was examined by Vlaanderen (1858), who found it tasteless, combining with metals, and becoming more hydrated in the course of purification. The principal constituent of lupulin is wax, which Lermer (1863) found to be *myricin* (myricylic palmitate). He also isolated the bitter principle and called it *lupamaric acid* (Hopfenbittersäure). To prepare it, the ethereal extract of fresh hops is treated with 90 per cent. alcohol, which leaves the wax behind; the alcohol is evaporated, the residue dissolved in ether, and this solution agitated with strong potassa solution to remove resin; agitation with water now dissolves the potassium lupamarate, which is precipitated with copper sulphate, and the precipitate, decomposed by hydrogen sulphide, yields the acid in white crystals, becoming yellow on exposure, insoluble in water, but soluble in alcohol, ether, chloroform, carbon disulphide, and oil of turpentine. Its composition is $C_{32}H_{50}O_7$.

Tests.—"On incineration, lupulin should yield less than 10 per cent. of ash. If exhausted with ether, lupulin should leave a residue weighing not over 30 per cent., and the ethereal tincture on being evaporated at a moderate temperature should leave a brown, soft extract having the odor of hop in a high degree."—*P. G.*

Pharmaceutical Uses.—Tinctura lupulinæ, U. S. 1870. Lupulin 4 troyounces; alcohol sufficient to obtain 2 pints of tincture; prepare by percolation.

Tinctura lupulinæ ammoniata. Lupulin 2 ounces; aromatic spirit of ammonia sufficient to obtain 1 Imperial pint (19¼ fluid ounces *U. S.*; Dr. Dyce Duckworth, 1868.)

Pills of lupulin may be prepared by triturating lupulin with a little ether until a plastic mass is obtained, which may be incorporated with camphor or with resins or oleoresins.

Action and Uses.—The account given of the operation of hop (see Humulus) makes an extended discussion of lupulin unnecessary, since it is upon this product that the virtues of hop chiefly depend. In doses of Gm. 1.30–1.60 (gr. xx–xxv) lupulin occasions a lively sense of warmth at the epigastrium, which afterward extends to the

whole abdomen. Constipation, with colicky pain, is apt to ensue, but the appetite and digestion appear to be invigorated. It is alleged that full doses of lupulin diminish the frequency of the pulse. It tends to allay the susceptibility which is a frequent cause of an excited circulation. Probably in this manner, rather than by a direct action upon the brain, it favors sleep and tends to repress that excitement which occasions *priapism*, *seminal emissions*, and *nocturnal incontinence of urine*. It has seemed to allay *irritability of the bladder* when opium was not tolerated. It may be prescribed in *doses* of from Gm. 0.30–0.60 (gr.v–x) and upward, mixed with jelly or syrup.

LYCOPERDON.—Puff-Ball.

Lycoperdon solidum, *Gronovius*, s. Pachyma Cocos, *Fries*.

Nat. Ord.—Fungi, Gasteromycetes.

Origin.—This curious product is found attached to the roots of fir trees in the southern part of the United States from Virginia westward to Kansas, and is known as *Indian bread* or *tuckahoe*. It likewise grows in China, where it is used under the name of *fuhling*. Currey and Kelley consider it to be an altered state of the root of the tree occasioned by the presence of a fungus, the mycelium of which traverses, disintegrates, and even obliterates, the wood and bark. This view is sustained by the result of the analyses made by R. T. Brown (1871) and J. L. Keller (1876).

Description.—The tuckahoe is an irregularly globular or elongated body, attaining 30 Cm. (1 foot) or more in diameter, and from a few ounces to several pounds in weight. It is externally of an ashy-black, and has a rugose surface; internally it is whitish, fissured, more or less spongy, but firm, of a somewhat farinaceous appearance, sometimes quite compact, and breaks into irregular masses. It is without odor and has an insipid taste.

Constituents.—Brown found it to contain 14 per cent. of water, 0.93 of glucose, 2.63 of gum, 17.34 of pectose, 64.45 of cellulose, and 0.16 per cent. of ash; the nitrogen amounted only to 0.36 per cent. Keller's specimen yielded 77.27 per cent. of pectose, 3.76 of cellulose, and 3.64 of ash, the other constituents being nearly in the same proportion as in the former analysis.

Allied Plants.—Lycoperdon Bovista, *Linné*, s. Lycoperdon (Bovista, *Nees*) giganteum, *Batsch*.—Giant puff-ball, *E.*; Vesse-loup, *Fr.*; Bovist, *G.*—This fungus forms globular or obconical masses of a more or less yellow, or when old dark-brown, color, and attaining a diameter of about 60 Cm. (2 feet). The inner part has a spongy texture, and was formerly known as Fungus chirurgorum, and used for arresting hæmorrhages.

Elaphomyces granulatus, *Fries* (Lycoperdon cervinum, *Linné*, Scleroderma, *Persoon*).—Puff-ball, Hart's truffle, *E.*; Truffe de cerf, *Fr.*; Hirschbrunst, *G.*—Its size is about that of a walnut. It is brown, verrucose, internally purplish-brown, and was considered to possess stimulant properties.

Tuber cibarium, *Sibthorp* (Lycoperdon Tuber, *Linné*)—Truffle, *E.*; Truffe, *Fr.*; Trüffel, *G.*—It is of subterraneous growth, subglobular, about the size of a walnut, externally blackish and verrucose, internally white, marbled with brown, fleshy. Like some allied species, it is edible.

Action and Uses.—In 1853, Dr. B. W. Richardson's attention having been directed to the fact that the smoke of the *common puff-ball* had been used in the country for stupefying bees in order to secure the contents of their hive without sacrificing the insects, he conceived the idea that it might be made use of as a surgical anæsthetic. He accordingly experimented upon dogs, cats, and rabbits, and in one case removed a tumor from a dog without any sign of pain being shown during the operation. When a moderate quantity was inhaled gradually, the narcotism came on and passed off slowly, the animal exhibiting all the symptoms of intoxication, with convulsions, and sometimes vomiting. It destroyed life slowly; a dog would inhale the fumes for twenty minutes or half an hour after being completely narcotized previous to expiring. The heart's beat in all cases survived the respiration. The lungs after death were pale; there was no sign of congestion in any organ; the blood retained its red color, but did not coagulate quickly; cadaveric rigidity set in within two or three hours. During recovery from protracted narcotism an animal would sometimes be quite conscious, although insensible to pain. Herapath made experiments which proved that the gas which is the active agent in producing the preceding phenomena is carbonic oxide, and his conclusion, confirmed by Snow, was accepted by Dr. Richardson. No practical application has been made of this curious discovery.

L. Bovista has long been employed in Europe as a topical means of arresting hæmorrhages. In 1869, Dr. Porcher stated concerning L. giganteum (L. Bovista) that it is

found in abundance near Charleston, S. C., particularly where the cattle are driven to graze. It is used sliced and fried in butter or stewed in milk like the common mushroom. A correspondent wrote to him, "I and a number of others have made several meals on *lycoperdon*, and I think I have discovered in myself well-marked evidences of its narcotic influence, and two other experimenters have described similar sensations to me." A case is also referred to in which a person "had been seriously affected in this way by too large a meal of lycoperdon." Dr. E. Thompson of Tyrone has reported its remarkable virtues as a hæmostatic, antiseptic, and anodyne dressing for *cancerous* ulcers and *bleeding wounds* (*Practitioner*, xxix. 288).

The powder of this fungus has been applied as a *hæmostatic* in slight and superficial wounds, and, like other dry absorbing powders, in *intertrigo*.

It is said to have been used as food by the Indians of the Southern States.

LYCOPODIUM, *U. S., P. G.*—Lycopodium.

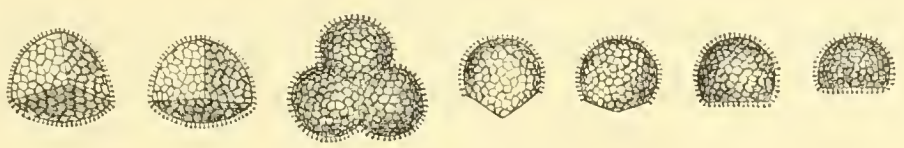
Semen lycopodii, Pulvis lycopodii, Sulphur vegetabile.—Vegetable sulphur, E.; *Lycopode, Soufre végétal*, Fr.; *Bärlappsamen, Streupulver, Hexenmehl, Blitzpulver*, G.; *Licopodia*, Sp.

The sporules of Lycopodium clavatum, *Linné*, and of other species of Lycopodium. Bentley and Trimen, *Med. Plants*, 299.

Nat. Ord.—Lycopodiaceæ.

Origin.—The common *club-moss* is a low creeping perennial which is found in dry woods distributed over the greater portion of the globe, but is most frequent in northern countries. The stem is 0.6–1.2 M. (2 to 4 feet) long, with evergreen imbricated linear awl-shaped inflexed leaves, and with ascending very leafy branches 5–10 Cm. (2 to 4 inches) high, the fertile ones terminated by a long peduncle bearing two or three erect linear cylindrical spikes 3–5 Cm. (1¼ to 2 inches) in length, with roundish ovate bristly-pointed bracts, in the axils of which are kidney-shaped sporangia containing the sporules. The spikes are collected before they are fully matured, and after the powder has fallen out, it is separated by a sieve from the other parts. It is collected in Germany and other countries of Central Europe.

Fig. 177.



Sporules of Lycopodium.

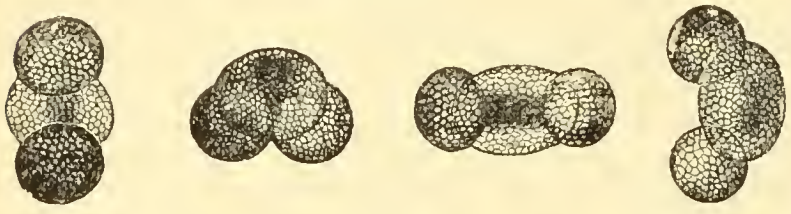
Description.—Lycopodium is a fine, very mobile, pale yellowish powder which is free from odor and taste. It floats upon water, and is wetted by it with difficulty and only after continued trituration, unless it has been previously washed with alcohol, ether, or chloroform to remove a superficial layer of oily matter; after boiling it sinks in water. When triturated it acquires a darker tint, becoming more coherent and greasy; when slowly heated it burns quietly, but when thrown into a flame it burns suddenly and with a hissing noise; when ignited it should leave not more than 5 per cent. of ash. Examined by the microscope, it is found to be rounded on one side while the other forms a three-sided pyramid. The entire surface is covered by fine polyhedric meshes except at the edges of the pyramid; but at its intersection with the rounded base short projections are observed.

Constituents.—Flückiger (1872) determined the presence in lycopodium of a much larger amount of fixed oil than the 6 per cent. observed by Bucholz (1807), and after rupturing the granules by long trituration with sand obtained 47 per cent. of a bland oil which does not solidify at −15° C. (5° F.). Bucholz found also in it 3 per cent. of sugar. Stenhouse obtained minute quantities of volatile bases, and Flückiger determined the ash to amount to 4 per cent., to be not alkaline, and to contain alumina and 1 per cent. of phosphoric acid. The substance of the cell-wall has been called *pollenin*; on treatment with potassa it is colored yellow, and then acquires a blue color with sulphuric acid and iodine.

Impurities and Adulterations.—The sporules of allied species of Lycopodium, particularly of L. complanatum, annotinum, and innundatum, *Linné*, which are found in both hemispheres, are sometimes collected; they are very similar in appearance and

properties. Mineral substances like powdered *talc*, *gypsum*, etc. are detected by the larger amount of ash, and will readily subside when a little is agitated with carbon disulphide or chloroform. Powdered *rosin* is detected by treatment with alcohol and evaporation of the tincture. Dextrin is soluble in water; its concentrated solution is precipitated by strong alcohol, and after having been boiled with dilute sulphuric acid it reduces red cuprous oxide from Trommer's solution. *Starch* is separated by carbon disulphide, in which it sinks, and sublimed *sulphur*, if present, will be dissolved by the liquid, and afterward obtained on evaporating it. Starch is also recognized by the blue color it acquires with solution of iodine. All admixtures are, however, easily detected by means of the microscope; the pollen of pine, which is sometimes found mixed with it, consists of an oval plano-convex cell, at each end of which is a smaller globular one projecting on the flat side.

Fig. 178.



Pollen of Pine.

Action and Uses.—This powder, on account of its extreme lightness and dryness, is used as a convenient protective for tender and raw surfaces of the skin in *intertrigo*, *erysipelas*, *eczema*, *herpes*, superficial *ulcers*, etc., and by druggists to place in boxes containing pills to prevent them from adhering to one another. Lycopodium was formerly used as a dressing for unhealthy ulcers as well as in various affections which required both stimulant and demulcent agents, particularly diseases of the *urinary organs* and *dysentery*, and we have known it to be credited with diuretic power. Mr. Fenwick (*Ther. Gaz.*, xi. 703) reports its tincture of value in cases of irritable bladder not due to actual disease, such as the spasmodic *retention of urine* in children in the dose of 15 minims to 1 fluidrachm. It has been given for the relief of chronic *bronchitis* and *rheumatism*. It is said (Cazin) that in Poland it is used upon the hair of persons affected with *plica Polonica*. But since it has been shown that this affection is not a disease, but only a result of filthiness (Kaposi), it has been cured by the free use of oil and the comb.

Lycopodium saururus. In 1886 Dujardin-Beaumetz (*Bull. et Mém. Soc. Ther.*, p. 139) drew attention to the emeto-cathartic properties of this plant which furnishes an alkaloid (piliganine) of which two grains killed a dog. Its alcoholic extract was purgative in the dose of Gm. 0.35 (gr. vi), and the hydrochlorate of piliganine in doses of Gm. 0.01–02 (gr. $\frac{1}{6}$–$\frac{1}{3}$).

LYCOPUS.—Bugleweed.

Lycope de Virginie, Fr.; *Virginischer Wolfsfuss*, G.

The herb of Lycopus virginicus, *Linné*.

Nat. Ord.—Labiatæ, Saturcieæ.

Origin.—Bugleweed is a perennial herb growing in woods and shady moist places in Canada and in the United States southward to South Carolina. It flowers from July to September.

Description.—The stem is nearly smooth, about 30–45 Cm. (12 to 18 inches) high, obtusely quadrangular, and with slender runners at the base; the leaves are opposite, short-petioled, elliptic-lanceolate, toothed, wedge-shaped, and entire at the base, and glandular-punctate beneath; the flowers are small, in axillary clusters, purplish, and have a calyx with four ovate and bluntish but pointless teeth. The herb has a somewhat mint-like odor and a bitter and slightly aromatic taste.

Constituents.—The plant has most likely the general constituents of the Labiatæ, prominent among which is volatile oil, some resin, and a little tannin; in this case perhaps also a bitter principle. We know of no analysis of the plant.

Lycopus europæus, *Linné* (Water horehound, *E.*; Lycope d'Europe, *Fr.*; Wasserandorn, *G.*), has been used in Europe as *Herba marrubii aquatici*. It is indigenous to Europe and North America, and resembles the bugleweed, being mainly distinguished by the often taller, sharply four-angled stem, the more deeply and sinuate-toothed, at the base often pinnatifid, leaves, and the five triangular, sharp-pointed calyx-teeth. It varies somewhat in its foliage, and is not unfrequently collected with the preceding.

Action and Uses.—Bugleweed is reputed to be astringent and sedative, to reduce the frequency of the pulse, to arrest *hæmorrhage* from the lungs, to allay coughing, and to be a mild narcotic. It has been compared with digitalis. As more than half a century has elapsed since such virtues were first ascribed to it, and it still continues to be neglected and generally unknown, it may be inferred that its supposed powers were in a great part imaginary. It may be used in an infusion made with an ounce of the herb in a pint Gm. 16 in Gm. 500 of boiling water. This quantity may be taken in a day. In 1886 it was stated that a decoction of bugleweed prevented the effects of the bites or stings of *venomous serpents* and *insects* (*Jour. Am. Med. Assoc.*, viii. 40).

L. europæus is said to have been used from time immemorial by the Piedmontese as a remedy for *intermittent fever*. It has also been employed to arrest passive *hæmorrhages* and *mucous discharges*.

LYTHRUM.—Loosestrife.

Herba salicariæ.—Purple willow-herb, E.; *Salicaire*, Fr.; *Rother Weiderich*, G.

Lythrum Salicaria, *Linné*.

Nat. Ord.—Lythraceæ.

Origin and Description.—Loosestrife is a tall perennial downy herb, indigenous to Europe and Asia, naturalized in moist places from New England northeastward, and is sometimes cultivated in gardens. It flowers in July and August. The leaves are opposite or whorled in threes, about 75 Mm. (3 inches) long, lanceolate, sessile, clasping with the heart-shaped base. The flowers are apparently whorled, form a long, interrupted, wand-like spike, and have six showy purple or sometimes whitish petals and twelve stamens. The herb has a mucilaginous, mildly astringent taste. The blackish-brown, branching, and fibrous root is astringent. The principal constituents of loosestrife are mucilage and tannin.

Allied Plants.—Lythrum alatum, *Pursh*, is a smooth perennial, has smaller purple flowers with six stamens, and is characterized by the marginal angles of the branches; it grows in North America, and with the allied forms L. lanceolatum, *Elliott*, and L. album, *Kunth*, growing in Texas, is used in Mexico in cataplasms as *yerba del cancer*.

Cuphea viscosissima, *Jacquin* (Meehan, *Nat. Flowers*, i. p. 41), is said to be useful in diarrhœa. It grows in dry fields southwestward to Louisiana, and is a viscidly-hairy annual, about 50 Cm. (20 inches) high, with opposite petiolate ovate-lanceolate leaves, a somewhat inflated tubular six-toothed calyx, six unequal bluish purple petals, and twelve included stamens. The Mexican *atlanchana*, C. lanceolata, *Kunth*, is employed in similar complaints.

The genus is mostly confined to tropical America, and several species are cultivated for ornament, among which the so-called *cigar-plant* (C. platycentra, *Kunth*), with its scarlet-red tubular calyx, is best known. The leaves and branches of C. antisyphilitica, *Kunth*, and C. microphylla, *Kunth*, are used in South America in syphilitic complaints.

Action and Uses.—Loosestrife unites in itself demulcent and astringent qualities. It has been much used in Europe in *chronic diarrhœa* and *dysentery*, *leucorrhœa*, *blenorrhœa*, and passive *hæmorrhages*, and for various local cutaneous irritations. It is generally given in a decoction prepared with Gm. 32 in Gm. 500 (℥j in Oj) of water and in doses of Gm. 32–64 (℥j–ij).

An infusion is, however, preferable to the decoction, and may be made with the leaves and stems Gm. 15 to Gm. 500 (℥ss in Oj). (Campardon, *Bull. de thérap.*, cv., 337).

MACIS, *U. S.; Fr. Cod., P. A.*—Mace.

Arillus myristicæ.—Fleur de muscade, Fr.; *Muskatblüthe*, G.; *Macias*, Sp.

The arillus of the fruit of Myristica fragrans, *Houttuyn*.

Nat. Ord.—Myristicaceæ.

Origin.—(See Myristica.) When the nutmeg is gathered, the arillus, which envelops the seed, is cut off and dried in the sun, whereby its bright red color is changed to brownish-orange. With the view of its better preservation it is often sprinkled with seawater. It is principally obtained from the Banda Islands.

Description.—Mace is about 25 Mm. (1 inch) or more long, smooth, flat, about 2 Mm. ($\frac{1}{12}$ inch) thick at the base, thinner above, longitudinally slit into irregular, narrow, and somewhat branching bands of a brownish-orange and nearly dull color, somewhat translucent, and fatty when pressed or scratched. It breaks readily with a short fracture, but cannot be triturated to powder on account of the oil. It has a very agreeable aromatic odor, closely analogous to that of nutmeg, and a warm aromatic taste.

Constituents.—The most important constituent is the volatile oil (Oleum macidis, *P. G.*), which is present to the amount of about 8 per cent., but occasionally as much as 17 per cent. may be obtained (*Pharmacographia*). Schacht (1862) found it to consist mainly of a hydrocarbon, $C_{10}H_{16}$, called *macene*, which yields a crystallized compound with hydrochloric acid gas, and appears to be related to, and by Koller (1865) considered identical with, the myristicene of oil of nutmeg. The oxygenated portion of the volatile oil is still less known than the hydrocarbon. Henry (1824) found red fat soluble, and yellow fat insoluble, in alcohol, but the 24.5 per cent. residue obtained by Flückiger (*Pharmacographia*) with boiling ether and drying at 100° C. (212° F.) appeared to have consisted solely of resin and semi-resinified volatile oil. The same author obtained with alcohol 1.04 per cent. of uncrystallizable sugar, and with hot water 1.8 per cent. of a body which turned blue, and after drying reddish-violet, with iodine, and is probably intermediate between starch and mucilage.

Adulterations are not likely to be met with, at least not of the unpowdered mace. The mace of the wild nutmeg (M. fatua) is of a darker red color, less divided at the base, with more slender bands, and destitute of the grateful fragrance and taste of true mace.

Pharmaceutical Preparation.—Tinctura macidis. Digest 1 part of mace with 5 parts of alcohol, and filter.

Action and Uses.—The operation of mace appears to be the same as that of nutmeg, and there is reason to believe that an excessive dose of it may induce dangerous narcotism. It is used to impart an aromatic taste to medicines, but more commonly as a condiment for flavoring food and promoting its digestion.

MAGNESIA, *U. S., Br.*—Magnesia.

Magnesia usta, P. G.; *Magnesia calcinata.—Calcined magnesia*, E.; *Magnésie, Magnésie calcinée*, Fr.; *Gebrannte Magnesia*, G.

Formula MgO. Molecular weight 40.26.

Preparation.—Take of Magnesium Carbonate 4 ounces. Put it into a Cornish or Hessian crucible closed loosely by a lid, and expose it to a low red heat until a small quantity, taken from the centre of the crucible when it has cooled and dropped into diluted sulphuric acid, causes no effervescence.—*Br.*

The Br. Ph. recognizes two varieties of magnesia—the heavy as *Magnesia ponderosa*, made from the heavy magnesium carbonate by the process just given, and *Magnesia levis* or *light magnesia*, which is made in precisely the same manner from the light magnesium carbonate. In the United States both kinds are extensively used, but when the heavy variety is desired it is usually designated in prescriptions as *Magnesia ponderosa*, under which title it has been admitted into the present Pharmacopœia, while the light magnesia is designated as *Magnesia*. Nearly 9000 pounds of calcined magnesia were imported into the United States in 1876, and afterward about 20,000 pounds annually.

The official magnesium carbonate consists of magnesium carbonate and hydroxide. On heating it, water and carbon dioxide are given off and magnesium oxide remains behind; $4(MgCO_3).Mg(OH)_2.5H_2O$ yields $5MgO+4CO_2+6H_2O$. The magnesium carbonate is pressed somewhat firmly into a crucible, and this is placed in a suitable furnace, loosely covered with a lid to prevent the product from becomming contaminated with ashes and other impurities, and then heated to dull redness. The expulsion of the water and carbon dioxide keeps the surface of the powder continually in motion, and there is no necessity of testing it as long as that motion is kept up; when the motion ceases a small quantity of the powder is taken from beneath the surface and near the centre, mixed with sufficient water to displace the air, and then poured into an excess of dilute sulphuric acid. If no evolution of carbon dioxide takes place, the product is finished, and may be dipped out with a ladle, and the crucible filled with a fresh portion of magnesium carbonate without removing it from the furnace. Made by the process formerly recommended in the U. S. Pharmacopœia, a large and rather flat earthen vessel is used, to allow of the magnesia being stirred continuously, in which case the heat may be raised to full redness; but it should never be raised to that degree if the stirring is omitted, because the magnesia would become dense and granular, and with difficulty soluble in dilute acids. The yield is between 40 and 43 per cent. of the weight of the magnesium carbonate.

Properties.—The two varieties of magnesia have the same composition and chemical properties, and differ from each other only in the degree of aggregation of the molecules. Heavy magnesia is more readily miscible with water than the light kind, and, like

the latter, should remain suspended in the water for some time, and settle gradually. Should it subside very rapidly, the probability is that it was exposed to too high a degree of heat. It may be obtained from the light variety by triturating the latter for some time in the presence of strong alcohol, drying, and rubbing to powder. Magnesia is a white, very fine powder, without odor, and of an earthy, but destitute of a saline, taste. Exposed to a high heat, it becomes more compact, but does not fuse except before the oxyhydrogen blowpipe. According to Fresenius, it requires 55,000 parts of water for solution, but the liquid, like the moistened magnesia, has a distinct alkaline reaction. Its specific gravity varies between 2.3 and 3.3. When mixed with water it unites with it forming a hydroxide having the composition $Mg(OH)_2$, and when heated losing 31 per cent. of its weight. Exposed to the atmosphere, a similar change takes place, but carbon dioxide is also absorbed and a corresponding quantity of oxycarbonate is formed. It should therefore be preserved in well-stoppered bottles. "On stirring 1 part of magnesia with 15 parts of water in a breaker, and allowing the mixture to stand for about half an hour, it will form a gelatinous mass of sufficient firmness to prevent it from falling out when the glass is inverted."—*U. S.*

Tests.—"A filtered solution of magnesia in diluted sulphuric acid, mixed with ammonium chloride test-solution and an excess of ammonia-water, yields, with sodium phosphate test-solution, a white, crystalline precipitate. If a mixture of 0.2 Gm. of magnesia with 10 Cc. of water be heated to boiling, and, after cooling, 5 Cc. of the supernatant liquid be filtered off, this filtrate should not have more than a faintly alkaline reaction to litmus-paper, and, when evaporated to dryness, should not leave more than a very slight residue (limit of foreign soluble salts). The magnesia mixed with water remaining from the preceding test, when poured into 5 Cc. of acetic acid, should dissolve without the evolution of more than a few isolated gas-bubbles (limit of carbonate). This latter solution, when filtered, should not afford more than a slight opalescence with ammonium oxalate test-solution (limit of calcium), or with barium chloride test-solution (limit of sulphate), or, after the addition of a few drops of nitric acid, with silver nitrate test-solution (limit of chloride). If 0.4 Gm. of magnesia be dissolved in 10 Cc. of diluted hydrochloric acid, the solution should be colorless, and should not be affected by hydrogen sulphide test-solution, nor, after the addition of a slight excess of ammonia-water, should it be immediately affected by ammonium sulphide test-solution (absence of metallic impurities). If magnesia be exposed to a low red heat in a porcelain crucible, it should not lose more than 5 per cent. of its weight (limit of water of hydration)."—*U. S.*

Several proprietary articles consisting of heavy magnesia are occasionally met with; this magnesia is generally characterized by freedom from grittiness and ready miscibility with water, but is not superior to a dense magnesia obtainable by careful manipulation from a properly-prepared magnesium carbonate.

Magnesium.—The metal magnesium is widely distributed, but is less abundant than calcium; it is found as silicate in *meerschaum*, *olivine*, *mica*, *serpentine*, and other minerals; as chloride in sea-water and the waters of saline springs; and as carbonate in most spring and mineral waters, in *magnesite*, and in *dolomite* or magnesian limestone. Black (1755) first proved magnesia to be distinct from lime, and Davy (1808) isolated the metal, which is now generally prepared by modifications of the process elaborated by St. Claire-Deville and Caron (1856), by heating sodium with anhydrous magnesium chloride; the resulting sodium chloride is dissolved by water, and the magnesium left behind in the form of a gray powder, which is fused and moulded as desired. It is a silver-white metal, of a strong metallic lustre, malleable, fusing at a red and volatilizing at a white heat, but burning with a bright white light when held in the flame of a gasjet. Its density is only 1.78; it is not altered in dry air and but slightly tarnished in a damp atmosphere. *Soapstone* or *French chalk* is a double silicate of magnesium and aluminum.

Action and Uses.—The action of magnesia and of its carbonates consists partly in neutralizing the acid in the alimentary canal, and partly in rendering acid secretions, as the urine, either neutral or alkaline. If a sufficient quantity of acid exists in the stomach or is attracted thither by the magnesia, a neutral purgative salt is formed; but in default of such a combination the magnesia may pass into the intestine unchanged in part, and if it be taken habitually may accumulate there and form concretions large enough to obstruct the bowel (*Bull. et Mem. de la Soc. de Thérap.*, 1879, p. 77).

Magnesia has the advantage over other laxatives in being almost tasteless and in rarely causing nausea or colic. It produces feculent rather than watery stools, which are remarkable for their slight degree of fetor. It is slower than salines in its operation, but nearly as thorough. Its use is distinctly indicated in whatever condition is attended with

gastro-intestinal acidity, with *heartburn*, *sour eructations*, and *flatulence*. It has even arrested the *vomiting of pregnancy* when the liquid rejected was acid. Although it corrects gastric acidity, it does not remove the cause of that symptom, for which purpose aromatics and bitter tonics are usually required. It is ordinarily associated with rhubarb in the treatment of dyspeptic *diarrhœa*, especially in children, and is a very appropriate laxative in *hæmorrhoidal* cases attended with constipation. It is useful in the *aphthous* affections of the mouth which attend infantile diarrhœa. In *gout* and its allied disorders its antacid qualities render it appropriate; the following formula is commonly employed: R. Magnesii sulph. ℥j–ij; Aquæ menthæ virid. f℥x; Vin. colchici seminis, Syrup. simpl. āā f℥j; Magnesiæ ℥ij.—M. S.—From 1 to 3 tablespoonfuls every 2 hours until from four to six stools are produced in the 24 hours. In infantile *colic* the following carminative mixture is used: R. Magnesiæ gr. xxx; Tinct. asafœtidæ gtt. xl; Tinct. opii gtt. xx; Sacch. alb. gr. lx; Aquæ f℥j.—M. S.—20 drops and upward every hour until relief occurs. Magnesia is appropriate, as already stated, in cases of *uric acid gravel*, but is probably less so than the carbonates of sodium and potassium; but in such cases, when marked by gastric acidity, it should not be neglected. Like its carbonate, magnesia taken internally will sometimes entirely remove *warts*. Dujardin-Beaumetz has reported a striking example of the efficacy of this treatment (*Bull. de thérap.*, civ. 232).

As a purgative the *dose* of magnesia is about Gm. 3 (gr. xl) and Gm. 0.30 (gr. iv) for infants. As an antacid it may be taken in doses of Gm. 0.60 (gr. x) after meals, suspended in water. Mixture with milk, which is usual to disguise its taste, renders its operations slower.

The medicinal action and uses of Magnesia ponderosa are identical with those of magnesia.

MAGNESII CARBONAS, *U. S.*—Magnesium Carbonate.

Magnesiæ carbonas, *Magnesium carbonicum*, P. G.; *Magnesia alba*, *Magnesia hydrico-carbonica*, *Carbonicas magnesicus.*—*Carbonate of Magnesia*, E.; *Carbonate de magnésie*, *Magnésie blanche*, Fr.; *Magnesiumkarbonat*, *Weisse Magnesia*, G.

Formula $4(MgCO_3).Mg(OH)_2.5H_2O$. Molecular weight 484.62.

Preparation.—Take of Magnesium Sulphate 10 ounces; Sodium Carbonate 12 ounces; Boiling Distilled Water a sufficiency. Dissolve the magnesium sulphate and the sodium carbonate each in a pint of the water, mix the two solutions, and evaporate the whole to perfect dryness by means of a sand-bath. Digest the residue for half an hour with 2 pints of the water, and, having collected the insoluble matter on a calico filter, wash it repeatedly with distilled water until the washings cease to give a precipitate with barium chloride. Finally, dry the product at a temperature not exceeding 212° F.—*Br.*

This process yields *Magnesii carbonas ponderosa*, Br.; if the two solutions are mixed and then boiled for ten or fifteen minutes, but not evaporated, the precipitate will be more bulky, and after washing and drying constitutes the *Magnesii carbonas levis* or *light magnesium carbonate* of the British Pharmacopœia.

On mixing cold solutions of magnesium sulphate and sodium carbonate a white voluminous precipitate results, which in the course of several days is gradually converted into the compound $MgCO_3.3H_2O$, identical with that which often crystallizes from the effervescing solution of magnesia (see page 971); but when heat is applied carbon dioxide is given off, and the insoluble portion remaining is a hydrocarbonate, the composition of which varies somewhat, a larger amount of carbon dioxide being given off if the heat be continued; and the heavy magnesium carbonate obtained as described above has probably the formula determined by Berzelius, $3MgCO_3.Mg(OH)_2.3H_2O$; which compound on ignition would yield nearly 44 per cent. of magnesia, MgO, as required by the British Pharmacopœia. Light magnesium carbonate yields less (between 40.3 and 41.7 per cent.) magnesia, according to Otto and Laake. The formula $3MgCO_3.Mg(OH)_2.4H_2O$ requires 41.9 per cent. MgO. A compound of the composition $4MgCO_3.Mg(OH)_2.5H_2O$ would yield 41.3, and with an additional H_2O only 40 per cent. MgO. Magnesium carbonate may be obtained from the mother-liquors or bittern of salt-works, and is prepared on an extensive scale in England from magnesian limestone by treating it in the state of powder with cold water and carbon dioxide under a pressure of five or six atmospheres; magnesium bicarbonate is first dissolved, removed from the calcium salt, and by boiling converted into the official carbonate. The importation of magnesium carbonate into the United

States increased from 134,000 pounds in 1867 to 357,447 in 1878, but since that time has been less.

Properties.—Besides the slight difference in composition just referred to, the heavy and light magnesium carbonates differ only in the degree of aggregation of their molecules, the former being slightly glandular, the latter a smooth and less dense powder, both being inodorous and of a slight earthy taste. It is almost insoluble in water, requiring, according to Fyfe, 2500 parts of cold and 9000 parts of boiling water for solution, and when it is moistened with water and applied to turmeric-paper a brown color is gradually produced. When heated to dull redness water and carbon dioxide are given off, and magnesia remains. It dissolves with copious effervescence in dilute sulphuric, hydrochloric, and other acids, and the solutions have the chemical behavior of magnesium salts.

Tests.—Magnesium carbonate may be contaminated with calcium compounds, and from incomplete washing also with the acidulous radicals contained in the mother-liquor more particularly with chlorides, bromides, and sulphates. These impurities are detected by dissolving the carbonate in dilute nitric acid, and this solution should not be precipitated by silver nitrate (chloride and bromide) or barium nitrate (sulphate); neutralized with ammonia, it should not be precipitated by ammonium oxalate (calcium). On the addition of ammonia or ammonium carbonate a white precipitate is produced, which should be completely soluble in an excess of the precipitant and in ammonium chloride (an insoluble portion would indicate alumina), and the ammoniacal solution should not yield a white precipitate with hydrogen sulphide (zinc).

The following tests have been adopted by the United States and German Pharmacopœias: Distilled water, boiled with the salt, and after filtration evaporated to dryness, should not have more than a trace of a fixed residue. The salt should be soluble in diluted hydrochloric acid to a colorless liquid. A 2 per cent. solution of the salt prepared with the aid of acetic acid should not be affected by hydrogen sulphide (*P. G.*). Another portion of the 2 per cent. solution should not at once (within two minutes, *P. G.*) be rendered more than faintly opalescent by test-solution of barium nitrate (limit of sulphate) of silver nitrate (limit of chloride), or of ammonium oxalate (limit of calcium). "If 0.4 Gm. of the salt be dissolved in 5 Cc. of diluted hydrochloric acid, the solution should be colorless, and should not be affected by hydrogen sulphide test-solution, nor, after the addition of an excess of ammonia-water, should it be immediately affected by ammonium sulphide test-solution (absence of metallic impurities). 1.0 Gm. of the salt should leave, on ignition, not less than 0.4 Gm. of residue."—*U. S.*

Action and Uses.—The carbonate is less efficient than magnesia itself, but its action and uses are the same. It is said to remove *warts* from the skin, when taken night and morning in teaspoonful doses and continued for several weeks. Several important witnesses to the apparent truth of this statement might now be cited (*Phila. Med. Times*, xvii. 125), and to theirs we may add our own testimony.

Magnesium carbonate may be given as a laxative in doses of Gm. 2–8 (gr. xxx–cxx); as an an acid Gm. 0.30–1.30 (gr. v–xx) may be taken after meals. It may be agreeably administered in carbonic acid water.

MAGNESII CITRAS EFFERVESCENS, *U. S.*—Effervescent Magnesium Citrate.

Magnesium citricum effervescens, P. G.—*Limonade sèche au citrate de magnésie*, Fr.; *Brausemagnesia, Magnesium-citrat in Körnern*, G.

Preparation.—Magnesium Carbonate 10 Gm.; Citric Acid 46 Gm.; Sodium Bicarbonate 34 Gm.; Sugar in No. 60 powder, 8 Gm.; Alcohol, Distilled Water, each a sufficient quantity. Mix the magnesium carbonate intimately with 30 Gm. of citric acid, and 4 Cc. of distilled water, so as to make a thick paste; dry this at a temperature not exceeding 30° C. (86° F.), and reduce it to a fine powder. Then mix it intimately with the sugar, the sodium bicarbonate, and the remainder of the citric acid, previously reduced to a very fine powder. Dampen the mass with a sufficient quantity of alcohol, and rub it through a No. 6, tinned-iron sieve, to form a coarse granular powder. Lastly, dry it in a moderately warm place, and keep in well-closed bottles.—*U. S.*

To prepare 1 pound of effervescent magnesium citrate the following quantities should be used: Magnesium carbonate 714 grains; citric acid 7 av. ozs. and 223 grains; sodium bicarbonate 5 av. ozs. and 241 grains; sugar, in fine powder, 572 grains; 4 av. ozs. and 390 grains of the citric acid should be used together with 5 drachms of distilled water to form the thick paste of acid magnesium citrate.

The addition of alcohol to the mixed powder must be cautiously made, only sufficient being used to enable the operator to form a mass which will permit of being rubbed through the meshes of the sieve. The subsequent drying of the granules must also be conducted with care, as the use of too high a heat will cause effervescence to take place and thus spoil the granular condition of the salt.

All granular effervescent salts containing sugar are apt to become discolored if made by the process recommended by the British Pharmacopœia, unless the heat necessary be carefully controlled.

The formula of the German Pharmacopœia is like the preceding. The French Codex uses calcined magnesia 65, magnesium carbonate 60, citric acid 300, and sugar 600 parts.

The first step is the preparation at as low a temperature as possible of an acid magnesium citrate, a little less than one-half the citric acid ordered for this manipulation being sufficient for the formation of the normal salt. The remaining operation has for its object the incorporation with this salt of sodium bicarbonate and citric acid in such a manner as to avoid mutual decomposition, which is designed to take place only when the mixture is to be used and is stirred with water. Sieves of different degrees of fineness are usually used, so as to obtain granules nearly uniform in size.

Properties.—This preparation forms white granules or a white granular inodorous powder having an acid reaction and a pleasantly saline and mildly acidulous refreshing taste. On exposure to air it attracts moisture, resulting in the decomposition of the bicarbonate and the evolution of carbon dioxide, and afterwards becomes damp without, however, completely deliquescing. It is nearly insoluble, or rather only partly soluble, in alcohol, but dissolves slowly and with copious, long-continued but not vehement effervescence in 2 parts of water at 15° C. (59° F.); this solution is rarely perfectly clear, but usually is more or less opalescent from traces of impurities contained in the magnesium carbonate, and in the course of several days deposits crystals of magnesium citrate. Boiling water dissolves more rapidly a larger amount of the granules, and this solution separates on cooling a portion of the magnesium citrate in crystals. The total amount of citric acid ordered by the U. S. Pharmacopœia is somewhat in excess (about 3.28 Gm.) of that required for the production of normal salts; this renders the taste pleasantly acidulous and the solution more permanent. The aqueous solution shows the reactions of citric acid and of magnesium salts; on boiling with test solution of calcium chloride a white precipitate is produced, and the cold solution, on being rendered alkaline with ammonia-water, yields with test solution of sodium or ammonium phosphate a white precipitate which is readily soluble in acetic acid.

Tests.—"The saturated aqueous solution of the salt, when mixed with a saturated solution of potassium acetate and some acetic acid, should not yield a white crystalline precipitate (absence of tartrate)."—*U. S.* A solution of 1 Gm. of the granules, on being treated with ammonia-water and ammonium phosphate, should yield a precipitate, which, after having been thoroughly washed with diluted ammonia-water, then dried, and ignited in a porcelain crucible, should leave a white residue of magnesium pyrophosphate weighing not less than 1.22 Gm., showing the presence of at least 4.4 per cent. of MgO.

Uses.—In the *dose* of from Gm. 8–30 (gr- cxx–℥j) this compound forms an agreeable laxative in mild febrile disorders.

MAGNESII SULPHAS, *U. S., Br.*—Magnesium Sulphate.

Magnesiæ sulphas, Br.; *Magnesium sulfuricum*, P. G.; *Sal amarum*, *Sal Epsomense*, *Sal anglicum*, *Sal Sedlicense*, *Sulfas magnesicus.*—*Sulphate of magnesia*, *Epsom salt*, E.; *Sulfate de magnésie*, *Sel d'Epsom*, *Sel de Sedlitz*, *Sel amer*, Fr.; *Magnesiumsulfat*, *Bittersalz*, *Schwefelsaure Magnesia*, G.

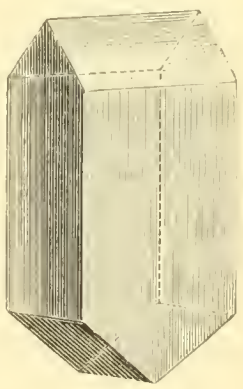
Formula $MgSO_4.7H_2O$. Molecular weight 245.84.

Origin and Preparation.—Magnesium sulphate is contained in sea-water and in the waters of many mineral springs, which thereby acquire a bitter taste. The *Crab Orchard salt* of Kentucky is the same salt in an impure state, and, as analyzed by J. T. Viley (1871), contains about 65 per cent. of magnesium sulphate after having been dried at 120°C. It probably results from the mutual decomposition of gypsum and magnesium limestone, and is obtained by evaporating the water which collects in wells dug in the ground. The pure salt is made on the large scale from *magnesite*, which is principally $MgCO_3$, by dissolving it in dilute sulphuric acid and crystallizing; large quantities of

the salt are made by various processes from magnesian limestone, and more recently it is extensively obtained at the Stassfurt salt-works, principally from the mineral *kieserite*, which is $MgSO_4$ combined with varying quantities of water, and in its natural state as insoluble as gypsum.

Properties.—As found in the market, magnesium sulphate has generally been purified by re-solution in water and rapid crystallization, and forms small rhombic prisms or needles, which resemble those of oxalic acid and zinc sulphate, are perfectly transparent, without odor, and have a cooling and bitter saline taste and a neutral reaction. It dissolves at 15° C. (59° F.) in one and a half times its weight of water, and in seven-tenths of its own weight of boiling water (*U. S.*); it is also soluble in diluted alcohol, but insoluble in strong alcohol. The German Pharmacopœia gives the solubility of crystallized magnesium sulphate as 1 part in 1.0 part of water at 15° C., and in 0.3 parts of boiling water; but a solution saturated at 15° C. contains for 100 parts of water, according to Mulder (1864), 69.29 parts; according to Gerlach (1859), 107.1 parts; and according to Michel and Krafft (1854), 108.44 parts; and at 100° C., according to Mulder, 151.29 parts of the crystallized salt. Exposed to air, the crystals slowly effloresce, becoming superficially opaque; when heated to 52° C. (125.6° F.) the salt loses 1 molecule (7.3 per cent.) of water, and is converted into a white powder. At about 132° C. (269.6° F.) it still retains 1 molecule of water, and at a temperature of 200°–238° C. (392°–460.4° F.) it is rendered anhydrous (*U. S.*); the total weight of water amounts to 51.34 per cent. The aqueous solution on the addition of barium chloride yields a white precipitate of barium sulphate insoluble in hydrochloric acid. It is not precipitated in the cold by potassium bicarbonate or ammonium carbonate, but gives white precipitates with the carbonates and the hydroxides of sodium and potassium, which are redissolved by ammonium chloride. Ammonia added to its solution likewise causes a white precipitate soluble in ammonium chloride, and this solution, on the addition of ammonium phosphate, deposits all magnesium in the form of a crystalline powder, which is magnesium and ammonium phosphate, $MgNH_4PO_4.6H_2O$, and is insoluble in diluted ammonia, sparingly soluble in water, and freely soluble in diluted acetic and other acids; the precipitate, after having been well washed with diluted ammonia, then dried, and ignited in a porcelain crucible, is converted into magnesium pyrophosphate, $Mg_2P_2O_7$ (mol. weight 222.24), which represents 21.86 per cent. Mg or 36.21 per cent. of MgO.

Fig. 179.



Crystal of Magnesium Sulphate.

Tests.—Impurities are detected in precisely the same manner as in the nitric acid solution of magnesium carbonate (see above). The following tests have been adopted by the U. S. P.: "When a small portion of the salt is introduced, on a clean platinum wire, into a non-luminous flame, it should not impart to the latter a persistent yellow color (limit of sodium). A 5 per cent. aqueous solution of the salt should not be affected by hydrogen sulphide test-solution (absence of metallic impurities); nor afford more than a slight opalescence with silver nitrate test-solution (limit of chloride); nor should 20 Cc. of the same solution afford any coloration or precipitate on the addition of 0.5 Cc. of potassium ferrocyanide test-solution (absence of iron, zinc, or copper). If 1 Gm. of the powdered salt be shaken with 3 Cc. of stannous chloride test-solution, a small piece of pure tin-foil added, and the test-tube then set aside, no coloration should appear within one hour (limit of arsenic)."

Magnesii sulphas effervescens, *Br. Add.*—Effervescent magnesium sulphate, Effervescent Epsom salt. Dry 10 parts of magnesium sulphate at about 54.4° C. (130° F.) until it has lost nearly one-fourth (23 per cent.) of its weight; powder the product, mix it with 2.1 parts of powdered sugar, then with 2.5 parts of citric and 3.8 parts of tartaric acid, both in fine powder, and finally add 7.2 parts of sodium bicarbonate. Place the mixture in a dish or pan heated to between 93.3° and 104.4° C. (200° and 220° F.), and when the particles of the powder begin to aggregate, stir them assiduously until they assume a granular form; then by means of suitable sieves separate the granules of uniform size and preserve them in well-closed bottles.

Magnesii sulphas exsiccatus, Magnesium sulfuricum siccum, *P. G.* The crystallized sulphate is exposed in a warm place until it has lost from 35 to 37 per cent. of its weight, and is then passed through a sieve. It is a white powder having the properties of the crystallized salt, except that it contains less water; on exposure to air it gradually attracts moisture, and should therefore be kept in well-stoppered bottles. The

German Pharmacopœia directs it to be dispensed when powdered magnesium sulphate is prescribed.

Magnesii lactas, Magnesium lactate, $Mg(C_3H_5O_3)_2.3H_2O$; mol. weight 255.76. 6 parts of calcium lactate (see page 71) and 5 parts of magnesium sulphate are separately dissolved in hot water, the solutions mixed and filtered from the precipitated calcium sulphate, the last traces of which are removed by digesting with a little magnesium carbonate; the filtrate is then evaporated and crystallized. Magnesium lactate may also be conveniently prepared by adding an excess of magnesium carbonate to lactic acid diluted with water, filtering and evaporating the solution to dryness on a water-bath. The salt forms white granular crystals or needles, is insoluble in alcohol, soluble in about 30 parts of cold and 6 parts of boiling water, and when heated is decomposed without melting. Its solution in water is not precipitated by barium nitrate, ammonium carbonate, or ammonium sulphide.

Magnesii sulphis, Magnesium sulphite, $MgSO_3.6H_2O$; mol. weight 211.87. Sulphur dioxide in excess is passed through a mixture of magnesium carbonate and water, or a solution of sulphurous acid is added to an aqueous suspension of magnesia; the mixture is filtered and the solution carefully concentrated. The salt occurs as a white crystalline inodorous powder, is insoluble in alcohol, but soluble in 20 parts of water at 15° C. (59° F.); at about 200° C. (392° F.) it softens, and parts with its water of crystallization, and at a higher heat is converted into magnesia and anhydrous magnesium sulphate. The aqueous solution shows with alkali carbonates and phosphates the same behavior as the sulphate.

Action and Uses.—Magnesium sulphate, dissolved in a large quantity of water and taken on an empty stomach, is very prompt in its operation, producing copious watery dejections and generally diuresis. Indeed, if the skin be kept cool the latter mode of operation may exceed the purgative effect, particularly if the dose be not large. Delicate persons, especially in cool weather, are apt to feel chilly and weak during its operation. This refrigerant influence renders it appropriate in warm weather and in febrile affections. If the dose be excessive and largely diluted, hypercatharsis may occur. On the other hand, large doses not thus diluted have sometimes occasioned an alarming sedation, with pallor, debility, coldness, and even syncope, although no purgation whatever occurred. In at least one case, that of a boy ten years old, death resulted. These effects, according to the dose and degree of dilution with water, are more or less produced by all saline cathartics. There is good reason for believing that this preparation, like other saline cathartics, purges by causing a profuse transudation into the intestine of the watery constituents of the blood. According to Rutherford, magnesium sulphate has no cholagogue action. Iaworski finds that a solution of sodium sulphate is much more rapidly absorbed from the stomach than one of magnesium sulphate (*Bull. de Thérap.* cvi. 228).

When properly administered it is nearly always a safe and harmless purgative; indeed, it is generally used without medical advice by persons affected with *constipation*, slight *febrile attacks*, etc. It is highly objectionable when habitually employed for the former purpose in a full purgative dose, for it soon ceases to act purgatively and confirms the evil it was used to cure. It is also one of the least eligible cathartics in cold weather. On the other hand, if used in small doses largely diluted, as 1 drachm in ½ a pint of water, it may be continued for a long time without sensibly diminishing in activity. As an antiphlogistic purgative at the commencement of *fevers*, especially of malarial fevers, it is justly esteemed, whether or not it is preceded by a dose of 8 or 10 grains of calomel, which many think essential to the result. In *typhoid fever* there is much reason to believe that a gentle purgative action maintained during the first week of the attack by this medicine tends to moderate the fever, mitigate the special typhoid phenomena of the disease, and lessen the danger of intestinal perforation. Tait and others have employed this saline to prevent *septic fever* (*Med. Record*, xxxi. 629). In acute *dysentery* of a sthenic type saline laxatives, and this one among the number, have a decided influence in lessening the tormina, tenesmus, and bloody and mucous stools, and reducing the febrile action. But to be efficient its administration ought to commence as early as possible in the attack and before ulcers form in the rectum. In both of the last-mentioned affections an ounce of the salt may be dissolved in a pint of water, and a wineglassful of the solution administered every two or three hours. When this treatment has been pursued for twenty-four or forty-eight hours it should be suspended for about twelve hours, and then resumed. The use of a saturated solution of the salt has also been advocated (Leahy, *Lancet*, Oct. 1890, p. 711). In various *inflammations*,

serous and parenchymatous, it was formerly the custom to administer Epsom salt in small doses, largely diluted, with the addition of half a grain of tartar emetic to each pint of the solution, which was given in wineglassful doses at intervals of three hours. The method, temporarily supplanted by the use of medicines which reduce the pulse-rate and temperature without providing any outlet for the effete products of morbid action, has been revived in the case of *pleurisy* with effusion (*Practitioner*, xli. 368).

In all cases of *intestinal obstruction* not clearly due to organic causes the use of this or some similar medicine should have a fair trial, care being taken to employ a weak solution and to administer it in moderate doses at proper intervals. In *painter's colic* magnesium sulphate, with the addition of sulphuric acid, has been regarded as a specific for the disease, but erroneously.

From Gm. 16–32 (℥ss–j) of Epsom salt dissolved in Gm. 250 half a pint of water is a full purgative dose, but even a less proportion of salt and a larger proportion of water will produce nearly an equal effect. Its taste may be partially disguised by aromatic sulphuric acid in the proportion of half a fluidrachm to the half pint of liquid. The addition to the saline solution of a little strong coffee helps to mask its nauseous flavor. It is frequently given in an infusion of senna when a prompt and vigorous operation is required. This mixture forms the basis of the so-called "black draught."

MAGNOLIA.—Magnolia-bark.

Écorce de magnolier, Fr.; *Magnolienrinde*, G.; *Corteza de laurel-tulipan*, Sp.

The bark of different species of Magnolia.

Nat. Ord.—Magnoliaceæ, Magnolieæ.

Origin.—Two of the species indigenous to the United States are evergreen in Southern localities. M. glauca, *Linné*, which is known as *sweet bay*, *white bay*, *beaver tree*, or *swamp sassafras*, grows in swampy localities near the coast eastward to Massachusetts, and has oval-oblong leaves, which are white, glaucous beneath, and may be used for marking by placing the white surface upon the fabric and writing with some pressure upon the upper surface; the roots yield a yellow dye. M. grandiflora, *Linné*, grows from South Carolina westward, and has the obovate-oblong leaves, rusty pubescent beneath. Both species have large white and fragrant flowers.

Of the deciduous-leaved species, M. macrophylla, *Michaux*, has the flowers white, and at the base purple; M. acuminata, *Linné*, is called *cucumber tree*, from the appearance of the young fruit; it has light bluish-green flowers tinged with yellow; and M. Umbrella, *Lamarck*, *umbrella tree*, so called from the large leaves appearing whorled at the ends of the branches, has white flowers. The last two species are found in mountainous districts of the Southern States, and northward to Illinois and New York, the latter to Southern Pennsylvania.

The magnolias produce their flowers in May and June; they have a white or greenish calyx of three sepals, many stamens with short filaments, and many ovaries collected on an elongated receptacle, forming a cone-like aggregation of fruits which open at maturity, the berry-like seeds being suspended by a thread-like funiculus.

Description.—The bark necessarily varies as obtained from the different species. The young bark of M. glauca is light orange-brown, glossy, with some gray spots, and underneath the thin corky layer of a green color. The bark of the larger branches is nearly smooth, externally of a light-gray or whitish color, marked with scattered warts and some longitudinal cracks. Older bark has the warts somewhat confluent and the cracks deepened into fissures. The inner surface is whitish, or, after drying, yellowish or pale-brownish, smooth, and very finely and closely striate. The bark of the other species is thicker, of a pale-brown underneath the ash-gray outer layer, and has a thick liber with rather tough bast-fibres. Magnolia-bark breaks in the outer layer with a smooth fracture, and with a more or less fibrous fracture in the bast-layer, and exhibits upon the light-brownish transverse section rather broad wedges of the bast and medullary rays. The dried bark has scarcely any odor, but its taste is warm, spicy, somewhat astringent, and bitter, particularly in the young bark.

Constituents.—The bark of Magnolia grandiflora was examined by Stephen Procter (1842), who found in it a little volatile oil, resin, and a crystalline principle resembling liriodendrin. The bark of M. glauca was investigated by W. D. Harrison (1862), and by Lloyd (1886), the latter showing the presence of three resins separable by a solvent; of a crystalline glucoside, soluble in alcohol and ether; and a crystalline tasteless

compound, soluble in alcohol, chloroform, ether, and alkalies, the solutions showing a blue fluorescence. Crystalline compounds were obtained from the leaves by W. F. Rawlins (1889), but were not further examined. By treating the alcoholic extract of the fruit of M. Umbrella with hot petroleum benzin, Wallace Procter (1872) obtained colorless crystals of *magnolin*, which are soluble in alkalies, alcohol, ether, chloroform, carbon disulphide, and fixed oils, but sparingly so in boiling water, in which they fuse; the solutions have an irritating taste. The crystals are colored red by sulphuric acid and brown by nitric acid. The pungent taste of the fruit is due to a soft resin and the odor to a little volatile oil.

Allied Plants.—Talauma mexicana, *Don*, the *yoloxochitl* of Mexico, has properties analogous to those of magnolia. The white fragrant flowers contain quercitrin, and are regarded as tonic and antispasmodic, while the bark is employed as an antiperiodic.

Liriodendron Tulipifera, *Linné;* Tulip tree, white poplar, yellow poplar, whitewood, *E.;* Tulipier, *Fr.:* Tulpenbaum, *G.*—It grows from Vermont to Wisconsin, and southward to the Gulf of Mexico; also in Western China; has broad, three-lobed, and emarginately truncate leaves, and in May produces tulip-shaped, greenish-yellow flowers striped with orange-red. The bark is collected from the branches and also from the trunk. The branch-bark is brown-gray or blackish-gray to purplish-brown, and marked with numerous small warts, their shallow scars or confluent lines forming more or less regular elongated meshes, which become longitudinally cleft in the older bark. The fissured, gray, corky layer, removed from the trunk-bark, leaves the liber, which has a pale-yellowish color and a smooth very finely and closely striate inner surface. The fracture is short, in old bark fibrous, and shows broad wedges of medullary rays and in the inner layers tangential rows of bast-fibres. The root-bark has a darker color. The bark is almost inodorous; the taste is somewhat pungently aromatic, bitter, and slightly astringent. When long kept the bark is said to become insipid; bark collected by us, and kept in a dry place for fifteen years without special precaution, has still the characteristic taste in a marked degree. The bitter and pungent principle is the *liriodendrin* of Prof. Emmet (1831), which he obtained crystallized by concentrating the alcoholic tincture, adding water until a permanent turbidity commenced to appear, and evaporating spontaneously. It forms white needles or small scales, a portion remaining amorphous, is insoluble in water, soluble in alcohol and ether, fusible at about 82° C. (180° F.), and volatilizes, partly undecomposed, near 132° C. (270° F.). Wallace Procter (1872) obtained it from the alcoholic extract with petroleum benzin in transparent yellowish globules of a persistently bitter and acrid taste. Lloyd (1886) determined the presence of a little volatile oil, brown resin, bitter extractive, and *tulipiferin*, which is colored yellow by sulphuric acid, changing to red.

Calycanthus, *Ord.* Calycanthaceæ.—The three species, C. floridus, *Linné*, C. lævigatus and C. glaucus, *Willdenow*, are indigenous to North America from Virginia and Carolina southward and westward, are frequently cultivated for ornament, and, owing to their pungent aromatic properties, are known as *Carolina allspice* or *sweet-scented shrub*. The dark-purple flowers have a strawberry-like odor. C. occidentalis, *Hooker et Arnott*, is known in California as *spice-bush*. The fruit of these plants resembles a rose-hip, but is dry when ripe, and consists of the closed calyx-tube enclosing several akenes, about 8 Mm. (⅓ inch) long. Müller (1831) found the bark to contain volatile oil, resin, acrid principle, tannin, etc. Dr. Eccles (1888) showed the akenes to contain a fixed oil, starch, albumin, and *calycanthine*, a crystalline alkaloid, slightly soluble in water, freely soluble in ether and chloroform, the salts very soluble in water, colored green by strong nitric acid. H. W. Wiley (1889) obtained 47 per cent. of oil and 4.25 per cent. of calycanthine from the embryo, while the integuments of the akenes yielded .83 per cent. of amorphous alkaloid with traces of calycanthine.

Action and Uses.—The bark of the several medicinal species of magnolia is bitter and aromatic without astringency. Like numerous other plants of similar qualities, it has been used in hot decoction to produce diaphoresis in *fevers*, bronchial *catarrhs*, *rheumatism*, and *gout*, and in cold decoction or tincture as a tonic. The tree is said to render clear the waters near which it grows, and to prevent malarial affections. The preparations of the bark spoken of above are used in the cure of intermittent fevers. The *dose* of the recently-dried bark in powder is stated to be from Gm. 2 to 4 (gr. xxx–lx), frequently repeated. The infusion or decoction is less eligible than the tincture, which is not, however, officinal.

Tulip poplar, used as a domestic tonic by the country people, was first introduced into medicine as a tonic by Dr. Benjamin Rush, who ascribed to it only the virtues of a simple bitter. Like other bitters, it has had some repute as a vermifuge and as an antiperiodic, and in warm infusion as a diuretic and sudorific. The *dose* of the powder is Gm. 4 to 8 (ʒj–ij). An infusion or decoction may be prepared with Gm. 32 in Gm. 500, and given in the dose of Gm. 64 (fʒij). A saturated tincture may be prescribed in the dose of a Gm. 4 (fʒj). According to Dr. Bartholow, the hydrochlorate of the alkaloid tulipiferin in the dose of one-eighth of a grain affects frogs, and one grain rabbits. "It causes paresis, muscular trembling, convulsions, partly clonic, partly tonic in character,

heightened cutaneous and ocular reflexes, followed by stupor, increasing paralysis, and finally complete suspension of motility and sensibility." In frogs the heart appeared to be the last organ to die; it seemed to lessen the irritability of the motor and sensory nerves, and in warm-blooded animals to induce a soporose state deepening into coma (*Amer. Jour. Med. Sci.*, Oct. 1886, p. 524).

Calycanthus glaucus has been used in a decoction of the root, leaves, and bark as a remedy for *intermittent fever*. The seeds are said to be poisonous to cattle. An alkaloid, it is stated, has been separated from the seed, but its medicinal properties, if any, have not been determined.

MALTUM, *P. A.*—Malt.

Maltum hordei.—Barley malt, E.; *Malt d'orge, Drêche*, Fr.; *Malz, Gerstenmalz*, G.

The seed of Hordeum distichum, *Linné* (Nat. Ord. Graminaceæ), caused to enter the incipient stage of germination by artificial means, and dried.

Preparation and Properties.—Different kinds of grain may be employed for the preparation of malt, but the kind most generally used is barley. The grain is soaked in water, and then placed in heaps; heat is spontaneously generated, and by occasional turning prevented from rising too high. Under these conditions germination takes place, and when the germ has acquired the desired length the grain is rapidly dried, and constitutes *malt*. According to the degree of heat employed in drying the color of the malt varies somewhat, and is known as either *pale, pale amber, amber*, or *amber-brown*. For some purposes malt is made to undergo a roasting process in revolving cylinders, to obtain *roasted* or *black* malt if the integuments are of a dark-brown color, or *crystallized* malt if the interior of the grain has become dark-brown. Malt has an agreeable odor and a sweet taste, and yields with water a more or less deep yellowish-brown or brown infusion. Only pale or pale amber-colored malt is employed medicinally.

Constituents.—The chemical changes taking place in germinating grain and sprouting potatoes were explained by Payen and Persoz (1833), who discovered a peculiar ferment, *diastase*, which exists in the vicinity of the embryo, but not in the radicle of the germ; on making an infusion of fresh malt, precipitating salts and some proteids with a little alcohol, and then adding more alcohol, diastase in an approximately pure condition is precipitated, but, according to Dubrunfaut (1868), is a mixture which contains the true fermentative principle, *maltin*. The remaining constituents of malt are those of barley, with the exception of *dextrin* (see pp. 203 and 817) and *sugar*, which have been formed from a portion of the starch, the remainder of which, still present in the malt, is likewise converted into the same compounds by the process of *mashing*, which consists in preparing an infusion of ground malt, called *wort*, and keeping it at a temperature of about 70° C. (158° F.).

During the process of malting good barley increases about 9 per cent. in volume, but loses about 20 per cent. in weight, and good malt should yield to water soluble principles amounting to two-thirds of its weight. Diastase has the property of converting starch into dextrin and sugar, and in this respect resembles *ptyalin*, a ferment met with in the salivary glands of animals. Contaret (1870) regards the two ferments as being identical.

Action and Uses.—Liquid and semiliquid extracts of malt were much used a few years ago in Germany, where they were first introduced, as tonic and nutritious substitutes for malt liquors. Thence they were diffused to every part of the world, until their local manufacture displaced the imported preparations, and both were superseded by some later fashionable medicine. Although their mode of action is by no means clear, in many cases they were found quite beneficial in states of chronic debility and *dyspepsia* due to organic disease or infirmity or to mere nervous exhaustion, but seldom more, and often less, than good malt liquors into the composition of which hops enter. Malt appears to be especially adapted to promote the digestion of amylaceous food by hastening its conversion into dextrin and glucose, and preventing the fermentation which would otherwise take place, and which would arrest or impair digestion. The semiliquid preparation, which is a true extract of malt, is very difficult to take, owing to its tenacious and adhesive qualities, and is generally prescribed in teaspoonful doses mixed with soup, wine, beer, or milk. It should be used at the beginning of or during a meal. Malt preparations are of use in tubercular *phthisis* and other wasting diseases, only because they enable the digestive organs to assimilate more food than it would otherwise be possible to digest, whether this be supplied by the malt itself or by other nutritious articles, the digestion of which it promotes.

An infusion of malt made with cold water is an energetic diastatic agent. The following directions may be followed in its preparation: "3 ounces (or heaped tablespoonfuls) of crushed malt are thoroughly well mixed in a suitable vessel with ½ pint of cold water. The mixture is allowed to stand over night—that is to say, for twelve or fifteen hours. It is then filtered through paper until it becomes perfectly bright. The above quantities yield about 7 ounces of product of a sherry-brown color and a faint sweetish taste. It is nearly neutral, and its sp. gr. about 1.025. Its chief solid constituent is maltose, and is rich in diastase. . . . . It is very prone to fermentation, and ought to be prepared fresh every day" (Roberts, *Practitioner*, xxiii. 405). A tablespoonful of this liquid, added to ½ pint of gruel prepared from wheat or other flour, or from oatmeal, groats, pearl-barley, arrow-root, or another farina, and at a temperature not too high for being eaten, will immediately transform the starchy ingredients of the mixture into sugar and dextrin. In this manner a food may be formed which will save or prolong the life of patients affected with tubercle, marasmus, or any *wasting disease* in which all other forms of nutriment are either vomited or passed by stool. Above all, it is valuable in the treatment of two of the most fatal diseases of infancy—*cholera infantum* and *summer diarrhœa*.

It appears that in Japan malt (*midzu ame*) has long been used for similar purposes (Eldridge, *Med. News*, xliv. 114).

MANGANI DIOXIDUM, *U. S.*—Manganese Dioxide.

Mangani oxidum nigrum, *U. S.* 1880; *Manganesii oxidum nigrum*, Br.; *Manganum hyperoxydatum, Oxidum manganicum, Magnesia vitriariorum.—Manganese peroxide, Black Oxide of Manganese, Pyrolusite*, E.; *Oxyde (Peroxyde) de manganèse*, Fr.; *Braunstein Mangansuperoxyd*, G.

Native, crude manganese dioxide containing at least 66 per. cent. of the pure dioxide (Formula MnO_2. Molecular weight 86.72).

Origin.—Pyrolusite.—or, as it is commercially called, *black manganese* or *manganese*—is found in different parts of Germany, France, Spain, and Great Britain, and also in Nova Scotia, Vermont, Pennsylvania, and other parts of North America. Sometimes it is found nearly pure, but it is generally associated with other manganic ores, particularly with the inferior brown *manganite*, and often with iron, lime, baryta, silica, etc. It may also be obtained artificially by carefully fusing manganous carbonate with potassium chlorate and washing the mass, or, according to Walter Weldon (1867), by exposing a mixture of manganous hydroxide and lime to the air at a temperature of about 55° C. (131° F.). The average importation of ore and manganese oxide into the United States for the eight years ending 1880 was nearly 1,700,000 pounds annually.

Properties.—It is amorphous, and is then of a dull gray-black color, or in masses composed of tabular, fibrous, or radiating crystals having a bright metallic lustre and yielding a black or grayish-black, somewhat gritty, tasteless powder. Its specific gravity is 4.7 to 4.94. It is insoluble in water and in all simple solvents, as well as in weak acids; it dissolves in hot hydrochloric acid to manganous chloride, while chlorine is given off; $MnO_2 + 4HCl$ yields $MnCl_2 + 2H_2O + Cl_2$. When it is treated with diluted sulphuric acid in the presence of oxalic acid, the latter is oxidized to carbon dioxide, manganous sulphate being dissolved; $MnO_2 + H_2SO_4 + H_2C_2O_4$ yields $2CO_2 + MnSO_4 + 2H_2O$. When heated to redness the black oxide parts with a portion of its oxygen, leaving brown manganic oxide, Mn_2O_3, or at a bright-red heat red manganoso-manganic oxide, $MnO.Mn_2O_3$; and when mixed with potassa and potassium chlorate and heated to dull redness, a black-green mass of potassium manganate is obtained, which yields with cold water a deep-green solution, the color changing to purple on the addition of an acid or on boiling, potassium permanganate being produced.

Valuation.—The value of black manganese oxide for the production of chlorine, may be determined in various ways, either by ascertaining directly the loss in weight occasioned by the evolution of carbon dioxide in the reaction just described, when the weight of $2CO_2$ (87.78) will indicate 1 molecule of MnO_2 (86.72), or after the reaction has been completed the excess of the oxalic acid added is estimated by a standardized solution of potassium permanganate, which is added until it ceases to be decolorized. The generation of chlorine and its oxidizing effect upon ferrous salts are utilized for the same purpose in the following manner: 5 Gm. of the finely-powdered oxide are mixed in a flask with about 15 Gm. of water and 35 Gm. of strong hydrochloric acid; 32.3 Gm. of pure granular ferrous sulphate are likewise weighed out and added, at first in larger, afterward in smaller,

portions, until, after some digestion, the odor of chlorine has entirely disappeared and a drop of the liquid is colored blue by potassium ferricyanide from the excess of ferrous salt. If the oxide was pure MnO_2 it would require 32.3 Gm. of ferrous sulphate; from the exact quantity of the latter used the percentage of the former is easily calculated. The Pharmacopœia requires black manganese to contain at least 66 per cent. of MnO_2, and if of this strength the above quantity, after the addition of 21.3 Gm., will give no blue reaction with the ferricyanide. This is the process of assay adopted by the Pharmacopœia, the quantities directed being black oxide of manganese 1 Gm., water 5 Gm., hydrochloric acid 5 Cc., and ferrous sulphate 4.22 Gm. The 32.3 Gm. of the ferrous sulphate may also be added at once, and after the completion of the reaction its excess ascertained by standardized potassium permanganate.

Impurities.—"If a portion of the dioxide be strongly heated in a dry test-tube, no combustion should ensue, nor should carbon dioxide be evolved (absence of organic impurities.) If to another portion of the dioxide, contained in a test-tube, a small quantity of diluted hydrochloric acid be added, no odor of hydrogen sulphide should be developed, nor should a strip of paper, moistened with lead acetate test-solution and suspended over the mixture, become blackened (absence of metallic sulphides). After the mixture of the dioxide with hydrochloric acid has been raised to boiling and filtered, the filtered liquid should not afford, with hydrogen sulphide test-solution, an orange-colored precipitate (absence of antimony sulphide)."—*U. S.*

Composition.—Manganese dioxide consists of 63.19 per cent. of manganum and 36.81 per cent. of oxygen.

The metal *manganum*, *manganium* or *manganesium* was first isolated by Gahn (1774) after Pott, Scheele, Bergmann, and others had shown black manganese to be free from iron; it may be obtained by reducing one of its oxides with carbon at a very high temperature. It resembles iron, but is harder, more brittle, and has a lighter or darker, sometimes a reddish, tint; its specific gravity is 7.13–7.21 (Brunner), and it melts at a white heat. Besides the oxygen compounds mentioned above it unites with this element also in several other proportions. *Manganous oxide*, MnO, is a grayish-green powder which readily oxidizes in contact with the air. *Manganic acid*, H_2MnO_4, is not known in the free state, but only in the form of salts, which have a green color. *Manganic heptoxide*, Mn_2O_7, is a heavy, dark red-brown, oily liquid which detonates violently when heated to between 30° and 40° C. (86° and 104° F.). *Permanganic acid*, $H_2Mn_2O_8$, is a deep violet-colored liquid which is a powerful oxidizing agent. (See Potassium Permanganate.)

Uses.—Manganese dioxide is used for the preparation of oxygen and largely in the manufacture of chlorine, and the solution obtained in this process may be employed for preparing other compounds of manganum.

Action and Uses.—Black oxide of manganese was introduced into medicine when its chemical affinities were found to be nearly analogous to those of iron. But the chemical ground of judgment proved, as it usually does in therapeutics, a fallacious one, and none of the curative effects anticipated were secured. The experiments of Cahn (*Arch. f. exper. Pathol. u. Phar.*, xviii. 129) led him to conclude that when manganese is thrown into the circulation it is not appropriated by the red corpuscles; that when introduced into parenchymatous organs it is absorbed, and the greater part excreted into the intestine to be discharged with the fæces; and that it is not absorbed from the sound gastro-intestinal mucous membrane in appreciable quantity. The black oxide has been substituted by some practitioners for the permanganate on account of the irritant operation of the latter (*Med. News*, liv. 367, 516). It has been employed in the treatment of morbid sensibility of the stomach—an affection which was doubtless, in some cases, *gastralgia*, and in others *simple ulcer*. When it was of service in such cases it probably acted as bismuth subcarbonate or subnitrate acts, by furnishing an inert and insoluble coating to the part. It was given in the *dose* of Gm. 0.30–3 (gr. v–xl).

MANGANI SULPHAS, *U. S.*—Manganese Sulphate.

Manganesii sulphas, *Manganum sulfuricum*, *Sulfas manganosus*.—*Manganous sulphate*, E.; *Sulfate de manganèse*, *Sulfate manganeux*, Fr.; *Manganosulfat*, *Schwefelsaures Manganoxydul*, G.

Formula $MnSO_4.4H_2O$. Molecular weight 222.46.

Preparation.—Manganese dioxide is mixed with sufficient strong sulphuric acid to obtain a thin magma, which is heated to boiling and evaporated to dryness; the mass is now heated in a crucible to dull redness for some time for the purpose of decom-

posing the iron sulphate. When cool it is treated with water, and the solution, if iron be still present, digested with manganous carbonate, then filtered, and evaporated to crystallize.

Properties.—When crystallized below 6° C. (43° F.) the salt contains $7H_2O$, and is isomorphous with ferrous sulphate; above that temperature and below 20° C. (68° F.) it contains only $5H_2O$ and has the form of copper sulphate. But the salt usually met with is crystallized between 20° and 30° C. (86° F.), and forms right rhombic—or, according to Marignac, monoclinic—prisms, containing $4H_2O$, three of which are given off at a temperature of 115° C. (239° F.). A salt of the same composition as this residue is also obtained by adding sulphuric acid to a solution of manganous sulphate and evaporating; it forms a granular powder. The crystals of the official salt are transparent and colorless, or more frequently of a pale rose-red color, slightly efflorescent in a dry atmosphere, insoluble in strong alcohol, but dissolve at 15° C. (59° F.) in 150 parts of 60 per cent., in 50 parts of 50 per cent., and in 2 parts of 10 per cent., alcohol. The salt requires at 15° C. (59° F.) 0.8 (U. S.), 1.06 parts (Mulder) of water, and 1.08 (U. S.) 1.28 (Mulder) parts of boiling water; at 55° C. (131° F.) 0.9 part of water is required. The solution has a styptic and slightly bitter taste, a neutral or faintly acid reaction, and yields with ammonium sulphide a flesh-colored precipitate, with ferrocyanide a white one, and with ferricyanide a grayish-brown one, but is not disturbed by tannic acid. The fixed alkalies and alkali carbonates produce white precipitates, which on exposure to air are rapidly oxidized, turning brown. Barium chloride yields an insoluble white precipitate. If a fragment of the salt be mixed with a little sodium hydroxide test-solution, and the mixture then dried and fused, it will yield a dark-green mass, dissolving in water with a green color.

Tests.—The most common impurity likely to be met with is sulphate of iron, the presence of which would be indicated by the blue-black color produced with solution of tannin or by the more or less deep-blue color of the precipitate with potassium ferrocyanide. Sulphate of copper would in the slightly acidulated solution produce a black precipitate with hydrogen sulphide. The precipitate with ammonium sulphide should be completely soluble in acetic acid, proving the absence of zinc salt. The sulphates of magnesium and the fixed alkalies are indicated by the residue left after precipitating the solution completely with ammonium sulphide or carbonate, evaporating the filtrate to dryness, and igniting. When heated to dull redness the salt should lose not more than 32.4 per cent. of its weight (proper (official) amount of water of crystallization).

Other Compounds.—MANGANI CARBONAS. Manganese carbonate is prepared by precipitating in the presence of a little syrup a solution of manganous sulphate with sodium carbonate, washing the precipitate well, and drying it rapidly with a moderate heat. It is a white powder having a brownish tinge and dissolving in carbonic acid water, leaving only a slight residue of brown manganic oxide.

MANGANI CHLORIDUM. Manganese chloride is most economically obtained when preparing chlorine from black oxide of manganese and hydrochloric acid; the resulting liquid is digested with manganese carbonate until the iron has been completely precipitated; the filtrate is evaporated, crystallized, and by recrystallization purified from calcium chloride if present. The salt is in granular, or when slowly evaporated in tabular, crystals of a pale rose-red color, and has the composition $MnCl_2.4H_2O$ (mol. weight 197.38). It is soluble in alcohol, and requires at ordinary temperature about $2\frac{1}{2}$ parts of water for solution.

MANGANI IODIDUM. Manganese iodide is a very deliquescent salt, and is best administered in the form of *syrup*, which may be prepared by dissolving manganese carbonate in hydriodic acid, or by the following formula proposed by Prof. Procter (1850): Take of manganese sulphate 16 drachms; potassium iodide 19 drachms; sugar, water, each sufficient. Dissolve each of the salts in 3 fluidounces of water containing 2 drachms of syrup; mix, and after precipitation filter the solution into a bottle containing 12 ounces of sugar; add water to make a pint, and shake the bottle till the sugar is dissolved. Each fluidounce contains 1 drachm of manganese iodide; it may be given in doses of 10 drops to $\frac{1}{2}$ fluidrachm.

The same author has also proposed a *syrup of the iodides of iron and manganese*, to be prepared as follows: Take of potassium iodide 1000 grains; ferrous sulphate 630 grains; manganese sulphate 210 grains; clean iron filings 100 grains; powdered sugar 4800 grains; distilled water sufficient. Rub the sulphates and iodide separately to powder, mix with the iron filings, add $\frac{1}{2}$ fluidounce of water, and rub to a uniform paste; add the same quantity of water a second and a third time at intervals of fifteen minutes, and rub. Place the sugar in a bottle, and drain the dense solution into it through a filter, adding water slowly to the magma, until the solution of the iodides is displaced and the liquid measures 12 fluidounces. Lastly, agitate the bottle till the sugar is dissolved. Each fluidounce contains 50 grains of the iodides in the proportion of 3 parts of ferrous iodide to 1 of manganous iodide. The dose is the same as the preceding. Both syrups contain some potassium sulphate.

Mangani lactas. Manganese lactate is formed by adding manganese carbonate to hot lactic acid; on evaporating the filtrate the salt is obtained in pale rose-red shining crystals, which contain 19 per cent. of water of crystallization, are soluble in 12 parts of cold water, and dissolve likewise in hot alcohol, crystallizing again on cooling.

Mangani phosphas. Manganese phosphate is obtained by precipitating 10 parts of manganese sulphate with 11 parts or sufficient of sodium phosphate, each separately dissolved in about 80 parts of water, washing the precipitate well to remove the sodium sulphate, and drying. It is a white crystalline powder, sometimes with a reddish tint, having the composition $Mn_3(PO_4)_2.4H_2O$, and dissolving readily in dilute acids. A syrup has been recommended by T. S. Wiegand (1854): the salt may be dissolved in dilute hydrochloric, or, better still, in phosphoric acid, and sufficient sugar dissolved in the cold solution.

Mangani tannas. Manganese tannate was recommended by Marletta (1865). It is obtained by adding recently-precipitated manganese carbonate to a hot solution of tannic acid in distilled water until it ceases to dissolve, filtering, and evaporating to dryness. The carbonate must be absolutely free from iron, and the solution must be protected from contact with iron, otherwise it will acquire an inky color. The salt is soluble in water, and when prescribed in solution syrup or glycerin should be added for preservation.

Mangani tartras, Manganese tartrate. On dissolving 10 parts of Rochelle salt and 8 parts of manganese sulphate, each in its own weight of hot water, and mixing the solutions, small white or pale-reddish crystals of manganese tartrate are obtained on cooling, which must be washed with cold water, since hot water decomposes them into a soluble acid and an insoluble basic salt.

Action and Uses.—Experiments prove that all the soluble manganic compounds are poisonous, and act as powerful sedatives of the nervous and circulatory systems. Apparently ignorant of these experiments or of their bearing, a non-medical scientist on the one hand, and on the other a pharmacist and a surgeon, drew the conclusion that because manganese had been detected in the blood, and because in its chemical habitudes it closely resembles iron, therefore it must possess therapeutical virtues analogous to those of iron, and might be used at least to reinforce the latter metal. These theorists went even so far as to suggest the idea that, inasmuch as in nearly all martial preparations there is some manganese, they may possibly derive their virtues from it, and not from the iron they contain. But the physiological action of manganese exhibits the absolute antagonism of its operation to that of iron in every point.

Sulphate of manganese has been employed as a *cholagogue* purgative in *jaundice* and other affections associated with hepatic engorgement, but it is not a cholagogue, and its irritating qualities render it an unsafe remedy. The *dose* of susphate of manganese is from Gm. 0.10–0.30 (2 to 5 grains). Its advantage as a substitute for iron are quite illusory. An ointment made with this salt which acts as an irritant upon the skin has been applied by friction to *glandular indurations* and swelling of the *joints*. The chloride has occasionally been used to stimulate indolent *ulcers*, especially those of syphilitic origin, but it possesses no superiority over the usual topical applications made for this purpose. Of the other manganic compounds above described it need only be said that they possess no recognized therapeutical value. (A further consideration of manganic compounds will be found under Potassium Permanganate.)

MANNA, *U. S., Br., P. A., P. G.*—Manna.

Manne, Fr. Cod.; *Manna*, G.; *Manna*, Sp.

The concrete saccharine exudation, in flakes, of Fraxinus Ornus, *Linné*, s. Ornus europæa, *Persoon*. Bentley and Trimen, *Med. Plants*, 170.

Nat. Ord.—Oleaceæ.

Origin.—The manna ash, or flowering ash, is a slender tree with opposite pinnate leaves and small white diandrous flowers grouped together on a terminal, drooping, very elegant panicle. It is indigenous to the countries bordering the Mediterranean on the north from Asia Minor west to Spain, and has been introduced into Central Europe and England as an ornamental tree. The foliage, even on the same tree, is very variable, and Fraxinus rotundifolia, *Lamarck*, cannot be regarded as a distinct species nor even as a well-marked variety.

Collection.—Manna is at present collected for commercial purposes solely in Sicily, as was ascertained by Hanbury, the plantations or *frassinetti* being chiefly on the northern shore of that island. When the tree is about eight years old and its trunk at least 75 Mm. (3 inches) in diameter, it will yield manna and remain productive for from twelve to twenty years, when the stem is cut down and replaced by a shoot from the stump.

The incisions are made in dry weather with a hooked knife, one each day, commencing near the root and directly above each other; they are transverse, 5 Cm. (2 inches) or less in length, and penetrate through the bark to the wood. In the following year the same operation is repeated on the untouched side, and this is continued from year to year until the tree ceases to be productive. The juice flowing from the lower incisions is collected on tiles or in receptacles made from the stem of an Opuntia; that from the upper incisions hardens on the stem, or, for producing a superior variety called *manna a cannolo* which is rarely seen in commerce, is allowed to harden on sticks or straws inserted into the cuts. When sufficiently hard the large pieces are gathered, and completely dried before being packed, while the smaller ones are afterward scraped from the stem and sold separately.

Description.—The varieties of manna generally distinguished in our commerce are *large flake*, *small flake*, and *sorts*. Flake manna (*Manna cannulata*) consists of three-edged pieces varying in length from 1 to 15 or 20 Cm. ($\frac{1}{2}$ inch to 6 or 8 inches), 1 to 5 Cm. ($\frac{1}{2}$ to 1 or 2 inches) wide, and somewhat less in thickness, flat or curved on one side where it adhered to the tree, and uneven from roundish projections on the others, showing the marks of different layers. It is externally of a yellowish-white, in some places pale-brownish color, friable, internally porous, and the cavities filled with white glistening crystals of mannit. Its odor is honey-like, somewhat nauseous, and its taste sweet, but combined with a very slight bitterness and acridity. Large and small flake manna differ only in size, the latter, however, being often of a darker shade. Manna in sorts (*Manna communis*, s. *geracina*) consists of the scrapings, and is met with in fragments of the size of a pin's head to about 12 Mm. ($\frac{1}{2}$ inch) in diameter, with a rather adhesive surface and of a brownish color outside, but internally nearly white and crystalline; not unfrequently the fragments are united by a viscid brownish matter, which, without the flakes, constitutes *fat manna* (*Manna pinguis*, s. *crassa*, s. *de Puglia*) a variety rarely seen in this country, and rejected by the pharmacopœias. It flows from the incisions late in autumn, and is more particularly yielded by old trees; it is soft and glutinous, entirely devoid of crystals, and less agreeable in odor and taste than flake manna, from which it differs in containing much less mannit and more gum, sugar, and coloring matter.

Sophistication.—Manna has occasionally been sophisticated by mixtures made of bread-crumb, starch, glucose, etc., which are very readily discovered if practised with flake manna; starchy substances can also be readily detected in manna sorts by the iodine tests.

Tests.—On boiling 5 parts of manna with 100 parts of alcohol a solution should be obtained which does not affect the color of litmus, and while cooling deposits many crystals of mannit.

Constituents.—The best dry flake manna contains about 90 per cent. of *mannit*, the remainder being fermentable *sugar*, *resin*, and *mucilage*. Mannit (mannitol), $C_6H_8(OH)_6 = C_6H_{14}O_6$, was discovered by Proust (1806), and may be obtained by treating manna with boiling alcohol and recrystallizing several times from hot alcohol. Charles T. Bonsall (1853) recommends the dissolving of manna in three times its weight of boiling water, precipitating gum and coloring matter by a little lead subacetate, removing excess of lead by hydrogen sulphide or a little sulphuric acid, concentrating the filtrate, and pouring the hot syrupy liquid into twice its bulk of cold alcohol: the mannit will crystallize on cooling. It crystallizes in colorless needles or glossy rhombic prisms which fuse at 165° C. (329° F.) and boil near 200° C. (392° F.), when a portion sublimes unaltered, but most of it is converted into *mannitan*, $C_6H_{12}O_5$, a sweetish, syrupy liquid. Mannit dissolves in about 6 parts of cold and in much less hot water, in 90 parts of cold 67 per cent. alcohol, and is insoluble in ether and nearly so in absolute alcohol. The solutions scarcely affect polarized light, are not altered by boiling with dilute acids, and do not reduce Fehling's solution. It unites with bases, forming compounds which are insoluble in alcohol. Nitric acid converts it into racemic acid and sugar, and ultimately into saccharic and oxalic acids. Gorup-Besanez (1861) observed that moist platinum-black converts it into *mannitic acid*, $C_6H_{12}O_7$, and *mannitose*, $C_6H_{12}O_6$, which is fermentable, but optically inactive. Berthelot (1856) has shown that under certain circumstances mannit will undergo alcoholic fermentation. Mannit has been found in a large number of plants, is formed in small quantity during the alcoholic fermentation of sugar, and may be obtained artificially by acting upon glucose with sodium amalgam.

The fermentable sugar present in manna reduces Fehling's solution very readily, and the mucilaginous matter is partly precipitated by lead acetate, partly by subacetate.

The resin is soluble in ether, and has a brown-red color and an acrid taste. The green color observed in some pieces of manna is due to *fraxin*, $C_{32}H_{36}O_{20}$, which was discovered by Salm-Horstmar (1857) in the bark of Fraxinus excelsior, the European ash (see pp. 756 and 813), and splits with dilute acids into glucose and *fraxetin*, $C_{10}H_8O_5$.

Pharmaceutical Preparation.—Syrupus mannæ, Syrup of manna. Dissolve 1 part of manna in 4 parts of distilled water, filter, and add 5 parts of sugar and 10 parts of syrup.—*P. G.*

Other Mannas.—The sweet exudations of various trees have received the name of manna; that sometimes obtained in Southern Europe from incisions into the trunk of Fraxinus excelsior, *Linné*, is identical with the foregoing. The young shoots of the European larch, Pinus Larix, *Linné*, yield in the middle of summer a white exudation known as *Briançon manna* and containing the sugar *melezitose*, $C_{12}H_{22}O_{11}.3H_2O$. The leaves of Eucalyptus viminalis, *Labillardière*, and other species of Australia, yield *Australian manna*, containing *melitose*, $C_{12}H_{28}O_{14}$. *Persian manna* comes from Alhagi Camelorum, *Fischer* (Leguminosæ), and contains spines and leaflets of the plant; other varieties are produced by Salix fragilis, *Linné*, and different species of Astragalus. *Tamarisk manna* exudes from Tamarix mannifera, *Ehrenberg*, in consequence of the puncture made by an insect, Coccus manniparus, *Ehrenberg*, and is collected near Mount Sinai, and sold by the monks of the convent of St. Catharine; it contains cane-sugar, glucose, and dextrin. *Armenian* (*oak*) *manna* results from the puncture of a Coccus upon the leaves of Quercus Vallonea, *Kotschy*, and Q. persica, *Jaubert et Spach*; it is either dissolved from the leaves by water, which is evaporated, or else scraped off, and then is mixed with numerous small fragments of the leaves; it consists chiefly of grape-sugar. *Lebanon manna* is in small sweet grains obtained from Cedrus libanotica, *Link*. Saccharine exudations have been observed upon a number of other plants, and the saccharine products of some insects, like the *trehala* (*tigala*) of Syria, containing the peculiar sugar *trehalose*, and the *lerp* of Australia, have sometimes been classed with the mannas; they are not entirely soluble in water.

Action and Uses.—Manna is a *laxative* peculiarly adapted to children and pregnant women; it is also a gentle *cholagogue*, and at the same time a suitable *expectorant* in febrile affections of the lungs. Some writers have held it to be peculiarly fitted, owing to the mildness of its action, to be employed in cases of *piles* and of *genito-urinary irritation*. It is slow in its operation, and is not apt to leave the bowels confined, but it tends to occasion flatulence and colic. It may be given in doses of Gm. 16–32 (℥ss–℥j), dissolved in hot water. Formerly, as at the present day, it was often associated with rhubarb, tamarinds, or senna, and it forms one of the ingredients of *the black draught*: ℞. Sennæ ℥ss; Magnesiæ sulph., Mannæ āā ℥ss; Sem. fœnieuli contus. ʒj; Aquæ bull. Oss.—M. Macerate in a covered vessel until the liquid cools. One-third of it may be given every four or five hours until it operates. The same infusion may be made with cold water by percolation. It is less nauseous and has a slighter tendency to gripe.

MARMOR ALBUM, *Br.*—White Marble.

Marmor.—Marble, E.; *Marbre*, Fr.; *Marmor*, G.

Formula $CaCO_3$. Molecular weight 99.76.

Native white granular calcium carbonate.

Properties.—Marble is found in various parts of the globe, the white kind being nearly pure calcium carbonate, while the colored varieties are more or less tinged or variegated by the presence of oxides of iron and manganese or by bituminous matter. It is met with in masses which are an aggregation of minute crystals, imparting a granular and glistening appearance. It has the specific gravity 2.7, is brittle, hard, insoluble in the ordinary solvents, but entirely soluble in dilute hydrochloric acid, carbon dioxide being given off. It is used in pharmacy for generating the gas mentioned, for which purpose black marble containing bituminous compounds is inadmissible, but other varieties may be used. In case the solution in hydrochloric acid is to be used for the preparation of other calcium compounds, it must be completely freed from iron by digesting it with milk of lime, and after filtration should not be precipitated by a solution of calcium sulphate (absence of barium and strontium), nor by ammonium phosphate after the previous addition of excess of ammonium chloride and ammonium carbonate and filtration (absence of magnesium).

Marble has the same composition as chalk, and when heated to redness parts with carbon dioxide, leaving lime or calcium oxide, CaO.

Pharmaceutical Uses.—In producing carbon dioxide and for preparing Liquor calcii chloridi.

MARRUBIUM, *U. S.*—Horehound, Hoarhound.

Herba marrubii.—Herbe de marrube blanc, Fr. Cod.; *Andornkraut, Weisser Andorn*, G.; *Marrubia*, Sp.

The leaves and tops of Marrubium vulgare, *Linné*. Bentley and Trimen, *Med. Plants*, 210.

Nat. Ord.—Labiatæ, Stachydeæ.

Origin.—Horehound is a perennial herb, and is found in waste places in Asia from Northern India westward to the Mediterranean, and throughout Europe except the extreme north; it has been naturalized in Canada and in many parts of the United States westward to California, also in some parts of South America. It is not unfrequently met with in gardens, and it flowers from June to September.

Description.—The branching stem is about 30 Cm. (1 foot) high, quadrangular, much-branched, and covered with a white felt. The leaves are opposite, petiolate, about 25 Mm. (1 inch) long, roundish-ovate, somewhat heart-shaped or rounded at the base, obtuse, serrate or coarsely crenate, wrinkled by the prominent veins below, pale-green and downy above and white-hairy beneath. The flowers are in dense axillary whorls, with woolly, linear, and hooked bracts, a tubular ten-ribbed calyx divided into ten short, spreading, stiff, and hooked teeth, and a white bilabiate corolla enclosing four stamens. The four akenes are dark-brown.

Horehound has a strong, peculiar, and aromatic odor and an aromatic and persistent bitter taste.

Constituents.—Horehound contains, besides some resin, tannin, and other common principles, a small quantity of volatile oil, and *marrubiin*, a bitter principle discovered by Mein (1855). Harms obtained 30 grains from 25 pounds of the dry herb by treating the aqueous extract with alcohol, distilling the latter, and agitating the residue with ether, which dissolves the marrubiin. Kromer (1861) agitated the infusion with charcoal and exhausted the latter with hot alcohol, which dissolves the bitter principle and tannin; the latter is removed by lead oxide. Marrubiin is slightly soluble in cold water, crystallizes from alcohol in prismatic and from ether in tabular crystals, is not precipitated by tannin, and has a very bitter and somewhat acrid taste.

Action and Uses.—Anciently regarded as a general stimulant, expectorant, deobstruent, carminative, and local anodyne, hoarhound continues to be employed as a stomachic tonic in *dyspepsia*, and in *chronic bronchitis* to restrain secretion. It has also been used in chronic rheumatism, hepatic and uterine disorders, and, like other bitter herbs, in intermittent fever. It has some reputation as an *anthelmintic*, and is said to diminish *salivation*. The *dose* of the powder is stated to be from Gm. 2–4 (gr. xxx–lx). An infusion made with Gm. 32 to Gm. 500 (℥j–Oj) of hot water may be given in doses of a wineglassful. The expressed juice should be administered with honey or milk in the dose of Gm. 4 (a teaspoonful or two) several times a day. An extract is prepared in Europe.

MASSÆ PILULARUM.—Pill Masses.

Masses pilulaires, Fr.; *Pillenmassen*, G.

The U. S. Pharmacopœia of 1890, in accordance with general custom, orders three pill masses to be kept in bulk, and designates such a pill mass as *Massa*, which is equivalent to *Pilula* adopted by the British Pharmacopœia. (For general remarks on the preparation of pill masses see Pilulæ.)

MASSA COPAIBÆ, *U. S.*—Mass of Copaiba.

Pilulæ copaibæ.—Solidified copaiba, E.; *Masse pilulaire de copahu*, Fr.; *Copaiva-Pillenmasse*, G.

Preparation.—Copaiba, 94 Gm.; Magnesia, 6 Gm.; Water, a sufficient quantity: Upon the magnesia, contained in an enamelled iron capsule, sprinkle a sufficient quantity of water to make it distinctly damp, and render it homogeneous by trituration. Then gradually incorporate with it the copaiba so that a uniform mixture may result, place the capsule on a water-bath and heat during half an hour, frequently stirring. Lastly, transfer the mixture to a suitable vessel and set this aside until the mass has acquired a pilular consistence.—*U. S.*

The official directions to sprinkle the magnesia with water are for the purpose of properly hydrating the same, as it is well known that anhydrous magnesia does not readily combine with the acid resin. The combination may be looked upon as magnesium copaivate with volatile oil of copaiba.

The variety of copaiba best adapted for this mass is Maracaibo copaiba (p. 537), since it contains a larger proportion of resin; this enters into combination with the magnesia, forming a resin soap, which gradually becomes dry and hard. If thin Para copaiba is to be used, it is advisable to evaporate sufficient of the volatile oil until the residue, after cooling, forms a viscid liquid, when it may be mixed with the magnesia. The *pilules de copahu* (F. Cod.) are made in the same manner, and contain 3.86 grains (0.25 Gm.) of copaiba; those of the U. S. P. 1870 contain 4.8 grains.

In Europe pills of copaiba and powdered cubebs are sometimes used, and made into a mass by means of wax. The quantities necessary are 1 part of each of the ingredients named, or 3 parts of copaiba, 5 of cubebs, and 1 of wax. This mass retains its plasticity for a long time.

Action and Uses.—The efficiency of copaiba must necessarily be very much impaired by being given in so insoluble a combination. Each pill should contain about 5 grains of copaiba, and the average *dose* would be two or three pills.

MASSA FERRI CARBONATIS, *U. S.*—Mass of Ferrous Carbonate.

Pilula ferri carbonatis, Br.—*Vallet's mass*, *Vallet's pill mass*, E.; *Masse pilulaire de Vallet*, *de carbonate ferreux*, Fr.; *Vallet'sche Pillenmasse*, G.

Preparation—Ferrous Sulphate, in clear crystals, 100 Gm.; Sodium Carbonate, 100 Gm.; Clarified Honey, 38 Gm.; Sugar, in coarse powder, 25 Gm.; Syrup, Distilled Water, each, a sufficient quantity, to make 100 Gm. Dissolve the ferrous sulphate and the sodium carbonate, each separately, in 200 Cc. of boiling distilled water, and, having added 20 Cc. of syrup to the solution of iron salt, filter both solutions, and allow them to become cold. Introduce the solution of sodium carbonate into a bottle having a capacity of about 500 Cc., and gradually add the solution of the iron salt, rotating the flask constantly or frequently until carbon dioxide no longer escapes. Add a sufficient quantity of distilled water to fill the bottle; then cork the bottle and set it aside, so that the ferrous carbonate may subside. Pour off the supernatant liquid, and, having mixed syrup and distilled water in the proportion of 1 volume of syrup to 19 volumes of distilled water, wash the precipitate with the mixture by decantation until the washings no longer have a saline taste. Drain the precipitate on a muslin strainer, and express as much of the water as possible. Lastly, mix the precipitate at once with the honey and sugar, and, by means of a water-bath, evaporate the mixture in a tared capsule, with constant stirring, until it is reduced to 100 Gm.—*U. S.*

To make 4 av. ozs. of Vallet's mass will require the following quantities: Ferrous sulphate, crystals, and sodium carbonate, of each 4 av. ozs.; clarified honey, 665 grains, sugar in coarse powder, 438 grains.

Take of saccharated carbonate of iron 1 ounce; confection of roses ¼ ounce. Beat them into a uniform mass.—*Br.*

On mixing solutions of ferrous sulphate and sodium carbonate, ferrous carbonate and sodium sulphate are formed by mutual decomposition (see p. 735). In contact with air the white iron precipitate rapidly oxidizes. The change is prevented by washing the precipitate in bottles by decantation with water recently boiled, and excluding the air; an additional protection is afforded by dissolving some sugar in the water. The pill mass, when recently made, is of a greenish-gray color, but on exposure becomes superficially greenish-black.

The quantity of ferrous sulphate ordered in the official formula is capable of yielding very nearly 42 Gm. of ferrous carbonate, but as some of the precipitate is lost by washing, and as the weight of the finished product is directed to be brought to 100 Gm., scarcely more than 35 or 36 Gm. of ferrous carbonate will be present, equal to 35 or 36 per cent.

Pilulæ ferri carbonici, *P. G.*; Pil. ferratæ Valleti.—Pills of ferrous carbonate, *E.*; Pilules de Vallet, Pilules ferrugineuses, *Fr.*; Eisenpillen, Vallet'sche Pillen, *G.*—Ferrous sulphate 100 parts is converted into carbonate with sodium bicarbonate by the process described on page 717; the washed precipitate is mixed with sugar 16 parts, honey 52 parts, and the mixture evaporated to 108 parts. 10 Gm. of this mass, with the

requisite quantity of powdered marshmallow-root, are made into 100 pills, which are rolled in powdered cinnamon, and each of which represents .025 Gm. iron.—*P. G.*

The formula of the French Codex is almost identical with that of the United States Pharmacopœia, except that milk-sugar is used in place of sugar; 6 parts of the mass are mixed with 1 part each of powdered marshmallow- and liquorice-root, and divided into pills, each weighing 0.25 Gm., which are to be silvered.

Action and Uses.—Mass of carbonate of iron is one of the most efficient forms in which iron can be exhibited. It is especially indicated in pure *anæmia* and in *anæmic chlorosis*, and in all affections in which the red corpuscles of the blood are deficient, particularly when the digestive function is not greatly impaired. When dyspeptic disorders attend, the soluble preparations of iron are usually more efficient. The *dose* of mass of carbonate of iron is Gm. 0.15–0.30 (gr. iij–v), and should usually be taken at meal-time.

MASSA HYDRARGYRI, *U. S.*—Mass of Mercury.

Pilula hydrargyri, Br.; *Massa cœrulea.—Blue mass, Blue pill*, E.; *Masse pilulaire bleue*, Fr.; *Mercurial- Pillenmasse*, G.

Preparation.—Mercury 33 Gm.; Glycyrrhiza, in No. 60 powder, 5 Gm.; Althæa, in No. 60 powder, 25 Gm.; Glycerin 3 Gm.; Honey of Rose 34 Gm.; to make 100 Gm. Triturate the mercury with honey of rose and glycerin until it is extinguished. Then gradually add the glycyrrhiza and althæa, and continue the trituration until globules of mercury cease to be visible under a lens magnifying ten diameters.—*U. S.*

To prepare 4 av. ozs. of blue mass will require 578 grains of mercury, 87 grains of glycyrrhiza, 437 grains of althæa, 53 grains of glycerin, and 595 grains of honey of rose.

Mercury 2 parts; confection of roses 3 parts; liquorice-root, in fine powder, 1 part.—*Br., F. Cod.*

The British Pharmacopœia still directs the mercury to be extinguished by trituration with confection of roses, and the U. S. Pharmacopœia recommends trituration with a saccharine liquid (honey) containing a little glycerin, which facilitates the division of the metal. W. W. Stoddart (1855) has shown that the globules of mercury rapidly disappear on being triturated with powdered liquorice-root kept moist by a liquid; the directions above given may be conveniently modified in accordance with this suggestion, so that the mercury is first completely extinguished with the powdered glycyrrhiza and sufficient of the mixed liquids before the remaining powder and liquid are incorporated. The use of a considerable proportion of powdered althæa is an improvement, the mass being of a lighter color and of a purer blue tint; but the large amount of mucilage present in marshmallow-root favors the production of mould in a damp atmosphere; which tendency is in a measure counteracted by the glycerin.

The U. S. P. prescribes the following tests: "If a portion of the mass be triturated in a mortar, with warm acetic acid, the filtrate should not become more than slightly opalescent on the addition of a few drops of hydrochloric acid (limit of mercurous oxide). If another portion of the mass be digested with warm, diluted hydrochloric acid and a little purified animal charcoal, the filtrate should not be affected by hydrogen sulphide test-solution or by stannous chloride test-solution (absence of mercuric oxide)."

When properly prepared, blue mass contains metallic mercury in the state of very fine division. It is not impossible that when kept on hand for a long time a change, due to the partial oxidation of mercury, may gradually take place, as has been repeatedly observed. Such a change, however, could only be very superficial, since the metal is well protected by the other ingredients of the pill mass.

Pulvis massæ hydrargyri, Æthiops saccharatus.—Powdered blue mass, *E.;* Poudre de mercure saccharin, Mercure (Ethiops) saccharin, *Fr.;* Wurmzucker, *G.*

Blue mass or blue pill is not unfrequently ordered in powders, but is unsuited for the purpose unless mixed with other absorbent powders. It may, however, be readily obtained in the state of a permanent powder having the same relative composition as the pill mass by substituting in the above directions for the glycerin and honey of rose an equal weight of milk-sugar, using a drop of oil of roses to impart the requisite flavor, and keeping the mixture moist by the addition of alcohol; after a uniform mass has been obtained it is spread out to allow the alcohol to evaporate spontaneously, after which it may be reduced to a permanent powder. W. E. Bibby (1876) recommended 1 part of mercury to be triturated with 2 parts of sugar of milk, without adding any liquid, the metal being rapidly extinguished.

Pilulæ hydrargyri; Pilulæ cœruleæ, *F. Cod.*—Blue pills, *E.;* Pilules de mer-

cure, Pilules bleues, *Fr.;* Mercurialpillen, *G.*—Each pill contains 0.05 Gm. ($\frac{3}{4}$ grain) of mercury, *F. Cod.* The pills of U. S. P. 1870 contained 1 grain of mercury.

Action and Uses.—Mass of mercury, or blue mass, differs from other mercurials in irritating the stomach and bowels less, and, therefore, in being less apt to act as a cathartic. For this reason, probably, it is more apt than they are to form combinations in the primæ viæ which are readily absorbed and produce constitutional effects. Such effects are commonly sought from mercury in this form when it is given in doses of Gm. 0.20 (gr. iij) or less, and repeated several times a day until the characteristic soreness of the gums is observed. To prevent its acting as a laxative it is usually associated with Gm. 0.016 (gr. $\frac{1}{4}$) or less of opium in each *dose*, or the mercurial is repeated at intervals of an hour or two in doses of Gm. 0.016–0.02 (gr. $\frac{1}{4}$–$\frac{1}{3}$). When it is desired to increase the secretions of the *liver* and *pancreas*, a dose of Gm. 0.15–0.30 (gr. iij–vj) is usually administered at night, and is followed the next morning by a saline, or, still better, a senna draught, or some other brisk cathartic. Whether the mercury does or does not specifically promote the secretion of the glands referred to is a question discussed elsewhere. (See Hydrargyrum.)

MASTICHE, *U. S., Br., P. A.*—Mastic, Mastich.

Mastix, Resina mastiche.—Mastic, Fr.; *Mastix*, G.; *Almaciga*, Sp.

The concrete resinous exudation from Pistacia Lentiscus, *Linné.* Bentley and Trimen, *Med. Plants*, 68.

Nat. Ord.—Anacardieæ.

Origin.—A small tree or shrub which is indigenous to the basin of the Mediterranean, has pinnate leaves with leathery sessile leaflets varying in form between linear and ovate, short-stalked, reddish-yellow pistillate, and larger greenish staminate, flowers, and small blackish drupes. Mastic is obtained in a few islands of the Grecian Archipelago, principally in Scio, from the var. γ Chia, which is tree-like and has broad leaves.

Collection.—The resin is contained in the bast-layer of the bark in elongated ducts having a large elliptic cavity and surrounded by one or more layers of small cells, in which the resin is secreted. To obtain it vertical incisions are made in June and July in the bark of the trunk and larger branches, and in July and August, after the exuding resin has hardened, it is carefully removed from the tree and collected in baskets; this is the finest quality. An inferior quality consists of the tears which have dropped from the incisions upon tiles or flat stones kept under the tree. A vigorous tree may yield 10 pounds of mastic; the total harvest is very variable, and occasionally reaches 50,000 cwt., but is generally considerably less.

Description.—The best quality of mastic is in globular or more or less elongated brittle tears of the size of a pea, which are externally covered with a whitish dust or have been freed from it by washing, and are then of a pale-yellow color, perfectly transparent, of a glass-like lustre, and break readily with a conchoidal fracture. Placed between the teeth, it is easily crushed, and then softens into a plastic mass. Its specific gravity is about 1.07; it becomes soft below the boiling-point of water, but fuses at some degrees above it. It has a balsamic odor, more apparent on being heated, and a slight terebinthinous taste. It dissolves partly in alcohol, and is also soluble in benzene, acetone, volatile oils, cold creosote, and warm petroleum, leaving a whitish residue. The alcoholic solution reddens litmus.

The inferior kinds of mastic consist of similar tears, to which sand and fragments of bark adhere, mixed with gray- or brown-colored pieces.

Constituents.—Mastic contains a minute quantity of *volatile oil* and about 90 per cent. of *alpha-resin* or *masticbic acid*, which is soluble in cold alcohol, combines with bases, and, according to Johnston, has the composition $C_{20}H_{32}O_2$. The portion insoluble in alcohol is white, tenacious, soluble in ether and oil of turpentine, and has been named *beta-resin* or *masticin;* its composition is $C_{20}H_{31}O_2$. Hot water dissolves the bitter principle, acquires an acid reaction, and the solution gives a precipitate with tannin.

Varieties and Adulterations.—Bombay Mastic. Under this name a drug has appeared in the market which, when well selected and clean, closely resembles the Scio mastic, but is usually in less clean and more opaque tears. It is obtained from Pistacia cabulica and Khinjuk, *Stocks*, which are indigenous to North-western India and Beloochistan. Pist. atlantica, *Desfontaines*, a variety of Pist. Terebinthus, *Linné*, growing in Algeria and other parts of Northern Africa, yields likewise a mastic-like resin.

Sandaraca.—Sandarac, *E.;* Sandaraque, *Fr.;* Sandarak, *G.*—It is the exudation of

Callitris quadrivalvis, *Ventenat*, s. Thuja articulata, *Vahl* (Nat. Ord. Coniferæ, Cupressineæ), a small tree of North-western Africa. It forms brittle elongated tears of a pale-yellowish color, with a dusty surface, the fracture glass-like and transparent, almost wholly soluble in alcohol, and becoming pulverulent when masticated.

The tears of *olibanum* are generally larger, translucent, and destitute of glassy lustre. The exudation of Atractylis gummifera is sold in Greece as *pseudo-mastich* or *acantho-mastich*, and consists of agglutinated tears which are oblong in shape and about 2 inches (5 Cm.) long by 1 inch (25 Mm.) in thickness.

Action and Uses.—Formerly employed internally for purposes similar to those for which other terebinthinates are prescribed, as catarrh of the bronchia and urinary passages, its medicinal use is now almost entirely restricted to forming a solution in ether with which cotton may be saturated for the purpose of filling *carious teeth* and protecting their tender surface from the influence of cold and the contact of food during mastication. Sandarac may be employed in a similar manner. A solution of mastic in alcohol may be applied to arrest *bleeding* from leech-bites and other slight wounds. Mastic is an ingredient of the "dinner pill" (Pil. aloes et mastiches). At a time when Chian turpentine was supposed to be a remedy for uterine cancer, mastic was substituted for it with equally negative results (*Med. Record*, xviii. 518).

Sandarac has been used for the same purposes as mastic.

MATICO, *U. S., Fr. Cod.*—Matico.

Maticæ folia, Br.; *Feuilles de matico*, Fr.; *Maticoblätter*, G.

The leaves of Piper angustifolium, *Ruiz et Pavon*, s. Piper elongatum, *Vahl*, s. Artanthe elongata, *Miquel*, s. Steffensia elongata, *Kunth*. Bentley and Trimen, *Med. Plants*, 242.

Nat. Ord.—Piperaceæ.

Origin.—A shrubby plant about 2.4 M. (8 feet) high, sometimes cultivated, and found in moist woods of tropical America from Mexico southward to Venezuela, Brazil, and Peru. The minute yellowish flowers are very numerous, aggregated into a solid, cylindrical, slender spike about 15 Cm. (6 inches) long, and produce blackish fruits of the size of a poppy-seed.

Fig. 180.

Matico leaf.

Description.—The leaves, which are very frequently mixed with branches and spikes of flowers or fruits, are rather thick, about 15 Cm. (6 inches) long, oblong-lanceolate, very finely serrulate, narrowed at the apex to a blunt point heart-shaped, and somewhat unequal at the base, having a very short petiole. The upper surface is nearly glabrous, of a green color, and very uneven or tessellated in appearance from the depressed veins, which are prominent beneath, making the downy lower surface reticulate, the meshes being small, and the veins densely covered with brownish hairs. The leaves, particularly when rubbed between the fingers, have an aromatic odor and a warm, aromatic, bitterish taste.

Constituents.—Matico contains about 1½ per cent. of a thickish, pale-yellow, volatile oil, consisting of two oils, one of which is sometimes heavier than water, and containing a crystalline camphor melting at 94° C. Wiegand (1846) proved the non-existence of Hodge's maticin, which is a potassium salt. Stell (1858) showed the absence of piperin and cubebin and obtained a ruby-colored resin of a very acrid and pungent taste. Subsequently Marcotte isolated a crystallized acid named *artanthic* acid. Matico contains also some tannin and other principles common to vegetables.

Substitutions.—In different parts of South and Central America the Spanish names *matico* and *yerba* or *palo del soldado* (soldier's herb or tree) are given to other plants besides the one described above—namely, to Eupatorium glutinosum, *Kunth* (Compositæ), and Waltheria glomerata, *Presl* (Sterculiaceæ), the leaves of which are likewise used for arresting hæmorrhage. The first-named species has opposite petiolate, ovate-lanceolate leaves, which are more or less heart-shaped at the base, acuminate, crenately serrate, roughish above and tomentose beneath. The leaves of the second species are ovate, serrate, rounded or subcordate at the base and soft-hairy on both sides. Artanthe (s. Piper) lanceæfolia, *Miquel*, is similarly used in New Granada. Bentley (1864) met with the leaves of Artanthe adunca, *Miquel*, Piper aduncum, *Linné*, which were offered as matico. They are similar in shape, and the upper surface is marked by some sunken, ascending, and parallel nerves, and the lower surface by corresponding reticulations, but

they have not the tessellated appearance nor the roughness and hairiness on the lower surface observed on the official matico-leaves; their properties appear to be the same.

Allied Products.—Piper Betle, *Linné.*—Betel, *E., G.;* Bétel, *Fr.*—It is a climbing shrub, indigenous to India and cultivated in various tropical countries. The leaves are broadly ovate, acuminate, obliquely cordate at the base, five- to seven-nerved, coriaceous, and above glossy. They have a burning aromatic and bitter taste, and are largely employed by the Malays for chewing with slaked lime and scrapings of the areca-nut (p. 276).

Piper Carpunya, *Ruiz et Pavon.* A small tree indigenous to Chili and Peru, the leaves of which are used. They are cordate-ovate, acute, coriaceous and glossy, and when dry have an agreeable odor, and are used in affections of the digestive organs.

Piper peltatum and P. umbellatum, *Linné.* Both plants are known in some parts of tropical America as *caapeba*, in others as *periparabo;* the roots are used as diuretics and the leaves in skin diseases and tumors. The rhizome is tuberous, with dark-brown woody rootlets and containing reddish oil-glands.

Piper methysticum, *Forster.* It is a shrub, with cordate, acuminate, and many-nerved leaves, indigenous to the Sandwich and other islands of the Pacific Ocean. The root is the part employed, and is known as *ava* and *kava-kava.* It is large, woody, but spongy and light, has a thin grayish-brown bark, and a meditullium consisting of a yellowish or yellow, occasionally pale-reddish, cellular tissue, and of numerous radiating linear wood-bundles. It has an agreeable odor, recalling that of lilac and of meadow-sweet, and a faintly pungent and slightly bitter taste. Cuzent (1860) found in the root some volatile oil of a lemon-yellow color, a large amount of starch, an acrid resin, and a principle called *kavahen* or *methysticin*, which crystallizes in needles on concentrating the tincture of kava-root, and is purified by treatment with animal charcoal and recrystallization from alcohol. It is colorless, tasteless, fusible above 120° C. (248° F.), sparingly soluble in cold water, and readily soluble in alcohol and ether. The masticated root, subjected to fermentation, yields an intoxicating beverage called *kava.*

Action and Uses.—In its nature and operation matico closely resembles the terebinthinate medicines, while its odorous and special stimulant qualities rank it with cubeb and copaiva. Like these substances, it is absorbed into the blood, and appears to produce a constriction of the capillary vessels, whereby it controls mucous fluxes and hæmorrhages, while it occasions more or less diuresis. It has been employed, like copaiva, in the treatment of *bronchitis*, *gonorrhœa*, *leucorrhœa*, *vesical catarrh*, *incontinence of urine*, and *chronic diarrhœa* and *dysentery*, and in *hæmorrhage* from the *lungs*, *stomach*, *bowels*, *rectum*, and *kidneys.* Like oil of turpentine, it has been used as a topical hæmostatic. The *dose* of the powder is Gm. 2–12 (ʒss–2–3) several times a day. An extract has been made, of which the dose is Gm. 4–5 (gr. lx–lxxv). The fluid extract and tincture are officinal. *Betel-leaves* are chewed in Malabar, as above stated, and it is said that in Java their juice is used to cure obstinate and dry coughs.

Kava-kava (*Piper methysticum*) is said to have long been used by the inhabitants of the South Sea islands as an intoxicant and as a remedy for gonorrhœa. In 1879, Dupuy (*Med. Record*, xvi. 106) stated in regard to it that it is a sialogogue, a tonic to the digestive organs, a stimulant of the nervous system, a diuretic, and a sedative of genital excitement. He found that it rapidly cured, after having increased, *gonorrhœal* discharges, and that it allayed *vesical* and *urethral* irritation. In 1882, Mr. Kesteven (*Practitioner*, xxviii. 199) related that the Fiji Islanders prepare from it a drink which has several of the qualities of tea and coffee, and is not intoxicating, for, although it impairs the muscular power and causes a staggering gait, the mind is not clouded. It does not raise the temperature, and steadies without exciting the pulse; its habitual and excessive use was said to impair the eyesight and produce leprous ulcers. Mr. Kesteven also refers to its use in the treatment of *vesical* and *urethral* disorders. In 1885, Lewin found that its resin applied to the tongue destroyed the perception of the bitterness of quinine, and that injected into the connective tissue it produced a local anæsthesia which, in some of the animals used, lasted for nine days. He noted that when taken internally it produced the intoxication above mentioned, and in excessive doses, moreover, malaise, headache, paresis of the limbs, and general nervous tremor. He also observed among its effects desquamation of the cuticle and inflammation of the eyes (*Bull. de Thérap.*, ex. 228; *Therap. Gaz.*, x. 253). In 1882, Dr. Boardman Reed (*Therap. Gaz.*, iii. 47) reported the rapid and painless cure of acute *gonorrhœa*, as Dupuy and others had already done, but with the co-operation of diet, saline laxatives, and astringent injections. Later observers, however, are in agreement with Sanné (*Bull. de Thérap.*, ex. 199) and Rogers (*Med. Record*, xxix. 525) who found, that the cure was as long as by ordinary methods, but less annoying and perturbating than that by cubebs or copaiba. The dose of the alcoholic extract given by Sanné was Gm. 0.13 (gr. ij) several times a day; and that of the fluid extract from Gm. 1.30–2 (♏xx–xxx) with like frequency.

MATRICARIA, *U. S.*—Matricaria, German Chamomile.

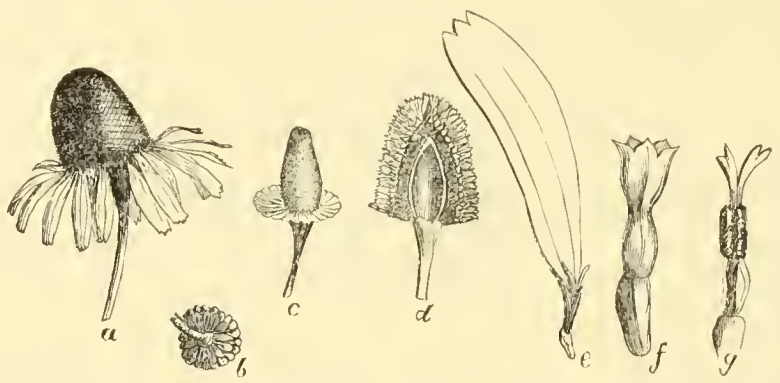
Flores chamomillæ, P. G; *Flores chamomillæ vulgaris.—Camomille commune (d'Allemagne)*, Fr. Cod.; *Kamille, Kamillenblumen*, G.; *Manzanilla comun*, Sp.

The flowers of Matricaria (Chrysanthemum, *Bernhardi*) Chamomilla, *Linné*, s. Chamomilla officinalis, *Koch*. Bentley and Trimen, *Med. Plants*, 155.

Nat. Ord.—Compositæ, Senecionideæ.

Origin.—An annual herb, with a branching stem about 30 Cm. (1 foot) high, smooth, twice- or thrice pinnatifid leaves, with spreading setaceous segments and numerous flower-heads terminating the slender branches. The plant is common in fields and waste places throughout Europe as far north as Finland, and in the temperate parts of Asia; it has been completely naturalized in Australia, and is occasionally cultivated in German settle-

Fig. 181.



Matricaria: *a*, flower-head; *b*, involucre; *c*, receptacle and involucre; *d*, longitudinal section of receptacle, with disk-florets: *e*, ray-floret; *f*, disk-floret; *g*, stamens and style of disk-floret.

ments in the United States. The flowers appear from May till August; on drying, from 20 to 25 per cent. of the drug is obtained.

Description.—The flower-heads are 12–18 Mm. ($\frac{1}{2}$ to $\frac{3}{4}$ inch) broad, and have a flattish involucre, with two or three rows of small, oblong-linear, obtuse scales having the margin membranous. The receptacle is at first convex, but becomes strongly conical and hollow, and is free from chaff. The ray-florets are about fifteen in number, soon reflexed, white, ligulate-oblong, with two notches at the apex and enclosing the bifid style, but no stamens. The numerous yellow disk-florets are tubular, five-toothed, somewhat glandular, hermaphrodite, and have the anthers united into a tube through which the bifid style projects. The akenes are small, curved, finely five-ribbed on the inner surface, brownish, without pappus, but with a slightly elevated margin at the apex. German chamomile-flowers have a peculiar aromatic odor and a bitterish aromatic taste. They are easily distinguished from allied composite plants by their smooth, conical, and hollow disks, which shrink very considerably on drying.

The similar flower-heads of Anthemis arvensis, *Linné*, and Maruta Cotula, *De Candolle*, have conical, solid, and chaffy receptacles.

Constituents.—German chamomile-flowers contain about $\frac{1}{4}$ per cent. of volatile oil, some bitter extractive, malates, tannates, and a little tannin, besides the principles common to vegetables. Pattone's *anthemic acid*, isolated (1859) from Anthemis arvensis, *Linné*, was obtained by Werner (1867) from the official flowers by exhausting them with hot water acidulated with acetic acid, concentrating, precipitating with alcohol, evaporating the filtrate, and treating with chloroform. It is described as colorless silky needles having an agreeable odor of chamomile, a strongly bitter taste, and dissolving in water, alcohol, ether, and chloroform. The precipitate obtained with alcohol is stated to contain a tasteless crystalline principle, *anthemidin*, which is insoluble in alcohol, ether, and chloroform, but soluble in acetic acid.

The volatile oil, Oleum chamomillæ æthereum, is a dark-blue, in thin layers transparent, thickish liquid, which gradually turns green and brown when exposed to light and air, and more rapidly if obtained from dried flowers; it has a strong odor of the flowers and a warm, aromatic taste; dissolves in about 8 parts of 80 per cent. alcohol, has the specific gravity 0.93, and seems to consist of a terpene, $C_{10}H_{16}$, associated with $C_{10}H_{18}O$. The volatile oil becomes dark-brown or green with strong or diluted nitric acid, and deep red-brown with sulphuric acid. The blue color is due to the presence of a

volatile principle which was named *azulene* by Piesse and *cærulein* by Gladstone (1863), and which, according to both investigators, is present in all other volatile oils having a blue or green color—in the latter associated with a yellow principle.

An oil of German chamomile, containing oil of lemon, is still sometimes met with in our market; it was formerly official in Europe as *Oleum chamomillæ citratum*, and prepared by adding to 480 parts of recently-collected flowers 1 part of oil of lemon, and then distilling with water; it has a deep-blue color, but is more limpid than the pure oil and more prone to change in color.

Pharmaceutical Preparations.—Oleum chamomillæ infusum is employed externally, and made like oleol of anthemis (p. 216); it has a yellowish-green color.

Syrupus chamomillæ. Prepare an infusion from 3 parts of German chamomile with sufficient hot water to obtain 10 parts of filtered liquid, and dissolve in this 18 parts of sugar.—*P. G.* 1872.

Action and Uses.—German chamomile has less agreeable qualities than English chamomile (Anthemis), but medicinally may be substituted for it.

MEDEOLA.—Medeola.

The rhizome of Medeola (Gyromia, *Nuttall*) virginica, *Linné*. Meehan, *Native flowers*, ii. 157.

Nat. Ord.—Liliaceæ.

Origin.—The medeola or *Indian cucumber* grows in damp soil in woods and shady places of the United States east of the Mississippi, and flowers in May and June. It has a slender stem, about 45 Cm. (18 inches) high, beset with a deciduous fine wool, and bearing above its middle a whorl of six or eight spreading oblong-lanceolate leaves, which are about 75 Mm. (3 inches) long, and acute at both ends. Near the top is a whorl of three or four smaller ovate pointed leaves, and above them three or four greenish-yellow recurved flowers having six sepals and stamens, and producing a purplish-blue three-celled berry, each cell containing about five triangular seeds.

Description.—The rhizome is horizontal, 25–38 Mm. (1 or 1½ inches) long, about 6 Mm. (¼ inch) thick, pointed at the lower end, beset with hair-like simple rootlets, pale brown-yellowish externally, white internally, and with a few small wood-bundles. It is without odor, and has a sweetish, in the fresh state somewhat cucumber-like, taste. Its constituents, among which is starch, have not been investigated.

Action and Uses.—Nothing appears to have been added for many years to the scanty knowledge originally possessed of this root—viz. that it was reputed to be hydragogue and diuretic and therefore useful in *dropsies*.

MEL, *U. S.*, *Br.*—Honey.

Miel, Fr. Cod.; *Honig*, G.; *Miel*, Sp.

A saccharine secretion deposited in the honey-comb by Apis mellifica, *Linné*, the hive bee.

Class Insecta; Order Hymenoptera.

Properties.—When recently prepared, honey is a translucent or nearly transparent, pale-yellowish or brownish, thick, syrupy liquid, which, on keeping, separates a granular deposit, and is ultimately changed into a crystalline mass intermixed with some liquid. It is stated that California honey gathered in May becomes granular in a few days, but if taken later in the season remains liquid for a long time. It has a slight acid reaction, an agreeable odor, varying more or less from causes mentioned above, and a sweet taste, followed by a slight acridity. E. Dieterich (1877) ascertained that, by dialyzing honey into water the dialyzed portion, on concentration, had a golden-yellow color and a remarkably fine floral odor, while the residue upon the dialyzer was destitute of honey odor and had a sweet but insipid taste. In some parts of Africa a brown, and even greenish, honey has been observed, which may be produced by different species of Apis.

Honey dissolves readily in water, also in diluted alcohol, yielding in both cases slightly turbid solutions which have a faint acid reaction. A mixture of honey with 2 parts of water should have a specific gravity not lower than 1.100 (*U. S.*), which corresponds to a specific gravity of 1.375 for the original honey.

Constituents.—The odor of honey is doubtless due to a minute quantity of volatile oil, which, according to Calloud, is intimately associated with a yellow coloring matter, *melichroïn*, separated by the nectaries and bleached on exposure to sunlight. Small

quantities of wax and gummy matter are usually present, and A. Vogel (1882) found in crude honey about .1 per cent. of formic acid, which appears to preserve it from decomposition; but the main constituents are *grape-sugar* or *dextrose* and *fruit-sugar* or *levulose*, of each of which from 32 to 42 per cent., or a total of about 72 to 78 or 80 per cent., is present. The honey of an American wasp, Polybia apicipennis, *Saussure*, according to Karsten (1857), contains cane-sugar, and the same may be the case with honey from other sources; this constituent, however, is gradually changed to *invert-sugar*, which is a mixture of grape- and fruit-sugars. It is the grape-sugar which renders honey granular, while the fruit-sugar remains liquid; the former turns polarized light to the right, the latter to the left. The albuminates, mucilaginous matter, pollen, and wax present in honey vary between about 0.5 and 1 or 2 per cent.; the ash left on incineration is generally between .12 and .16 per cent., and, according to Hager, should not exceed .5 per cent.

Adulterations.—The coarse adulteration with starchy substances is easily recognized in the soluble matter left on treating with alcohol, and by the blue color produced on the addition of solution of iodine. Adulterations with artificial grape-sugar prepared from starch by boiling with sulphuric acid are difficult to establish; aside from the physical properties, the presence of soluble sulphate (of calcium) affords the best criterion. Beet-root molasses contains chlorides, and if used for adulterating honey causes a white precipitate with silver nitrate. Starch-paste, added with the view of rendering honey thick, is deposited as a jelly-like, stringy mass on dilution with water. Neither crude honey nor honey clarified by the process of the U. S. P. yields with water an absolutely clear solution. The tests given by the pharmacopœias are as follows: "If 1 part of honey be dissolved in 4 parts of water, a clear solution should result, which should not be rendered more than faintly opalescent by a few drops of test solution of silver nitrate (limit of chlorides) or of barium nitrate (limit of sulphates). If a small portion of honey be diluted with 1 volume of water and then gradually mixed with 5 volumes of absolute alcohol, it should not become more than faintly opalescent, and should neither become opaque nor deposit a slimy substance at the bottom and along the sides of the test-tube (starch, dextrin). When incinerated in small portions at a time in a platinum crucible, it should not leave more than 0.2 per cent. of ash (any larger percentage of ash and failure to respond to the preceding tests indicating the presence of glucose or other foreign admixtures). Water boiled with honey and allowed to cool should not be rendered blue or green on the addition of test solution of iodine (absence of starch)."—*U. S.*

Action and Uses.—Honey is one of the most ancient of medicines, and its nutritious qualities were always well known. Medical history shows that the Greeks and Arabians were well acquainted with its uses and the noxious qualities of certain kinds of it. Honey may be used with other food without any unpleasant effects in most instances, but there are persons who cannot take even a small quantity of it without feeling the head heavy or confused, while in others it causes flatulence or diarrhœa. Among the plants which are frequented by bees producing poisonous honey are Nerium oleander, Azalea pontica, Daphne mezereum, Aconitum, and Kalmia latifolia. The last, or mountain-laurel, is the chief source of poisonous honey in this country. The symptoms it produces are dimness of sight, vertigo, a mild or furious delirium, abdominal pain, vomiting and purging, perspiration, convulsions, foaming at the mouth, and, in a few instances, death. In some cases an eruption also appears upon the skin, and there is soreness of the throat with hoarseness of the voice. *Eucalyptus honey* is reported to reduce the pulse and temperature in dogs, but in man to incite a glow throughout the body, and to increase the respiratory power and the urinary secretion; and to have been used with advantage in diseases of the urinary tract (*Amer. Journ. Pharm.*, lix. 471). Its peculiar virtues appear to depend on the eucalyptus oil it contains.

Anciently, honey was employed for most of the medicinal purposes for which sugar is now used, and especially with barley-water for bronchial affections and sore throats. Its present use is almost exclusively local and for the same purposes as of old, and particularly to stimulate mucous surfaces, and even cutaneous sores, when their condition denotes impaired vitality. It is habitually employed in gargles to cure *aphthæ*, *thrush*, and *pseudo-membranous deposits*, but its efficacy is increased by the addition of muriatic acid, sodium borate, potassium chlorate, etc. Honey of rose is official. Sodium borate, in the proportion of 60 grains to an ounce of honey, is a very convenient application to aphthæ, etc. of the female genital organs. Honey is sometimes used as an ingredient of poultices for *boils* and *carbuncles*, as an application to *fissures of the nipple*, etc., and is applied in plasters to the mammæ for *drying up the milk*.

In this connection it may be mentioned that *propolis*, a resinous exudation with which bees cover the bottom of their hive, is reported to be beneficial in the treatment of acute and chronic *diarrhœa*.

MEL DESPUMATUM, *U. S.*—Clarified Honey.

Mel depuratum, Br., P. G.—*Miel despumé*, *Mellite simple*, *Sirop de miel*, Fr.; *Gereinigter Honig*, G.

Preparation.—Honey, a convenient quantity; Glycerin, a sufficient quantity. Mix the honey intimately with 2 per cent. of its weight of paper-pulp, which has been previously reduced to shreds, thoroughly washed and soaked in water and then strongly expressed and again shredded. Then apply the heat of a water-bath, and, as long as any scum rises to the surface, carefully remove this. Finally, strain and mix the strained liquid with 5 per cent. of its weight of glycerin.—*U. S.*

The object of clarification is to remove the wax and other impurities of honey, which rise to the surface when the honey is kept for a while in the condition of a thin fluid by exposing it to the heat of a water-bath; in the above process the impurities are more effectually removed by aid of the paper-pulp, and the final addition of glycerin is for the purpose of better preservation.

The Br. Ph. simply directs that honey shall be melted in a water-bath and strained while hot through flannel previously moistened with warm water. The process of the French Codex is similar to that of the U. S. P., except that the honey is first diluted with one-fourth its weight of water; no glycerin is used. The Ger. Ph. orders that honey (of which 10 Gm. require not more than 0.5 Cc. of normal potassa solution for neutralization), mixed with one and a half times its weight of water, shall be digested at 100° C. (212° F.) for one hour, cooled to 50° C. (122° F.), then strained through flannel, and rapidly concentrated on a water-bath until a density of 1.33 is obtained. Various other methods have been suggested involving the use of different clarifying agents, such as white of egg, gelatin and tannin, animal charcoal, aluminum hydroxide, Irish moss, etc., but all require dilution of the honey with water and subsequent concentration by heat, which is apt to darken the color and impair the aroma. In our experience the first-mentioned process yields quite a satisfactory result.

Properties and Tests.—These should correspond to those mentioned under Crude Honey.

Pharmaceutical Uses.—Clarified honey is used as an excipient for some pill masses and confections, and also as a basis of *mellita*.

Mellita.—Medicated honeys, *E.*; Mellites, *Fr.*; Honige, *G.*—These are simply mixtures of honey with certain medical substances. Owing to their proneness to change, the number of these official mixtures has been considerably diminished, and with but few exceptions none are kept on hand, but are prepared extemporaneously when required by the physician.

Oxymellita.—Oxymels, *E.*, *Fr.*; Sauerhonige, *G.*—are medicated honeys containing acetic acid. (See Oxymel.)

MEL BORACIS, *Br.*—Borax Honey.

Mel sodii boratis.—Honey of sodium borate, E.; *Mellite de borax*, *Miel boraté*, Fr.; *Boraxhonig*, G.

Preparation.—Take of Borax, in fine powder, 60 grains (2 parts); Glycerin 30 grains (1 part); Clarified Honey 480 grains (16 parts). Mix.—*Br.*

Uses.—It is made extemporaneously, and is applied to most of the local affections enumerated in the article on honey.

MEL ROSÆ, *U. S.*—Honey of Rose.

Mel rosatum, P. G.; *Mellitum rosatum.—Mellite de roses rouges*, *Miel rosat*, Fr.; *Rosenhonig*, G.

Preparation.—Fluid Extract of Rose, 120 Cc.; Clarified Honey, a sufficient quantity; to make 1000 Gm. Into a tared vessel introduce the fluid extract of Rose, then add enough clarified honey to make the contents weigh 1000 Gm., and mix them thoroughly. —*U. S.*

If it is desired to make this preparation entirely by measure, 120 Cc. of fluid extract of rose should be mixed with 630 Cc. of clarified honey, or if 12 fluidrachms of the fluid

extract be mixed with 8 fluidounces of clarified honey, the official strength will be practically maintained.

The present official honey of rose is 50 per cent. stronger than that of 1880, the latter Pharmacopœia having directed only 8 parts of rose for every 100 of finished product. The French Codex directs rose-leaves to be infused in water (1 part in 6 of water), and the infusion, after straining, to be mixed with 6 parts of honey and evaporated to a density of 1.27. The Ger. Ph. requires that 1 part of rose-petals shall be macerated with 5 parts of diluted alcohol for twenty-four hours; the expressed liquid to be mixed with 9 parts of clarified honey and 1 part of glycerin, and evaporated to 10 parts.

Action and Uses.—Its agreeable flavor and slight astringent and stimulant virtues render it a very pleasant and useful addition to water as a mouth-wash and gargle in cases of *sore mouth* and *sore throat*, or it may be applied undiluted to the affected part. It is a convenient vehicle for the administration of aromatic sulphuric acid and other acids.

MELILOTUS,—Melilot.

Herba (*Summitates*) *meliloti*, P. G.; *Sweet clover*, E.; *Mélilot officinal*, Fr. Cod.; *Steinklee*, *Melilotenklee*, G.; *Meliloto*, *Trebol oloroso*, Sp.

Nat. Ord.—Leguminosæ, Papilionaceæ.

The leaves and flowering branches of Melilotus officinalis, *Desrousseaux* (Mel. arvensis, *Wallroth*, Mel. diffusa, *Koch*), and of Mel. altissimus, *Thuilliers* (Mel. officinalis, *Willdenow*, Mel. macrorrhizus, *Persoon*).

Origin.—Both plants are indigenous to Europe, the first species having an ascending stem 0.5–1 M. (20 to 40 inches) long, and growing in dry fields and along roadsides; its pale yellow flowers have a short carina and produce obovate, transversely-wrinkled, mostly one-seeded legumes. The second species has been naturalized in the United States, grows in meadows and damp places, has an erect stem 0.9–1.5 M. (3 to five feet) high, the flowers bright yellow, with the carina as long as the standard and wings, and the legume obliquely oval, pointed, pubescent, reticulately wrinkled, and two-seeded. Both plants flower from July to September, and on drying acquire an agreeable odor of coumarin.

Description.—The stipules are entire, awl-shaped; the petiolate trifoliate leaves have oval or obovate-oblong leaflets, the lower ones notched, the upper ones truncate at the apex, entire near the base, and somewhat sharply serrate above, about 2 to 3 Cm. ($\frac{4}{5}$ to $1\frac{1}{4}$ inches) long; the flowers are in spreading or ascending racemes, and the reflexed legumes are brown or blackish. The drug has a strong agreeable odor and a bitterish, aromatic, and somewhat pungent taste.

Allied Plant.—Melilotus albus, *Desrousseaux* (M. vulgaris, *Willdenow*). White melilot is indigenous to Europe and naturalized in the United States; it resembles the preceding species, but has white flowers, the petals of which are unequal, the standard being longest.

Constituents.—The odorous principle was observed by Vogel (1820) and supposed to be benzoic acid. Guillemette (1835) proved it to be identical with Guibourt's *coumarin*, obtained from tonka beans, and which exists also in some rubiaceous plants. (See Galium.) It may be prepared by exhausting the herb with strong alcohol, distilling off most of the solvent, separating the fat, crystallizing, and purifying by recrystallization from alcohol. Coumarin, $C_9H_6O_2$, which has since been isolated from many odorous plants (see pp. 763 and 936), crystallizes in colorless shining prisms, which fuse at 67° C. (152.6° F.) and are readily soluble in fixed and volatile oils, alcohol, and hot water. It was obtained artificially by W. H. Perkin (1867) by treating salicyl-aldehyde with sodium, and decomposing the compound with acetic anhydride. When treated with sodium amalgam it is converted into *melilotic* and *coumaric acids*, which are also present in the herb, sometimes in combination with coumarin. Both acids are crystallizable, and have a bitter taste. Melilotic acid, $C_9H_{10}O_3$, fuses at 82° C. (179.6° F.), and its salts, when strongly heated, yield phenol. Coumaric acid, $C_9H_8O_3$, is also obtained from coumarin by boiling it with concentrated potassa solution; it fuses at 195° C. (383° F.), and the solutions of its salts are fluorescent.

Tonka beans, *E.*, Fève tonka, *Fr.*, Tonkabohnen, *G.*, Haba tonka, *Sp.*, are the seeds of a papilionaceous tree of Guiana, Dipteryx (Coumarouna, *Aublet*) odorata, *Willdenow*. They are nearly 5 Cm. (2 inches) long, somewhat two-edged, deeply wrinkled, blackish-brown, of a fatty lustre, and usually covered with a crystalline efflorescence of coumarin. The so-called English tonka beans, from Dip. oppositifolia, *Willdenow*, are smaller, about an inch (25 Mm.) long, smoother, and contain less coumarin.

Pharmaceutical Preparation.—Emplastrum meliloti. Melt together 4 parts of yellow wax and 1 part each of turpentine and olive oil, and while cooling add 2 parts of powdered melilot.—*P. G.*, 1872.

Action and Uses.—The peculiar odor of melilot, which is closely analogous to that of tonka bean, of vanilla-grass, etc., as well as its active properties, are attributed to a proximate principle, coumarin. In Europe melilot is sometimes strewn among clothing to protect them from moths, and is mixed with snuff to scent it. Formerly it was used in a variety of disorders, including colic, diarrhœa, dysury, dysmenorrhœa, and rheumatism, but at present it is only applied externally, in decoction or infusion or in plasters or or ointments, to allay *local pains*, especially in the abdomen and joints. The liquid preparations named are made with the flowering-tops in water Gm. 16–32 to Gm. 500 (℥ss–j in Oj).

MELISSA, *U. S.*—Melissa.

Folia (*Herba*) *melissæ*, P. G.—*Balm*, *Lemon balm*, E.; *Mélisse officinale*, Fr. Cod.; *Céline*, *Herbe au citron*, Fr.; *Melissenblätter*, *Citronenkraut*, G.; *Toronjil*, Sp.

The leaves and tops of Melissa officinalis, *Linné*.

Nat. Ord.—Labiatæ, Satureineæ.

Origin.—Balm is a perennial herb, from the woody root-stock of which a number of branching, pubescent stems 0.6–1.2 M. (2 to 4 feet) high, are produced. The plant is indigenous to Western Asia and Southern Europe, has become naturalized to some extent in the United States, and is not unfrequently cultivated. The variety *a* citrata, *Bischoff*, or lemon balm, is generally preferred, and is alone recognized by some of the European pharmacopœias. On drying, the fresh leaves lose about 75 per cent. of their weight.

Description.—The leaves are 3–5 Cm. (1¼ to 2 inches) long, petiolate, ovate, with a rounded or somewhat heart-shaped base, coarsely crenate-serrate at the margin, obtusely pointed at the apex, the upper surface with scattered hairs, the lower surface glandular in the axils of the nerves. The upper leaves are smaller, often slowly pubescent on both sides, and at the base rather wedge-shaped. The axillary cymules are about four-flowered; the calyx is hairy, tubular bell-shaped, with the upper lip three-toothed and the lower two-cleft. The milk-white or pale-purplish corolla has the tube curved upward, the upper lip notched and the lower three-lobed, with the lowest lobe largest; the stamens are four in number, the lower pair longer, all converging toward the upper lip. The dried herb has a mild agreeable odor, in the variety mentioned above somewhat like that of lemon; the taste is slightly bitter.

Melissa cordifolia, *Persoon*, of Southern Europe has larger and more woolly leaves of a rather disagreeable odor; it is now regarded as a variety of M. officinalis.

Cedronella Mexicana, *Bentham*, and C. pallida, *Lindley*, are used as substitutes for melissa in Mexico.

Adulterations are not likely to be met with. The leaves of Nepeta cataria, *Linné*, var. *β* citriodora, have an odor resembling that of lemon balm, but they are cordate-ovate, of a gray-green color, soft downy above and tomentose beneath, and by these characters are easily distinguished from melissa.

Constituents.—The leaves contain, besides the common constituents of plants, a small quantity of tannin and bitter principle and about ⅛ to ¼ per cent. of volatile oil, which is colorless or yellowish, has a spec. grav. of about 0.89, dissolves in about 5 parts of alcohol, spec. grav. 0.85, and contains a stearopten.

Pogostemon Patchouly, *Pelletier* (Pog. suave, *Tenore*), is an East Indian, hairy, suffruticose plant, with petiolate ovate or rhombic-ovate, doubly crenate-serrate leaves of a strong, aromatic odor. The volatile *oil of patchouly* is brownish-yellow, and begins to boil at about 257° C. (495° F.), but the greater part distils near 285° C. (545° F.). It contains a hydrocarbon (Gladstone) and a liquid oil, having the same composition as the the stearopten present, $C_{15}H_{26}O$ (Montgolfier, 1877), which after purification melts at 55° C. (131° F.).

Pharmaceutical Preparations.—Aqua melissæ, *P. G.* Take 1 part of balm-leaves and sufficient water; distil 10 parts.

Spiritus melissæ compositus.—Compound spirit of balm, *E.;* Eau des Carmes, *Fr.;* Karmelitergeist, *G.*—Take of balm 14 parts; lemon-peel, 12 parts; nutmeg, 6 parts; cinnamon and cloves, each 3 parts; alcohol, 150 parts; and water, 250 parts; distil 200 parts. —*P. G.* The French Codex gives a similar formula, and directs for the above quantity of spirit nearly 2 parts each of coriander and angelica in addition to the other ingredients

Action and Uses.—Balm tea is a popular and refreshing drink when made with the fresh plant and taken cold. A hot infusion of the dried plant, Gm. 5–10 in Gm. 100 (ʒ1¼–21½ in ʒiij) is one of the mildest that can be used to favor the operation of diaphoretic medicines.

MENISPERMUM, *U. S.*—Menispermum.

Canadian moonseed, Yellow parilla, E.; *Ménisperme du Canada*, Fr.; *Canadisches Mondkorn*, G.

The rhizome and roots of Menispermum canadense, *Linné*.

Nat. Ord.—Menispermaceæ.

Origin.—This is a North American climber, with peltate, roundish-cordate, and angular leaves, small clusters of greenish-yellow flowers, and black, glaucous, roundish kidney-shaped drupes. The rhizome was formerly brought into commerce as *Texas sarsaparilla*, and its botanical source was established by R. P. Thomas (1855).

Description.—The rhizome is several feet long, about 5 Mm. (⅕ inch) thick, of a yellowish-brown color, cylindrical when dry, with numerous fine longitudinal wrinkles, and beset with thin branching rather brittle rootlets. Internally it is yellowish, breaks with a tough fibrous fracture, and exhibits on transverse section a bark of about one-tenth the diameter of the rhizome and composed of two distinct layers, a woody zone consisting of about fourteen rather broad porous wood-wedges separated by medullary rays of nearly the same width, and a large central pith. The rhizome has a slight odor and a bitter taste.

Constituents.—We found (1863) the rhizome to contain a small quantity of berberine and a larger proportion of a white alkaloid, which has a bitter taste, neutralizes acids completely, and yields precipitates with the group reagents for alkaloids. H. L. Barber (1884) found this alkaloid to differ from oxyacanthine and menispermine, and to be insoluble in benzene and alkaline liquids; it dissolves in 75 parts of water, in 6 parts of alcohol, in 40 parts of ether, and in 20 parts of chloroform, and gives with sulphuric acid a brown color, gradually fading; with nitric acid, a yellow color; and with fused zinc chloride, a brownish-yellow color. We propose for this alkaloid the name *menispine*. The rhizome also contains starch, gum, resin, tannin, and other common constituents of plants.

Action and Uses.—It has been reputed for many years that menispermum is tonic, alterative, and diuretic, and that its medicinal qualities are similar to those of sarsaparilla. It much more probably resembles calumba, not so much because, like that medicine, it yields berberine, as because it is bitter. We read that it is used in *scrofulous* affections as a substitute for sarsaparilla, but without the assurance that the latter medicine is itself of demonstrable utility in their treatment. Whatever virtues it may possess await discovery by intelligent investigation.

MENTHA PIPERITA, *U. S.*—Peppermint.

Folia (Herba) menthæ piperitæ, P. G.; *Menthe poivrée*, Fr. Cod.; *Pfefferminze*, G.; *Yerba buena piperita*, Sp.

The leaves and tops of Mentha piperita, *Linné*. Bentley and Trimen, *Med. Plants*, 203.

Nat. Ord.—Labiatæ, Saturcieæ.

Origin.—Peppermint is a perennial plant, readily multiplying by runners, and with a square frequently purplish stem, about 90 Cm. (3 feet) high. Its native country is unknown; it is regarded as a mere variety of M. hirsuta, *Linné*, with which it is connected by many intermediate forms, and from which it was probably produced by cultivation. It is now found wild in wet places in England, in other countries of Europe, and in North America; it is largely cultivated. It flowers in August and September. The moisture of the fresh herb amounts to about 80 per cent.

Description.—The leaves are 50–75 Mm. (2 to 3 inches) long, and all petiolate, the petioles being about 12 Mm. (½ inch) long; they vary in shape between lanceolate and ovate lanceolate, have a rounded base, an acute apex, and a sharply serrate margin; the upper surface is dark-green and smooth, the lower surface paler with numerous glands, and upon the nerves sparingly pubescent. The inflorescence is terminal, and consists of twelve to sixteen whorls, the lowest of which are somewhat distant; it is conical in shape, rounded or somewhat acute above, and 5 Cm. (2 inches) long; the cymules of each

whorl contain about twenty or thirty flowers. The calyx is often purplish, tubular, five-toothed, ten-ribbed, glabrous, but dotted with yellowish glands. The corolla is pale purplish-red and smooth, with the tube about as long as the calyx, and the limb nearly equally four-lobed, and the upper lobe emarginate. The four short stamens are equal in length, and included in the tube. The fruit consists of four brownish smooth or rugose akenes. The herb has a strong peculiar aromatic odor and a pungent and cooling taste.

Several varieties are known, differing in the width of the leaves, the amount of pubescence, and the compactness of the flowering spikes. In Mexico Hedroma piperita, *Bentham*, is used in the same manner as peppermint.

Fig. 182.

Mentha piperita, *Linné:* flower and corolla cut open, magnified 8 diameters.

Constituents.—The most important constituent is the volatile oil to which the drug owes its odor and taste, and of which the dried herb yields in the neighborhood of 1 per cent. (See Ol. Menthæ Piperitæ.) A little tannin and the other constituents are of no medicinal importance. (For Menthol, see page 1034.)

Pharmaceutical Preparations.—Species aromaticæ, *P. G.*—Aromatic herbs, *E.;* Espèces (Herbes) aromatique, *Fr.;* Aromatische Kräuter, *G.*—Peppermint, wild thyme, garden thyme, and lavender-flowers, of each 2 parts; cloves and cubebs, of each 1 part. Cut and bruise separately, separate the fine powder, and mix.—*P. G.* Peppermint, sage, wild thyme, garden thyme, rosemary, hyssop, origanum, and wormwood, of each 1 part.—*F. P.*

Syrupus menthæ (piperitæ).—Syrup of peppermint, *E.;* Sirop de menthe poivrée, *Fr.;* Pfefferminzsyrup, *G.*—Dissolve 60 parts of sugar in 40 parts of infusion prepared from 10 parts of peppermint, 50 parts of water and 5 parts of alcohol.—*P. G.*

Action and Uses.—The name, "peppermint," describes the sharp, biting taste of this plant, whose odor when fresh is likewise very powerful, but refreshing. In the mouth it produces a pungent sensation, followed by a sense of coolness and numbness, increased by inhaling strongly. The essential oil occasions this feeling more sensibly, as well as a diffusive warmth in the abdomen, when it is swallowed. The action of peppermint is mainly that of a carminative stimulant, with a certain degree of anodyne power, which last is especially recognized by the popular use of the bruised fresh leaves to allay *colic*, *headache*, and other local pains. A hot infusion is commonly employed to relieve *colic*, *flatulence*, *diarrhœa*, *vomiting*, *cholera morbus*, *dysmenorrhœa*, and the associated abdominal pains. Nervous *headache*, *palpitation of the heart*, *hiccup*, and other phenomena of difficult digestion are palliated by this medicine. The hot or warm infusion, especially when made with from half an ounce to an ounce of the fresh herb to a pint Gm. 15–32 to Gm. 500, (℥ss–j in Oj) of water is a very excellent preparation. It may be given in tablespoonful *doses*. Usually the water or the spirit is more convenient, given in sweetened hot water. The special virtues of the oil are described elsewhere.

MENTHA VIRIDIS, *U. S.*—Spearmint.

Herba menthæ acutæ (vel romanæ).—*Menthe verte*, Fr. Cod.; *Menthe romaine, Baume vert*, Fr.; *Grüne Minze, Römische Minze*, G.; *Yerba buena*, Sp.

The leaves and tops of Mentha viridis, *Linné*, s. M. sylvestris, var. glabra, *Koch.* Bentley and Trimen. *Med. Plants*, 202.

Nat. Ord.—Labiatæ, Satureieæ.

Origin.—Spearmint is a perennial herb with a square green or sometimes purplish stem about 90 Cm. (3 feet) high, and multiplying extensively by long runners. It is probably a cultivated variety of M. sylvestris, *Linné*, the typical form of which has broader woolly leaves and a cylindrical or subconical inflorescence, and is frequently found in moist and swampy localities throughout the greater portion of Europe. Spearmint appears to be indigenous to England, but it is cultivated and has been naturalized

in the United States and most civilized countries. It flowers from July to September; on drying, its weight diminishes from 80 to 85 per cent.

Description.—The leaves are sessile, or only the lowest with a very short petiole, about 5 Cm. (2 inches) long, lanceolate, acute, serrate, smooth or sparingly hairy, and densely glandular beneath. The inflorescence is in terminal, narrow, acute spikes, with distant whorls of about fifteen to twenty flowers in each. The glandular calyx is tubular-bell-shaped, with five sharp and ciliate teeth; the corolla is light-purplish, naked, four-lobed, and bears upon its tube four long and nearly equal stamens. Spearmint has a strong aromatic odor and a warm aromatic taste, which resembles that of peppermint, but is less pungent, and scarcely cooling.

Folia (herba) mentiæ crispæ.—Crisped (curled) mint, *E.*; Menthe crépue, *Fr.*; Krauseminze, *G.*

The German and other pharmacopœias recognize, instead of spearmint, this cultivated variety, known as Mentha crispa, *Linné*, which is by different botanists referred to M. aquatica, M. sylvestris, or M. piperita, *Linné*. The leaves are sessile or short-petiolate, smooth or somewhat pubescent, heart-shaped or roundish-ovate, acute or pointed, and sharply toothed and crisped on the margin. Other species of mint, like M. viridis, sativa, arvensis, and rotundifolia, *Linné*, frequently produce in cultivation forms with crisped leaves, and the crisped mints cultivated in different parts of continental Europe probably belong to several of these species.

Constituents.—The principal constituent of spearmint is volatile oil (see Ol. Menthiæ Viridis); the others, like a little tannin, are of no medicinal or pharmaceutical importance.

Action and Uses.—The action of spearmint is generally described as identical with that of peppermint, but it is really much less intense. Its uses are the same as those of peppermint, but its milder action has led to its being preferred for infantile cases. An infusion of spearmint may be made with the proportions mentioned under Peppermint.

MENTHOL, *U. S., Br.*—Menthol.

Menthol, Fr., G.

A stearopten (having the nature of a secondary alcohol), obtained from the official oil of peppermint (from *Mentha piperita*, Smith), or from the Japanese or Chinese oil of peppermint (from *Mentha arvensis*, Linné, var. *piperascens*, Malinvaud, and *Mentha canadensis*, Linné, var. *glabrata*, Bentham; nat. ord. Labiatæ).

Formula $C_{10}H_{19}OH$. Molecular weight 155.66.

Origin and Preparation.—The Chinese and Japanese solid oil of peppermint, which consists mainly of menthol, was shown by E. M. Holmes to be prepared from the varieties *glabrata* and *piperascens* of Mentha arvensis, *De Candolle*. Within the past few years A. M. Todd has prepared a very handsomely crystallized and perfectly dry menthol from oil of peppermint distilled from Mentha piperita grown in the United States. This volatile oil, carefully rectified by steam, is cooled by means of ice and salt to — 22.2° C. (— 8° F.), and after it has solidified the temperature is allowed to rise very slowly, the liquid portion being drained off from time to time. This article has become known in our commerce as *pipmenthol*. The yield is about 20 per cent. of the weight of the oil.

Properties.—Menthol forms colorless, acicular or prismatic glossy crystals, which, seen in quantity, have a white appearance; if rapidly congealed the crystals are thin, stellately arranged, and of a satiny lustre. They melt at 43° C. (109.4° F.) to a colorless liquid, boiling at 212° C. (413.6° F.), and have an agreeable odor and taste of peppermint, producing, if air is inhaled, a sensation of coolness. The Chinese menthol appears either in fused crystalline masses or in colorless acicular crystals, which are more or less moist from adhering oil, and differ somewhat in odor from that of pipmenthol. Menthol dissolves sparingly in water, but is freely soluble in alcohol, ether, chloroform, and other solvents of volatile oils; the solutions have a neutral reaction to test-paper. Boiled with sulphuric acid diluted with half its volume of water, menthol acquires an indigo-blue or ultramarine color, the acid becoming brown. Menthol should be entirely volatilized by the heat of a water-bath (absence of magnesium sulphate and other saline or waxy impurities). In contact with thymol, which has a higher melting-point, it becomes liquid (Flückiger, 1885). Triturated with an equal weight of chloral, thymol, or camphor, an oily colorless liquid is produced, soluble in alcohol, benzin, chloroform, ether, and carbon

disulphide, and on being mixed with sulphuric acid acquiring a blue color, the mixture yielding with alcohol a nearly colorless solution (H. V. Becker, 1886).

If a little menthol be heated in an open capsule on a water-bath, it should gradually volatilize without leaving any residue (absence of wax, paraffin, and inorganic substances). If a few crystals of menthol be dissolved in 1 Cc. of glacial acetic acid, and then 3 drops of sulphuric acid and 1 drop of nitric acid added, no green color should be produced (absence of thymol)."—*U. S.*

Action and Uses.—Menthol in a solid form has but a trifling advantage, if any, over pure oil of peppermint, and may be employed for the same purposes. Rubbed upon the skin or mucous membrane as a crystal or in the form of a "pencil," it occasions a sense of coolness, followed by one of burning. It is said to have powerful antibacterial properties. It has been largely used to palliate *zona*, *eczema*, *bites of insects*, *burns*, *scalds*, *carbuncles*, local pains, including *neuralgia*, *toothache*, *earache*, *furuncle* of the *auditory canal* (Szenes, *Therap. Monatsh.*, iv. 488) (a 20 per cent. solution in oil being applied on cotton), *pruritus vulvæ*, *p. ani*, and other forms of pruritus (*Therap. Monatsh.*, iii. 262); to cure *ringworm of the scalp* (a solution of 1 : 12), *hay-fever*, and *coryza* by applying a 10–20 per cent. solution to the nostrils or simply inhaling its vapor, etc. In 1887, S. and A. Rosenberg asserted that nebulized menthol had a remarkable power of controlling, if not of arresting, the progress of *phthisis*, whether laryngeal or pulmonary. In 1888 this praise was repeated by Beehag (*Edinb. Med. Jour.*, xxxiii. 625), who, as well as others, applied menthol to the treatment of affections of the *ear* and *Eustachian* tube, *ozæna*, *catarrhal angina*, chronic *pharyngitis*, and even *diphtheria* (Wolf, *Therap. Monatsh.*, lv. 446). In 1889 the palliative influence of the medicine in vapor or spray was illustrated by Potter and by Knight (*Therap. Gaz.*, xiii. 556), who used it in chronic *bronchitis*, *asthma*, *whooping cough*, etc. (Compare Bishop, *Med. News*, lvii. 81; 197.) Menthol has been given internally to relieve *vomiting*, including that of pregnancy, by Gottschalk and others (℞. Menthol, 1 part, dissolved in spirit of wine and simple syrup, of each 20 parts. Dose, a teaspoonful (*Therap. Monatsh.*, iv. 375). Added to chloroform or ether, it may be applied in spray to produce local *anæsthesia*. Liniments or ointments of the strength of 1 : 10–20 have been employed; and internally menthol has been given in doses of one or two grains, Gm. 0.06–0.12, in pill or olive oil.

MENYANTHES.—Buckbean, Bogbean.

Folia (*Herba*) *trifolii fibrini*, P. G.; *Marsh trefoil*, *Water shamrock*, E.; *Ményanthe*, *Trèfle d'eau* (*de marais*), Fr. Cod.; *Fieberklee*, *Bitterklee*, *Dreiblatt*, G.; *Trébal acuatico*, Sp.

The leaves of Menyanthes trifoliata, *Linné*. Bentley and Trimen, *Med. Plants*, 184.

Nat. Ord.—Gentianaceæ.

Origin.—The buckbean is a perennial indigenous to North America from Pennsylvania northward and to Europe and Northern Asia. It grows in boggy places, has a fleshy rhizome of the thickness of a finger and sheathed by the remnants of the leaf-stalks, and bears a naked scape with about fifteen rose-colored or whitish flowers. It blooms in May and June. The leaves are collected in spring, and on drying lose about 80 per cent. in weight.

Description.—The leaves are on petioles 10–15 Cm. (4 or 6 inches) long, ternate, the leaflets sessile, 5–8 Cm. (2 to 3 inches) long, obtuse, oblong or obovate, entire or slightly crenate, smooth, and pale-green. They are inodorous, and have a very bitter taste, free from astringency.

Constituents.—Trommsdorff found in the leaves the principles usually present in herbaceous parts of plants, and obtained the bitter principle in the form of an extract-like mass. Brandes (1830 and 1842) succeeded in gaining it partly as a thick amorphous mass, partly in yellowish-white granules. Landerer (1839) found an ethereal extract of buckbean to contain white bitter needles, which were soluble in water and alcohol and precipitated by alkalies from their acid solution (?). Kromayer and Ludwig (1861) obtained *menyanthin*, which has probably the composition $C_{33}H_{54}O_{16}$. It dries over sulphuric acid to an amorphous whitish mass, which on the application of heat softens, and at 115° C. (239° F.) is limpid and transparent. It is sparingly soluble in cold water, soluble in alkalies and alcohol, but insoluble in ether. It has a very bitter taste, and when boiled with dilute acids is resolved into sugar, a brown resin, and *menyanthol*, the latter being oily, volatile, heavier than water, and of an agreeable odor resembling that of bitter almonds. The leaves contain a pectin compound, which causes the infusion,

sweetened with sugar, to gelatinize in a few days; this compound is insoluble in dilated alcohol.

Pharmaceutical Uses.—EXTRACTUM MENYANTHIS, S. TRIFOLII FIBRINI. The French preparation is the inspissated juice. In Germany it is made by hot infusion of the dry leaves with water.

Action and Uses.—Water shamrock or marsh trefoil is a bitter tonic which is reputed to be also antiscorbutic, emmenagogue, and vermifuge, and was anciently used in dropsy, urinary disorders, etc. In large doses, like other bitters, it acts as an emetic, and some observers have attributed to it narcotic qualities. It is chiefly used in atonic *dyspepsia* and those hepatic and digestive derangements which are apt to prevail in damp malarial localities. It is a popular remedy for chronic *cutaneous eruptions*, both internally and externally. Its ancient use in *ammorrhœa* has been revived by White (*Lancet*, Jan. 31, 1885, p. 235). The most efficient form of the medicine is the expressed juice, which is administered in the dose of Gm. 64–96 (f℥ij–iij) daily, in whey or thin broth. An infusion is made with Gm. 16 to Gm. 500 (℥ss in Oj) both for internal and external use.

METHYLENI BICHLORIDUM.—METHYLENE BICHLORIDE.

Dichlormethane, *Chloro-methyl*, E.; *Chlorure de méthyle monochloré*, *Ether chlorhydrique monochloruré de l'esprit de bois*, Fr.; *Methylenchlorid*, *Chlormethylchlorür*, G.

Formula CH_2Cl_2. Molecular weight 84.71.

Preparation.—Chlorine gas is conducted into a glass globe containing methyl chloride, CH_3Cl, which glass is drawn out below so as to form a thin tube, passing into one aperture of a Woulfe's bottle, the second tubulure being connected, by means of a bent glass tube, with a second Woulfe's bottle placed in ice, and this with a flask cooled by means of a freezing mixture; the liquid condensed in the Woulfe's bottles is chiefly chloroform, while that condensing in the flask will be pure methylene bichloride. This is Regnault's process, by whom the compound was discovered (1840). It can also be obtained by the reduction of chloroform (in alcoholic solution) by zinc and hydrochloric acid; the heavier liquid is separated and purified by successive treatment with soda solution, sulphuric acid, water, calcium chloride, and fractional distillation.

Properties.—Methylene bichloride is a colorless liquid, having at 15° C. (59° F.) the spec. grav. 1.360, and boiling at 30.5° C. (87° F.) or 41.6° C. (106.88° F.) (Helbing). The same compound, obtained by Butlerow (1859) by heating methylene biniodide in a current of chlorine gas, boiled at 40.5° C. (105° F.). Its odor resembles that of chloroform. It has no action upon test-paper, is soluble in alcohol and ether, and scarcely affected by alcoholic solution of potassa. It is decomposed when exposed to light and air, the change being prevented by the addition of a little alcohol. Its vapor has the density 3.012 and burns with a bright flame.

In composition it may be regarded as the chloride of methylene (CH_2) or as a derivative of methyl, CH_3; the following shows its relation to allied compounds:

	Methyl, CH_3.	Methylene, CH_2.
Marsh gas	$CH_3.H$	———
Methyl chloride	$CH_3.Cl$	———
Methylene bichloride	$CH_2.Cl.Cl$	CH_2Cl_2
Chloroform	$CHCl_2.Cl$	$CHCl.Cl_2$
Chlorocarbon	$CCl_3.Cl$	$CCl_2.Cl_2$

ENGLISH METHYLENE CHLORIDE, or methylene, is a mixture of methylene chloride and ether; it was recommended as a safe anæsthetic in doses of from 1–4 drachms (Richardson), but is not as free from danger as its originator believed. Care should be taken to distinguish between this mixture and the definite chemical compound above mentioned.

A mixture of chloroform and methyl chloride has also figured in commerce as "methylene chloride" (Helbing).

Allied Compounds.—METHYL CHLORIDE, Chlormethyl, Monochlormethane, CH_3Cl. Mol. weight, 50.34. A gaseous compound first proposed by Berthelot, and obtained by the reaction between methyl alcohol and hydrochloric acid in the presence of zinc chloride. After purification by means of water, acid, and alkali, it occurs as a colorless gas with an ethereal odor; it is soluble in one-fourth its volume of water, much more so in alcohol, and freely in ether and chloroform. Under a pressure of five atmospheres at normal temperature methyl chloride is a liquid which should be neutral to test-paper and unaffected by silver nitrate or potassium iodide and starch paste. The compressed liquid form of methyl chloride has been recommended for use as a spray to produce local anæsthesia.

Carbon Tetrachloride, Tetrachlormethane, CCl_4. Mol. weight, 153.45. A transparent, colorless liquid, of the specific gravity, 1.599, boiling at 77° C. (170.6° F.), and an agreeable aromatic flavor. It is obtained in an impure form when dry chlorine is first passed through a bottle containing carbon disulphide, and then through a porcelain tube, filled with pieces of porcelain, and kept at a bright-red heat; the vapors are condensed in a cooled receiver, forming a yellowish-red liquid, which is a mixture of carbon tetrachloride and sulphur chloride. The sulphur chloride is removed by slowly adding the liquid to an excess of potash lye or milk of lime, the mixture being set aside and agitated from time to time till the sulphur compound is decomposed, and then distilled. Carbon tetrachloride passes over, and, if necessary, may be freed from remaining carbon disulphide by further treatment with caustic potash.

Action and Uses.—The inhalation of the vapor is described as being very pleasant and but slightly irritating, drowsiness and unconsciousness coming on without any noise in the head or oppression, and recovery taking place at once and completely, without any sense of depression. Like chloroform, it is very apt to occasion vomiting, and like ether it sometimes causes a stage of excitement and struggling which may be difficult to subdue. Although it does not produce fatal effects as frequently as chloroform, it is not exempt from that danger. Up to 1874 at least four cases had been reported in which death was directly traceable to this anæsthetic, and in the following year a fifth occurred in London. In the last case the breathing became suddenly loud and stertorous, deep, full, and exaggerated: the lips and cheeks retained their color; the pulse at the wrist failed rapidly, and then ceased almost abruptly. A sixth case occurred at Ipswich, England, in which the stertor was preceded by rather violent struggling. Up to 1881 nine deaths were attributed to this anæsthetic, in some of which the abrupt occurrence of death seems to prove that it was due to syncope. In several, also, it followed doses of ½ drachm (Reichert, *Amer. Jour. of Med. Sci.*, July, 1881, p. 52). In 1884 a death by syncope due to this agent occurred in Plymouth, England. The operation for which it was administered was a slight one, and only ten minims of the preparation were given (*Lancet*, June 28, 1884). A similar accident occurred in the same place in 1890 (*ibid.*, Oct., 1890, p. 768). A further, although a subordinate, objection to this compound is its volatility, which renders its use difficult in a hot atmosphere.

In 1877, Mr. Spencer Wells made the following statement (and substantially repeated it in 1888), which, in relation to the particular class of cases referred to, appears conclusive as to the superiority of this anæsthetic: "In 1872, I made known my opinion that all the advantages of complete anæsthesia, with fewer drawbacks, could be obtained better by the use of bichloride of methylene than by any other known anæsthetic. This was the result of the experience of five years and of three hundred and fifty serious operations. The experience of the five succeeding years, with more than six hundred additional cases of ovariotomy and many other cases of surgical operations, has fully confirmed me in this belief. Given properly diluted with air, it has, in my experience of ten years, with more than one thousand operations of a nature unusually severe as tests of an anæsthetic, proved to be, without a single exception, applicable to every patient, perfectly certain to produce complete anæsthesia, relieving the surgeon from all alarm and even anxiety, and its use has never been followed by any dangerous symptoms which could be fairly attributed to it." Other surgeons have testified to its efficiency in a great variety of surgical operations, both capital and trivial, yet, from whatever cause, it does not seem to have supplanted to any great extent either chloroform or ether. Perhaps it may be, as Mr Wells remarks, that the fluid sold as bichloride of methylene may have been only chloroform mixed with some spirit or ether; perhaps the reason may be found in the opinions expressed by Dr. Richardson, that "he was not favorably impressed with the application of the bichloride to *quick* general anæsthesia," and that "it belongs to a dangerous family of chemical substances, and cannot therefore be played with without risk."

In administering the vapor a sufficient proportion of atmospheric air should be admitted along with it. For this purpose a hollow cone made of pasteboard pierced with holes, should contain the cloth or sponge upon which the liquid has been poured. The quantity used should not exceed, for a first inhalation, 30 or 40 minims; half as much may be used each time that signs of returning consciousness appear.

Methylene blue is an anodyne for the pain of *neuralgia* and *rheumatism*, and neuralgic *headache*. It is reported to be ineffectual to relieve *osteocopic* (syphilitic) *pain*, *gastralgia* from ulcers, mental excitement, hallucinations, and insomnia. Its anodyne effect is perceptible about two hours after its administration, and is said to be sustained for about an equal time. During its use the urine acquires a greenish hue. It does not seem to affect the pulse, appetite, or digestion. Its alleged efficacy in phthisis and diph-

theria has not been confirmed (Erlich and Lepmann, *Centralblatt f. Therap.*, viii. 401). It has been given hypodermically in doses of Gm. 0.02–0.08 (gr. $\frac{1}{3}$–1); and internally in doses of Gm. 0.10–0.50 (gr. $1\frac{1}{2}$–8) in gelatin capsules.

Methyli Chloridum.—Methyl chloride was first employed in 1884, in Paris, by Debove, who treated *neuralgia* by directing upon the seats of pain a stream of the compound from a vessel where under pressure it remained liquid, but on escaping into the air was converted into a vapor. When this stream impinges upon the skin it produces smarting and burning, followed by congelation of the part, and, if continued, by vesication and even sphacelus. Hence it was soon recommended not to allow the vapor to fall upon the same spot longer than four or five seconds at a time, nor to strike it vertically. The vesicated skin on healing is apt to be stained brown, but less frequently on the face than elsewhere.

The treatment of *neuralgia* by cold is far from novel. In 1851 it was successfully used by Arnott in England and by Nélaton in France, who both employed freezing mixtures for the purpose. Methyl chloride is only a new agent for effecting a familiar object.

The cases first treated by Debove were of *sciatica* from cold, and in these the method was most successful. Sciatica due to disease of the spine or of the spinal cord has been palliated, but not cured, by congelation. Witness also the results of this treatment in *chorea* and *locomotor ataxia*. *Trigeminal neuralgia* has sometimes been palliated or even removed by it. Its use in articular *rheumatism* has been advocated, but we must regard it as of doubtful value if not dangerous; and the same remark applies to internal *inflammations* for which it has been used, if only to relieve the element pain. Many other agents exist for this purpose, and do not, like this one, involve danger. It has been also used to suspend the sensibility of parts to which the *actual cautery* was applied. To lessen the danger of causing a slough by freezing the skin, Debove suggested that the point on which the spray is to fall should be first coated with glycerin. Instead of the spray, tampons of wool or floss silk saturated with the liquid and covered with thin silk tissue may be applied to the skin with wooden or vulcanite holders.

METHYLI IODIDUM.—Methyl Iodide.

Iodure de methyle, Fr.; *Jodmethyl*, G.

Formula CH_3I. Molecular weight 141.50.

Preparation.—This compound was first obtained by Dumas and Peligot (1835) by adding very gradually 1 part of phosphorus to a solution of 8 parts of iodine in 12 or 15 parts of methylic alcohol, agitating the distillate with water and rectifying. According to Wanklyn (1867), potassium iodide and anhydrous methylic alcohol are mixed in a retort in equivalent proportions; dry hydrochloric acid gas is passed into the mixture, which is then distilled, and the distillate purified as before.

Properties.—Methyl iodide is a colorless liquid of an ethereal odor and the spec. grav. 2.199 at 0° C. (32° F.). It boils at 43.8° C. (111° F.), and by the aid of a wick burns with difficulty, giving off violet vapors.

Allied Compound.—Methylenі iodidum, s. biniodidum, CH_2I_2 (mol. weight, 267.03), was prepared by Butlerow (1859) by acting upon iodoform with sodium ethylate. It is readily formed by heating chloroform with very concentrated hydriodic acid for several hours to near 130° C. (266° F.). It is a yellow liquid having the spec. grav. 3.34, congealing to glossy scales near the freezing-point, and boiling at 180° C. (356° F.), at the same time suffering partial decomposition.

Action and Uses.—Proposed in 1868 by Dr. B. W. Richardson, iodide of methyl was stated to be respirable and anæsthetic when pure, but to give rise to great excitement of the heart and circulation, and when decomposed, as it was apt to become, to produce the irritating effects of iodine, including lachrymation, salivation, and bronchial secretion. In experiments upon animals inhalation of the vapor produced fatal engorgement of the bronchia. Of it Sir James Y. Simpson wrote: "I found it very powerfully anæsthetic, but dangerously so. After inhaling a very small quantity for two or three minutes I remained for some seconds without feeling much effect, but objects immediately began to multiply before my eyes, and I fell down in a state of insensibility, which continued for upward of an hour. I did not completely recover from the effects of it for some days." In 1884, Dr. Richardson used methyl iodide internally, by giving 10 minims of a solution of 6 grains of the iodide in 60 minims of absolute alcohol. This dose he found to be anæsthetic and sedative in cases of *hyperæsthesia* and *neuralgia* attending mammary and uterine *cancer*. Similar effects were noted by Kirk (*Asclepiad*, 1884; *Lancet*, Oct., 1885).

METHYL SALICYLAS, *U. S.*—Methyl Salicylate.

Artificial or synthetical oil of wintergreen, E.; *Methylsalicylat, Künstliches Wintergrünoel*, G.

Formula $CH_3C_7H_5O_3$. Molecular weight 151.64.

Preparation.—The process probably most used is the one which is used extensively for the preparation of ethers, and consists in the heating of the acid in methylic alcohol with concentrated sulphuric acid.

Properties.—Methyl salicylate is "a colorless, or slightly yellowish liquid, having the characteristic, strongly aromatic odor, and the sweetish, warm, and aromatic taste of oil of wintergreen, with the essential constituent of which it is identical, and in place of which it may be used. Specific gravity, 1.183–1.185 at 15° C. (59° F.). Boiling-point, 219°–221° C. (462.2°–429.8° F.). It is optically inactive. Soluble, in all proportions, in alcohol, glacial acetic acid, and carbon disulphide. The alcohol solution is neutral or slightly acid to litmus-paper. If a drop of methyl salicylate be shaken with a little water, and a drop of ferric chloride test-solution subsequently added, a deep violet color will be produced. When heated on a water-bath, in a flask provided with a suitable condenser, it should yield no distillate having the characteristics of alcohol or chloroform. If to 1 Cc. of methyl salicylate, contained in a capacious test-tube, 10 Cc. of sodium hydroxide test-solution be added, and the mixture agitated, a bulky, white, crystalline precipitate will be produced; and, if the test-tube, loosely corked, be subsequently allowed to stand in boiling water for about five minutes, with occasional agitation, a clear, colorless or faintly yellowish and complete solution should be obtained without the separation of any oily drops, either on the surface or at the bottom of the liquid (absence of other volatile oils or of petroleum). If the alkaline liquid thus obtained be subsequently diluted with about three times its volume of water, and a slight excess of hydrochloric acid added, a white, crystalline precipitate will be produced which, when collected on a filter, washed with a little water, and recrystallized from hot water, should respond to the tests of identity and purity described under Acidum Salicylicum (absence of methyl benzoate, etc.)."—*U. S.*

Uses.—The virtues of this compound appear to be the same as those of oil of wintergreen, from which it is derived. (Vid. Oleum Gaultheriæ.)

MEZEREUM, *U. S.*—Mezereon.

Mezerei cortex, Br.; *Cortex mezerei, Cortex thymeleæ (vel coccognidii).—Mezereon-bark*, E.; *Mézéréon, Bois gentil, Garou sanbois*, Fr. Cod.; *Lauréole, Thymelée*, Fr.; *Seidelbast, Kellerhals*, G.; *Macereon, Torriso*, Sp.

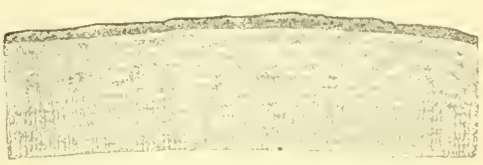
The bark of Daphne Mezereum, *Linné*, Daphne Gnidium, *Linné*, and Daphne Laureola, *Linné*. Bentley and Trimen, *Med. Plants*, 225, 226, 227.

Nat. Ord.—Thymelæaceæ.

Origin.—The three plants named above are small shrubs about 0.6–1.2 M. (2 to 4 feet) high. The mezereon has rose-red, sessile, fragrant flowers in small clusters preceding the deciduous leaves, and is indigenous to hilly and mountainous regions of Europe, extending to the Arctic Circle, and eastward to Siberia. The other two species are found in Southern Europe; D. Laureola, or *spurge laurel*, is also met with eastward to Asia Minor. This species has large evergreen leaves and yellowish-green flowers in axillary clusters, while the *spurge flax* (D. Gnidium) has narrow annual leaves and small white flowers in terminal, corymbose racemes. The bark is usually collected during the winter.

Description.—Mezereon-bark is in long bands about 12 Mm. ($\frac{1}{2}$ inch) wide, 1 Mm. ($\frac{1}{25}$ inch) thick, either folded and tied together in bundles or rolled up into flat disks with the inner surface outward. The outer surface varies in color from pale-yellowish or brownish to brown-yellow, with a coppery lustre, and is marked with numerous minute blackish warts and transversely elongated leaf-scars, in the axils of which is found a cluster of blackish spots. Older bark shows some transverse fissures. The corky layer is easily separated from the pale-greenish outer bark, and with this from the bast-layer. The inner surface is whitish, of a silky lustre, and from loosened bast-fibres has a hairy appearance. The bark tears somewhat

Fig. 183.



Mezereon-bark: transverse section, magnified.

irregularly in a longitudinal direction, but with difficulty transversely. The fine and tough bast-fibres are in tangential rows and alternate with layers of parenchyma, this tissue being radially striate by narrow one-rowed medullary rays. The dried bark is inodorous and has a persistently acrid and burning taste.

The bark of the spurge flax is of a darker brown color, and has numerous spirally arranged leaf-scars; that of the spurge laurel is more of a gray or brown-gray color, not prominently marked with leaf-scars, and has a greenish bast; both agree with mezereon-bark in acridity. The root-bark of the three species is regarded as the strongest, but the stem-bark is most generally met with.

Constituents.—Landerer observed (1836) that mezereon-bark contains a neutral acrid principle which volatilizes with the vapors of water; a similar observation was made by Squire (1842) with mezereon-root, and by Vauquelin (1808) with the distillate from water which had been used for washing the resin. The acrimony is, however, mainly due to a soft resin or oil, which, according to C. G. Gmelin (1822), is not precipitated by lead acetate from its alcoholic solution. This acrid principle deserves further investigation. Vauquelin (1808) discovered *daphnin* in the bark of spurge flax, and the same principle was isolated by Gmelin and Bär (1822) from mezereon-bark. Rochleder (1864) obtained it from the aqueous decoction of the alcoholic extract, after precipitating with sugar of lead, by precipitating it with lead subacetate, decomposing with hydrogen sulphide, washing with ether, and crystallizing from water. It has a persistently bitter, not acrid, taste, and an acid reaction, dissolves readily in hot water and alcohol, is insoluble in ether, yields with alkalies yellow solutions, and colors ferric chloride blue. Zwenger (1860) ascertained it to be a glucoside of the composition $C_{31}H_{34}O_{19}.4H_2O$, yielding *daphnetin*, $C_{19}H_{14}O_9$, which has a coumarin-like odor. On the dry distillation of the alcoholic extract *umbelliferon* is obtained.

Pharmaceutical Uses.—The comminution of the bark requires some precaution to avoid the injurious effects of the dust. The bark may be readily cut into small pieces, and should then be moistened with a little water, which should also be added on bruising the bark in a mortar.

Unguentum mezerei, *U. S.* 1880.—Mezereon ointment. Melt together 12 parts of yellow wax and 80 parts of lard, add 25 parts of fluid extract of mezereon, and heat moderately on a water-bath until the alcohol has evaporated; then stir the mixture until cool.

Allied Drugs.—Fructus (Grana) mezerei, s. gnidii, s. coccognidii.—Mezereon-fruit, *E.*; Grains de garou, *Fr.*; Kellerhalskörner, *G.*—The berry-like fruit of the above species is in the fresh state red or of the spurge laurel blackish, globular-ovate or oval, about 5 Mm. ($\frac{1}{5}$ inch) thick; after drying, brown or black, wrinkled; contains a black glossy seed, is inodorous, and has a strongly acrid and burning taste. Besides gum, vegetable acids, protein compounds, and other medicinally unimportant principles, Casselmann obtained from the fruit 31 per cent. of drying oil, 0.22 per cent. of acrid resin, and 0.38 per cent. of *coccognin*, which differs from daphnin in having a neutral reaction, in being very sparingly soluble in hot water, and in not being a glucoside; when heated it melts, and sublimes apparently unchanged, giving off a coumarin-like odor.

Daphne salicifolia, *Kunth*, grows in Mexico; the leaves, *hojas al San Pedro*, are used for their epispastic properties.

Action and Uses.—Excessive doses of mezereon give rise to symptoms of gastro-intestinal irritation, with violent pain and sometimes very severe urinary irritation. When the bark is fresh or has been soaked in water or in vinegar, it reddens the skin, and at length occasions vesicles, followed by moist and painful ulcers which are difficult to heal. We have elsewhere furnished illustrations of the narcotico-acrid action of mezereon berries and of their use in medicine (*Therapeutics*, 4th ed., i. 407).

At one time mezereon was much in vogue as a remedy for *syphilis*, and to this day it is an ingredient of the compound decoction of sarsaparilla. But the evidence in its favor is not adapted to convince. In chronic non-syphilitic *cutaneous diseases* its reputation was equally ill-founded. In *chronic rheumatism* it seems to have been more useful, but here also its real value in a complex system of treatment is difficult to determine. It is seldom used alone, except as a *local irritant* in the form of the recent or moistened bark above referred to. In this respect it may more or less take the place of cantharides. It has been applied to improve the condition of foul or indolent *ulcers* and to maintain the discharge from *issues* and *setons*. For these purposes mezereon ointment is convenient. To excite vesication the bark, prepared as already described and bound firmly to the skin with a roller, should be freshly applied twice every day until vesication begins.

Mezereon ointment may be used to prolong and renew the suppuration originally produced by cantharides.

When poisoning by mezereon occurs the stomach should be evacuated by lukewarm albuminous or mucilaginous liquids. Milk and fatty oils may also be administered.

MICA PANIS, *Br.*—Bread-Crumb.

Mie du pain, Fr.; *Brodkrumen*, G.

The soft part of bread made with wheat flour.

It is employed as an excipient in the preparation of certain pills, like those of corrosive sublimate, etc., and externally for emollient poultices. It is a constituent of *Cataplasma carbonis.*

Action and Uses.—It may be presumed that this article was made officinal in order that only wheaten bread should be used. But in the only preparation for which it is directed, charcoal poultice, any other form of bread would answer equally well. In this country Indian corn meal is generally employed.

MISTURÆ vel MIXTURÆ.

Mixtures, E.; *Potions, Mixtures*, Fr.; *Mixturen*, G.

Liquid medicines which contain insoluble substances in suspension, or which are composed of two or more liquids, with or without the addition of saline or other material, are termed "mixtures," and in its more limited application the term is restricted to mixtures intended for internal use. They are most frequently prepared extemporaneously and upon the prescriptions of physicians, since even among the official ones but few possess sufficient stability to permit them to be kept on hand for a longer period than a few days. Insoluble substances, when light and readily diffusible in water, do not generally require the addition of gum-arabic or other mucilaginous body to ensure their uniform suspension and the equalization of the dose; such an addition is desirable in all cases where the insoluble bodies are much heavier than water. However, some judicious restrictions are necessary, lest the insoluble compound form a compact deposit which cannot be readily suspended again by agitation. This difficulty may be avoided by reducing the gum to a very small proportion, and increasing the suspending power of the vehicle by the addition of sugar or glycerin.

The term Saturations is applied in Europe to effervescing draughts made from lemon-juice, vinegar, tartaric or citric acid, to which is added a sufficient quantity of a carbonate to afford a nearly neutral salt, the solution remaining charged with as much carbonic acid gas as it will retain without being filtered. The weight of official alkalies required for the neutralization of 100 parts of official acid will be seen from the following table:

Acids.	Ammonium.		Potassium.			Sodium.		
	Ammon. carbon., 100 %.	Ammonia-water, 10 %.	Potassa, 90 %.	Potassium bicarbon., 100 %.	Potassium carbon., 95 %.	Soda, 90 %.	Sodium bicarbon., 98.6 %.	Sodium carbon., 98.9 %.
Acetic	31.43	102.30	37.41	60.07	43.65	26.70	51.14	86.79
" diluted	5.24	17.05	6.22	10.01	7.27	4.45	8.52	14.46
" glacial	86.43	281.32	102.89	165.19	120.00	73.43	140.65	238.66
Benzoic	42.94	139.76	51.11	82.06	59.63	36.48	69.87	118.57
Citric	74.83	243.58	89.09	143.03	103.93	63.58	121.78	206.65
Hydrobromic, diluted	6.47	21.06	7.70	12.37	8.99	5.50	10.53	17.87
Hydrochloric	45.84	149.19	54.57	87.60	63.66	38.94	74.59	126.57
" diluted	14.37	46.77	17.10	27.46	19.96	12.21	23.38	39.68
Lactic	43.65	142.08	51.96	83.43	60.62	37.09	71.03	120.54
Nitric	56.51	183.92	67.27	108.00	78.48	48.01	91.95	156.03
" diluted	8.31	27.05	9.89	15.88	11.54	7.06	13.52	22.95
Phosphoric	90.83	295.67	108.14	173.62	126.16	77.18	147.82	250.84
" diluted	10.69	34.78	12.72	20.43	14.84	9.08	17.39	29.51
Salicylic	37.96	123.55	45.19	72.55	52.72	32.25	61.77	104.82
Sulphuric	98.83	321.70	117.65	188.90	137.26	83.97	160.83	272.92
" diluted	10.68	34.78	12.72	20.42	14.84	9.08	17.39	29.50
Tartaric	69.84	227.35	83.15	133.49	97.00	59.34	113.66	192.87

Mixtures are usually taken by the teaspoonful or tablespoonful; occasionally they are made of such a strength that they require to be taken by drops, and are then often distinguished as GUTTÆ (Drops, *E.*; Gouttes, *Fr.*; Tropfen, *G.*). If intended to be taken at once or in a few divided doses, the mixture is designated as HAUSTUS s. POTIO (Draught, *E.*; Tisane, Potion, *Fr.*; Tränkchen, *G.*). JULAPIUM (Julep, *E.*, *Fr.*, *G.*) is a sweet mixture rendered aromatic by the addition of volatile oil or medicated water, and occasionally colored by the use of a fruit syrup or a little cochineal, etc. A sweet mixture prepared so as to have a thick syrupy consistence is still occasionally distinguished as LINCTUS (*vel* Looch, Lohoch, Eclegma).

MISTURA CREOSOTI, *Br.*—CREOSOTE MIXTURE.

Mixture de créosote, Fr.; *Kreosot-Mixtur*, G.

Preparation.—Take of Creosote, Glacial Acetic Acid, each 15 minims; Spirit of Juniper ½ fluidrachm; Syrup 1 fluidounce; Distilled Water 15 fluidounces. Mix the creosote with the acetic acid, gradually add the water, and lastly the syrup and spirit of juniper.—*Br.*

Uses.—Creosote mixture, it is stated, is intended to allay *vomiting*, but the bulk of its dose and the spirit of juniper and syrup contained in it render it peculiarly unfit to relieve the cases of vomiting in which creosote is most useful. The purpose of the glacial acetic acid in this mixture is not evident. The *dose* is stated to be from Gm. 32–64 (f℥j–ij).

MISTURA CRETÆ, *U. S.*, *Br.*—CHALK MIXTURE.

Mixture avec la craie, Fr.; *Kreidemixtur*, G.

Preparation.—Compound Chalk Powder, 200 Gm.; Cinnamon-water, 400 Cc.; Water, a sufficient quantity, to make 1000 Cc. Rub the compound chalk powder, in a mortar, with the cinnamon-water and about 200 Cc. of water, gradually added, to a uniform mixture; transfer this to a graduated vessel, and rinse the mortar with enough water to make the product measure 1000 Cc. Mix the whole thoroughly. This preparation should be freshly made, when wanted.—*U. S.*

To prepare 4 fluidounces of chalk mixture will require 365 grains of compound chalk powder, 13 fluidrachms of cinnamon-water, and sufficient water to make 32 fluidrachms.

Take of prepared chalk ¼ ounce; gum acacia, in powder, ¼ ounce; syrup ½ fluidounce; cinnamon-water 7½ fluidounces. Triturate the chalk and gum acacia with the cinnamon-water, then add the syrup, and mix.—*Br.*

This mixture spoils readily during warm weather; the addition of a little glycerin or the substitution of glycerin for the sugar, as recommended by G. W. Kennedy (1872), would tend to preserve it for several days while in the hands of the patient, but it should be dispensed only freshly made.

Uses.—Chalk mixture is one of the most convenient forms in which chalk can be administered in the *diarrhœas* both of adults and children, especially when the discharges are yeasty or greenish and there is flatulent distension of the abdomen with sour eructations. If there is reason to suspect the presence of undigested food in the bowels, a dose of magnesia should first be given. For the watery diarrhœa which often precedes the attack of *epidemic cholera* there is no better medicine than this. In most cases laudanum should be added to the mixture or given along with it, and ordinarily its efficiency is much increased by the addition of kino, krameria, or catechu. The *dose* is Gm. 16 (f℥ss).

MISTURA FERRI AROMATICA, *Br.*—AROMATIC MIXTURE OF IRON.

Potion (Mixture) de fer aromatique, Fr.; *Aromatische Eisenmixtur*, G.

Preparation.—Take of Red Cinchona-bark, in powder, 1 ounce; Calumba-root, in coarse powder, ½ ounce; Cloves, bruised, ¼ ounce; Fine Iron Wire ½ ounce; Compound Tincture of Cardamoms 3 fluidounces; Tincture of Orange-peel ½ fluidounce; Peppermint-water a sufficiency. Macerate the cinchona-bark, calumba-root, cloves, and iron with 12 fluidounces of peppermint-water in a closed vessel for three days, agitating occasionally; then filter the liquid, adding as much peppermint-water to the filter as will make the product measure 12½ fluidounces; to this add the tinctures, and preserve the mixture in a well-stoppered bottle.—*Br.*

This has been introduced into the British from the old Dublin Pharmacopœia. During the maceration a portion of the iron is dissolved by the organic acids contained in the drugs.

Uses.—This is a mixture of bitter tonics and aromatic stimulants with a modicum of iron. Many years ago it was appropriately described by Neligon, who said; "In consequence of its black color it is commonly known as *Heberden's ink*." It is an unchemical compound, but an excellent tonic; it is very generally used in Dublin in the various states of debility attended with anæmia. *Dose*, Gm. 32–64 (℥j–ij).

MISTURA FERRI COMPOSITA, *U. S., Br.*—Compound Iron Mixture.

Griffith's mixture, E; *Mixture de Griffith*, Fr.; *Griffith's Eisenmixtur*, G.

Preparation.—Ferrous Sulphate, in crystals, 6 Gm.; Myrrh, in small pieces, 18 Gm.; Sugar, 18 Gm.; Potassium Carbonate, 8 Gm.; Spirit of Lavender, 60 Cc.; Rose-water, a sufficient quantity, to make 1000 Cc. Rub the myrrh, sugar, and potassium carbonate, in a mortar, with 700 Cc. of rose-water, at first very gradually added, so that a uniform mixture may result. Transfer this to a graduated vessel, add the spirit of lavender, then the ferrous sulphate, previously dissolved in about 50 Cc. of rose-water, and lastly, enough rose-water to make the product measure 1000 Cc. Mix the whole thoroughly. This preparation should be freshly made, when wanted.—*U. S.*

Each fluidounce of this preparation contains about 3 grains of ferrous sulphate, 9 grains each of myrrh and sugar, 4 grains of potassium carbonate, ½ fluidrachm of spirit of lavender, and 7½ fluidrachms of rose-water.

In the formula directed by the British Pharmacopœia the ingredients are sulphate of iron 25 grains; potassium carbonate 30 grains; myrrh and refined sugar, each 60 grains; spirit of nutmeg 4 fluidrachms; and rose-water 9½ fluidounces (Imperial).

The preparation of this mixture presents no difficulty if good tears of myrrh are selected and the directions are strictly followed. The reaction between the iron and potassium salts, resulting in the formation of ferrous carbonate and potassium sulphate, takes place in the myrrh emulsion, by which the insoluble ferrous carbonate is kept in suspension. Unless in full and well-corked bottles, the mixture, at first of a dirty greenish color, is hardly protected against oxidation by the small quantity of sugar present, and should be freshly made when needed.

Uses.—This preparation has special advantages over other ferruginous medicines in several chronic affections, and especially in *chlorotic anæmia*, *chronic bronchitis*, *albuminuria*, and certain chronic *diseases of the skin* (eczema, psoriasis). These disorders have in common a deteriorated condition of the blood and a debility of the nervous system, which the iron of the mixture is adapted to correct, and several among them present in addition a relaxed state of the secretory organs, which the myrrh and the sulphuric acid tend to counteract. The first-named two are those which usually exhibit the most favorable results of its use. The mixture was originally called *antihectic* from the utility it manifested in hectical conditions of pulmonary disease—not those, however, as is sometimes erroneously supposed, which belong to tubercular consumption, but those of chronic bronchitis attended with purulent expectoration, and usually associated with dilatation of the bronchia. The *dose* is from ½ ounce to 1½ Gm. 16–40 (f℥ss–iss) two or three times a day.

MISTURA GLYCYRRHIZÆ COMPOSITA, *U. S.*—Compound Mixture of Glycyrrhiza.

Brown Mixture, E.; *Mixture de réglisse*, Fr.; *Lakritzen-Mixtur*, G.

Preparation.—Pure Extract of Glycyrrhiza, 30 Gm.; Syrup, 50 Cc.; Mucilage of Acacia, 100 Cc.; Camphorated Tincture of Opium, 120 Cc.; Wine of Antimony, 60 Cc.; Spirit of Nitrous Ether, 30 Cc.; Water, a sufficient quantity, to make 1000 Cc. Rub the pure extract of glycyrrhiza in a mortar, with 500 Cc. of water, until it is dissolved. Transfer the solution to a graduated vessel containing the other ingredients, and rinse the mortar with enough water to make the product measure 1000 Cc. Mix the whole thoroughly.—*U. S.*

Each fluidounce of "brown mixture" contains about 15 grains of pure extract of glycyrrhiza, 25 minims of syrup, 50 minims of mucilage of acacia, 1 fluidrachm of cam-

phorated tincture of opium, 30 minims of wine of antimony, and 15 minims of spirit of nitrous ether.

The present official formula differs from that of 1880 in ordering syrup and mucilage in place of sugar and powdered acacia, whereby the preparation of the mixture is expedited. The appearance of the finished product is still very unsightly and by no means in keeping with modern elegant pharmacy. The formula suggested by C. Tilyard in 1860 yields an equally efficient and far handsomer preparation: it prescribes a larger proportion of sugar (by no means a disadvantage), and can be still further improved upon by the use of purified extract of licorice, as now ordered by the Pharmacopœia. The formula as modified and adapted to the proportions of the Pharmacopœia is as follows: Dissolve 1 av. oz. of purified extract of glycyrrhiza in 10 ounces of water; add 4 fluidounces of camphorated tincture of opium, 2 fluidounces of antimonial wine, and 1 fluidounce of spirit of nitrous ether, and set the mixture aside for twelve or twenty-four hours with occasional agitation; filter the liquid into a bottle containing 3 fluidounces of mucilage of acacia and 20 av. ozs. of granulated sugar, and wash the filter with sufficient water to bring the volume of the finished product up to 2 pints. The sugar is readily dissolved by agitation, and the result is a thin, rich-looking, clear syrup which keeps admirably.

Uses.—Compound liquorice mixture, or *brown mixture*, as it is frequently called, is an agreeable and efficient remedy in the early stages of *acute bronchitis* and catarrhal *laryngitis*. It hastens and promotes expectoration, chiefly by reducing the febrile tension of the vascular system. The average *dose* for an adult is Gm. 16 (f℥ss).

MISTURA MAGNESIÆ ET ASAFŒTIDÆ.—Mixture of Magnesia and Asafetida.

Mistura carminativa Dewees.—Dewees' carminative, E.; *Mixture carminative de Dewees*, Fr.; *Dewees' Carminativ*, G.

Preparation.—Magnesium carbonate, 5 parts (350 grains); Tincture of Asafetida, 7 parts (490 grains or 8½ fluidrachms); Tincture of Opium, 1 part (70 grains or 75 minims); Sugar, 10 parts (700 grains or 1⅝ oz. av.); Distilled Water, a sufficient quantity, to make 100 parts (7000 grains). Rub the magnesium carbonate and sugar in a mortar with the tincture of asafetida and tincture of opium. Then gradually add enough distilled water to make the mixture weigh 100 parts (7000 grains = 16 oz. av. or about 15 fluidounces).

Uses.—It is to be regretted that this mixture was made official. An intelligent physician would desire to vary the proportions of its several constituents, and especially of its narcotic ingredient, for almost every case of infantile colic under his care. Such mixtures do not tend to promote rational medicine. It will be observed that the laudanum in this mixture forms one-hundredth of the whole. The average *dose* is Gm. 1.25 (♏xx).

MISTURA OLEI RICINI, *Br. Add.*—Castor-oil Mixture.

Mixture d'huile de ricin, Fr.; *Ricinusöl Mixtur*, G.

Preparation.—Take of Castor Oil, 6 fluidrachms; Oil of Lemon, 10 minims; Oil of Cloves, 2 minims; Syrup, 1½ fluidrachms; Solution of Potash, 1 fluidrachm; Orange-flower water sufficient to produce 2 fluidounces. Mix the oils in a mortar; then incorporate one-third of the solution of potash, and afterward the syrup, then an additional third of the solution of potash, then, gradually, half of the orange-flower water, the remainder of the solution of potash, and lastly, enough orange-flower water to produce the required volume.—*Br. Add.*

This mixture cannot be strictly classed among the emulsions, since partial saponification of the oil is effected by aid of the potassium hydroxide, and this facilitates the suspension of the remaining oil in the aqueous liquid. Each fluidrachm of the preparation contains 22½ minims of castor oil.

Dose, ½ to 2 fluidounces.

MISTURA RHEI ET SODÆ, *U. S.*—Mixture of Rhubarb and Soda.

Potion à la rhubarbe alcaline, Fr.; *Alkalische Rhabarbermixtur*, G.

Preparation.—Sodium Bicarbonate, 35 Gm.; Fluid Extract of Rhubarb, 15 Cc.;

Fluid Extract of Ipecac, 3 Cc.; Glycerin, 350 Cc.; Spirit of Peppermint, 35 Cc.; Water, a sufficient quantity, to make 1000 Cc. Dissolve the sodium bicarbonate in about 400 Cc. of water. Then add the fluid extracts, the glycerin, and the spirit of peppermint, and, lastly, enough water to make 1000 Cc.—*U. S.*

To prepare 4 fluidounces of this mixture dissolve 64 grains of sodium bicarbonate in 14 fluidrachms of water, add 30 minims of fluid extract of rhubarb, 6 minims of fluid extract of ipecac, 12 fluidrachms of glycerin, 72 minims of spirit of peppermint, and, finally, enough water to make the volume as desired.

The mixture has a deep brown-red color.

Uses.—Like the mixture of magnesia and asafetida, this preparation is much more appropriate for magistral than for official prescription. The Pharmacopœia already possesses the aromatic syrup of rhubarb, which is purgative and carminative, and to it bicarbonate of sodium is commonly added when required. The *dose* of this mixture is variously stated at from ½ drachm (*U. S. D.*) to 3 ounces (Ede's *Handbook*). For infantile dyspeptic *colic* and *diarrhœa* about Gm. 2 (fʒss) may be given, and repeated, if necessary, at hourly intervals.

MISTURA SENNÆ COMPOSITA, *Br.*

(See Compound Mixture of Senna, under Infusum Sennæ, p. 873.)

MISTURA SPIRITUS VINI GALLICI, *Br.*

Mixture of spirit of French brandy, *Brandy mixture*, E.; *Mixture de cognac*, Fr.; *Branntwein-Mixtur*, G.

Preparation.—Take of French Brandy, Cinnamon-water, each 4 fluidounces; the Yolks of 2 Eggs; Refined Sugar, ½ an ounce. Rub the yolks and sugar together, then add the cinnamon-water and spirit.—*Br.*

In our opinion this preparation scarcely deserves a place in a pharmacopœia.

Uses.—As a nutritious and stimulant draught this preparation is often useful in *typhoid states* of fever and in exhaustion from nervous excitement, hæmorrhage, and other conditions which do not contraindicate the use of alcohol. "Eggnog" made with milk is much more efficient than this preparation.

MITCHELLA.—Mitchella.

Partridgeberry, *Checkerberry*, *Squaw-vine*, *Winterclover*, E.

Mitchella repens, *Linné*.

Nat. Ord.—Rubiaceæ, Cinchoneæ.

Description.—This pretty North American evergreen, which is found in woods, has a creeping and branching stem 25–30 Cm. (10 to 12 inches) long, and opposite petiolate, roundish-ovate, entire leaves, which are about 12 Mm. (½ inch) long, and often marked with white lines. The flowers are in pairs, often diœcious, have a white or pale-purplish funnel-shaped corolla, and four exserted or included stamens, and produce a rather dry berry-like scarlet-red fruit, which is composed of two united ovaries and contains four bony nutlets. The flowers are fragrant; the leaves are inodorous, somewhat astringent, and bitter.

Constituents.—Brenneiser (1887), besides the usual constituents of plants, found a saponin-like body, precipitable by baryta, and frothing in aqueous solution, and also a principle yielding precipitates with tannin and picric acid, but being neither alkaloid nor glucoside.

Action and Uses.—The virtues of this plant are exceedingly indefinite, for it is reputed to be diuretic, tonic, and astringent, and capable of facilitating childbirth if taken for several weeks before the close of pregnancy. It very probably may be useful in chronic disorders of the urinary passages when given in decoction.

MONARDA.—Horsemint.

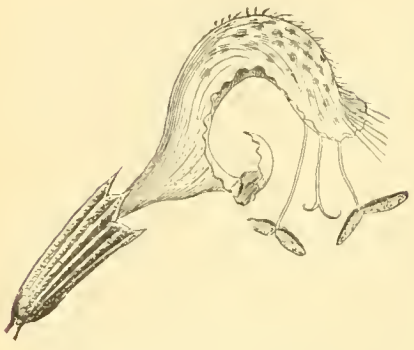
American horsemint, E.; *Menthe de cheval*, Fr.; *Pferdeminze*, G.

The leaves and tops of Monarda punctata, *Linné*. Bentley and Trimen, *Med. Plants*, 208.

Nat. Ord.—Labiatæ, Monardeæ.

Origin.—Horsemint is a perennial herb 30–60 Cm. (1 to 2 feet) high, which is indigenous to the United States, where it grows in dry sandy fields from New York westward to Illinois, and southward to near the Gulf of Mexico. It flowers in the latter part of summer until September, and should be collected with the flowering tops.

Fig. 184.



Flower of Monarda punctata, *Linné*.

Description.—The leaves are about 5 Cm. (2 inches) long, lanceolate, somewhat toothed, acute, narrowed at the base into a petiole, smooth above, and glandular dotted beneath. The whorls of cymules are about ten-flowered, situated in the axils of the upper leaves, and surrounded by about eight leafy, sessile, and entire bracts, which are pale-yellow and purple in color. The tubular, downy calyx is divided into five short and rigid teeth. The corolla is prominent, yellowish, with the large arched upper lip spotted with purple, and a small, three-lobed, somewhat crisped lower lip. The two slender exserted stamens are inserted in the throat above the narrow corolla-tube. Horsemint has a strong aromatic odor and a warm, pungent, somewhat bitterish taste.

Other Species of Monarda.—M. DIDYMA, *Linné*, or *Oswego tea*, is found in the Alleghanies and northward to Canada and Wisconsin. It has the larger bracts and floral leaves tinged with red, and showy bright-red corollas, with the stamens exserted beyond the narrow upper lip.

M. FISTULOSA, *Linné*, or *wild bergamot*, has the larger bracts and floral leaves of a grayish tint, and whitish or pale-purplish flowers with exserted stamens; it grows in woodlands from New England to Wisconsin southward.

Substitutions.—In some counties of Pennsylvania Pycnanthemum incanum, *Michaux*, or *wild basil*, is known and popularly used as horsemint; the plant is downy to hoary, has acute, ovate, or oblong leaves, the upper ones whitened, and the flowers in dense heads with narrow linear bracts and awned calyx-lobes. In Great Britain, Mentha sylvestris, *Linné*, is known as horsemint.

Constituents.—The important constituent is the volatile oil, which is contained in the leaves and flowers; nothing is known about the other principles, among which are doubtless those commonly met with in herbaceous plants.

OLEUM MONARDÆ, *U. S.* 1870.—Oil of horsemint, *E.;* Essence de menthe de cheval, *Fr.;* Pferdeminzöl, *G.*—This volatile oil is obtained in the United States from fresh horsemint by distillation with water or steam. It is yellowish or usually of a reddish or brownish-red color, lighter than water, readily soluble in alcohol, crystallizing below 5° C. (39° F.), and of a peculiar fragrant odor and pungent taste. Boiled with nitro-prusside of copper, it becomes colorless, greenish, brown, and finally nearly black. Iodine dissolves quietly, turning the oil bright red, afterward blackish and pitchy. The elæopten is probably a hydrocarbon, but has not been examined. The stearopten is *thymol*, $C_{10}H_{14}O$, identical with that obtained from oil of thyme. (See THYMOL.)

Action and Uses.—Horsemint is regarded as being diaphoretic, diuretic, carminative, and emmenagogue, like most other plants of its class containing an acrid essential oil. It may be used in hot infusion to prevent the formation of *catarrhal*, *rheumatic*, and *diarrhœal* affections occasioned by cold. The infusion is usually made with Gm. 16 in Gm. 500, half an ounce of the herb in a pint of hot water, and may be given in wineglassful doses. The smallest drop of the oil of horsemint diffuses a pungent, aromatic, and persistent heat over the tongue and fauces; when applied to the skin it excites redness and heat, and, if the application is continued, pain and vesication also. It may be used for the same purposes as oil of pepermint, etc., but is more frequently employed with soap liniment or camphorated oil in embrocations to relieve the pain of *muscular rheumatism*, *chronic articular rheumatism*, and *neuralgia*. It is also applied in liniments for local *paralysis*, *flatulent colic*, *cholera infantum*, and even in *low forms of fever*. For these purposes 1 part of oil to 3 or four of the excipient may be prescribed. In neuralgia it may be applied pure. Internally the oil may be given in doses of Gm. 0.06–0.15 (♏i–iij), properly diluted with sweetened water.

MONESIA.—MONESIA-BARK.

The bark of Chrysophyllum glyciphlœum, *Casaretti*.

Nat. Ord.—Sapotaceæ.

Origin.—The tree yielding monesia-bark is indigenous to the forests of Brazil, and has alternate, coriaceous, and entire leaves. The berry-like fruits of several species of Chrysophyllum are edible, Ch. Cainito, *Linné*, being known as *star-apple*.

Description.—The bark is in flat or curved pieces 3 to nearly 6 Mm. ($\frac{1}{8}$ to $\frac{1}{4}$ inch) thick, often 5 to 7 Cm. (2 or 3 inches) broad, externally marked with confluent ridges, forming large irregularly quadrangular or hexagonal meshes, which are covered with a thin, smooth, whitish tissue while the bark is young. The inner surface is cinnamon-colored and longitudinally striate, otherwise smooth. The bark is very hard, breaks with a granular fracture, and shows in the interior alternate layers of brown and pale-reddish tissue. It is inodorous and has a peculiar taste, which is at first sweet like liquorice, afterward bitterish, somewhat acrid and astringent.

Constituents.—Monesia-bark was examined by Derosne, Henry, and Payen (1840), who announced the presence of *glycyrrhizin*, *monesin*, which appears to be identical with saponin, *tannin*, red-coloring matter resembling kinic red, trace of volatile oil, pectin, 3 per cent. of ash, etc. Heydenreich (1839) separated from the aqueous extract 52 per cent. of tannin and 36 per cent. of a sweet principle, which was not precipitated by sulphuric acid or lead acetate, and was not fermentable.

Extractum monesiæ, *Monesia*, comes from Brazil in irregular dark-brown friable angular pieces, destitute of any red hue. It is soluble in water, and has a sweet afterward astringent taste, followed by slight but persistent acridity.

Allied Trees.—Achras Sapota, *Linné*, s. Sapota Achras, *Miller*, is known in the West Indies and South America as *sapota* (*zapotillo*, Sp.); it has large whitish flowers and globular-oval somewhat angular fruits, which are externally rust-brown and rough, internally whitish, and soft-pulpy, and contain several glossy black seeds. The tree contains a bitter milk-juice. The bark has a bitter and strongly astringent taste, and is employed as a febrifuge. Bernou (1882) found in it two resins, 11.8 per cent. of tannin, and the alkaloid *sapotine*, which is soluble in alcohol, ether, and chloroform, and is precipitated from its salts by ammonia. The ripe fruit has a quince-like flavor, and is known as *sapodilla plum*. The very bitter seeds possess diuretic and aperient properties; they contain an acrid, white crystalline glucoside, *sapotin*, $C_{29}H_{52}O_{20}$, which is soluble in water and hot alcohol, but insoluble in ether, chloroform, and benzene (G. Michaud, 1891).

Lucuma salicifolia, *Kunth*, is the *zapote borracho* (*z. amarillo*) of Mexico, the fruit being considered soporific, and the seed useful in pleurisy.

Mimusops Elengi, *Linné*. The bark and root are used in India as a tonic and astringent; the flowers yield by distillation with water a very fragrant perfume; the fruit is sweet and edible; the seeds yield a fixed drying oil, and the timber is durable and heavy.

Bassia longifolia, *Linné*. The East Indian *elloopa tree* yields valuable timber, and from the flowers and fruits a nourishing jelly; the leaves and bark, like the fixed oil of the seed, are used in rheumatic and cutaneous diseases. A similar use is made of *fulwa-butter*, a butyraceous fat prepared from the pale-brown glossy seeds of Bassia butyracea, *Roxburgh*.

Action and Uses.—Internally and in small doses, as from 4 to 8 grains, monesia gives tone to the stomach and increases the appetite, but in doses of 20 or 30 grains it occasions gastric oppression and constipation. Upon recent sores it causes a burning and stinging pain of brief duration, lessening their secretions and promoting granulation and cicatrization. Monesin acts upon such sores as a more active irritant, inducing rapidly a plastic exudation.

The medicinal uses of monesia denote its possession of a stimulant as well as an astringent property. It has been found useful in atonic *dyspepsia*, in *vomiting* produced by atony rather than by active irritation of the stomach, and in all forms of *diarrhœa* unattended with fever. It has been employed with profit in chronic *bronchitis*, in various forms of hæmorrhage, especially *hæmoptysis* and *menorrhagia*, and locally by injection in *epistaxis*. In various ecchymoses depending upon *scurvy* its internal administration is said to have been advantageous. As a topical application it has been recommended in *ulcers* and *pseudo-membranous* exudations of the mouth and fauces and of many other parts; also in *leucorrhœa* and *gleet*, and especially in *fissures* of the *mouth* and *anus*. Although these virtues of monesia appear to have been demonstrated by clinical observation, the medicine seems to have been neglected and almost fallen into disuse.

The *dose* of monesia may be stated at from Gm. 0.15–1.30 (gr. iij–xx) or Gm. 0.60–4 (gr. x–lx) a day. Monesin has been recommended in the dose of $\frac{1}{2}$ grain. For local applications the tincture diluted with from 10 to 20 parts of water has been used; also an ointment made with 1 part of the extract to 7 of lard, and a glycerole of similar proportions

MORI SUCCUS, *Br.*—Mulberry-juice.

Succus mororum.—Suc de mûres, Fr.; *Maulbeersaft*, G.; *Jugo del moras*, Sp.

The juice of the ripe fruit of Morus nigra, *Linné*. Steph. and Church, *Med. Bot.*, plate 39; Bentley and Trimen, *Med. Plants*, 229.

Nat. Ord.—Urticaceæ, Artocarpeæ.

Origin.—The black like the white mulberry, Morus alba, *Linné*, is indigenous to the Levant; both are rather small trees, about 9 M. (30 feet) high, and are cultivated and partly naturalized in Europe, where the leaves of both, more generally of the white, are employed for feeding the silkworm. Both species are also occasionally seen in cultivation in the United States; alba, however, is alone naturalized. The mulberry is usually monœcious; the staminate flowers are in loose catkins, the pistillate flowers in short dense spikes; the latter flowers contain a two-celled ovary with two thread-like styles, one of the cells disappearing after fructification, while the four-lobed calyx becomes fleshy.

Description.—Through the coalescence of the fleshy calyces the pistillate spikes of the mulberry ripen into what appears to be a compound berry or drupe having some resemblance to the blackberry. The mulberry is of an oblong or ovate form, about 25 M. (1 inch) long, fleshy and juicy, purplish-black, each fruit crowned with the filiform styles. The fruit proper is a lenticular akene enclosed in the fleshy calyx. Mulberries contain a dark reddish-purple juice, and have scarcely any odor, but possess a very agreeable acidulous taste.

Morus rubra, *Linné*, is common in rich woods in the United States from Western New England southward to Florida, and westward to Dakota and New Mexico. It is usually from 6 M. (20 feet), but occasionally 18 (60 feet) high, and has a durable, hard, yellowish wood. The fruit is dark-purple, 25–38 Mm. (1 to 1½ inches) long, and otherwise resembles the preceding.

Constituents.—From comparative experiments made in the laboratory of Fresenius (1857), it appears that mulberries contain more sugar than gooseberries, currants, strawberries, raspberries, blackberries, and huckleberries, while in the free acid they are about intermediate between wild and cultivated raspberries. The analytical results, as obtained by Van Hees, were as follows, caculated for 100 parts of the fruit: sugar, 9.192, free acid (estimated as malic acid) 1.860, albuminous compounds 0.394, pectin, gum, and other organic compounds 2.031, ashes 0.566, and water 84.707 parts, the remaining 1,250 parts consisting of the akenes and other tissues, with the insoluble organic compounds and ash.

C. R. A. Wright and G. Patterson (1878) examined the juice expressed from mulberries not quite ripe, and obtained from one liter 26.83 Gm. of citric acid, 7.82 malic acid, 2.74 glucose, 23.37 other organic constituents, and 9.40 ash—a total of 76.16 Gm. of solids. The juice had slightly fermented, and contained a trace of volatile, probably acetic, acid.

Action and Uses.—Mulberries are refreshing to the taste like all subacid fruits, and slightly laxative. Their fresh juice, or a syrup prepared with it, is frequently employed in Europe for the same purposes to which in this country the juice and jelly of currants are applied—viz. in *inflammations* with *fever*, and especially *sore throat*. The bark of the root of Morus nigra has been found an efficient substitute for pomegranate-root in the treatment of *tænia*.

MORPHINA, *U. S.*—Morphine.

Morphia, Morphinum, Morphium.—Morphia, E.; *Morphine*, Fr.; *Morphin*, G.

Formula $C_{17}H_{19}NO_3.H_2O$. Molecular weight 302.34.

Origin.—Morphine is an alkaloid which has thus far only been found in opium, in the capsules of the different varieties of Papaver somniferum, *Linné*, and in the milk-juice of the red-flowering Pap. orientale, *Linné*; according to Charbonnier (1868), it is also present in Argemone mexicana, *Linné*. Although obtained by Derosne (1803) in an impure condition by precipitating a concentrated infusion of opium with ammonia, it was confounded by him with narcotine. Sertürner (1816), however, not only established its difference from that body, but also proved its basic nature and its poisonous effects. Morphine was the first organic alkaloid known.

Preparation.—The process of Dr. E. Staples (1829) is essentially the following: Opium, sliced, 12 troyounces; Water of Ammonia, 6 fluidounces; Animal Charcoal, in

fine powder, Alcohol, Distilled Water, each a sufficient quantity. Macerate the opium with 4 pints of distilled water for twenty-four hours, and, having worked it with the hands, again macerate for twenty-four hours, and strain. In like manner, macerate the residue twice successively with the same quantity of distilled water, and strain. Mix the infusions, evaporate to 6 pints, and filter; then add 5 pints of alcohol, and afterward 3 fluidounces of the water of ammonia, mixed, as before, with ½ pint of alcohol, and set the liquid aside for twenty-four hours that crystals may form. To purify these, boil them with 2 pints of alcohol until they are dissolved, filter the solution while hot through animal charcoal, and set it aside to crystallize.

On maceration with water, the morphine, minute traces excepted, is readily dissolved, together with other constituents. To decompose the morphine salt ammonia is added; by this process the morphine is rapidly deposited, together with narcotine and some of the other alkaloids, and mixed with considerable coloring matter, from which it may be freed by repeatedly recrystallizing from dilute hydrochloric acid and expressing. Most of the coloring matter and narcotine remains in solution. and at the same time not an inconsiderable amount of morphine hydrochlorate enters the mother-liquors. from which it may be subsequently recovered. If, however, the concentrated infusion of opium is mixed with not more than an equal bulk of the alcohol, and a sufficient amount of ammonia-water is added, the morphine will be more slowly precipitated in a crystalline condition, while the great bulk of the coloring matter remains in solution. The slower the separation of the alkaloid, the larger and purer will be its crystals; hence the advantage of adding the ammonia in separate portions. Since morphine is soluble in ammonia, only sufficient of the latter should be added to unite with the acids, and if in slight excess it should be allowed to evaporate by exposure. The mother-liquor from this evaporation contains a small amount of morphine, which, when working on a larger scale, it is important to recover. The alcohol may be distilled off, and if not otherwise purified may be reserved for a similar purpose. If the process has been well conducted, the crude morphine has a light-brownish color, which is removed by dissolving in hot alcohol and treating with animal charcoal. The mother-liquor from this crystallization retains a portion of the morphine, together with the narcotine first precipitated. On distilling off the alcohol the alkaloids are obtained, and may be preserved until sufficiently accumulated for further purification. Narcotine may be separated from morphine by treatment with ether, in which the former is readily soluble, the latter entirely insoluble.

Many other processes have been proposed. As a rule, the treatment of opium with acidulated water or alcohol offers no advantages, since more narcotine and other organic compounds are thereby dissolved. Wittstock proposed to separate the narcotine from the infusion of opium by sodium chloride, in which the narcotine is insoluble, but a little morphine is likewise liable to be deposited. The first precipitation with ammonia is sometimes effected at a boiling temperature; after cooling the morphine will be granular, and may be more advantageously washed with cold water and expressed. Precipitation with sodium carbonate does not appear to ensure a larger yield. Pelletier observed that when acetic acid is added to crude powdered morphine until the liquid begins to retain an acid reaction, all the morphine will be dissolved, while the narcotine remains behind; and this behavior may be used for separating the two alkaloids; or the impure morphine may be completely dissolved in dilute acetic acid, the solution evaporated to dryness, and the residue treated with water, which leaves narcotine. Gregory has proposed a process which has been adopted by the British Pharmacopœia for preparing morphine hydrochlorate from opium, and which has the advantage of dispensing with alcohol in the purification of the alkaloid. To obtain this in a pure state the following directions are given: Take of opium, sliced, 1 pound; calcium chloride ¾ ounce; purified animal charcoal ¼ ounce; solution of ammonia, distilled water, each a sufficiency. Macerate the opium for twenty-four hours with 2 pints of the water, and decant. Macerate the residue for twelve hours with 2 pints of the water, decant, and repeat the process with the same quantity of the water, subjecting the insoluble residue to strong pressure. Unite the liquors, evaporate in a water-bath to the bulk of 1 pint, and strain through calico. Pour in now the calcium chloride, previously dissolved in 4 fluidounces of distilled water, and evaporate until the solution is so far concentrated that upon cooling it becomes solid. Envelop the mass in a double fold of strong calico and subject it to powerful pressure, preserving the dark fluid which exudes. Triturate the squeezed cake with about ½ pint of boiling distilled water, and, the whole being thrown upon a paper filter, wash the residue well with boiling distilled water. The filtered fluids having been evaporated as before, cooled, and solidified, again subject the mass to pressure; and, if it be still

much colored, repeat this process a third time, the expressed liquids being always preserved. Dissolve the pressed cake in 6 fluidounces of boiling distilled water; add the animal charcoal and digest for 20 minutes; wash the filter and charcoal with boiling distilled water, and to the solution thus obtained add the solution of ammonia in slight excess. Let the pure crystalline morphia, which separates as the liquids cool, be collected on a paper filter and washed with cold distilled water until the washings cease to give a precipitate with solution of silver nitrate acidulated by nitric acid. From the dark liquids expressed in the above process an additional product may be obtained by diluting them with distilled water, precipitating with solution of potash added in considerable excess, filtering, and supersaturating the filtrate with hydrochloric acid. This acid liquid, digested with a little animal charcoal and again filtered, gives, upon the addition of ammonia, a small quantity of pure morphia.—*Br.*

In this process the morphine salts, as naturally obtained in the opium, are decomposed by an excess of calcium chloride, with the formation of morphine hydrochlorate, which, crystallizing on cooling from the sufficiently concentrated solution, produces with the calcium meconate a solid mass, from which the mother-liquor is removed by strong pressure. The pressed cake, on being treated with boiling water, yields up the morphine (and codeine) hydrochlorate, while the calcium meconate remains upon the filter. The evaporation, expression, and resolution are repeated until most of the coloring matter has entered the mother-liquors and nearly the whole of the calcium meconate remains upon the filter. The removal of the last traces of color is then effected by animal charcoal, and the morphine precipitated in a granular condition by adding a slight excess of ammonia to the boiling solution. The dark-colored mother-liquors contain, besides coloring matter and calcium salts, narcotine and morphine, which are precipitated by potassa, an excess of which dissolves the latter readily and completely, but narcotine sparingly and slowly, as observed by Robiquet, Wittstock, and others. The filtration of the strongly alkaline liquid must, therefore, not be long delayed; and when the clear liquid is acidulated with hydrochloric acid it contains morphine hydrochlorate, potassium chloride, and some coloring matter, from the last of which it is freed by animal charcoal; ammonia then precipitates the nearly pure alkaloid. The decoloration of the morphine salt by means of animal charcoal is more readily effected when in aqueous solution, as here directed, than when dissolved in alcohol.

Lime has an action upon morphine and narcotine similar to that of potassa. Couërbe has founded upon this behavior a method for preparing morphine which was somewhat modified by Mohr (1840), who directs 4 parts of opium to be exhausted by repeated boiling with water; the strained and expressed decoction is gradually added to boiling milk of lime, made of 1 part of burned lime and 8 parts of water; and after boiling for a few minutes the mixture is strained, pressed, and the undissolved portion twice boiled with a fresh portion of water. The liquid, containing mainly morphine, lime, and coloring matter, is concentrated to 8 parts, filtered, and the filtrate, while boiling, mixed with sufficient powdered sal ammoniac to convert all the lime into calcium chloride, while ammonia is given off, and the morphine on cooling separated as a granular mass; this is washed with cold water, dissolved in hydrochloric acid, purified with animal charcoal, and crystallized as morphine hydrochlorate, or the alkaloid precipitated by ammonia. The morphine precipitated from the lime solution is darker in color than the first morphine precipitate obtained by Staples' process, but much lighter than the corresponding precipitate by Gregory's process.

Properties.—Morphine crystallizes in short, transparent, and colorless or white prisms or needles, which require for solution 4350 parts of water at 15° C. (59° F.) and 455 parts at 100° C. (212 F.). Chastaing (1882) ascertained that 1 liter of water dissolves at 10° C. (50° F.) 0.1 Gm., at 20° C. (68° F.) 0.2 Gm., at 30° C. (86° F.) 0.3 Gm., and at 100° C. (212° F.) 2.17 Gm., of morphine. At or near 15° C. (59° F.) the alkaloid is stated to be soluble in 300 parts (*U. S.*), 90 parts (Merck), 42 parts (Choulant) of alcohol, and at the boiling temperature in 36 parts (*U. S.*, Choulant), 24 parts, of alcohol (Bucholz). It is also soluble in 4000 parts of ether. Duflos found it soluble in 20 parts of cold and 13.3 parts of boiling absolute alcohol; Pettenkofer, in 40 and 30 parts respectively. Prof. Prescott (1875) determined morphine to be soluble in the following quantities of hot liquids: in 6146 parts of ether sp. gr. 0.729, in 4379 parts of chloroform sp. gr. 1.4953, in 8930 parts of benzene sp. gr. 0.8766, and in 91 parts of amylic alcohol sp. gr. 0.8136; all except the last liquid dissolved from four to five times more of the nascent alkaloid. Chloroform containing 7 per cent. of alcohol dissolves $\frac{1}{150}$ of morphine (Vander Burg, 1879). Reveil (1863) found morphine to be soluble in 220

parts of glycerin. It is soluble in 400 parts of cold amylic alcohol and 500 parts of acetic ether, in fixed alkalies and alkaline earths, less so in ammonia (117 parts), and still less in ammoniacal salts, but nearly insoluble in fixed oils. The alkaloid is not altered by exposure to air, and is inodorous, and at first tasteless, developing, however, a bitter taste. Its solutions have an alkaline reaction upon test-paper, and with acids it yields salts, most of which are crystallizable. Heated to about 75° C. (167° F.) it begins to lose its water of crystallization, and becomes anhydrous when heated for some time to 200° C. (212° F.). At 254° C. (489° F.) it melts, forming a black liquid, and on ignition is completely dissipated.

Reactions.—Commercial concentrated sulphuric acid dissolves morphine with a yellowish afterward gray color. Mixed with six or eight times its weight of sugar, morphine acquires with sulphuric acid a bright purple-red color, gradually changing to violet-blue, blue-green, and dingy-yellow (Schneider, 1872). The delicacy of this test is increased by the addition of a little bromine-water, so that .00001 Gm. of morphine will still show a rose-red color (Weppen, 1874). Dissolved in sulphuric acid and the solution heated to near 150° C. (302° F.), the addition of a little nitric acid colors violet-blue, changing quickly to blood-red, and afterward to deep orange (Husemann, 1863). *Fröhde's reagent* (1866) (0.001 to 0.005 sodium molybdate in 1 Cc. H_2SO_4) acquires a beautiful violet color, changing to blue, olive-green, yellow, and in twenty-four hours to purplish-blue. In the reaction of this reagent upon many alkaloids and other organic substances a light- or dark-blue or more or less green color is produced; the changes in color must, therefore, be noticed, and a larger amount of the molybdate in the test carefully avoided. (See papers by Buckingham, Wellcome, and Prescott in *Amer. Jour. Phar.*, 1873, p. 150; 1876, pp. 21, 59.) Morphine decomposes iodic (Serullus) and periodic (Boedeker) acids, liberating iodine; in dilute solutions the addition of sulphuric acid is advisable; ammonia deepens the yellow color of the solution. Solutions of silver nitrate, gold chloride, potassium ferricyanide, cuprammonium, and chromic acid are reduced by morphine and its salts. Pellagri (1877) recommended a test which depends upon the production of apomorphine (see page 234), and is applied as follows: The suspected substance is dissolved in concentrated hydrochloric acid, a little sulphuric acid is added, and the solution evaporated at 100° C.; a purple color will be produced. To the residue is added a little hydrochloric acid, then sodium bicarbonate, and finally a strong solution of iodine in hydriodic acid, when a green compound is produced, dissolving in ether with a purple color.

The *salts of morphine* are precipitated from their solutions by the alkalies and alkaline earths, the precipitates being soluble in an excess of the precipitant. Similar precipitates are produced by the alkali carbonates and cyanides, but the alkali bicarbonates fail to precipitate acid solutions in the cold. Tannin causes a white precipitate soluble in acetic acid, in mineral acids, and in alcohol. Auric or platinic, but not mercuric, chloride occasions a yellow precipitate. Codeine causes a precipitate of morphine in the solution of the salts. The acidulated solutions of morphine are precipitated by potassio-mercuric iodide, potassio-cadmium iodide, and other general reagents for alkaloids; the precipitate with phosphomolybdic acid turns blue with cold sulphuric acid and brown on warming. 1 Cc. of Mayer's test-solution precipitates 0.020 Gm. morphine. When a salt of morphine is heated with an excess of sulphuric or hydrochloric acid to near 150° C. (302° F.), the alkaloid parts with H_2O and is converted into apomorphine, $C_{17}H_{17}NO_2$ (see page 234).

Beckett and Wright (1875) ascertained that morphine treated with acetic, benzoic, or butyric anhydride is converted into derivatives containing acetyl, benzoyl, or butyryl in the place of 1 or 2H. Hesse (1883) obtained similar compounds with propionic anhydride at 85° C. (185° F.). *Diacetyl-morphine* and the analogous derivatives are not colored by ferric chloride, and are decomposed into morphine and the corresponding acids on being warmed with alcoholic solution of potassa.

Tests.—When heated upon platinum-foil, no fixed residue should be left (lime, magnesia, etc.). "When crystals of morphine are sprinkled upon nitric acid (specific gravity 1.250 to 1.300), they will assume an orange-red color, and then produce a reddish solution gradually changing to yellow. On shaking a small portion of morphine, in a test-tube, with 10 Cc. of chlorine-water, the latter will acquire a yellowish color. On now carefully pouring a small amount of ammonia-water on the surface of the liquid, a brown or reddish-brown zone will develop at the line of contact of the two liquids. Addition of a few drops of solution of ferric chloride to a 1 per cent. solution of morphine prepared by the aid of dilute sulphuric acid but carefully neutralized, produces a blue color which

is destroyed by acids, alcohol, or heating (but not by alkalies). On treating morphine with cold, concentrated sulphuric acid free from nitric acid, the liquid should not at once acquire more than a faintly yellowish tinge [when heated to 100° C. (212° F.) for half an hour a pink-red color is developed (Prescott)] (absence of more than traces of narcotine, papaverine, etc.), nor should a purple or violet, but merely a greenish color be produced by the subsequent addition of a small crystal of potassium permanganate (difference from strychnine). On precipitating a solution of any of the salts of morphine by ammonia-water, dissolving the washed precipitate in solution of sodium hydroxide, and shaking the solution with an equal volume of ether, upon evaporation of the ethereal solution, no appreciable residue should remain (absence of narcotine, codeine, etc.). On adding 4 Cc. of solution of potassium or sodium hydroxide to 0.2 Gm. of morphine, a clear, colorless, solution should result, free from any undissolved residue (absence of and difference from various other alkaloids)."—*U. S.*

Pharmaceutical Uses.—The alkaloid is used in preparing morphine salts.

Action and Uses.—The general effects of morphine on the system are almost identical with those of opium, but there are some points of difference which call for notice, and some peculiarities depending upon the manner in which morphine is administered. It does not appear to stimulate the nervous system or the circulation as much as opium, nor display so decided a narcotic influence. It has been remarked that although 2 or even 3 grains of opium certainly contain less than a grain of morphine, yet their action is more intense, rapidly occasioning a degree of narcotism bordering upon coma, but soon subsiding without leaving decided secondary effects behind; while morphine does not so readily produce narcotism, but its after-effects are of longer duration. Opium also increases the temperature as well as the sense of heat, but morphine, while agreeing in the latter effect, lowers the temperature. So, too, opium primarily increases the frequency of the pulse, but morphine diminishes it. Opium is less apt to excite nausea and vomiting than morphine. Of this operation it has been remarked that women are much more liable to it than men, and especially to vomiting. When morphine is used hypodermically, such effects usually take place immediately, but when given by the stomach they may not appear for several days. A corresponding contrast is presented by its action on the bowels: by the hypodermic method morphine continues to constipate, but by the mouth it tends to occasion diarrhœa after a few days. Under like circumstances opium does not cause looseness of the bowels, but ceases to confine them. Contrary to the general opinion, morphine does not, according to Rutherford's experiments, affect the secretion of bile; and equally opposed to professional belief is the statement of Filhene and Pinzani that doses of morphine varying from Gm. 0.01–0.02 ($\frac{1}{6}$ to $\frac{1}{3}$ of a grain) may be given to a nursing mother without injury to the child (*Therap. Gaz.*, xii. 460; *Centralbl. f. Ther.*, viii. 569). The experiments of Filhene (*Archiv f. Pathol. u. Pharmakol.*, xi. 60) led him to a conclusion in harmony with general clinical experience—viz. that when respiration is interfered with by anæmia of the medulla oblongata, without previous pulmonary obstruction, the use of morphine in doses capable of restoring the act of respiration to its normal type is thoroughly indicated. But when, on the other hand, an obstacle to the arterialization of the blood exists in the lungs themselves, morphine must be circumspectly used. Berkart, in like manner, teaches that when the pulmonary obstruction originates in the heart itself, it may often be overcome by stimulation of the heart; and no better agent can be resorted to for that purpose than morphine in small doses, administered hypodermically. Morphine is very apt to occasion ardor urinæ, with vesical irritation and diminished secretion of urine. The last symptoms may be accounted for, in part, by the profuse sweating that often follows the administration of morphine in full doses. It is said to be more marked in females than in males. A portion of the morphine may be recovered from the urine (*Asclepiad*, 1885) where the quantity consumed is not very large; but the failure to detect it does not prove that morphine was not used. Although itching of the skin sometimes attends the action of opium, it is usually insignificant compared with that which morphine frequently causes. It generally begins in the eyes and nose, and often extends to the whole surface of the body, causing great restlessness and distress. Along with this symptom, or independently of it, various fugitive eruptions appear of a papular or erythematous description, and especially urticaria. They probably depend upon the same immediate cause that provokes diaphoresis, and they have been oftener noticed after the hypodermic use of morphine than otherwise. Among many instances the following may be cited in illustration: In a case of sciatica Comanos used a hypodermic injection of Gm. 0.02 ($\frac{1}{3}$ grain) of morphine. The next day the whole skin was covered

with a scarlet rash, the temperature was 102° F., and at the end of four days desquamation took place. Some time afterward the same dose was given by the mouth, and produced a similar febrile eruption; and later an ointment containing morphine was rubbed into the skin over the painful nerve, and after several days an eruption broke out as before, and then a large carbuncle formed (*Berlin. klin. Wochensch.*, No. 42, 1882). Other abnormal effects may be met with: for instance, A hypodermic injection of $\frac{9}{10}$ of a grain of morphine caused a prolonged and deep sleep, followed by convulsive movements, cyanosis, dry tongue, dyspnœa, tracheal râles, incontinence of urine and fæces, lowered temperature, and, after these phenomena ceased, with aphasia, agraphia, and mental irritability (Scheiber, *Zeitsch. f. klin. Med.*, xiv. 39). As with all narcotics, so with morphine: if it is left off abruptly, wakefulness and restlessness, with nervous depression, are apt to ensue. These effects sometimes closely resemble delirium tremens. The fatal dose of morphine cannot be determined; it may not exceeed a single grain, and, on the other hand, a case is recorded in which 7 grains of morphine were taken in the form of Magendie's solution, and yet by dint of powerful excitation, chiefly electrical, the patient recovered (Schweig). An infant fourteen days old recovered after taking $\frac{1}{6}$ grain of morphine, and another three weeks old after taking a teaspoonful of wine of opium (*Boston Med. and Surg. Jour.*, July, 1880, p. 57). In another case it is said that 10 grains were taken, but the patient recovered after the hypodermic injection of atropine (*Med. News*, xli. 592). Still more remarkable are the cases of a woman who recovered after taking 25 grains (*Therap. Gaz.*, xiii. 93); of a man who also recovered after taking about 36 grains (*Boston Med. and Surg. Jour.*, May, 1887, p. 443); and of a woman who also survived a dose of 51 grains (*ibid.*, June, 1887, p. 603). On the other hand, two cases are recorded of sudden death after the subcutaneous injection of Gm. 0.005 ($\frac{1}{12}$ gr.) (*Therap. Monatsh.*, iii. 436).

The influence of morphine used habitually is most pernicious. Even in dogs, after a time emaciation sets in and ultimately reaches an extreme degree; the animal is habitually torpid, the skin of the feet grows morbidly sensitive, and the temperature is very low. After death the brain and spinal marrow are anæmic and the lungs and liver engorged. In man the disturbances are similar, but those of the intellectual sphere predominate. They include nervousness, tremor, hyperæsthesia, spasms, neuralgia, insomnia, anxiety, hypochondria alternating with excitement, hallucinations, and a suicidal tendency. A devotee to the hypodermic use of morphine thus described to us its occasional effects: "My head and buttocks begin to throb and bump like trip-hammers; my teeth are set; a metallic taste is in my mouth; my face, neck, hands and arms are as red as fire, and all the veins stand out swollen. The worst is the awful throbbing pain in my head. It is terrible." Among the physical symptoms are dryness of the tongue, constipation, and scanty urine, with vesical irritation, and occasionally albuminous urine. Sometimes excessive sweats occur; the respiratory passages and throat are dry; impotence is usual. Caries of the teeth has also been observed, and suspension of the catamenia is an ordinary occurrence. The morphine habit also blunts the perception of duty, gratitude, and even delicacy, and perverts the sense of truth. No doubt these effects are due in part to the efforts made by its slave to conceal his illicit indulgence or the degree of it, but they are chiefly attributable to the obtuseness which it creates in the moral faculties as well as the senses. If the drug is abruptly withdrawn, the patients suffer a collapse, with indescribable distress from nervousness and loss of self-control, profuse sweats, or diarrhœa, and a dusky discoloration of the face. The tolerance of morphine in some cases of its habitual use is extremely remarkable, as the following summary will prove: A man gradually increased his daily dose until at the end of two years it reached 40 grains (Siredey). A woman who used morphine hypodermically at last took 14 grains every day. Except habitual lassitude of mind and body no bad effect of any kind was produced (Braithwaite). But the most singular instance of this nature is one reported by Dr. Lyman of Boston: A woman forty-seven years of age had been addicted to the morphine habit since the age of eighteen. She was in good flesh, though a small eater and with an indifferent appetite; she experienced no disorder of the heart or kidneys, her bowels were moved by the help of injections, and her catamenia were always regular. Yet throughout this long period of twenty-eight or twenty-nine years her daily dose of morphine averaged about 16 grains. A woman aged sixty-six years often had three hypodermic injections daily, each of 6 grains of morphine (*Practitioner*, xxv. 66). Another habitually took this amount internally, and occasionally doubled it. During one period of three years she took a drachm of morphine daily, and on several days 80 grains (*Boston Med. and Surg. Jour.*, Feb. 1882, p. 128). A lady addicted to the habit would take hypo-

dermically 25 grains of morphine at a single sitting (*New York Med. Jour.*, Mar. 29, 1884). A man during seventeen years used on an average 24 grains of morphine daily (*Lancet*, Dec. 29, 1883). Burkart gives as the maximum daily dose Gm. 3.5 (50 grains). In some persons almost every hypodermic injection is followed by an abscess. We are familiar with the case of a lady who for several years was subject to violent attacks of neuralgia of the face and head, for which she was treated by hypodermic injections of morphine. Almost all the punctures were followed by abscesses, and both of her arms from the shoulders almost to the wrists are deformed by the scars they left behind them. According to Obersteiner, about 74 per cent. of the victims of the morphine habit are males, and of these nearly 47 per cent. are medical men.

Many cases occur in which idiosyncrasies modify the usual effects of morphine. In some it causes violent mental excitement, hallucinations, and a total inability to sleep; in others it occasions nervous depression, syncope, pallor of the skin, feebleness of the pulse, dyspnœa, insensibility, urgent vomiting, etc.; in others, again, spasmodic movements or a fully-formed tetanoid paroxysm (*British Med. Jour.*, Oct. 18, 1879). No doubt some of the most alarming examples of this nature have followed the hypodermic injection of morphine, either because of the swift absorption of the narcotic or from its having been thrown into a vein. Hence the wisdom of the rule to introduce morphine hypodermically with great deliberation, and of the advice that has been given to associate with each injection $\frac{1}{96}$ grain of atropine to counteract the depressing and nauseating effects of the morphine. This dose should never be repeated while the effects of a previous dose appear to be increasing. In all cases the condition of the pulse and the heart should be considered. Not a few examples are recorded of death by syncope immediately after the administration of morphine hypodermically, and many also in which death seemed imminent. In one case, among others, a case of lumbago, this effect resulted from the hypodermic injection of $\frac{1}{6}$ grain of morphine at a spot midway between the spine and the crest of the ilium. In about ten minutes collapse with syncope occurred, and the patient was with difficulty saved (*Boston Med. and Surg. Jour.*, Oct. 1879, p. 619). A case is on record in which fatal narcotism followed the hypodermic use of gr. $\frac{1}{4}$ (*Med. News*, xlvi. 18), but the circumstances make the cause of death doubtful. In several instances of angina pectoris death has seemed to be the consequence of morphine injections (*Centralbl. f. d. g. Therap.*, iii. 71). It is stated under Opium that all preparations of that narcotic are peculiarly dangerous in very early or in advanced life. The use of morphine hypodermically is even more so because it cannot be removed from the system as an overdose of opium may be. One-sixth, and even one-eighth, of a grain so administered has proved fatal to old and feeble patients, and even without producing narcotic symptoms until a repetition of the dose has suddenly developed them (*Boston Med. and Surg. Jour.*, May, 1884, p. 427). The administration of chloroform to a person under the *full* influence of morphine is peculiarly dangerous. Even ether should be cautiously employed, especially if severe pain is suffered (*Med. Record*, xxii. 274). The immediate and remote effects of the hypodermic use of morphine and of the "morphine habit" have been fully depicted by numerous writers. To their works the reader is referred (Burkart, *Die chron. Morphium Vergiftung*, 1877–78; Petit, *Bull. de Thérap.*, vol. xcvi.; Levinstein, *Die Morphinmsucht*, 1880; Obersteiner, *Med. News and Abst.*, July, 1880, 438, *Wiener Klinik*, März, 1883; Kane, *Morphia Hypodermically*, 1880; Burkart, *Die Wesen*, etc. *der chronischen Morphiumvergiftung*, 1884).

Although morphine may, in general terms, be used for the same purposes as opium, which are fully treated of elsewhere (see Opium), and especially as an internal medicine, it is true, nevertheless, that the introduction of the hypodermic method of employing it has shown its fitness for certain special conditions. This method is superior to any other when the prompt action of the medicine is necessary to save life or lessen pain, when the patient is unable or unwilling to swallow, and when a local rather than a general influence is sought. The use of morphine, and especially its hypodermic use, in the treatment of *insanity*, while it is unquestionally preferable to allowing the insane to become exhausted by excessive mental and physical exertion, is just as certainly abused to save trouble for physicians and attendants. Very often the disease, whether it have a physical basis or not, is fostered and prolonged by this method, which is really but little better than the strait-jacket, the tranquillizing-chair, and other instruments of torture now seldom used in asylums managed by a sound intelligence. Hardly less mournful is it to know that in these institutions the baleful habit of morphine-intoxication has often been formed. Undoubtedly, a wise and prudent use of this remedy is most advantageous, especially in cases of transient or of periodical mania, or when it

is attended by severe bodily pain, provided that the administration be absolutely controlled by a responsible physician and not trusted to inexperienced assistants or ignorant or unfaithful nurses. (Compare Voisin, *Bull. de Thérap.*, c. 385, 443.) In *sunstroke* attended with convulsions, jactitation, delirium, and general excitement the hypodermic injection of a salt of morphine, in the dose of $\frac{1}{4}$ grain, affords prompt relief. *Infantile convulsions* have been successfully treated by means of hypodermic morphine, but the dose of it should not exceed $\frac{1}{40}$ gr. In *epileptiform convulsions* due to mental excitement, in pregnancy and the *puerperal state*, in *hysteria* and aggravated *chorea*, in various *local spasms*, as of the face, glottis, diaphragm, etc., this remedy should always be borne in mind. Morphine hypodermically employed is perhaps the best remedy in *tetanus*, even of the traumatic form, and a like statement is true of the analogous condition caused by *strychnine-poisoning*. It is the proper antidote in *poisoning by belladonna* or *atropine*. Of all the remedies for *spasmodic asthma*, this one procures incomparably the most speedy relief. Nor is it only in spasmodic dyspnœa that the treatment is efficient. Huchard, among others, contends that, with rare exceptions, this symptom is by itself an indication for the use of hypodermic injections of morphine (*Bull. de Thérap.*, xcvi. 477). Attacks of dyspnœa due to mitral obstruction are less amenable to this medicine than any other, whether cardiac, pulmonary, or nervous (*ibid.*, c. 173). Morphine may be sometimes used to lessen the violence of the paroxysms in *whooping cough*. The pain of *neuralgia*, especially in its severe forms, such as affect the fifth nerve, the sciatic, and the gastric nerves, is promptly palliated by it. In neuralgia of the superficial nerves rapid vesication of the skin over the painful points, and the application to the cutis of a strong solution or ointment containing a morphine salt, may also be employed, but its effect is less prompt and sure than the hypodermic plan. Of all palliatives employed in that most terrible of pains, *angina pectoris*, none (except perhaps nitrite of amyl) affords more prompt and sure relief, not only subduing the neuralgic anguish, but calming the tumultuous and disordered movements of the heart. It has the advantage over some other methods of being almost free from danger, so long as the dose of the palliative does not become narcotic. In that case all opium preparations embarrass a weakened or obstructed heart. One of the best occasional remedies for *nervous headache* which females are apt to experience during the menstrual periods is a cup of strong coffee with $\frac{1}{5}$ grain of morphine salt, but it is a remedy which is not to be recommended for general or frequent use. The hypodermic injection of morphine is the promptest of all palliatives for *muscular rheumatism*, and especially for *lumbago*. In the various forms of abdominal pain hypodermic injections of morphine afford prompt and sure relief, whether the cause of it be *colic* due to indigestion with flatulence, to cholera morbus, to obstipation, to intestinal displacements, to lead-poisoning, or even to inflammatory conditions; to *biliary* or *renal* or *vesical calculi*, etc. Of all the methods of using opiates in *epidemic cholera*, this is the least disappointing; but although it is of little value when once collapse has set in, it is probably more useful than the internal administration of morphine. In some cases the hypodermic use of morphine has been signally successful in curing *sea-sickness* (Pietra-Santa, *Bull. de Thérap.*, cv. 472; Vincent, *Therap. Gaz.*, viii. 479). It is important to note that the established value of opiates in *diabetes* depends upon their administration by the mouth. They seem not to lessen the sugar in the urine when given hypodermically (Bruce, *Practitioner*, xxxviii. 20). Fraser found it generally superior to codeine in this disease (*ibid.*, xlii. 374). The use of morphine as an antidote to poisoning by Belladonna, Atropine, and Physostigmine is considered under these several titles. It may, however, be mentioned in this place that the antagonism in question may sometimes be usefully employed to meet special indications. Thus, morphine, which is so essential to moderate cough in phthisis, and which is at the same time contraindicated by its tendency to produce sweating, may, if associated with a minute proportion of atropine, fulfil its important object without inducing profuse diaphoresis. In like manner, the depressing influence of morphine, which renders it dangerous in certain cases of extreme exhaustion accompanied with severe pain, may be counteracted by giving atropine along with it (Fothergill).

The hypodermic use of morphine has been greatly perverted; the prompt alleviation of pain and the pleasing intoxication which follows form too strong a temptation to its use for all persons to resist successfully. Like alcohol, it leaves behind it a sense of debility and depression which nothing but a fresh resort to the medicine relieves. If continuously employed, it creates an artificial necessity for resorting to its powerful and genial support, and the longer it is used the larger is the dose of it required. A peculiar allurement of the habit as compared with that of taking opiates by the mouth is that in

many cases it does not so readily derange the stomach, impair the appetite, or produce constipation. These effects should be borne in mind, but it is equally important to remember that in cases of hopeless disease the duty of the physician is, above everything else, to relieve his patient's suffering.

The treatment of the morphine habit cannot be fully discussed here. Suffice it to say that it consists essentially in the withdrawal of the drug—abruptly if the constitutional symptoms are not grave, gradually if they are serious, while by food, passive and active exercise, and occupation the body is strengthened and the mind diverted. (Compare OPIUM.) Whatever plan may be adopted, its success depends mainly upon the patient being restrained from indulging his vicious habit. The treatment of *poisoning* by morphine is the same as that used for opium-poisoning.

The average *dose* of morphine or of its salts is about Gm. 0.013 ($\frac{1}{5}$ grain), but morphine uncombined is seldom prescribed. For hypodermic uses an officinal solution of acetate of morphine has been provided by the British Pharmacopœia. (See INJECTIO MORPHINÆ HYPODERMICA.) It is said that if the morphine solution is heated in a spoon before being injected, organic growths that may have formed in it will be destroyed, and the solution will then become less irritating. The recommendation that the physician carry with him powders of morphine of $\frac{1}{6}$ grain and dissolve them as just suggested when required for use, appears to be judicious and practical. The so-called "sterilized" solutions of the salt may be employed. (See *Therap. Gaz.*, x. 541.) The tartrate has been proposed as superior to any other salt of morphine for hypodermic injections. It is said to be entirely bland and unirritating, and that its solution can be kept fresh for any length of time (Stuart).

MORPHINÆ ACETAS, *U. S., Br.*—MORPHINE ACETATE.

Morphiæ acetas, *Morphinum* (*s. Morphium*) *aceticum*, *Acetas morphinæ*, *Acetas morphicus.*—*Acetate of morphia*, E.; *Acétate de morphine*, Fr.; *Morphinacetat*, *Essigsaures Morphin*, G.

Formula $C_{17}H_{19}NO_3.HC_2H_3O_2.3H_2O$. Molecular weight 398.12.

Preparation.—The British Pharmacopœia, not recognizing morphine officially, directs that alkaloid to be prepared from 2 ounces of the hydrochlorate by precipitating its solution with ammonia and washing the precipitate with distilled water; the moist morphine is diffused in 4 ounces of water, dissolved by neutralizing with acetic acid, the solution evaporated on a water-bath until it concretes on cooling, and the mass dried with a gentle heat and reduced to powder. The salt should be kept in small well-stoppered vials. A very slight excess of acetic acid is rather of advantage, since the salt begins to decompose during the evaporation by the liberation of a little acid; it is therefore advisable to facilitate evaporation at a rather low temperature by means of a current of air. The salt may be crystallized with some difficulty in the form of white silky needles, but is very generally obtained in powder as directed above.

For obtaining the salt of very handsome appearance Hager gives the following directions: Rub 10 parts of pure morphine to powder, keeping it moist by the addition of a little alcohol, and add 25 parts of glacial acetic acid, triturating constantly; then drop alcohol into the mixture until it has become of a syrupy consistence, and afterward ether until the color of the mixture has changed to milk-white; after two or three days the solidified mass is loosened in the mortar and turned, and when completely dry is rubbed to powder and preserved.

Properties.—Morphine acetate forms a white or faintly yellowish, crystalline or amorphous powder which has a slight acetous odor and a very bitter taste. Belohoubek (1880) found in the crystallized salt two forms of needles—the first transparent and distinct, the other white, opaque, and aggregated to tufts. When freshly prepared, the salt dissolves at 15° C. (59° F.) in 25 parts of water and 476 parts of alcohol (*U. S. P.*), in 45 parts of alcohol (Hager), and at the boiling-point requires 1.5 parts of water and 14 parts of alcohol (*U. S. P.*), 2 parts of alcohol (Hager). The salt is soluble in 2.44 parts of water (Dott, 1881–82), in 2100 of cold and 60 parts of boiling chloroform, and in 1700 parts of ether. The alcoholic solution, mixed with an excess of ether, deposits crystals of morphine, free acetic acid remaining in solution. Cold strong sulphuric acid dissolves the salt without color only when recently made. When kept on hand it slowly loses acetic acid; its reaction to test-paper changes from neutral to alkaline, and the salt becomes incompletely soluble in water unless a little acid be added; it gradually acquires a yellowish-gray, and finally brownish, color, and should then be redissolved in acetic acid

and evaporated or converted into another salt of morphine. Its aqueous solution undergoes similar changes, the acetic acid being slowly decomposed, with the separation of brown flocculent compounds, while the morphine crystallizes out, forming long prisms if the solution is not disturbed. The formula given by the Pharmacopœia is that of Oudemanns (1857), and requires 71.4 per cent. of anhydrous or 75.94 per cent. of crystallized morphine. Kieffer (1857) found the salt to contain 79.8 per cent. of morphine.

Tests.—The salt responds to the morphine tests described above, and leaves no residue when ignited. If its solution is precipitated by tannin, the addition of dilute hydrochloric acid redissolves the precipitate; solution of potassa or soda gives a white precipitate soluble in excess of the alkali; a remaining turbidity would indicate the presence of narcotine. Sulphuric acid added to the salt liberates acetous vapors.—*U. S.*

Uses.—The action and uses of the acetate are the same that have been described in the article on MORPHINE. The *dose* of the acetate is about Gm. 0.01 (gr. $\frac{1}{5}$).

MORPHINÆ HYDROCHLORAS, *U. S.*, *Br.*—MORPHINE HYDROCHLORATE.

Morphiæ hydrochloras, Morphiæ murias, Morphinum hydrochloricum, P. G.; *Murias (Hydrochloras) morphicus.—Muriate of morphia*, E.; *Chlorhydrate de morphine*, Fr.; *Morphinhydrochlorat, Salzsaures Morphin*, G.

Formula $C_{17}H_{19}NO_3HCl.3H_2O$. Molecular weight 374.64.

Preparation.—The British Pharmacopœia has a process for preparing this salt from opium, which was given under MORPHINA, as far as the precipitation of pure morphine. The remaining steps are as follows: "Diffuse the pure morphine (obtained from 1 pound of opium) through 2 fluidounces of boiling distilled water placed in a porcelain capsule kept hot, and add, constantly stirring, the diluted hydrochloric acid, proceeding with caution, so that the morphine may be entirely dissolved and a neutral solution obtained. Set aside to cool and crystallize. Drain the crystals, and dry them on filtering-paper. By further evaporating the mother-liquor and again cooling additional crystals are obtained." If pure morphine has been used and an excess of hydrochloric acid avoided, the salt may be wholly obtained in crystals by judicious evaporation of the mother-liquor. On account of the greater stability of this salt and of its solution, the German Pharmacopœia directs it to be dispensed whenever morphine acetate is prescribed.

Properties.—Morphine hydrochlorate crystallizes in white silky, flexible, and inodorous needles or minute, colorless, cubical crystals having a bitter taste and neutral reaction. It is soluble in 20 parts of cold (24 parts at 15° C. *U. S. P.*; 25 parts *P. G.*; 23.9 parts, Dott, 1882) and in less than its own weight (about 0.5 parts *U. S. P.*) of boiling water; in 62 parts (48 parts, Candidus, 1882) of alcohol at 15° C.; and in 30 parts of boiling alcohol; in 50 parts of alcohol sp. gr. 0.832 (*P. G.*); in 19 parts of glycerin and in 800 parts of olive oil; it is slightly soluble in ether or chloroform. Heated to 100° C. (212° F.), it loses 14.38 per cent. of water of crystallization at 300° C. (512° F.) it coheres slightly, but does not completely melt. It yields 75.9 per cent. of anhydrous and 80.7 per cent. of crystallized morphine. On triturating the salt with sulphuric acid and sprinkling bismuth subnitrate upon the mixture, a dark-brown color is produced (*P. G.*).

Tests.—The salt should not have an acid reaction, and should answer to all the morphine tests described before; its aqueous solution yields with silver nitrate a white precipitate, which is insoluble in nitric acid, but dissolves in ammonia. With solution of potassium or sodium hydroxide it should yield a precipitate soluble in excess of alkalies and corresponding to the tests for morphine. When heated to 130° C. (266° F.) the pure salt remains white, while the commercial salt generally turns brown or black from the decomposition of resinous substances present (Tausch, 1880). When ignited, the salt should leave no fixed residue.

Uses.—The operation of the hydrochlorate of morphine is identical with that of the acetate, and its *dose* is the same, or about Gm. 0.01 (gr. $\frac{1}{5}$).

MORPHINÆ SULPHAS, *U. S.*, *Br.*—MORPHINE SULPHATE.

Morphiæ sulphas; Morphinum sulfuricum, P. G.; *Sulfas morphicus.—Sulphate of morphia*, E.; *Sulfate de morphine*, Fr.; *Morphinsulfat, Schwefelsaures Morphin*, G.

Formula $(C_{17}H_{19}NO_3)_2H_2SO_4.5H_2O$. Molecular weight 756.38.

Preparation.—This salt may be prepared in the same manner as the hydrochlorate. 1 ounce of pure morphine is diffused in 2 ounces of boiling distilled water, and diluted sulphuric acid is cautiously added until the alkaloid is dissolved and the liquid has a neutral reaction to test-paper; it is then allowed to cool and crystallize; the crystals are drained and dried, and the mother-liquor concentrated to obtain an additional crop of crystals.

The importation of morphine and its salts into the United States amounted to somewhat over 3000 ounces annually in 1879 and for some years previous, but has been much larger since, and was 23,239 ounces in 1882.

Properties.—Morphine sulphate crystallizes in white fasicles of transparent, silky, inodorous, and bitter needles, which are neutral to test-paper, and are not altered on exposure to air. At 100° C. (212° F.) it parts with 3 molecules of water (7.48 per cent.); but on being heated to 130° C. (266° F.) it loses the remaining two molecules (4.39 per cent.). On raising the heat to 255° C. (491° F.) the salt melts, and at a higher temperature is consumed without leaving a residue; the exsiccated salt absorbs water on exposure (Liebig). The official salt dissolves in 21 parts of water at 15° C. (59° F.) in 0.75 parts of boiling water, in 702 parts of alcohol at 15° C., and in 144 parts of boiling alcohol (*U. S. P.*); Hager states it as readily soluble, and P. C. Candidus (1882) found it to dissolve in 40 parts of alcohol. It dissolves in 5 parts of glycerin (Reveil, 1863), but is insoluble in ether. The salt represents 75.2 per cent. of anhydrous and 79.94 per cent. of crystallized morphine. Its aqueous solution yields a white precipitate with barium chloride insoluble in nitric acid. Dott (1877) noticed an article sold in England which was adulterated with 34.63 per cent. of anhydrous sodium sulphate.

Tests.—Morphine sulphate should have a neutral reaction to test-paper, should show the behavior of morphine salts described in the article on MORPHINA.

Other Salts of Morphine.—MORPHINÆ HYDROBROMAS, $C_{17}H_{19}NO_3HBr.2H_2O$; mol. weight, 401.06. This salt is prepared by dissolving the alkaloid in warm hydrobromic acid or by double decomposition between alcoholic solutions of six parts of potassium bromide and 19 parts of morphine sulphate, and by evaporating the filtrate from the precipitated potassium sulphate. E. Schmidt (1877) found it to crystallize in long white needles, which are more soluble in water than the hydriodate, and become anhydrous at 100° C. According to Latour, it contains $3H_2O$, and requires 25 parts of water at 15° C. for solution.

MORPHINÆ HYDRIODAS, $C_{17}H_{19}NO_3.HI.2H_2O$; mol. weight, 447.83. It is prepared, like the preceding, from morphine and hydriodic acid, or from 4 parts of potassium iodide and 9 parts of morphine sulphate. A concentrated solution of potassium iodide, added to a solution of morphine acetate or hydrochlorate, separates the same salt. It crystallizes in long silky needles, parts with its water at 100° C., and recombines with it on exposure to air. Prepared by either process, Schmidt found it to have the above formula and to be sparingly soluble in cold water.

MORPHINÆ TARTRAS $(C_{17}H_{19}NO_3)_2C_4H_6O_6.3H_2O$; mol. weight, 772.28. On dissolving 4 parts of morphine with 1 part of tartaric acid in 20 parts of hot water, the greater portion of the salt crystallizes on cooling in small needles. It is somewhat efflorescent in dry air, loses at 130° C. 6.76 per cent. of water, is soluble in alcohol, and dissolves in 9.7 parts of water at 15° C. (Dott, 1882); the aqueous solution is not precipitated by alkalies, alkali carbonates, or calcium chloride (Arppe). The salt represents 78.3 per cent. of crystallized morphine.

MORPHINÆ MECONAS $(C_{17}H_{19}NO_3)_2C_7H_4O_7.5H_2O$, mol. weight, 858.07. This salt is present in opium, and may be prepared by neutralizing morphine with meconic acid. According to Robiquet, it is uncrystallizable and is readily soluble in alcohol, and, according to Dott (1882), dissolves in 33.9 parts of water at 15.5° C. (60° F.).

Uses.—Sulphate of morphine is more generally used than any of the other salts of this alkaloid. Its *dose* is about Gm. 0.01 (gr. $\frac{1}{5}$).

MOSCHUS, *U. S., Br.*—MUSK.

Musc, Fr. Cod.; *Moschus*, G.; *Almizell*, Sp.

The dried secretion from the preputial follicles of Moschus moschiferus, *Linné*.

Class Mammalia. Ord. Ruminantia.

Origin.—The musk deer resembles the deer (Cervus), but differs from it in the want of horns, and in the canines, which are long and project considerably downward from the lips of the male. It inhabits chiefly the mountainous regions and elevated table-lands of Central Asia, and is met with from Anam, in Farther India, north-westward to Thibet, and northward in China and Tartary to Mantchooria and Southern Siberia. It lives in pine forests in the Himalayas, frequently at an altitude of 3000–4260 M. (10,000 to 14,000 feet). The musk-sac is found in the male only, and is located on the

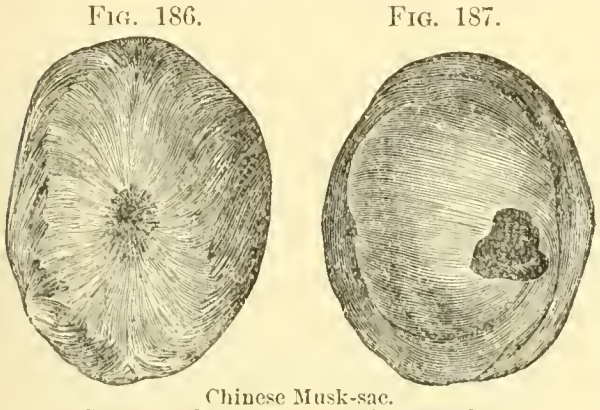
abdomen, immediately before the preputial orifice and to the rear of the umbilicus. The animal has nocturnal habits and is taken by snares and pitfalls, or sometimes by shooting; the sac is cut off as soon as possible, and rapidly dried by pressing it against heated stones.

Fig. 185.

Musk Deer.

Description.—The musk-bag (called sac, pod, or pouch) is oval in shape, about 5 Cm. (2 inches) long and 38 Mm. (1½ inches) wide, with a thickness of about 13 Mm. (½ inch). The upper surface is smooth and flat, the lower surface convex and hairy. The hairs are grayish and brown, rather stiff and appressed, and arranged in a circle toward the aperture near the centre of the bag, and in the form of a pencil toward the preputial orifice, which is about 6 Mm. (¼ inch) in the rear of the former. From this orifice, underneath the hairy skin between the strata of the muscular coat and toward the posterior end of the sac, is a canal containing the front portion of the thin penis. Following the muscular coat is the musk-pouch proper, with an external fibrous coat, having on the inner surface numerous depressions resembling meshes and surrounded by folds, and covered by two coats—the one soft and pearly, and the other very delicate, silvery-white on the outside, and yellowish or brownish on the inside. The musk is supposed to be separated by a number of glands, of which two or more are situated in each depression. In the young animal the secretion is slight and of a milky appearance, but after it has passed its third year the musk is of better quality; in the fresh state it is of an unctuous consistence.

Fig. 186. Fig. 187.



Chinese Musk-sac.
Lower surface. Upper surface.

From a record kept by Messrs. Cramer and Small (*Amer. Jour. Phar.*, 1872, p. 565) the average weight of Chinese musk-bags was found to be 394 grains, and of the musk in each 157 grains.

Musk is of a crummy appearance, near the musk-orifice mixed with grayish hairs of a reddish-brown color or darker brown, and irregularly granular, somewhat unctuous to the touch, of a strong, diffusible, and persistent odor, and of a bitterish taste. When entirely exsiccated it is almost inodorous, but the odor reappears on moistening, and is increased by the addition of a little alkali. Musk should be kept in not too warm a place, where the air has some access to it. The German Pharmacopœia now requires it, for medicinal use, to be dried over sulphuric acid until it ceases to lose weight. Its odor disappears or is more or less modified on triturating the musk with camphor, oil of bitter almond, fennel, ergot, mustard, sulphur, acids, various salts, etc.

Varieties.—Several varieties are known in commerce, the best being the *Chinese*, *Thibet*, or *Tonquin* musk. It is usually imported in small boxes, internally lined with sheet lead and containing about twenty-five sacs, each wrapped in paper. The outer hairs are trimmed short, and are of a yellowish or grayish color. Musk enters commerce through the Chinese ports. *Siberian musk* comes by way of St. Petersburg, hence the name *Russian musk;* it often resembles and has the same quality as the preceding; when in flatter ovate sacs with thinner and paler hairs, and of fainter, less aromatic, and more urinous odor, it is called *Cabardine musk*. The small and inferior *Bucharian* and *Assam musk-sacs* rarely, if ever, reach this country. Chinese musk only should be employed in medicine, and should always be purchased in sacs.

Substitutions and Adulterations.—The substitution of artificial musk-bags, made from a piece of the hide stitched to a membrane, is readily recognized by the absence of the circular arrangement of the hairs and of the central aperture. Genuine sacs are sometimes slit open, the musk partly removed, and other substances introduced in place thereof. This may usually be detected by being stitched together on the edge of the hide and inside membrane. There is no means of detecting the fraudulent introduction through the orifice of pieces of lead, etc. until after the bags have been opened.

Tests.—Musk should not have an ammoniacal odor. Cold water dissolves about one-half the weight of the musk; the solution should be deep-brown, faintly acid, and scarcely disturbed by solution of corrosive sublimate (ammonium carbonate). Weak

alcohol yields a similar solution. Strong alcohol dissolves about 10 per cent., yielding a slightly colored tincture, which should scarcely become turbid on the addition of water (resins, etc.). Carefully freed from fragments of skin and hairs and heated upon platinum-foil, musk should give off a slightly urinous odor, but very distinct from the odor of burning blood, and should leave about 6 to 8 per cent. of a gray (not red) ash. The German Pharmacopœia has adopted the examination of musk by the method suggested by Bernatzik: A small quantity of musk, kept in a thin layer under oil of turpentine (or warmed with a little glycerin), and examined under the microscope, is seen to consist of diaphanous brown amorphous splinters and lumps, without being mixed with other foreign substances.

Constituents.—Musk, treated with potassa, gives off ammonia; it contains cholesterin, various fatty and waxy substances, gelatinous and albuminous compounds, and salts. The odorous principle volatilizes partly with the vapors of water, but is not a volatile oil; it is most probably formed in the presence of moisture by the slow and continuous decomposition of one of the constituents.

Allied Drugs.—Antilope Dorcas, *Linné.* This is a deer-like ruminant inhabiting Northern Africa. Its small globular excrements have a strong musk-like odor, and have been recommended as a substitute for musk, more especially in perfumery. Jacqueme obtained from them 7 per cent. of alcoholic extract, consisting of biliary substances, of a crystallizable acid, and of an odorous resin, which is also soluble in carbon disulphide. Water dissolves ammonium and sodium salts, and the insoluble portion contains calcium phosphate.

Hyraceum is supposed to be the dry excrements of the *klipdas* or *badger* (Hyrax capensis, *Curier*), a mammal of the order Hyracoidea, inhabiting Southern Africa and attaining a length of about 18 inches (45 Cm.). Hyraceum is in irregular tough but plastic pieces of a black-brown color; when warmed of a castor-like odor and having a bitter nauseous taste. It is partly soluble in water, less soluble in alcohol and ether, and when heated becomes soft, and afterward burns, giving off acrid vapors. It contains a volatile oily matter, resin, fat, various acids, biliary constituents, etc.

Civetta, Zibethum.—Civet, *E.;* Civette, *Fr. Cod.;* Zibeth, *G.;* Zibeto, *Sp.* This is an unctuous secretion contained in a pouch located between the anus and genitals of both the males and females of Viverra Civetta, *Schreber*, and V. Zibetha, *Schreber* (class Mammalia, ord. Carnivora). The former animal inhabits Africa, the latter Southern Asia, and they are occasionally kept captive for collecting the secretion, which is removed by means of a small ladle. It is at first yellowish, but becomes dark-brown, is fusible, nearly insoluble in water, partly soluble in ether and in hot alcohol, and has a strong musk-like odor and a bitterish, acrid, nauseous taste. It contains volatile oil, different fats, resin, coloring matters, and salts.

The above substances are sometimes, though rarely, employed as stimulants and antispasmodics, but are more or less used in perfumery.

Action and Uses.—In man it produces an effect comparable to that of alcohol, since, after stimulating the brain and heart and raising the temperature, it occasions, according to some, drowsiness and thoracic oppression, but, according to others, leaves no reactionary effects behind. Its odor continues for several days to impregnate the breath and all the secretions.

The scarcity, high price, and falsification of musk have caused its use to be comparatively restricted, and explain the varying and often contradictory estimates of its value as a medicine Yet, on the whole, the conditions it is adapted to remedy are pretty well defined. They include all those nervous phenomena which are represented by the term *ataxia*, and among them subsultus tendinum, mild muttering delirium, floccitation, muscæ volitantes, and hiccough, with a small, frequent, tremulous or irregular pulse, without coma and without collapse. Under these circumstances musk tends to produce refreshing sleep, while it calms muscular spasm and favors perspiration, while the pulse grows fuller, more regular, and less frequent. These are phenomena which may occur in all febrile diseases originally of a typhoid type or tending to assume it, and notably in *typhus*, *typhoid fever*, generally at an advanced stage, the *eruptive fevers*, and certain inflammations also, but particularly *pneumonia.* In proportion as ataxic prevail over adynamic phenomena is musk advantageous. The former are often met with in the advanced stages of *cholera infantum*, besides others that indicate serous effusion upon the brain; and they are sometimes dissipated by the administration of musk. Yet it occasionally avails in more typically adynamic cases, in which exhaustion involves all the functions, and there does not seem to remain enough strength to manifest disorder.

Its fitness to combat the special phenomena above indicated is illustrated by its efficacy in purely nervous and non-febrile affections. There can be no doubt of its having repeatedly effected a cure in cases of *hiccough*, *pharyngeal spasm*, *laryngismus stridulus*, *spasmodic croup* (spasmodic laryngitis), *spasmodic cough*, *whooping cough*, *vomiting*, and

colic. Even *chorea*, *hysterical convulsions*, and *tetanus* have occasionally been cured by its means. Its power as a nervine is also shown by its relieving *wakefulness* resulting from combined mental and bodily fatigue—such cases, in fact, as are benefited by valerian, camphor, asafœtida, and ammonia. Among these may be mentioned *delirium tremens.* Macgowan confirms the belief of the Chinese that musk is anodyne, and recommends its use in plasters for *muscular rheumatism*, *sprains*, etc.

Musk is usually administered in pill or emulsion and in *doses* of Gm. 0.60 (10 grains) or upward, every two or three hours. It may also be employed in suppositories. To children it may be given in doses of Gm. 0.06 (gr. j+) in the above-mentioned forms or in a small enema.

MOXA.—Moxa.

Moxa, Fr., Sp.; *Brenncylinder*, G.

Moxas are vegetable substances, either cut or formed into short cylinders, and which when united will burn without fusing. In China and Japan moxas are made of the felt-like down covering the leaves of Artemisia chinensis, *Linné*, and perhaps of other plants. In other countries paper, cotton, or hemp impregnated with a weak solution of potassium nitrate has been employed for the purpose, or the pith of some plants containing sufficient nitrates to sustain an even combustion, like that of the sunflower. Occasionally mixtures have been made of potassium nitrate with substances like lycopodium, beaten together with some adhesive material and rolled into cylinders of convenient size. Instead of nitrate, potassium chlorate or chromate has been employed. Cylinders made of saltpetre-paper (see Chartæ) have been used for the same purpose.

Action and Uses.—The moxa is said to have been employed as a form of cautery from time immemorial by Oriental nations, and particularly by the Chinese and Japanese, from whom it was introduced into Europe by the Portuguese; but it was also used by the Egyptians, the Persians, and the Laplanders. The moxa cylinder should be about an inch long and from ¼ to ½ inch in diameter. One end of it is applied to the skin and held in its place by a pair of forceps or a *porte-moxa*, while the opposite end is lighted and the surrounding skin protected by a damp rag, adhesive plaster, or paper saturated with a solution of alum and dried and having an aperture in its centre. Combustion is maintained by the breath or by a pair of bellows until the whole cylinder is consumed. To prevent deep cauterization liquor ammoniæ is applied immediately after the burning. Sometimes the cylinder is moved about within a small area, without permitting any one spot to become deeply involved; or it may be held very near, but without touching the skin; or, finally, it may be removed when the combustion of the moxa has reached to within a line or two of the skin. It should not usually be applied where the skin is the only covering of bone, tendon, ligament, or cartilage, nor to the mammæ, genital organs, or abdomen. The first sensation of heat is apt to be considered agreeable rather than painful, but it increases and grows tolerably severe. Yet we are assured that it causes less pain than either blisters or caustic issues.

In regard to the *modus operandi* of the moxa, those who have most employed it consider that its action differs from that of the hot iron. Some have suggested that a very volatile (anæsthetic) principle is given off by the burning fibres, and in point of fact an empyreumatic oil must be formed by their combustion upon or near the skin; others consider that the operation is most efficient when there is really no burning of the integument or any serous or purulent discharge.

The remedial uses of moxa are those of counter-irritant agents in general. It seems to have been most efficient in affections of the superficial joints, as the *knee* and the *wrist;* in *white swelling* and *coxalgia;* in diseases of the *vertebræ* and their ligaments, and in *lumbar abscess;* in *neuralgia*, and especially in *sciatica;* in *lumbago*, *rheumatic gout*, and *paralysis;* and finally in *hypertrophy of the spleen* and in *chronic bronchitis.* Of late years most of the applications of the moxa have been superseded by those of the galvanic cautery. This cautery has the advantage of being under the control of the surgeon more completely than any other, and also of being applicable to deep-seated lesions even of the bones.

MUCILAGINES.—Mucilages.

Mucilages, Fr.; *Schleime*, G.

These preparations consist of viscid, more or less tenacious, and adhesive liquids, or of opaque semi-liquid jellies; in all cases the solvent vehicle is water. All mucilages as directed by the pharmacopœias are prone to change, and gradually acquire an acid reaction and offensive odor, at the same time becoming more liquid. If not intended for medicinal use the change may be retarded or prevented by the addition of alum, creosote, or glycerin.

MUCILAGO ACACIÆ, *U. S., Br.*—Mucilage of Acacia.

Mucilago gummi arabici, P. G.—*Mucilage of gum-arabic*, E.; *Mucilage de gomme arabique*, *Mucilage arabique*, Fr.; *Gummischleim*, G.

Preparation.—Acacia, in small fragments, 340 Gm.; Water a sufficient quantity, to make 1000 Gm. Wash the acacia with cold water, then add to it enough water to make the mixture weigh 1000 Gm.; agitate or stir occasionally until it is dissolved and strain.—*U. S.*

To prepare 1 pint of mucilage of acacia use 6 av. ozs. and 175 grains of select acacia and 12 fluidounces of water; after solution has been effected add sufficient water to make the required volume.

Gum-arabic 4 oz. av.; distilled water 6 fluidounces (Imperial).—*Br.* Gum-arabic 1 part; distilled water 2 parts.—*P. G.* Powdered gum-arabic 1 part; cold water 1 part; dissolve in a mortar.—*F. Cod.*

Owing to the fact that the solution of acacia becomes denser as it progresses, stirring or agitation of the mixture will be found somewhat difficult, and solution can be more readily effected by what is known as circulatory displacement, namely, the suspension of the washed acacia in the water in a bag of loosely textured cloth; if the bag be occasionally moved about in the liquid, fresh portions of water will continually displace the solution formed, which latter will sink to the bottom by reason of its own gravity. Mucilage of acacia should be kept in well-stoppered, completely filled bottles in a cool place.

White and clear pieces of gum-arabic should be selected for preparing this mucilage. The impurities which necessitate the subsequent straining are generally accidental admixtures of the gum, and may mostly be removed by rapid washing with cold water before dissolving it. It is a nearly transparent, colorless, or scarcely yellowish, viscid liquid, having a faint rather agreeable odor and an insipid taste.

Pharmaceutical Uses.—This mucilage serves for the suspension of insoluble substances in mixtures and to impart adhesiveness to pill masses. The British Pharmacopœia directs it to be used as an excipient in the preparation of troches.

Mistura gummosa.—Gum mixture, *E.*; Potion gommeuse, Julep gommeux, *Fr.*; Gummimixtur, *G.*—Powdered gum 10 parts, syrup of gum 30 parts, water 100 parts and orange-flower water 10 parts.—*F. Cod.*

Action and Uses.—This mucilage, diluted according to the taste or the condition of the patient, and, sweetened and flavored, forms a customary drink in *fevers* and in inflammatory affections of the *respiratory* and *digestive* organs. It is probably not directly nutritive, but it possibly retards tissue-waste.

MUCILAGO AMYLI, *Br.*—Mucilage of Starch.

Mucilage d'amidon, Fr.; *Stärkeschleim*, G.

Preparation.—Take of Starch 120 grains; Distilled Water 10 fluidounces. Triturate the starch with the water gradually added, then boil for a few minutes, constantly stirring.—*Br.*

It should always be made fresh when needed.

Action and Uses.—Mucilage of starch is generally entrusted to domestic manufacture, but it may be worth while for physicians to know that this mucilage is of the proper density for an enema, such as may be used in *dysentery*. In that disease, if opiates or any other medicines intended to be retained are to be added to the mucilage, the quantity of it injected should not exceed 3 ounces.

MUCILAGO CYDONII.—Mucilage of Cydonium.

Mucilago cydoniæ.—Mucilage of quince-seed, E.; *Mucilage de coing*, Fr.; *Quittenschleim*, G.

Preparation.—Cydonium 18 grains; Distilled Water 2 fluidounces. Macerate the cydonium for thirty minutes in a covered vessel with the distilled water, frequently agitating. Then strain the liquid through muslin, without pressure. This preparation should be freshly made when required for use.

The P. G. 1872 recognized the same formula, but employed rose-water. The French Codex directs quince-seed 1 part and tepid water 50 parts, to be left in contact for six hours, after which the mucilage is strained with pressure.

Bandolin is a mucilage of quince-seeds used for dressing the hair, and is made by macerating 2 drachms of unbroken quince-seeds in a pint of water, and adding about an ounce of cologne-water, with some other scent to suit.

Action and Uses.—Quince-seed mucilage is lenitive and protective, and, like other mucilages, may be applied to the *inflamed skin* or *conjunctivæ*, and may be administered internally in *gastro-intestinal* and *urinary inflammations*, and to allay *cough*, irritation of the air-passages, etc.

MUCILAGO SASSAFRAS MEDULLÆ, *U. S.*—Mucilage of Sassafras-pith.

Mucilage de moëlle de sassafras, Fr.; *Sassafrasmark-Schleim*, G.

Preparation.—Take of Sassafras-pith 2 Gm.; Water 100 Cc. Macerate for three hours, and strain. It should be freshly made when wanted.—*U. S.*

It is a colorless, thickish, transparent liquid of a bland taste.

Action and Uses.—The mucilage of sassafras-pith is a refreshing and useful application to the eye in *acute conjunctivitis*, and may serve as a vehicle for more active agents. It is equally appropriate as a soothing lotion in erythematous and other *inflammations of the skin*. Internally, it may be freely used as a drink in *dysentery* and other bowel complaints, and in *febrile affections* generally.

MUCILAGO TRAGACANTHÆ, *U. S., Br.*—Mucilage of Tragacanth.

Mucilage de gomme adragante, *Mucilage adragant*, Fr.; *Traganthschleim*, G.

Preparation.—Tragacanth 6 Gm.; Glycerin 18 Gm.; Water a sufficient quantity, to make 100 Gm. Mix the glycerin with 75 Cc. of water; heat the mixture to boiling, add the tragacanth, and let it macerate for twenty-four hours, stirring occasionally. Then add enough water to make the mixture weigh 100 Gm., beat it so as to render it of uniform consistence, and strain forcibly through muslin.—*U. S.*

Action and Uses.—Tragacanth mucilage has scarcely any medicinal qualities peculiar to itself. It is seldom used unless as an excipient in lenitive mixtures, and in troches and lozenges which are intended to dissolve slowly in the mouth. Its tenacity has led to its occasional use as a protective for *burns and ulcers*.

MUCILAGO ULMI, *U. S.*—Mucilage of Elm.

Mucilage d'écorce d'orme fauve, Fr.; *Ulmenrinden-Schleim*, G.

Preparation.—Elm, bruised, 6 Gm.; Boiling Water 100 Cc. Digest for one hour in a covered vessel on a water-bath, and strain.—*U. S.*

The mucilage contains at least a portion of the starch of the bark; if intended to be free from starch, cold water should be used. (See also Decoctum ulmi.)

Action and Uses.—As a demulcent, mucilage of slippery elm is employed in *acute* affections of the respiratory, digestive, and urinary organs. As a lenitive for external use it is frequently applied to *erysipelatous* and other acute *cutaneous eruptions*, *abscesses*, *rheumatic joints*, etc. It is very apt to grow sour, and, if allowed to get dry, renders the skin painfully hard and stiff.

MUCUNA.—Cowhage.

Setæ siliquæ hirsutæ.—Cowhage, E.; *Pois velus*, *Pois à gratter*, Fr.; *Kratzbohnen*, *Kuhkrätze*, G.; *Picu-picu*, Sp.

The hairs of the pods of Mucuna (Dolichos, *Linné*, Stizolobium, *Persoon*, Carpopagon,

Roxburgh) pruriens, *De Candolle*, s. Mucuna prurita, *Hooker*. Woodville, *Med. Bot.*, t. 153; Bentley and Trimen, *Med. Plants*, 78.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—This is a long, slender, twining plant, with large trifoliate, nearly smooth leaves, and showy dark-purple and greenish flowers in pendulous axillary racemes, producing flattish, hairy, S-shaped legumes, with about four brownish seeds mottled with black. It is cultivated and wild both in the East and West Indies.

Description.—The hairs covering the legumes are about 3 Mm. ($\frac{1}{8}$ inch) long, of a glossy-brown color, straight, quadrangular prismatic, sharply pointed at the apex, somewhat retrorsely serrate on the upper half, and partly empty, partly filled with a brown granular matter. They easily penetrate the skin, and occasion an intolerable itching, which is greatly increased by washing and rubbing.

The fruits of Stizolobium (Mucuna, *DeCandolle*, Dolichos, *Linné*) urens, *Persoon*, are shorter, less bent, and covered with shorter and darker hairs, which are used like the preceding. An emulsion of the seeds is used in the West Indies in dysuria, and an infusion of the root of the first species is considered to possess diuretic properties, and in India is employed as a remedy in cholera.

Constituents.—Nothing is known of the composition of cowhage, except that it contains a little tannin and resin (Martius, 1827).

Action and Uses.—Cowhage was originally employed as a *vermifuge* under the idea that its prickly setæ, which irritate the skin so severely and are so difficult to detach, would wound and injure the worms, and either kill them or promote their expulsion. Observation showed, however, that when the spiculæ are moistened they are quite innocuous, and there is much reason for believing that the supposed vermicide virtues of this substance are imaginary. It is difficult to imagine that an agent which has actually been employed to produce a painful irritation and eruption upon *paralyzed limbs* for the purpose of arousing their dormant functions should cripple or destroy intestinal worms and leave the intestine itself uninjured. As a vermifuge the setæ were mixed with honey or molasses by dipping the pods in the liquid, and when it reached the consistence of an electuary it was given, fasting, in doses of one or more teaspoonfuls for several successive days. Subsequently a purge of calomel and jalap was prescribed, and this was, doubtless, the most efficient part of the treatment. When formerly used to relieve paralysis, it was applied in a layer upon the affected part, supported by thin paper or a similar substance, or else incorporated in simple ointment or lard.

MYRICA.—Wax-Myrtle.

Bayberry, *Candleberry*, E.; *Arbre à suif*, Fr.; *Wachsbaum*, *Wachsgagel*, G.; *Arbal del la cera*, Sp.

Myrica cerifera, *Linné*.

Nat. Ord.—Myricaceæ.

Origin.—The wax-myrtle is shrubby or arborescent, and grows near Lake Erie, but chiefly along the Atlantic coast of North America. It has alternate, oblong-lanceolate, entire or near the apex sparingly toothed leaves, which are nearly smooth, on both sides covered with resinous dots, and fragrant when bruised. The flowers are diœcious, the staminate ones in nearly cylindrical catkins about 18 Mm. ($\frac{3}{4}$ inch) long, the pistillate ones shorter, and producing globular one-seeded nuts, which are of the size of a pea, blackish, and covered with a white waxy incrustation.

The bark and waxy incrustation of the fruit have been employed.

Description.—1. The bark is in quills or curved pieces about 1.5 Mm. ($\frac{1}{16}$ inch) thick, externally covered with a whitish, slightly wrinkled, thin, corky layer, which separates in small fragments, underneath of which the bark is dark reddish-brown and nearly smooth, resembling the inner surface, except that the latter is slightly striate. The fracture is granular, of a pale-reddish color, and scarcely fibrous in the inner layer. The bark yields a light reddish-brown irritating powder, which has a peculiar aromatic odor and an astringent somewhat bitter and pungently acrid taste.

2. Myrtle-wax, or *bayberry tallow*, is prepared by boiling the fruit with water until the fat collects on the surface. It has a balsamic odor, is harder and more brittle than beeswax, varies in color between green, yellowish, and gray, and breaks with a shallow conchoidal fracture. G. E. Moore (1862) found its specific gravity to range from 1.004 to 1.006, its fusing-point from 47° to 49° C. (116.6° to 120.2° F.), and four-fifths of it to be soluble in hot alcohol.

Constituents.—The constituents of bayberry-bark, as determined by G. M. Hambright (1863), are, besides those more generally met with, a trace of volatile oil, tannin, an acrid resin soluble in alcohol and ether, an astringent resin insoluble in ether, and *myricinic acid*, the latter obtained from the alcoholic extract, after having been treated with ether, by exhausting it with hot absolute alcohol. It forms small granules, which produce a thick froth on being agitated with water, and on the addition of ammonia a deep-green color, rapidly changing to red and yellow. It has a lastingly acrid taste. Dana obtained from the fruit 32 per cent. of solid fat, 5 of resin, and 45 of starch. The myrtle-wax consists, according to G. E. Moore, of about one-fifth palmitin, the remainder being palmitic acid, with a small quantity of lauric acid.

Allied Plants.—Myrica Gale, *Linné.*—Sweet gale, Dutch myrtle, *E.;* Piment royal, Galé odorant, *Fr.;* Gagel, Brabanter Myrte, *G.*—This is a smaller shrub than the preceding, growing in swampy places from the mountains of North Carolina northward to Canada, and in the northern parts of Europe and Asia. The leaves are on short petioles obovate-lanceolate, wedge-shaped at the base, serrate near the apex, subcoriaceous, softly pubescent beneath, and on both sides with yellow resinous dots. The fruit is likewise resinous-dotted. The leaves and brown branches have a strong balsamic odor and an aromatic, astringent, and bitterish taste. Rabenhorst (1836) obtained from 3000 parts of leaves 1 part of a thickish volatile oil containing 70 per cent. of stearopten. A solid fat similar to myrtle-wax is obtained from the fruit of other species of Myrica indigenous to different countries.

Myrica jalapensis, *Kunth*, the root bark is quite acrid and astringent. The fruit yields a firm fat.

Action and Uses.—The bark of the root is acrid and stimulant, and in doses of a drachm causes a sensation of heat in the stomach, followed by vomiting and sometimes by diuresis. When chewed it acts as a sialagogue, and has proved useful in *toothache.* The powder is an active errhine. The leaves have some celebrity in domestic practice as an antispasmodic, antiscorbutic, and astringent medicine. They have been used to check *hæmoptysis.* The other native species are very similar in their properties. The "myrtle-wax" which covers the berries appears to have astringent and slightly narcotic properties, and was used with alleged success in an epidemic of typhoid *dysentery* when it was administered in the dose of Gm. 4–8 (1 or 2 drachms) (Griffith).

MYRISTICA, *U. S., Br.*—Nutmeg.

Semen myristicæ, P. G.; *Nux moschata.—Muscade, Noix Muscade*, Fr. Cod.; *Muskatnuss*, G.; *Nuez mosedda*, Sp.

The kernel of the seed of Myristica fragrans, *Houttuyn*, s. M. moschata, *Thunberg*, M. aromatica, *Lamarck*, M. officinalis, *Linné filius.* Bentley and Trimen, *Med. Plants*, 218.

Nat. Ord.—Myristicaceæ.

Origin.—The nutmeg tree is indigenous to the Molucca Islands, but is at present cultivated in various parts of India, in the Philippines, West Indies, and South America. It is a tree having alternate, smooth, entire, and prominently veined, leathery leaves, and small, yellowish, diœcious flowers, and the stamens united into a fleshy column, and a superior ovary, ripening into a dehiscent, pear-shaped, tough, one-seeded berry. It commences to yield fruit when about nine years old, and continues productive for sixty or seventy years.

Collection.—The fruit, when split on one side, is gathered by means of a long hook fastened to a long stick; the pericarp is removed, and the arillus (see Macis, p. 1003) detached from the nut-like seed, which on the Banda Islands is carefully dried first by solar heat for a few days, or in Bencoolen at once on frames over a slow wood-fire at a temperature of about 140° F. This requires about two months, during which time the seeds are frequently turned, and when the kernels rattle in the shell they are packed for the Chinese market. The entire seeds do not enter the European and American commerce, but only the kernels, which are removed from the shell by cracking the latter with a wooden mallet, carefully garbled and packed (*unlimed nutmegs*), sometimes mixed with cloves, in casks which have been smoked and whitewashed on the inside. In the Dutch colonies the kernels are dipped in a thick milk of lime (*limed nutmegs*)—a custom which originated in the desire

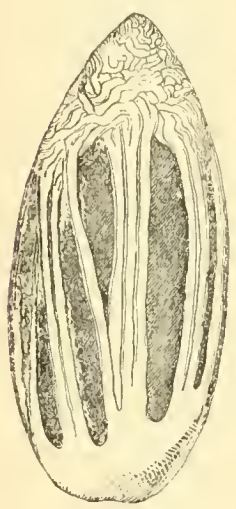
Fig. 188.

Nutmeg with mace, and transverse section.

to destroy the vitality of the embryo, and thus limit this culture to their own possessions. Small and worm-eaten nutmegs are usually used for obtaining the fixed oil.

Description.—Nutmeg in the shell is an oval or elliptical seed about 25 Mm. (1 inch) or more in length, with a brown, somewhat glossy, woody but brittle testa, light-brown raphe, and bearing the shallow impression of the mace. The nutmegs of our commerce are deprived of the testa or shell, oval or ovate in shape 25 Mm. (1 inch) or a little less in length, and marked on the broad end with a circular scar, from which proceeds a shallow furrow to a deeper depression near the upper end. The entire surface is reticulately furrowed and of a light-brown color, or covered, particularly in the furrows, with a white powder (lime). The embryo is located near the broad end in a small conical cavity of the albumen or endosperm, which constitutes the remainder of the commercial article, is of a pale brownish-yellow color, has a fatty lustre, and is dissected by numerous curved channels filled with brown tissue and penetrated by the inner seed-coat (tegmen). Nutmegs have a strong and pleasant aromatic odor and a warm, aromatic, somewhat bitter taste.

Fig. 189.



Wild Nutmeg, with mace.

The Penang and Singapore nutmegs are unlimed; the Dutch are limed.

False Nutmegs.—The *long*, *wild* or *male* nutmeg resembles the foregoing, but is oblong, about 4–5 Cm. (1½ to 2 inches) long; the mace inodorous, less deeply lobed, the kernel of a paler color than nutmeg, and scarcely aromatic. It is obtained from Myristica fatua, *Houttuyn*, and is rarely seen in our commerce.

The so-called *California nutmeg* is the seed of Torreya californica, *Torrey*, s. T. Myristica, *Hooker*; nat. ord. Coniferæ, sub-ord. Taxineæ. It is oblong, with a smooth, brownish, thin testa, enclosing a kernel of the same shape, which has upon cross-section a marbled appearance similar to that of the nutmeg, but has a terebinthinate odor and taste. The tree grows to the height of 21 M. (70 feet), and has an odorous light colored and close-grained wood.

Constituents.—Nutmegs contain between 2 and 8 per cent. of volatile oil (see Oleum Myristicæ), between 25 and 30 per cent. of fat (see Oleum Myristicæ Expressum), some starch, protein compounds, and other principles of no medicinal importance.

Action and Uses.—Observation and experiment agree in showing that nutmeg has a narcotic and intoxicating power. A woman took ½ pint of whiskey in which an ounce of finely-powdered nutmeg was mixed. She suffered various symptoms, probably due to the alcohol in the draught. It is stated that after these subsided she had pain in the ovaries, a leucorrhœal discharge, and sexual excitement (*Phila. Med. Times*, x. 438). In this case the intoxication might be attributed to the alcohol, which was also taken; but in the following this confusing element was absent: "A lady ate one and a half nutmegs (about 135 grains). Two hours afterward she became drowsy, and remained so nearly an hour. This was followed by excitement with sharp pain in the head, and then involuntary laughter, wild fancies, and incessant talking, without loss of consciousness. Presently pain was felt in the region of the heart, with cold extremities and a depressing sensation. Her face was very pale and her pulse weak and thready. These alarming symptoms lasted more than an hour" (Palmer, *Amer. Jour. Phar.*, lvii. 23). Very similar symptoms were presented in the case of a pregnant woman who took five grated nutmegs at one dose. She suffered headache, giddiness, itching, flushing and swelling of the face; there was frequent micturition and copious perspiration; the pupils were contracted, the pulse 130 and full; there was also nausea, but no vomiting or purging. Collapse followed, with pallor and rapid pulse, but no drowsiness at any time. The patient recovered (*Phila. Med. Times*, xvii. 726). A boy three years old ate the greater part of five nutmegs. He was comatose, but not delirious, and urinated twice. The pupils were dilated. He also recovered (*Med. News*, lv. 408). A boy of four years ate two nutmegs; he became comatose, and had suppression of urine. Death took place within twenty-four hours (*Med. Record*, xxxii. 624). These cases suffice to prove that neither the symptoms nor the issues of nutmeg-poisoning are uniform. The treatment of poisoning by nutmeg should consist of stimulant evacuants (mustard) and ammoniated stimulants. Nutmeg is but little used as a medicine, except for flavoring purposes, but extensively as a condiment to qualify the action of oleraceous vegetables, soups, and pastry. It may be given in cases of simple debility of the stomach in *doses* of from Gm. 0.30–1.30 (gr. v–xx).

MYROBALANUS.—Myrobalan.

Myrobalans, E., F.; *Myrobalanen*, G.; *Myrobalani*, Sp.

The fruit of Terminalia (Myrobalanus, *Gærtner*) Chebula, *Retzius*.

Nat. Ord.—Combretaceæ.

Origin.—A large tree, indigenous to India, with coriaceous entire leaves, decandrous whitish or yellowish racemose flowers, and one-seeded drupaceous fruits; several varieties are known, T. citrina, *Roxburgh*, being one of them.

Description.—The *chebulic myrobalans* are 2 to 4 Cm. (1 to 1½ inches) long, oblong or ovoid in shape, obtusely five- or six-angled and ribbed, yellowish-brown, the endocarp pale-brown and resinous-dotted, and contain a white seed. The yellow myrobalans, *M. citrinæ*, are externally of an orange- or ochrey-yellow color. The black myrobalans are the shrivelled unripe fruits, blackish, brittle, glossy upon the fractured surface, and contain a rudimentary seed.

Constituents.—The astringent taste of myrobalans is due to tannin; Stenhouse (1843) found in the first variety also gallic acid, mulage, and brown-yellow color. The last variety contains notable quantities of sugar. According to Hennig (1869), myrobalans yield about 45 per cent. of tannin. This is a mixture of two tannins (Zoelffel, 1891), of which one yields *gallic*, and the other *ellagic acid*. Both decomposition products were observed by Fridolin (1884), who also isolated *chebulinic acid*, $C_{28}H_{24}O_{10}$, which crystallizes in colorless sweet prisms, and by heating with water in a closed tube splits into gallic acid and a tannin. The *myrobalanin* of Apéry (1887), obtained from black myrobalans, appears to be the ethereal extract. The seeds contain fixed oil.

Allied Plants and Products.—Terminalia bellerica, *Roxburgh*, yields the *belleric myrobalans*, which are of about the size of a nutmeg, subglobular, and contracted into a short stalk, reddish-brown, tomentose, and contain a hard pentagonal putamen.

Other species of Terminalia yield barks, which in tropical countries are employed for their astringent properties and in tanning.

Phyllanthus Emblica, *Linné* (Emblica officinalis, *Gærtner*), a euphorbiaceous tree of India, yields *emblic myrobalans*, which are drupaceous, subglobular, six-grooved, and three-celled, each cell containing two small brown-red glossy seeds.

Action and Uses.—These fruits were once held in high esteem as medicines (*Paulus Ægineta* (Adams), iii. 440). Pliny speaks of one species as an astringent in diarrhœa and menorrhagia and as a vulnerary. The Arabian physicians abound in their praise. Some species appear to have been cholagogue and others astringent. Rhazes declares that they act as emetics and cathartics, purge away the excrement, remove humidity, strengthen the senses and the understanding, and are useful in cutaneous eruptions, colic, mental debility, obstinate fevers, headache, dropsy, and splenic disorders. Mesue embellishes this statement by adding, among other things, "that they restore youth, improve the complexion, the breath, and the perspiration, impart joy and hilarity," etc. They continued to be used by European physicians as late as the last century. In 1887 attention was recalled to this ancient medicine by M. Apéry of Constantinople (*Bull. et Mém. Soc. thérap.*, 1887, p. 237), who pointed out their possession at once of purgative and astringent qualities, in which respect they resemble rhubarb, and also in the former action being destroyed by heat. They have a styptic and acidulous taste, and color the saliva green. Their astringency depends on the large proportion of tannin they contain, which is qualified by the resin myrobalanin. The observations above referred to were made in the treatment of *diarrhœa* and *dysentery*, especially in their chronic forms. The *dose* is stated at Gm. 0.25 (4 or 5 grs.), which should be given at appropriate intervals from four to twelve times a day. It may be administered in pill or in powder enclosed in a wafer.

MYRRHA, *U. S., Br., P. G.*—Myrrh.

Gummi-resina myrrha.—*Myrrhe*, Fr. Cod., G.; *Mirra*, Sp.

A gum-resinous exudation from Commiphora Balsamodendron (*Nees*) Myrrha, *Engler;* Berg and Schmidt, *Off. Gew.*, t. 29; Bentley and Trimen, *Med. Plants*, 59.

Nat. Ord.—Burseraceæ.

Origin.—Myrrh exudes spontaneously from large shrubs or small trees, growing in the Somali country and in south-western Arabia, and is collected by the Somalis, who cross the Gulf of Aden for the purpose; but the principal supply of myrrh comes from Eastern Africa, from the country of the Somalis. The plant was collected by Ehrenberg

(1820–26) in Arabia, and a second species found in Africa was subsequently named Bals. Ehrenbergianum, *Berg*, but is by Oliver and Bentley considered identical with B. Opobalsamum, *Kunth*, which grows northward into Abyssinia, and is the source of balm of Gilead (see below). Formerly, myrrh entered commerce through Egypt and the ports of the Levant, hence the term *Turkey myrrh;* at present it is mostly taken from Aden and Berbera to Bombay, where it is assorted before being shipped to Europe and America. From the observations of Marchand (1866), it seems to be chiefly produced in the bark and to a small extent in the pith. About 20,000 pounds of myrrh are imported into the United States.

Description.—Myrrh is in roundish or irregular tears, or in larger masses having an uneven surface of a lighter or darker reddish-brown color and dull musty appearance. These break readily with an uneven somewhat splintery fracture, which is of a waxy lustre, apparently fatty to the touch, often marked with semicircular whitish lines of a brownish-yellow or reddish color, and translucent, at least when in thin layers. In cold weather myrrh may be readily powdered, but in warm weather it cannot be reduced to a fine powder until after it has been well dried and deprived of some volatile oil. When triturated with water it yields a brown yellow emulsion. Alcohol dissolves it partly, leaving the gum behind and yielding a brownish-yellow tincture, which acquires a purple tint with nitric acid. The alcoholic extract dissolved in ether acquires a red or violet color in the presence of bromine vapor. Myrrh has a peculiar rather agreeable odor and an aromatic, acrid, and bitter taste.

"Dark-colored pieces, the alcoholic solution of which is not rendered purple by nitric acid, and pieces of gum which dissolve completely, as well as those which nearly swell in water, should be rejected."—*U. S.*

Other Varieties of Myrrh.—According to Vaughan (1853), there are two other varieties of myrrh found in the Arabian commerce at Aden—one called by Arabs *mur*, or by the Somalis *mulmul*, also known as *heera bul*, by which names African myrrh is likewise known; it resembles the latter in all sensible properties, and is considered identical with it, although it is usually upon the fractured surface destitute of the whitish lines and dissolves in alcohol, sometimes to the extent of 25 per cent. The other variety is known as *bissa bul*, or by the Somalis as *hebbakhade*. Hanbury (1853) states that it is the *Myrrha indica* of Martigny, and was formerly, but is not now, distinguished in commerce as *Indian myrrh;* it has the appearance of an inferior dark-colored myrrh, and is chiefly distinguishable by its different odor, which is likened to that of mushrooms.

Admixtures.—Myrrh is not unfrequently mixed with dark-colored pieces of various gums, some of which merely swell with water, and with *East India bdellium*. The latter is referred to Balsamodendron (Balsamea, *Engler*) Mukul, *Hooker*, and, according to Dymock (1876), a similar exudation is yielded by B. Roxburghii, both species indigenous to India, but perhaps also growing in Southern Arabia. It is in large pieces, rounded and dusty on the surface, breaks with a flat conchoidal fracture, has a dark sometimes blackish-brown color, is translucent in thin layers, and has an odor somewhat resembling myrrh; its tincture does not acquire a purplish color on the addition of nitric acid.

Constituents and Tests.—Myrrh contains a small quantity of volatile oil which may reach 2 or 2½ per cent., from 25 to 40 per cent. of resin, 40 to 65 (or in Arabian myrrh 75) per cent. of gum, and yields about 3½ per cent. of ash, mostly $CaCO_3$. *Oil of myrrh* is a pale-yellow, thick liquid, of specific gravity 0.98, but, according to Brandes (1819), sometimes heavier than water. The variable yield is explained by Bley and Diesel (1845) by oxidation, whereby, among other products, formic acid is formed. From the same cause, probably, the composition may vary: Ruickholdt (1845) obtained results leading to the formula $C_{10}H_{14}O$, which would make it isomeric with thymol and carvol; Heldt (1847) found $C_{22}H_{32}O_2$; Buri (*Pharmacographia*) obtained $C_{22}H_{32}O$. Dissolved in carbon disulphide, the oil gradually assumes a permanent violet or blue color after the addition of nitric acid or bromine. The *resin* is entirely soluble in alcohol, ether, and chloroform. Hager (1865) found it only partly soluble in carbon disulphide, the soluble portion acquiring a violet color with nitric acid and with bromine. Hydrochloric acid produces the same color with the resin, after previously moistening it with alcohol. The bitter principle, according to Flückiger, is sparingly soluble in water, partly soluble in carbon disulphide, soluble in ether and in alcohol, and from the latter solution precipitated by lead acetate; its alkaline solution reduces Fehling's test-liquid and precipitates floccules on the addition of acids. The *gum* consists, according to Hekemeijer (1858), of two kinds—one being precipitated by neutral, the other by basic lead acetate. Shuttleworth (1871) recommends it as making a good paste of unlimited keeping qualities; its adhesiveness is increased by the addition of a little molasses.

Myrrh melts together with caustic potassa with some difficulty; Hlasiwetz and Barth (1866) found among the products protocatechuic acid and a little pyrocatechin.

Allied Drugs.—Balsamum gileadense, *Balm of Gilead*, *Mecca balsam*, or *Opobalsamum*, though differing greatly from myrrh, is referred to Balsamodendron Opobalsamum, *Kunth*. It is said to exude spontaneously, and is an opaque yellowish or whitish, fragrant, viscid liquid, in which Trommsdorff found 30 per cent. of volatile oil and 64 per cent. of hard resin, while Bonastre obtained only 10 per cent. of volatile oil, 70 per cent. of adhesive, and 12 of hard resin. It is at present rarely, if ever, met with in our commerce.

Bdellium. Indian bdellium is described above. African bdellium is the exudation of Balsamodendron (Balsamea, *Engler*; Hendelotia, *Richard*) africanum, *Arnott*, a shrub indigenous to West Africa, and is used in France chiefly as an addition to some plasters. It is met with in irregular roundish or oval tears, and varying in color from pale yellowish to brown-red. It is translucent, breaks with a waxy fracture, and resembles myrrh in odor and taste, but its tincture does not become purple on the addition of nitric acid.

Pharmaceutical Preparation.—Extractum myrrhæ, Extract of myrrh, made with cold distilled water, contains chiefly gummy matter and the bitter principle.

Action and Uses.—Myrrh is both stimulant and tonic. In small doses it appears to quicken the appetite and digestion; in larger doses it irritates the stomach, occasioning nausea, and even vomiting and diarrhœa, quickening the pulse, stimulating the bronchial mucous membrane, and probably exerting a special influence of the same sort upon the uterine system. It has been found useful in *atonic dyspepsia* with flatulence, mucous evacuations, constipation, and associated nervous disorders of a hysterical or hypochondriacal description. In such affections it is profitably combined with vegetable bitters and iron. The compound iron mixture is a valuable preparation of this nature which is extensively employed in *amenorrhœa* connected with anæmia and general torpor of the functions. In like manner it may be employed in chronic uterine and vaginal *leucorrhœa*. Myrrh is especially useful in *chronic bronchitis* with profuse expectoration, but if fever is present its dose should at first be small. In ancient times it was much used as a vulnerary to promote the healing of *wounds*, *ulcers*, etc. of an indolent type. Its stimulant and astringent qualities are manifested in cases of *spongy* and *ulcerated gums*. Its *dose* is from Gm. 0.30–2 (gr. v–xv), but it is seldom used in substance. It may be prescribed in emulsion as an enema.

Balm of Gilead and *Indian bdellium* are both obsolete in Western medicine. The former was once famous as a vulnerary, and more recently entered into a stimulant balsamic application for gout; the latter was, besides, in great repute as an expectorant and emmenagogue.

MYRTUS.—Myrtle.

Myrte, Fr., G.

Myrtus communis, *Linné*.

Nat. Ord.—Myrtaceæ.

Origin and Description.—The myrtle is a shrub or small tree inhabiting the countries near the Mediterranean, and frequently cultivated. It has a dark grayish-brown, fissured, astringent bark, and opposite, smooth and glossy, entire leaves, varying in length from ½ inch to 2 inches (12–50 Mm.), and in shape from ovate to linear-lanceolate and mucronate; they are on very short petioles, are densely pellucid-punctate, and bear in their axils a white or light-pinkish flower with numerous stamens. The fruit is a roundish-oval or subglobular, fleshy, bluish-black berry of the size of a pea, with two cells, each containing four or five whitish kidney-shaped seeds. The leaves, flowers, and fruit have a very agreeable odor.

Constituents.—Riegel (1849) obtained from the ripe berries volatile oil, resin, tannin, citric acid, malic acid, sugar, etc. Raybaud (1834) found the volatile oil, as distilled from the leaves, flowers, and fruit, to have a yellowish or greenish-yellow color, and to be lighter than water. Gladstone (1863) ascertained it to have the specific gravity .891, to be dextrogyre, and to consist mostly of a hydrocarbon, $C_{10}H_{16}$, boiling between 160° and 170° C. (E. Jahns, 1889). The bitter principle has not been investigated.

The fragrant water distilled from the flowers and leaves is known in France as *eau d'ange*.

Allied Plants.—Myrtus Arragon, *Kunth*, is used in Mexico in place of the preceding.

Myrtus Chekan, *Sprengel*, s. Eugenia Cheken, *Molina*, is a shrub with a rough brown astringent bark, and indigenous to Chili, where it is known as *cheken*, *chekan*, or *chequen*. The leaves are collected with the brown-gray branches, and are nearly sessile, about 2 Cm. (⅘ inch)

long, oval-lanceolate or elliptic, somewhat revolute on the margin, rather light-green, smooth, delicately feather-veined, and dotted with minute oil-glands; they have a slight aromatic odor and an aromatic, pungent, and slightly bitter taste. C. H. Hutchinson (1879) found tannin and volatile oil, but no alkaloid. J. Höhn (1882) obtained 4.2 per cent. of tannin and indications of the presence of a glucoside. J. W. England (1883) isolated from the distillate with potassa small white crystals, which he believes to be the acetate of a volatile alkaloid, *chekenine;* this supposed salt is insoluble in ether, soluble in alcohol and water, not precipitated by iodine or by Mayer's solution, has a feeble bitter taste, and with nitric acid and potassium ferrocyanide gives a green color. The leaves yield from 2 to 4 per cent. of volatile oil and from 8 to 10 per cent. of ash. Mr. England proposed for the *fluid extract of cheken* a menstruum composed of 3 parts of alcohol and 1 part of water.

Psidium pyriferum, *Linné*, and Ps. pomiferum, *Linné*, are small trees of the West Indies and other tropical countries, having an astringent bark, aromatic and astringent leaves, and fragrant flowers. The acidulous fruit is known as *guava* (*guayaba*, Sp.), and is used in the form of jelly, marmalade, etc. F. L. Bertrand (1888) obtained from the bark and leaves a resinous principle, *guavin*, which is said to possess febrifuge properties.

Jambosa vulgaris, *De Candolle* (Eugenia Jambos, *Linné*), and J. malaccensis, *De Candolle*, are larger East Indian trees, of which the flowers, leaves, and bark are employed. The fruit, known as *rose-apple*, has an acidulous rose-like flavor.

Action and Uses.—It is remarkable that a plant which was formerly used for so many medicinal purposes should have become almost obsolete as a medicine. In 1876 attention was directed toward it by Delioux de Savignac, from whose essay the following particulars are taken: He used the infusion of the leaves or a dilution of the tincture as an injection in *leucorrhœa* and *prolapsus of the uterus*. Its agreeable odor renders it more acceptable than other analogous preparations to delicate women, and, besides arresting the discharge, it renders firm the parts to which it is applied. A fine powder prepared with the dried leaves was applied on tampons of cotton wadding with excellent results in cases of *ulcers* of the *uterus*, especially when the cotton was previously moistened with glycerin. The same powder was used with striking advantage as a dressing for recent and suppurating *wounds* and *ulcers*, for *eczema* and *intertrigo*, and was confined by carded cotton and a bandage. The infusion of the fruit or of the leaves was found equally efficacious in similar cases, and as a lotion for sinuses and other ulcers not readily accessible to the powder. Where fetid discharges or a tendency to *gangrene* existed, myrtle wine was used to destroy the fetor and promote granulation and the cure. It was also injected with excellent results into deep, suppurating sinuses. The essential oil and its alcoholic solution appear not to possess to an equal degree the anæsthetic properties of oil of peppermint, etc., but they nevertheless are somewhat anodyne.

In catarrhal affections of the *kidneys* and *bladder* powder of myrtle-leaves is recommended in doses of from Gm. 1–4 (gr. xv–lx), and the same prescription is stated to lessen the colliquative *sweats* of phthisis. The infusion would be more suitable in such cases, but its taste is repugnant to most patients. It is more applicable to the treatment of *dysentery* by enema. The powder, given to the extent of Gm. 1–2 (gr. xv–xxx) a day, was used with great benefit in *menorrhagia*. The author whom we cite recommends the infusion as a collyrium in *conjunctivitis*, as a gargle in various forms of *pharyngitis*, and to be used like rhatany in the treatment of *hæmorrhoids*. For the last-mentioned purpose he also found it remarkably useful when given internally with Venice turpentine in a bolus. Finally, the infusion was of service in *chronic bronchitis*. The essential oil is, however, more efficient. Linarix (*Thèse*, 1878; *Brit. Med. Jour.*, Apr. 10, 1890) attributed to it antiseptic virtues, and claimed that it was a stimulant of the digestive, pulmonary, and urinary organs. This judgment has been confirmed by Eichhorst, who was impressed by its prompt and complete disinfecting action in *gangrene of the lung* and *fœtid bronchitis*, as well as by its rapidly curative power in these diseases. He exhibited it in capsules, each containing about Gm. 0.12 (gr. ij) of the oil, and of these prescribed two or three every two hours (*Therap. Monatsheft.*, iii. 22).

An infusion of myrtle for topical use may be prepared with Gm. 8–16 (℥ij–iv) of the leaves to a pint of water; for internal administration it should be diluted. An infusion of the berries may be made with similar proportions for internal as well as external administration. The finely-powdered and sifted leaves may be prescribed in doses of Gm. 1–2 (gr. xv–xxx). An infusion of the bark may be prepared with Gm. 32–64 (℥i–ij) in Gm. 250 (half a pint) of water. The essential oil has also been used in the catarrhal affections above mentioned. It is best administered in capsules containing 4 or 5 drops of the oil.

Cheken, or *chequen*, is represented by Murrell (*Practitioner*, xxiv. 321) to be an efficacious remedy for mucous profluvia of the *air-passages* and the *urinary tract*. A fluid

extract of it was given in *doses* of a teaspoonful three or four times a day. These statements have failed of confirmation by Gottheil (*Med. Record*, xxiv. 258).

NAPHTALINUM, *U. S.*, *P. G.*—Naphtalin.

Naphtalene, *Naphthalin*, E.; *Naphthaline*, *Naphthalène*, Fr.; *Naphthalin*, G.
Formula $C_{10}H_8$. Molecular weight 127.7.

A hydrocarbon obtained from coal-tar.

Origin.—Naphtalene was discovered by Garden (1820) in coal-tar oil, and recognized by Reichenbach as resulting from the decomposition of the products of distillation of coal. It has since been obtained from a large number of organic bodies, particularly if the distillation-products are conducted through a red-hot tube, and is a constituent of the petroleum of Burmah.

Preparation.—The fraction of coal-tar oil collected during the distillation of coal tar, between 180°–250° C. (356°–482° F.) gradually deposits a dark crystalline substance, which consists chiefly of impure naphtalene. By treatment successively with sodium hydroxide solution and sulphuric acid certain acid and basic by-products (phenols, aniline, etc.) are removed, and the residue after distillation in the presence of steam, is further purified by repeatedly heating with concentrated sulphuric acid to 188° C. (356° F.) and redistilling. Finally, a white product is obtained which is practically pure naphtalene, but has a tendency to darken when exposed to air and light, owing to slight contamination with some remaining phenols; to remove these the oxidizing effect of a mixture of sulphuric acid and manganese dioxide is resorted to for fifteen or twenty minutes at a water-bath heat, and the mixture is then washed with water and sodium hydroxide, and finally resublimed.

Naphtalene recrystallized from alcohol should alone be used for pharmaceutical purposes, and should be kept in well-stoppered bottles.

Properties and Tests.—On dissolving naphtalene and picric acid together in hot alcohol the two unite, forming on cooling golden-yellow needles having the composition $C_{10}H_8.C_6H_2(NO_2)_3OH$, and yielding all the picric acid to ammonia. Naphtalene yields with chlorine and bromine numerous products of addition and substitution and with sulphuric acid well-defined sulpho-acids. When treated with strong nitric acid, *nitronaphtalenes* are generated, which by the action of reducing agents are converted into *naphtylamine*, $C_{10}H_7.NH_2$, which is crystallizable, turns red in the air, and the salts of which yield blue, and finally purple-colored, precipitates with ferric chloride, chromic acid, and other oxidizing agents. By means of diluted nitric acid it is converted into phtalic acid, $C_8H_6O_4$. "Colorless, shining, transparent laminæ, having a strong, characteristic odor resembling that of coal-tar, and a burning aromatic taste; slowly volatilized on exposure to air. Insoluble in water, but when boiled with the latter, imparting to it a faint odor and taste. Soluble in 15 parts of alcohol at 15° C. (59° F.), and very soluble in boiling alcohol; also very soluble in ether, chloroform, carbon disulphide, fixed and volatile oils. Naphtalene volatilizes slowly even at the ordinary temperature; rapidly when heated. It also volatilizes with the vapors of water or alcohol. At 80° C. (176° F.) it melts, and at 218° C. (424.4° F.) it boils. Its vapor is inflammable, burning with a luminous and smoky flame. When ignited, it is consumed, leaving no residue. Naphtalene is neutral to litmus-paper moistened with alcohol. On shaking a small portion of naphtalene with concentrated sulphuric acid, the acid should remain colorless; nor should it acquire more than a pale reddish tint, if the mixture be heated for five minutes in a water-bath (absence of contaminations derived from coal-tar)."—*U. S.*

Action and Uses.—Applied to the tongue, naphthalin gradually develops a strong, acrid, burning taste in the mouth and throat and the expectoration of ropy or frothy sputa (Dupasquier, 1842–43). On the sound skin it produces no irritation, but it causes smarting and burning on raw surfaces, although it does not inflame them, and it arrests the decomposition of their secretions: 20 grains of it mixed with 8 ounces of urine have preserved the liquid unchanged for three weeks. It is found to destroy animal and vegetable parasites. Much has been said of its insolubility, but taken internally it turns the urine of a dark color, and doses of 15 grains daily have occasioned frequent micturition with burning pain, vesical tenesmus, and redness of the urethral orifice. Purdy states that in certain cases of genito-urinary disease he has known a dose of 5 grains to cause severe suffering along the whole urinary tract (*Jour. Amer. Med. Assoc.*, vii. 504). The urine voided is not stated to be albuminous. Used in cases of infantile diarrhœa, it has produced a tendency to collapse, with sallowness of the face, which ceased upon the sus-

pension of the medicine. These poisonous effects of naphthalin directly contradict the statement of Rossbach, that it may be given for weeks together to the extent of 75 grains a day without injury of any sort, and that it is very slightly absorbable (*Berlin. klin. Wochenschr.*, No. 42, 1884). It has been employed with reputed advantage in *whooping cough* (in the form of vapor), and also in *chronic bronchitis* and *bronchorrhœa*, particularly as they occur in advanced life. In other words, its operation in these affections resembles that of the terebinthinate and balsamic medicines. Although the claims made by Rossbach for the virtues of this medicine in *diarrhœa* have not been substantiated, it would seem to be useful in various forms of the disorder, especially in such as are directly due to intestinal irritation, caused by fermentation of the food, in summer diarrhœa, by ulcers of the intestine in typhoid fever, and dysentery, etc. The comparative insolubility of naphthalin is regarded as an advantage in these affections, but especially in the chronic forms of bowel complaint. The doses which have been regarded as efficient have varied from Gm. 1 to Gm. 4 (gr. xv–lx) a day, and were given in gelatin capsules. In 1885, Götze attributed to it the power of shortening the duration of *typhoid fever* and ameliorating all of its symptoms, as well as reducing its mortality (*Zeitsch. f. klin. Med.*, ix. 71). Neither more nor less than the antipyretics proper has naphthalin accomplished this object. Fischer (*Times and Gazette*, Dec. 1881, p. 718) was one of the first to state that naphthalin is a powerful antiseptic, preventing putrefaction and correcting the putrid exhalations from *wounds*, *ulcers*, and mucous canals, without irritating the exposed tissues or exciting eczema in the surrounding skin. It stains neither the skin nor the linen, and is said to have no unpleasant smell of its own, but after remaining for a while upon the skin it exhales a peculiar, but not a very strong, odor. In the main, experience has confirmed these statements. Continued application of it to raw surfaces or to mucous membranes, or to the skin by friction, is sometimes followed by irritation in the urinary passages, and even by hæmaturia (Fürbinger *Bull. de Thérap.*, ciii. 47). Djankonow states that a solution of 1 part of naphthalin in 4 parts each of alcohol and ether, when applied to foul and indolent ulcers and wounds, causes them to granulate and cicatrize rapidly (*Amer. Jour. of Med. Sci.*, Jan. 1883, p. 247). Although condemned by Fronmüller as liable to excite eczema, the disease in which naphthalin has been found most useful is *scabies*. Its use was first suggested by the fact that furriers employed it to protect their goods from insects. Kaposi recommends for this affection the following ointment: R. Naphthalin, 15 parts; lard, 100; green soap, 50; powdered chalk, 40. Except in aggravated cases, a single thorough friction is declared to be sufficient for the cure. In severer cases two frictions suffice. After friction the patient is made to lie between blankets for several hours (*Centralblatt f. d. gesammte Ther.*, i. 69). The same dermatologist strongly commends the use of a 5 per cent. ointment of naphthalin in *prurigo* as the most efficient remedy for that distressing affection. It certainly does not cure the disease radically, for prurigo is an outward expression of a constitutional disorder. In eczema, psoriasis (Emery, 1842), tinea tonsurans, and various other cutaneous diseases in which it has been employed this preparation is of very subordinate efficiency. Dissolved in alcohol, it serves as a substitute for tincture of camphor in treating *sprains*, *contusions*, etc. It has been administered internally for *intestinal worms*. The *dose* is Gm. 0.50-2 (gr. viii.-xxx) given in some aromatic and alcoholic vehicle. An ointment is made with Gm. 1.60 to Gm. 32 (gr. xxv. in ℥j).

Fluorescein and Fluorescin in solution are used for coloring lesions of the cornea, and thereby rendering them more visible, and for testing the permeability of strictures of the nasal duct. They are not irritating (*Jour. Amer. Med. Assoc.*, xvii. 462). The solution recommended consists of water Gm. 32 (℥j). sodium bicarbonate, Gm. 0.50 (gr. vij), fluorescein, Gm. 0.66 (gr. x).

NAPHTOL, *U. S.*—Naphtol.

Naphtholum, P. G.; *Naphthol*, *Beta-Naphtol*, *β-Naphtol*, *Iso-Naphtol*.
Formula $C_{10}H_7OH$. Molecular weight 143.66.

A phenol occurring in coal-tar, but usually prepared artificially from naphtalene. It should be preserved in dark amber-colored, well-stoppered bottles.

Naphtol was first prepared by Schäffer (1869) by fusing beta-naphtalene sulphonic acid with potassa, and later on (1876) by Liebermann by action of nitrous acid on beta-naphtylamine.

Preparation.—Concentrated sulphuric acid is allowed to act on naphtalene for

several hours at a temperature of 200° C. (392° F.), whereby β.-naphtalene sulphonic acid is formed ($C_{10}H_7.HSO_3$); during the early stage of the process, and particularly at 80°–90° C. (176°–194° F.), much alpha acid is produced, but at a higher heat this is converted into the beta variety. The acid is next dissolved in water, saturated with milk of lime, and the resulting calcium salt separated by crystallization; this is redissolved in water and decomposed by sodium carbonate yielding sodium naphtalene-sulphonate, $C_{10}H_7SO_3Na$. The sodium-salt is next added to fused sodium hydroxide, and thus sodium-naphtol, $C_{10}H_7ONa$, and sodium sulphite, Na_2SO_3, are obtained; the former is treated with hydrochloric acid, yielding naphtol and sodium chloride. Beta-naphtol thus obtained is purified by sublimation and final recrystallization from hot water or benzin (petroleum ether). Medicinal naphtol should be from alpha-naphtol, with which the commercial varieties are frequently contaminated (to the extent of 5 per cent. or more.

Properties and Tests.—"Colorless or pale buff-colored, shining, crystalline laminæ, or a white or yellowish-white crystalline powder, having a faint phenol-like odor, and a sharp and pungent, but not persistent taste. Permanent in the air. Soluble at 15° C. (59° F.), in about 1000 parts of water, and in 0.75 part of alcohol; in about 75 parts of boiling water, and very soluble in boiling alcohol. Also very soluble in ether, chloroform, or solutions of caustic alkalies. When heated, naphtol sublimes easily. It is also volatilized with the vapors of alcohol or water. It melts at 122° C. (251.6° F.), and boils at 286° C. (546.8° F.). On ignition it is consumed, leaving no residue. It is neutral to litmus-paper moistened with alcohol. A cold, saturated, aqueous solution of naphtol, when mixed with ammonia water, exhibits a faint bluish fluorescence. Chlorine or bromine-water, added to the aqueous solution, produces a white turbidity, which disappears on adding ammonia-water in excess. On adding about 0.1 Gm. of naphtol to a few Cc. of a concentrated, aqueous solution (1 in 4) of potassium hydroxide, then about 1 Cc. of chloroform, and gently warming, the aqueous layer will acquire a blue tint, changing after a while to green and brown. Ferric chloride test-solution colors the aqueous solution of naphtol greenish, and, after some time, causes the separation of white flakes, which turn brown on heating the liquid. A piece of pine wood dipped into an aqueous solution of naphtol, and afterward moistened with dilute hydrochloric acid, becomes green on exposure to daylight. On dissolving naphtol in 50 parts of ammonia-water, no residue should be left (absence of naphtalene), and the solution should not have a deeper tint than pale yellow (absence of other organic impurities). If 0.1 Gm. of naphtol be mixed, in a test-tube, with 1 drop of syrup and 5 Cc. of water, and about 3 Cc. of concentrated sulphuric acid be then poured into the tube held in a slanting position, so that the liquids may form separate layers, a yellowish-brown color will appear at the zone of contact, which becomes darker on standing (absence of, and distinction from alpha-naphtol, which produces at once a crimson color, turning deep blue in the upper part of the zone on standing)."—*U. S.*

Derivative and Allied Compounds.—Microcidin.—Under this name a compound was recommended by Polaillon as an antiseptic, which is practically sodium-naphtol, and is obtained as a white powder by fusing beta-naphtol with half its weight of sodium hydroxide, and cooling. It is soluble in water (about 3 parts) and is non-caustic.

Benzonaphtol or β.-naphtol benzoate is obtained by action of benzoyl chloride on beta-naphtol in a sand-bath; the reaction begins at 125° C. (257° F.), and is completed in half an hour at 170° C. (408° F.). A hard crystalline mass results, which yields the benzonaphtol to boiling alcohol. It occurs as a white crystalline powder or in form of long needles, is odorless and tasteless, and insoluble in cold water. Its chemical formula is $C_6H_5CO_2C_{10}H_7$, and it melts at 110° C. (230° F.). When internally administered it causes diuresis, lowering of temperature and of cardiac and respiratory action. Benzonaphtol has been given to children to the extent of 30 grains a day in frequently repeated small doses.

Betol or β-naphtol salicylate, Naphtalol, Naphtosalol, Salinaphtol.—$C_6H_4OHCO_2.C_{10}H_7$.—A crystalline compound analogous to salol and prepared in a manner identical with that employed for the latter substance, except that sodium-naphtol is used instead of sodium-phenol. In order to free the crude product from the accompanying sodium chloride and meta-phosphate, it is well washed with water and then crystallized from its solution in alcohol. Pure betol occurs as a colorless lustrous crystalline powder, without odor and taste and melting at 95° C. (203° F.); it is insoluble in water or glycerin, difficultly soluble in turpentine and cold alcohol, but readily soluble in boiling alcohol, ether, benzene, and warm linseed oil. Betol is not affected in the cold by moderately strong acids or solutions of the caustic alkalies, but when heated with concentrated solutions it is split up into salicylic acid and beta-naphtol. As in the case of salol, the same effect is produced by the alkaline pancreatic juice and other intestinal ferments, but gastric juice has no effect upon it. Betol is readily distinguished from salol by its much higher melting point (salol melts at 43° C. (109.4° F.)), and by the production of a pure

lemon-yellow colored solution with pure concentrated sulphuric acid, which a trace of nitric acid changes to olive brownish-green; salol gives no such color reactions. Betol has been administered in cases of vesical catarrh and articular rheumatism in doses of 5 or 6 grains four times a day.

Diiodo-beta-naphtol or Naphtol-aristol.—A greenish-yellow compound, odorless and tasteless, insoluble in water, sparingly soluble in alcohol, ether, or acetic acid, but freely soluble in chloroform; when heated it evolves violet fumes. It is made by mixing a solution of 2.4 parts each of iodine and potassium iodide with a solution of 11 parts of beta-naphtol and 4 parts of sodium carbonate, and then adding to the mixture a solution of sodium hypochlorite, which precipitates the new compound.

Asaprol, Calcium beta-naphtol-alpha-monosulphonate $(C_{10}H_6.OH.SO_3)_2Ca + 3H_2O$. This compound was introduced by Stackler and Dubief as an antiseptic in 1892. It is obtained by neutralizing the free acid with calcium carbonate, concentrating the solution and crystallizing. Asaprol occurs as a colorless neutral crystalline powder, soluble in one and a half parts of water and in 3 parts of alcohol; it has been given internally in doses of 1–4 Gm. (15–60 grains) a day.

Alumnol, Aluminum naphtolsulphonate. Introduced by Heinz and Liebrecht toward the close of the year 1892 as an astringent antiseptic. It is probably obtained by mutual decomposition between aluminum sulphate and barium naphtolsulphonate. An almost colorless non-hygroscopic powder readily soluble in cold water or glycerin; it is less soluble in alcohol and insoluble in ether. The aqueous and alcoholic solutions show a blue fluorescence and have an acid reaction. A peculiar reaction of alumnol consists in the precipitation of solutions of albumen and gelatin, the precipitate being redissolved by an excess of the latter substances. A 40 per cent. solution prepared with hot water remains clear upon cooling; an aqueous solution of alumnol is colored blue by ferric chloride.

Hydronaphtol is the name given to a derivative of beta-naphtol obtained by the action of reducing agents. It occurs in scale-like crystals of a silvery white or grayish hue; it is sparingly soluble in water (1 in 1100), but dissolves freely in alcohol, ether, glycerin, benzene, chloroform, and fixed oils. Odor and taste are slightly aromatic. Hydronaphtol may be distinguished from beta-naphtol by the following tests: melting-point at 117° C. (242.6° F.); a drop of tincture of chloride of iron added to 1 fluidrachm of a 5 per cent. alcoholic solution of hydronaphtol produces a deep yellow-brown color, and dark-brown flocculi will separate; in the case of beta-naphtol the color is bright green, and nothing separates; hydronaphtol forms a yellowish-brown solution with alcohol or a cold dilute solution of soda, beta-naphtol forms a colorless solution with alcohol, but is insoluble in cold dilute soda solution. Hydronaphtol is non-poisonous, non-irritant, and non-corrosive; its minimum antiseptic action lies very nearly at 1 in 7200, while the maximum lies between 1 in 2500 and 1 in 3000. It is used in the form of powder diluted with 50 parts of Fuller's earth or starch as a dry dressing, also in form of ointment, jelly, plaster, soap, and solution. Internally it has been used in the treatment of enteric fever, diarrhœa, etc., in doses of 2 or 3 grains in capsules three or four times a day.

Alpha-naphtol, isomeric with the beta-compound, may be obtained in the manner already stated above; its chief use has been as a test for sugar in urine, as follows: If one drop of urine with one drop of a 10 per cent. solution of alpha-naphtol in chloroform is placed in a test-tube with 15 minims of water and concentrated sulphuric acid be then carefully poured in so that the chloroformic solution floats on it, a beautiful violet ring is formed at the line of contact of the two liquids if only $\frac{1}{30}$ per cent. of sugar be present (Molish and Luther). It resembles β-naphtol, but is more readily soluble in water, and is more poisonous than the latter; its melting-point is at 95° C. (203° F.), and boiling point between 278°–280° C. (532.4°–536° F.).

Camphorated naphtol is a brownish transparent, syrupy liquid, obtained by mixing 1 part of beta-naphtol with two parts of camphor; it has been used with success in the antiseptic treatment of boils, coryza, etc. The pain caused by painting the diseased parts with camphor-naphtol may be alleviated by the addition of cocaine.

Alpha-oxynaphtoic acid ($C_{10}H_6OHCOOH$) is obtained by a method analogous to that employed in the manufacture of synthetic salicylic acid—namely, by the action of carbon dioxide upon sodium alpha-naphtol. The acid occurs in acicular crystals of a naphtol-like odor, free from color and melting at 185° C. (365° F.); it is slightly soluble in cold and more readily in hot water; glycerin takes up 0.5 per cent., and alcohol and ether 10 per cent. It forms soluble salts with the alkalies. Alpha-oxynaphtoic acid has been recommended as a disinfectant and antiseptic, and has been used in form of a 10 per cent. ointment in skin diseases and scabies.

Action and Uses.—Beta-naphtol was introduced by Kaposi into the therapeutics of skin diseases. He says of it: "A weak solution in water and alcohol imparts an agreeable pliancy to the sound skin; when stronger and repeated, it occasions slight fissures and a delicate brownish-yellow staining of the outer epidermic layers. It is absorbed by the skin, and excreted, in part at least, as naphtol by the kidneys. It possesses hardly any smell, does not stain the skin or hair, and its slight discoloration of linen washes out (*Edinb. Med. Jour.*, xxvii. 184). Allen states that several patients with itch, and who had a naphthol ointment applied to the whole body, appeared to be affected with gay intoxication (*Med. Record*, xxxi. 568). This naphthol has been given internally in *typhoid fever* to the extent of Gm. 2.50 (gr. xl) a day as an antifermentative—*i. e.* on purely speculative grounds. No practical benefits from it have been demonstrated,

although they have been claimed for it (*Practitioner*, xli. 421). Like its congeners, beta-naphthol is a powerful deodorizer, and, as it is also a wholesome stimulant, it has been applied to many ulcerated and secreting surfaces, and notably in *ozæna*. Rualt recommended for irrigating the nostrils a teaspoonful of beta-naphthol 12 parts, in alcohol (90 per cent.) 84 parts, in a quart of water to which has been added a teaspoonful of equal parts of borate of sodium and bicarbonate of sodium. In obstinate cases this lotion was supplemented by the introduction into the nostrils of cotton tampons saturated with the following solution: Beta-naphthol, 12 parts; tincture of quillaia, 88; distilled water, 400 (*Med. News*, liii. 102). Among *diseases of the skin*, Kaposi found that *scabies* could be cured by two frictions with a 10–15 per cent. beta-naphthol ointment. In various other cutaneous affections, as *morbus pediculosus*, *pruritus*, *psoriasis*, *acne*, *prurigo*, *lupus erythematosus*, etc., in all from which active inflammation is absent, it was of signal advantage; but in *eczema* Kaposi found it less useful or positively irritating, and so have other dermatologists (Van Harlingen, *Amer. Jour. Med. Sci.*, Oct. 1883, p. 479; Allen, *Med. Record*, xxxi. 567).

Microcidin.—The antiseptic virtue of this compound, as set forth by Berlioz, is that "it is somewhat inferior to corrosive sublimate and naphthol, and ten times greater than carbolic acid, and twenty times greater than boric acid. Ulcers and suppurating wounds rapidly cicatrize, and gangrenous surfaces are effectually deodorized after washing with a 0.3 per cent. solution" (Squibb). Others give the proper strength of its solution as 3 to 5 per 1000.

Benzonaphthol is regarded as antiseptic and diuretic, and but slightly poisonous. Its daily dose has been stated to be Gm. 4–5 (gr. lx–lxxv), (*Med. News*, lx. 423); but others recommend doses of Gm. 0.25–0.50 (gr. iv–viij), suspended in syrup and water.

Naphthalol or *naphthosalol* was studied by Kobert (1887), who found that it was decomposed by pancreatic juice and the secretions of the cæcum and colon, but not by the gastric juices. Doses of from Gm. 0.3–0.5 (gr. v–viij) caused no disagreeable symptoms, and no poisonous effects of it were met with. The urine discharged while it was taken turned violet with perchloride of iron. It was found useful in various forms of *catarrh of the bladder*, especially in gonorrheal *cystitis* with ammoniacal urine. It seemed to act well in acute *articular rheumatism*, and in the same manner as phenolsalol. It does not counteract putridity as well as that preparation (*Am. Jour. Phar.*, Aug. 1887, p. 418).

Betol has been used chiefly in the *bowel complaints of children*, but also in those of adults; as well as in acute *articular rheumatism* and *bladder affections*. It is but little if at all poisonous, and its taste is rather agreeable than otherwise. It may be administered by the rectum as well as by the mouth, and associated with bismuth or with antacids. Dose, Gm. 0.50 (gr. viij) suspended in mucilage or syrup.

Asaprol, as its name implies, is antiseptic, and is said to destroy the bacilli of typhoid fever, etc. It is held to be antipyretic and analgesic, and more rapidly and efficiently than the salicylates, with the advantage of neither exciting vomiting nor disturbing the brain or the auditory apparatus. It has been especially commended for its action in acute *rheumatism*, *influenza*, and *typhoid fever*. It has been prescribed in gradually increased and divided doses—Gm. 2 the first, Gm. 3 the second, and Gm. 4 the third day—with a considerable quantity of water.

Hydronaphthol is stated by Dr. Fowler (*New York Med. Jour.*, Oct. 3, 1885) to possess antiseptic properties fifteen times greater than carbolic acid, over which it is said to possess the advantages of being neither corrosive, nor poisonous, nor odorous, nor injurious to textile fabrics or their colors, nor to steel instruments. A saturated watery solution of 1 : 1000 is completely antiseptic. It can be mixed with dry powders and render them antiseptic, and is not decomposed by organic matters. According to Dr. Levis, "its germicidal and proper disinfectant power is ineffective, but it prevents the formation of putrescent germs, and it is adapted to take the place of carbolic acid in surgery" (*Therap. Gaz.*, ix. 825). Dr. Dockrell, however, applauds it as one of the surest agents for destroying the tricophyton fungus of *tinea tonsurans* (*Lancet*, Nov. 1889, p. 1110).

Hydroxylamine was shown by Brunton and Bokenham to produce a fall of blood-pressure almost exactly similar to that produced by nitrite of amyl (*Proceedings of the Royal Society*, vol. xlv.). Binz held that it does not directly affect the brain, but only through the changes it occasions in the constitution of the blood (*Therap. Monatsh.*, iv. 136), which turns of a deep brown color through the dissolution of the red corpuscles. As effects of this disorganization the urine becomes blood-red and a narcotic action on the brain is produced. Hydroxylamine is, however, not given internally, but is applied

to the treatment of certain diseases of the skin, especially *lupus, parasitic sycosis, herpes tonsurans*, and *psoriasis*. It has the advantage over chrysarobin and pyrogallic acid of not staining the skin or the clothing, but it is sometimes very irritating, and by absorption has occasioned albuminuria. A 10 per cent. solution of it has vesicated the skin. Eichoff (*Therap. Monatsh.*, iii. 137) has recommended the following: Hydroxylamin. hydrochlor. Gm. 0.1, spirit. vini, glycerini, āā Gm. 50: to be applied several times a day after cleansing the part with soap and water. Doutrelepont and Fabry (*Centralbl. f. Therap.*, vii. 376) prescribe: Hydroxylamin. hydrochlor. Gm. 0.2–0.5, spt. vini. Gm. 100, calcis carb. q. s. ad neutral.—M. For painting on the eruption; and for a lotion to be applied on cloths, 1 : 1000.

NARCISSUS.—Daffodil.

Narcisse des prés, Porrillon, Fr.; *Gelbe Narcisse*, G.

Narcissus Pseudonarcissus, *Linné.*

Nat. Ord.—Amaryllidaceæ.

Description.—Daffodil is found wild in moist and shady places in Southern Europe, and is frequently cultivated in gardens. It has an ovate, tunicated, whitish *bulb*, which is covered by brown leaf-scales and has a mucilaginous and bitter taste. The *leaves* are flat, linear, erect. The *flowers* are single on the scape, nodding, large, yellow, with a top-shaped tube and a large bell-shaped cup, wavy or crisped at the margin, and equal to the six spreading divisions of the perianth; they have an unpleasant odor and a nauseous, bitter, and acrid taste.

Constituents.—The acrid and bitter principles of daffodil have not been investigated. Caventou obtained from the flowers by ether a yellow, and by alcohol a brown-yellow, coloring matter. Jourdain (1840) gave the name *narcitin* to an emetic, probably extractive, substance, of which he obtained 37 per cent. from the bulb and 25 per cent. from the flowers; it is described as white, translucent, of a slight odor and taste, deliquescent and soluble in water, alcohol, and vinegar. He also found 6 per cent. of gum and 24 per cent. of tannin. Gerrard obtained a crystalline neutral principle and *pseudonarcissine*, an amorphous alkaloid.

Narcissus jonquilla, *Linné*, *Jonquil.* The scape bears two to five small, yellow, fragrant flowers, from which ether takes up a yellow, butyraceous, volatile oil of a very agreeable odor; afterward alcohol dissolves a brown, viscid oil of an unpleasant odor (Robiquet, 1835).

Action and Uses.—M. Gerrard extracted from the flowering bulbs an alkaloid which in many respects resembles atropine. It dries the mouth; checks the cutaneous circulation; dilates the pupil, especially in topical applications to the eye, the dilatation being preceded for a short time by contraction; quickens the pulse; in a great measure antagonizes the effects of muscarine and pilocarpine on the heart of frogs, and, directly applied to the frog's heart, slows and weakens its contractions. The alkaloid extracted from the bulb after flowering causes copious salivation, and probably increases cutaneous secretion; given internally, contracts the pupils; topically applied, dilates the pupils, but less so than the alkaloid of the flowering plant; slightly relaxes the bowels, and causes some faintness and nausea. An extract of the flowered bulbs exhibits emetic and purgative properties not possessed by the alkaloids. In man the most noticeable effect of narcissus is vomiting. Gm. 1–2 (gr. xv–xxx) of wild narcissus-flowers are said to act as an emetic, especially if given in a decoction prepared from the flowers dried slowly in the sun. In 1876 the infusion was strongly recommended for children when prepared in the following manner: Gm. 2–3.30 (gr. xxx–l) of narcissus-flowers are infused for fifteen or twenty minutes in Gm. 160–190 (℥v–vj) of hot water, and strained. When slightly sweetened, children take it without repugnance and vomit within ten or twelve minutes. The emetic action of narcissus has been used to break up *intermittent fever* and relieve *bronchial catarrh* with congestion or obstruction of the air-tubes. Like ipecacuanha, it has also been prescribed in *dysentery*, especially of the epidemic form. Its influence on the nervous system is attested by the vogue it has enjoyed in *hysteria, chorea, whooping cough* and even *epilepsy*. The *dose* of the powdered flowers is Gm. 1–2 (gr. xv–xxx); of the powdered bulb from Gm. 2–8 (℥ss–ij) may be given as an emetic.

NECTANDRÆ CORTEX, *Br.*—Bebeeru-Bark.

Cortex beberu, s. bibiru.—Green-heart bark, E.; *Écorce de bébéeru*, Fr.; *Bibirurinde*, *G.*

The bark of Nectandra Rodiæi, *Schomburgk*. Bentley and Trimen, *Med. Plants*, 219.

Nat. Ord.—Lauraceæ, Perseaceæ.

Origin.—The greenheart is a tree from 18 to 30 M. (60–100 feet) high, growing in British Guiana on hillsides a short distance from the sea, and disappearing farther inland. The small compound racemes of white flowers are situated in the axils of the coriaceous oblong elliptical and acuminate leaves, and produce a subglobular berry about 5 Cm. (2 inches) in diameter, supported by the enlarged cup-shaped tube of the calyx, and containing a single seed nearly the size of the fruit. The wood is very durable and useful in shipbuilding.

Description.—The bark is in flat or somewhat curved pieces, sometimes 30 to 60 Cm. (1–2 feet) long and 10 to 15 Cm. (4–6 inches) wide by 6 Mm. ($\frac{1}{4}$ inch) thick, is heavy, hard, and brittle, and consists of fiber only. The outer surface is gray-brown, with numerous irregular conchoidal depressions, the ridges between consisting of soft cork, sometimes with light reddish-gray patches containing small suberous warts. The inner surface is cinnamon-brown and rather coarsely striate. The bark breaks with a short and rough granular fracture, which is somewhat fibrous in the inner layer. It has no odor; its taste is astringent and persistently bitter.

Constituents.—Besides tannin, producing green precipitates with iron salts, some starch, and other common constituents, the bark contains an alkaloid, *beberine*, $C_{19}H_{21}NO_3$, discovered by Rodie (1834). In its pure state it is a white bitter fusible powder, soluble in alcohol and ether, according to Walz (1860) identical with *buxine*, the alkaloid of Buxus sempervirens, *Linné*, and, according to Flückiger (1869), also with *pelosine* and paracine. (See Pareira Brava.) The commercial beberine sulphate was found by Maclagan (1843) to contain another alkaloid, *sipirine*, which is red-brown, resin-like, and insoluble in ether. Maclagan obtained the alkaloid also from the fruit. It is combined with *bebiric acid*, which forms white deliquescent crystals, fuses at 150° C., and sublimes at 200° C. Together with Gamgee (1870), he examined the wood and obtained several alkaloids, one of which, *nectandrine*, $C_{20}H_{23}NO_4$, fuses in boiling water, is very soluble in chloroform, little so in ether; sulphuric acid and manganese dioxide produce a green color, changing to violet. The others have not been further examined. It has not been determined whether any one of these alkaloids is identical with *parabuxine*, $C_{24}H_{48}N_2O$, which was found by Pavia in box-bark; according to Pavesi and Rotondi (1874) its sulphate is insoluble in alcohol, its nitrate crystallizes in pearly scales, and its hydrochloride in minute needles.

Allied Drugs.—Nectandra (Ocotea, *Martius*) Puchury major and N. Puchury minor, *Nees*.—Pichury bean, *E.*; Fève pichurim, Noix de sassafras, *Fr.*; Pichurimbohnen, Sassafrasnüsse, *G.*—This Brazilian drug consists of the cotyledons, which are oblong or roundish ovate, convex on one, and flattish concave on the other side, marked near one end with a depressed scar left by the detached radicle; about 4 Cm. ($1\frac{1}{2}$ inches) long and 12 Mm. ($\frac{1}{2}$ inch) broad, externally blackish-brown, internally light-brown, and with yellow oil-cells; of an aromatic odor and taste, resembling that of nutmeg with an admixture of sassafras. Small pichurim beans rarely exceed 18 Mm. ($\frac{3}{4}$ inch) in length. The chief constituents are starch, gum, about 30 per cent. of fat, partly butyraceous and partly solid, and 2 to 3 per cent. of volatile oil, which was examined by Alex. Müller (1853), and contains a little lauric acid, probably also safrol.

Ocotea (Oreodaphne, *Nees*) opifera, *Aublet*, of Brazil, yields *canella de cheiro*, and from the fruit is obtained considerable fragrant volatile oil, which is used in embrocations.

Ocotea guianensis, *Aublet*.—The bark is employed in decoctions in the treatment of abscesses.

Mespilodaphne (Cryptocaria, *Martius*) pretiosa, *Nees*, yields the *casca pretiosa* of Brazil, which bark is externally yellowish-brown, smooth and somewhat warty, internally cinnamon-brown, of an odor resembling cinnamon and sassafras, and has a sweetish, warm, and aromatic taste.

Cryptocaria australis, *Bentham*.—The bark of this Australian species is persistently bitter and poisonous. T. L. Bancroft (1887) isolated a very bitter alkaloid crystallizing in needles.

Coto-bark was sent from Bolivia to Europe in 1875. Its origin has not been determined, but it is probably derived from a lauraceous tree. However, Schuchardt succeeded (1890) in tracing a coto-bark received from Venezuela to Drimys Winteri, *Forster*, var. granatensis, *Eichler*. Coto-bark is met with in flat or curved pieces 6 Mm. ($\frac{1}{4}$ inch) or more thick, of a cinnamon-brown color, externally smooth, the inner surface usually darker, and upon the transverse section showing numerous yellow dots of groups of stone-cells and bast fibres; the bark breaks with a short, granular, and in the inner layer irregular and coarsely splintery, fracture, and has an aromatic odor resembling a mixture of cardamom, cajuput, and camphor, and a bitterish aromatic and pungent taste.

By extracting the bark with ether Jobst and Hesse (1876, 1877) isolated a number of new proximate principles. *Cotoin*, $C_{22}H_{18}O_6$, crystallizes in white fusible prisms, has a biting taste, is readily soluble in alcohol, ether, chloroform, and carbon disulphide, and with difficulty soluble in benzene, petroleum benzin, and cold water. Nitric acid dissolves it with a blood-red, sulphuric acid with a brown-yellow, and hydrochloric acid with a yellow color. Ferric salts precipitate its concentrated solutions blackish-brown, while *dicotoin* is colored brown-red. Wittstein found in coto-bark also pale-yellow *volatile oil* of a peppery taste, a volatile alkaloid, probably propylamine, resin, starch, etc., and 1.8 per cent. of ash.

Paracoto-bark resembles the bark described above in color and appearance, except that the outer layer consists of whitish deeply-fissured cork, and that the odor resembles that of nutmeg.

Paracotoin, $C_{19}H_{12}O_6$, crystallizes in yellowish-white scales, is tasteless, and dissolves in sulphuric and nitric acids with a yellow color; solution of potassa converts it into paracotoic acid, paracumarhydrin, and other products. *Leucotin*, $C_{34}H_{32}O_{10}$, is tasteless, dissolves in sulphuric acid with a dark-yellow, in nitric acid with a blue-green color, and is freely soluble in alcohol, ether, and chloroform. *Oxyleucotin*, $C_{34}H_{32}O_{12}$, *hydrocotoin*, $C_{15}H_{14}O_4$, and *protocotoin*, $C_{16}H_{14}O_6$, have also been isolated, the latter by Ciamician and Silber (1891). Both barks contain *piperonylic acid*, $C_8H_6O_4$, which has been obtained by Mielck (1869) among the products of oxidation of piperic acid, and was shown by Fittig and Remsen (1871) to be methylene-protocatechuic acid; it is sublimable, and crystallizes in needles melting at 228° C. (442.4° F.).

Tincture of coto-bark has been made from 1 part of the bark and 9 parts of alcohol.

Action and Uses.—The bitterness and astringency of nectandra are due in a great measure to its alkaloid, *beberina*. According to its original promoters, beberine had all the virtues without the objectionable qualities of quinine, such as the production of tinnitus, headache, etc. In small doses it appeared to be a stomachic tonic. In experiments upon the frog, in which the alkaloid was used hypodermically, it caused tetanic retraction of the limbs in the same manner as quinine, but these effects were not produced by either substance when given by the stomach. Nor did the tetanism resemble that of strychnine, since it was not intensified by external excitation.

In the treatment of *periodical fevers* this substance proves to be very inferior in efficacy to quinine, since it fails in at least one-half of the cases. It has also been vaunted in the treatment of periodical *headache* and *neuralgia*, as an antihectic remedy in *consumption*, as a tonic in *atonic dyspepsia*, in *menorrhagia*, *leucorrhœa*, etc. It may, on the whole, be regarded as an imperfect substitute for quinine. The *dose* of beberine is from Gm. 0.06 to 0.18 (gr. 1–3) as a tonic, and from Gm. 0.30 to 0.60 (gr. 5–10) as an antiperiodic medicine. (See Beberinæ Sulphas.)

Coto-Bark. Burkart observes that from Gm. 0.5 to 1 (gr. 8–15) of coto-bark produces eructations, nausea, a continued feeling of warmth in the stomach, and even vomiting. The tincture, applied to the skin, causes redness and heat. Cotoin and paracotoin are excreted with the urine (*Amer. Jour. Phar.*, Jan. 1880, p. 26).

Coto, although belonging to the same natural family as Nectandra, does not in the least resemble it in its properties or medicinal uses. Indeed, there is nothing whatever in its sensible qualities, and especially no astringency, to denote its possession of a power to control sweating and diarrhœa, the affections for which it is chiefly used. Its smell is rather aromatic and its taste acrid and somewhat bitter. Its preparations, including cotoin, given to rabbits, occasioned no definite symptoms. It seems to be stomachic without constipating. In Germany it has been clinically studied by several physicians, whose results substantially agree with one another. The most elaborate reports of them have been furnished by Fronmüller and Albertoni. Of *diarrhœa*, against which other remedies had for the most part proved useless, colliquative forms following *typhoid fever* or accompanying *phthisis*, it cured the greater number of cases in the former category and palliated all in both diseases. Even when most efficient the medicine could not be abruptly discontinued without risking a return of the symptoms. In the successful cases the quantity of the tincture taken during the day varied from 10 to 500 drops, but the most usual quantity was Gm. 3.30 (50 drops) three times a day. Similar results have been reported by Yeo (*Practitioner*, xxiii. 257), but Dr. Gee gave the "liquid extract of coto-bark for the diarrhœa of phthisis, typhoid fever, and lardaceous disease without the least benefit" (*St. Bart's Rep.*, xv. 232). Large doses are evidently more efficient than small ones. Unless the tincture is well prepared, it occasions an unpleasant burning in the throat; but, properly made, the stomach not only tolerates it, but the appetite improves under its use; which is not apt to be the case when opium, tannic acid, acetate of lead, etc. are used for a similar purpose. Albertoni ascribes the medicinal power of cotoin to a power of dilating the blood-vessels, and thereby increasing absorption. But this rationale would scarcely apply to its utility in sweating. Indeed, its mode of action is unknown.

As regards immoderate *sweating*, Fronmüller observed in the case of a phthisical patient

suffering at the same time from colliquative diarrhœa that both symptoms disappeared under full doses of tincture of coto. He prescribed it in ninety-one cases of excessive sweating—in thirty-four with complete, in thirty-six with partial success, and in twenty-one without result. Its beneficial effects generally lasted only one night. It appeared to be more efficient than other medicines commonly used under such circumstances. These results are substantially confirmed by Burkart, Rohne, and Stewart (*Edinb. Med. Jour.*, xxvii. 750), who, as well as Frommüller, found that cotoin and paracotoin produced analogous effects. The latter has been tried subcutaneously in *cholera* in Gm. 0.20 (3-grain) doses. The urine of patients taking cotoin is said to assume a red color on the addition of concentrated nitric acid, at least during a few hours after the medicine has been used. In the summer complaint of this country, or *cholera infantum*, the medicine is reported to have been efficacious when used in an elixir (Parsons). Its chief, if not its sole, medicinal virtue consists in its checking diarrhœa of the atonic sort and without regard to its origin. It is said to be well borne even by feeble stomachs, but to irritate powerfully, though transiently, the mucous membrane of the nose and pharynx. Shurley advises its application diluted with starch (1 : 3 or 4) in atrophic *nasal* and *pharyngeal catarrh*.

Coto-bark is not conveniently given in powder on account of its persistently acrid taste, but the proper dose is stated to be from Gm. 0.30 to 0.50 (gr. 5–10), given three or four times a day. Cotoin has been used in doses of Gm. 0.10 to 0.20 (gr. 1½–3), and paracotoin in doses of Gm. 0.30 (gr. 4–5), three times a day. The tincture appears to have been found the most convenient preparation of coto-bark. It was made with 1 part of the bark to 9 of 85 per cent. alcohol, and given in average doses of about Gm. 8 (fʒij) sufficiently diluted. Yeo states that as the resin is precipitated from the tincture or fluid extract on the addition of water, either preparation should be given in an emulsion, so that each dose should contain about 5 minims of the active ingredient.

Cryptocaria australis furnishes an alkaloid which in warm-blooded animals causes dyspnœa and asphyxia (*Therap. Gaz.*, xi. 747).

Pichurim beans were introduced a century ago into Europe by the Portuguese, and were for a long time regarded as possessing a great medicinal value, and even very recently were included in the lists of the German, Spanish, and Portuguese Pharmacopœias. They appear to depend for their virtues upon a concrete volatile oil, and are sometimes used as substitutes for nutmeg. They have been chiefly used as stimulants and tonics in mild, subacute, and chronic *diarrhœa* and *dysentery*, and in habitual debility of the intestinal canal tending to produce flatulence and diarrhœa. Pichurim-bark, which has an aromatic smell resembling that of nutmegs and an astringent taste, is employed in Panama in the treatment of *typhoid states* of the system, in atonic *dyspepsia*, *chronic vomiting*, *intermittent fever*, and *menstrual disorders*. The beans are given in powder in doses of from Gm. 0.60 to 1.30 (gr. x–xx), or else in an infusion; the bark is used in the same manner and in doses twice as great as these.

NICCOLI SULPHAS.—Nickel Sulphate.

Sulfate de nickel, Fr.; *Nickelsulfat*, G.

Formula $NiSO_4.7H_2O$. Molecular weight 280.14.

Origin.—The metal nickel was first obtained in 1751 by Cronstedt from *niccolite* or *kupfernickel*, a pale, copper-colored mineral, the composition of which is NiAs. The metal exists in various ores found in Sweden, Germany, and other parts of Europe, and in North America in Pennsylvania and near Lakes Huron and Superior; it is also present in a few mineral waters. It is prepared from the oxide or carbonate by reducing it at a white heat in the presence of charcoal or organic matters.

Preparation.—Nickel sulphate may be prepared by dissolving pure nickel carbonate in diluted sulphuric acid, concentrating the solution and crystallizing at or below 20° C. (68° F.), or precipitating it with alcohol. The salt is extensively manufactured on the large scale from impure carbonate, the process involving the separation of other metals, like arsenic, iron, copper, and cobalt.

Properties.—The salt forms either a green crystalline powder or it is generally seen in emerald-green, transparent, rhombic prisms, which effloresce on exposure, losing $1H_2O$, and being at the same time converted into an aggregation of octahedral crystals. A salt containing $6H_2O$ is also obtained by crystallization from an acid solution at above 20° C. (68° F.). The salt has a sweetish and styptic taste and a slight acid reaction, is soluble in about 3 parts of water at 15° C. (59° F.), insoluble in alcohol and ether, and loses at 103.3 C. (218° F.) 38.5 per cent. (the salt with $6H_2O$, 34.2 per cent.) of water, the remain-

ing molecule of water being expelled above 250° C. (482° F.). The solution of nickel sulphate, on being mixed with a saturated solution of ammonium sulphate in excess, gives a precipitate of *nickel-ammonium sulphate*, $(NH_4)_2Ni(SO_4)_2.6H_2O$. This salt is blue-green, almost insoluble in solutions of alkali sulphates, but soluble in about 8 parts of water; it, like the sulphate, is largely used for the electro-plating of iron, copper, and other metals with nickel.

Allied Salts and Metallic Nickel.—Niccoli carbonas—Nickel carbonate, *E.;* Carbonate niccolique, *Fr.;* Nickelkarbonat, *G.*—It is pale-green or blackish-green, of variable composition, and is prepared by precipitating the solution of a nickel salt with sodium or potassium carbonate.

Niccoli Bromidum.—Nickel bromide, *E.;* Bromure de nickel, *Fr.;* Nickelbromür, *G.* $NiBr_2.3H_2O$; mol. weight 272.—It is prepared by digesting nickel with bromine and water, or by dissolving nickel carbonate in hydrobromic acid and crystallizing. It crystallizes in green deliquescent needles or prisms, which are soluble in alcohol, ether, and water; the latter solution on exposure is decomposed, depositing nickel hydroxide.

Niccoli chloridum.—Nickel chloride, *E.;* Chlorure de nickel, *Fr.;* Nickelchlorür. *G.*—The hydrated salt is green, very deliquescent, and contains $6H_2O = 45.4$ per cent. The anhydrous chloride is yellow, or, in the presence of cobalt, has a green tint; it sublimes in yellow lustrous scales.

Nickel is a malleable metal, resembling silver in color and lustre. It is attracted by the magnet, has the density 8.8, melts at a somewhat lower temperature than iron or cobalt, does not readily tarnish on exposure, and is but little attacked by dilute acids. The *sesquioxide*, Ni_2O_3, and its hydrates are black or black-brown, and dissolve in acids with the evolution of oxygen. The *monoxide*, NiO, is greenish-gray or yellowish-gray; its hydrate is a green crystalline powder, and its salts are likewise green, or in the anhydrous state yellow, and have a slight acid reaction. The solution of the acetate gives a black precipitate with hydrogen sulphide; other nickel salts with ammonium sulphide. Alkalies and alkali carbonates produce green or pale-green precipitates, which dissolve in ammonia with a blue, and in ammonium carbonate with a greenish-blue, color. Potassium ferrocyanide produces greenish-white precipitates; potassium cyanide, a similar precipitate soluble in excess of the cyanide; and if to this solution caustic soda and chloride be added and heat applied, a precipitate of black nickel hydroxide is produced (difference from cobalt). A concentrated solution of oxalic acid precipitates nearly all the metal as *nickel oxalate* from simple salts, but not from solutions of the double salts.

Action and Uses.—In 1852, Simpson stated that this preparation appeared to act as a gentle tonic, that it does not occasion nausea and vomiting like the sulphates of zinc and copper, and that its action and that of manganese were comparable to the action of iron. He reported the cure by it of inveterate periodical *neuralgia* of the face after it had resisted iron, quinine, and many other medicines. He prescribed it in doses of from ½ to 1 grain three times a day (*Month. Jour. of Med. Sci.*, 3d Ser., vi. 136). In 1869, Broadbent attributed the cure of *anæmia* and *amenorrhœa* to the *chloride* of nickel in 2-grain doses (*Trans. Clin. Soc. Lond.*, ii. 125). By Bernatzik it was compared to cerium, and by Schuhhardt to iron and manganese (*Arzneimittellehre*, ii. 106, 283). Dr. J. M. DaCosta (pamphlet, 1883) found that in doses of 5 grains the *sulphate* caused giddiness as well as nausea, but no such soporific effect as had been attributed to it. The doses employed by him varied from 1 to 3 grains. He thought that it relieved the pains of rheumatism, checked diarrhœa, and allayed irregularity due to valvular disease of the heart. In some instances it appeared to him beneficial in chronic gastric catarrh. It was of no use in night-sweats nor in typhoid fever. In, 1886 Dr. H. A. Hare (*Therap. Gaz.*, x. 297) from experiments on the lower animals concluded that the *bromide of nickel* is soporific anæsthetic—that it suppresses spinal reflexes and motility, lowers the force and frequency of the heart's beats, and arrests that organ when directly applied to it. As these effects are widely different from those of other nickel salts, and as they are identical with those produced by familiar bromine compounds, the conclusion seems to be justified that the metallic base of such nickel compounds can have little to do with their remedial action. Nickel bromide, used by Dr. DaCosta in doses of from 5 to 10 grains, seemed to him to exert the peculiar power of other bromides and in smaller doses. In several cases it suspended *epileptic* seizures after the failure to do so of the alkaline bromides. He found that it slightly lowered the temperature, affected the pulse but little if at all, did not act on the bowels or the skin, and perhaps increased the urine a little. He concluded that "its effect on the nervous system is that of a sedative, without, however, producing a weakening or depressing influence." Dr. Leaman, who obtained substantially the same results, estimated that ten grains of the nickel salt were equal in efficacy to 30 grains of potassium bromide. He found it most efficient when the fits took place regularly at long interval, and that, especially when given as a granular effervescent salt, it disordered the digestion less than the alkaline bromides (*Med.*

News, xlvi. 427). On the other hand, Bourneville found that it did not diminish, but increased the epileptic attacks (*Practitioner*, xliii. 208).

NIGELLA.—Fennel-Flower.

Faux cumin, Fr.; *Schwarzkümmel*, G.

The seeds of Nigella sativa, *Linné*, and of Nig. damascena, *Linné*.

Nat. Ord.—Ranunculaceæ, Helleboreæ.

Origin.—Both plants are annuals, indigenous to Southern Europe and the Levant. They have finely-divided leaves like fennel; the second species has also a similar involucre. The fruit consists of five united follicles, which contain numerous seeds. Both plants are cultivated in gardens, and are known respectively as *nutmeg-flower* and *ragged lady*.

Description.—The seeds are about 2.5 Mm. ($\frac{1}{12}$ inch) long, triangular-ovate, rough, of a dull-black color, internally white, contain a fleshy albumen enclosing a small straight embryo, and have a somewhat acrid taste. When rubbed the seeds exhale a peculiar odor, that of the first species being camphoraceous and resembling cajeput, while that of the second species resembles the odor of strawberries. The latter are sometimes sold as *magnolia-seeds;* they differ from the former also in being rounded at the angles and having the testa deeply netted-wrinkled.

Constituents.—Reinsch (1841) obtained from the seeds N. Sativa 35 per cent. of fixed oil, which, according to Flückiger (1871) contains myristin, palmitin, and stearin. The volatile oil is lighter than water, colorless, shows a blue fluorescence, has an odor different from that of the seed, and, according to Flückiger, consists of a terpene and of the compound $C_{20}H_{24}O$. Reinsch's *nigellin* is an extract-like yellow mass having the consistence of turpentine and a bitter taste. H. G. Greenish (1880) isolated *melantnin*, which is nearly insoluble in water, ether, benzene, benzin, and carbon disulphide, very soluble in alcohol, is acrid, foams similar to parillin, consists of $C_{20}H_{33}O_7$, and by acids is split into sugar and *melanthigenin*, $C_{14}H_{23}O_2$; both principles are colored dark-violet by warm sulphuric acid and rose-red by cold pure sulphuric acid. Greenish (1882) observed that the seeds of N. damascena impart fluorescence to petroleum benzin. A. Schneider (1890) recognized this principle as a crystalline alkaloid *damascenine*, present to the extent of about 0.1 per cent., and the salts of which are not fluorescent.

Action and Uses.—Nigella is closely analogous in its properties to coriander, anise, and cumin, and like them is used in the East as a condiment for food, and medicinally as a carminative, aphrodisiac, emmenagogue, galactagogue, diuretic, and expectorant.

NITROBENZENUM.—Nitrobenzene.

Oil of mirbane, E.; *Nitrobenzène, Essence de mirbane*, Fr.; *Mirbanöl*, G.

Formula $C_6H_5NO_2$. Molecular weight 122.75.

Preparation.—Benzene is added in small portions to warm fuming nitric acid, when a violent action takes place and a dark-red liquid is formed, which is mixed with water and the oily precipitate washed with the same liquid. 100 parts of benzene yield between 135 and 140 parts of nitrobenzene.

Properties.—Nitrobenzene is a yellowish oily liquid having the spec. grav. 1.209 crystallizing in needles at 3° C. (37.4° F.), and boiling at 205° C. (401° F.). It has a strong odor resembling that of oil of bitter almond—hence the incorrect name *artificial oil of bitter almonds*—a sweet taste, and dissolves in concentrated sulphuric and nitric acids, and in all proportions in alcohol and ether. In its alcoholic solution it is readily converted into aniline through the influence of nascent hydrogen.

The different benzenes yield also different nitro-products. One has the specific gravity 1.19, boils between 210° and 220° C. (410° and 428° F.), and has a cinnamon-like or unpleasant fatty odor, which is still more unpleasant in nitrobenzene boiling between 225° and 335° C. (437° and 455° F.).

Pharmaceutical Uses.—The low-boiling nitrobenzene is often used for scenting soaps and in various perfumes as a tolerably good substitute for the more costly oil of bitter almond, which is sometimes adulterated with it (See Ol. Amygd. Amaræ), but its most important use is in the manufacture of aniline (see page 211).

Action and Uses.—Numerous cases have been published of poisoning by nitrobenzene—sometimes by its being swallowed, sometimes by the inhalation of its fumes,

and sometimes by its application to the skin. Boehm collected 42 cases, of which 14 were fatal (1883), Elaberg says that 34 per cent. die; and White observed about 50 (*Practitioner*, xliii. 14), but does not state their issue. A remarkable illustration of the potency of this poison is furnished by several cases of females affected by the odor of the so-called "almond glycerin soap," and by that of a person who, by using such a soap in a warm bath, fainted from the the effects of nitrobenzene set free by the heat, and was ill for some time afterward. A case is also recorded of a man who, having used a liniment containing this product in the treatment of scabies, became partially paralyzed, while his head was drawn back, and his face, hands, mouth, and pharynx were all cyanosed, and the breath and matters vomited smelled of bitter almonds. In this case, as in some others, the blue tint remained for at least a week. The pulse is generally small and frequent. The sight is sometimes cloudy. The symptoms produced in man are identical with those observed in animals, except the purple color of the skin, which appears to be due in part to venous congestion, but in part also to the inability of the blood to absorb oxygen. This condition of the blood helps to explain the dyspnœa which attends some cases of poisoning by this substance, and also the extreme cyanosis, which so far surpasses both in degree and duration that which is due to merely asphyxiating causes. The opinion that this blue color of the skin is in part due to the presence of aniline derived from the decomposition of the nitrobenzene in the body is ascribed by Filehne to an error of manipulation by which anilin was developed. The lesions found post-mortem are tarry dark blood, congested lungs, heart and brain, etc. In one case the liver is described as being of a deep-purple color. All these phenomena and lesions support the conclusion of Lewin (*Virchow's Archiv*, lxxv.; 443), that the poisonous action of nitrobenzene depends upon its destructive effect upon the red blood-corpuscles, which prevents the supply of oxygen essential to life. This opinion seems more probable than that the symptoms are primarily due to the action of the poison on the nervous system, as maintained by T. Prosser White. Whether recovery or death occur, the peculiar odor of nitrobenzene persists for many days. The probable fatal dose of nitrobenzene may be stated to be between a few drops and 2 drachms.

The only disease, so far as we are informed, in which the preparation has been used is *scabies*, but its dangerous effects from accidental conditions, and the case of poisoning by it in this very disease to which reference has been made, ought to exclude it altogether from medical practice.

In *poisoning* by nitrobenzene the proper remedies consist of emetics to remove the poison in the stomach, and of stimulants, internally and externally, carbonate of ammonia, electricity, artificial respiration, the hot bath, and a simultaneous cold douche upon the head and spine, friction of the skin, etc. Oil and alcohol, which dissolve the poison, are contraindicated.

Nitropentane has been the subject of some physiological experiments. In dogs and cats, when the inhalations were continued from eight minutes to one hour, convulsions began to occur which gradually increased in intensity until they passed into true epilepsy. The peristaltic movements of the intestines were quickened and the fæces were evacuated. The urine was also discharged; sometimes the saliva flowed profusely, and the pupils were dilated. The pulse was not materially affected, and the vessels of the pia mater underwent no change during the inhalation (Schadow).

NITROGENII MONOXIDUM.—Nitrous Oxide.

Laughing gas, E.; *Oxyde nitreux*, *Protoxyde d'azote*, Fr.; *Stickstoffoxydul*, *Lachgas*, G. Formula N_2O. Molecular weight 43.98.

Origin.—Nitrous oxide was first obtained by Priestly (1772) by acting upon nitric oxide with moist iron filings; he also noticed that ignited bodies burn in this gas with a brighter flame than in atmospheric air. The composition of the gas was determined by Deimann and Troostwijk (1793), who prepared it from ammonium nitrate. H. Davy (1800) observed its exhilarating effects.

Preparation.—Ammonium nitrate which is absolutely free from chloride is gradually heated to about 200° C. (392° F.), when the decomposition commences, and the heat may be slowly increased. The salt yields then water and nitrous oxide, without other products of decomposition; NH_4NO_3 yields $2H_2O+N_2O$. The gas is passed through a little warm water, which will retain any undecomposed salt or other product without retaining much of the gas. (For other precautions in the preparation of this gas refer to the decomposition of Ammonii Nitras, on page 190.

Properties.—Nitrous oxide is a colorless gas of a very slight agreeable odor and a sweetish taste. It has the specific gravity 1.6 (Dalton), and a liter of it at 0° C. (32° F.) weighs 1.97 Gm. It is not inflammable, but supports the combustion of ignited bodies, which burn more vigorously than in the open air. By the aid of pressure and cold it may be condensed into a thin, very mobile, colorless liquid, which at a temperature of about — 100° C. (— 148° F.) congeals to colorless crystals. The gas is soluble in water, alcohol, ether, volatile and fixed oils.

Nitrous Oxide Water.—The solubility of nitrous oxide in water has been determined by Carius (1855) as follows: Water absorbs at a barometric pressure of .76 meter and a temperature of

0°	5°	10°	15°	20°	25° C.,
1.3052	1.0954	.9196	.7778	.6700	.5963 measures of the gas.

Such an aqueous solution, prepared under a pressure of about five atmospheres, has been employed under the name of *oxygenous aërated water*.

Action and Uses.—The primary effect of inhaling nitrous oxide gas is stimulation of the whole system; a tingling sensation is felt all over the body, the senses seem unnaturally acute, the pulse becomes stronger and more frequent, the breathing is more rapid and shallow, and the face grows pale. If the inhalation is interrupted at this period a lively intoxication is developed. It was formerly the custom to have semi-public exhibitions of this appropriately called "laughing gas," in which one of the most familiar phenomena was a high degree of mental excitement, generally exhibited in rhapsodical declamation or singing, but sometimes also in a sudden fit of violent pugnacity, which subsided abruptly when the vapor had exhaled. But if the inspiration is not interrupted, the breathing in about one and a half minutes begins to be stertorous; at the same time the pallor of the face is replaced by a cyanotic hue, and complete unconsciousness and anæsthesia ensue. Without a renewal of the inhalation it does not last more than a minute or two. Unlike ether or chloroform, it is apt to occasion rhythmical movements, muscular twitching, or even rigidity. Like ether it sometimes causes hysterical or erotic manifestations. In general, feeble persons are more quickly affected than the strong—children, females, and the aged more speedily than adult males.

The number of deaths due to the administration of this gas is surprisingly small when compared with those following chloroform, and even ether, and, as in the case of the latter agent, they may always, or nearly so, be fairly ascribed to the special condition of the patient or to the mode of administration of the anæsthetic. According to the statistics of Darin, 53 deaths occurred in 152,260 administrations of chloroform, or 1 : 2872; 4 in 92,815 of ether, or 1 : 23,203; and 3 in 300,000 of gas, or 1 : 100,000, one of which was due to an accident—namely, the falling of a cork into the air-passages. In a case that occurred in Paris, 1884, death took place by syncope during the extraction of a tooth (*Brit. Med. Jour.*, Jan. 24, 1885). A similar one happened in Montreal in 1890, under like conditions (*Med. Record*, xxxviii. 103). In 1889 one occurred in England under conditions that should have forbidden the use of any anæsthetic (*Lancet*, Oct. 1889, p. 804). Other ill effects have occasionally been noticed; *e. g.* coma of several days' duration, hemiplegia, temporary catalepsy, or hysteria, clonic convulsions, etc. It sometimes also produces a transient albuminuria or even glycosuria, according to Lafont, but the statement has not been confirmed (*University Med. Mag.*, ii. 428). According to Dr. Silk's analysis of 1000 cases in which this anæsthetic was administered, no serious accident occurred in any (*Lancet*, June, 1890, p. 1327).

Nitrous oxide has been used in surgical operations, but chiefly in those requiring a comparatively short time for their performance. *Teeth* have been extracted with its aid in cases innumerable in this country and in Europe, and whoever has experienced its effects must be satisfied with its efficiency and convenience. All surgical operations which can be quickly completed, from the opening of *abscesses* to the operation for *cataract*, have been successfully performed with its aid; and in numerous instances it has sufficed for operations lasting from fifteen to twenty minutes. Dr. J. M. Barton has illustrated the great aid it gives to the surgeon in examining fractures, dislocations, etc. He notes particularly the muscular relaxation that remains after the anæsthesia has passed off. (*Phila. Med. Times.*, xvi. 108). In 1865, Ziegler of Philadelphia proposed the inhalation of this gas for a variety of disorders, the chief of which were nervous and asthenic, and included *neuralgia*, *anæsthesia*, *hypochondria*, *insomnia*, etc., and it was so employed soon afterward by Dr. Benjamin Lee (*Med. Record*, xvii. 494). It did not, however, seem to find many advocates. In 1880 attention was directed to it anew by Drs. Blake and

Hamilton (*Med. Record*, xvii. 118; *Boston Med. and Surg. Jour.*, May, 1880, p. 469). In all of these instances the exhilarating, and not the anæsthetic, action of the gas was sought, and it was believed to act as a stimulant of the nervous system and the heart, very much as a moderate dose of alcohol does. It, however, did not retain its vogue. Nitrous oxide has also been employed as an anæsthetic in labor. According to Klikewitsch, four or five inhalations abolish sensation, but not consciousness; it involves neither danger nor inconvenience, and may be administered by an intelligent nurse (*Med. Record*, xxi. 514). He has more recently used a mixture of 80 parts of this gas with 20 of oxygen, and Zweifel administered it continuously during the latter stage of labor. It did not at all retard this process (*Med. News*, xlvii. 598).

Mr. Woodhouse Braine, comparing the several anæsthetics in use, says: "Of all anæsthetics, the quickest and safest, but the most difficult to administer really well, is nitrous oxide; deep snoring and an insensitive conjunctivitis are the best signs of insensibility." No age and hardly any physical condition forbids its use (*Times and Gaz.*, Nov. 1884, p. 758.) The nostrils being closed, the gas may be inspired from the reservoir in which it is collected or from caoutchouc bags through a tube and mouthpiece furnished with valves opening outward to permit the breathed air to escape during expiration. It is also kept in wrought-iron vessels in a highly condensed or even a liquid state, and may thus be conveniently transported from place to place.

Bert proposed to prevent the "asphyxia" produced by nitrous oxide by mixing 85 parts of this gas with 15 of oxygen in a chamber filled with compressed air. Several surgical operations of considerable duration were successfully performed under these circumstances (*Bull. et Mém. de la Soc. de Thérap.*, 1879, p. 71). Others have experimented in the same direction (Witzinger, *Centralbl. f. Med.*, vi. 96; Hewett, *Lancet*, Apr. 1889, p. 832), but without notable advantage.

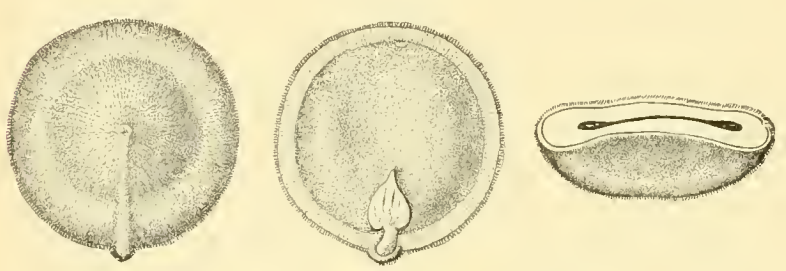
NUX VOMICA, *U. S., Br.*—Nux Vomica.

Semen strychni, P. G.; *Semen nucis vomicæ.—Poison-nut, Quaker buttons*, E.; *Noix vomique*, Fr. Cod.; *Krähenaugen, Brechnuss*, G.; *Nuez vomica*, Sp.

The seeds of Strychnos Nux vomica, *Linné*. Bentley and Trimen, *Med. Plants*, 178. *Nat. Ord.*—Loganiaceæ.

Origin.—The tree has a short, thick, often crooked trunk, opposite, oval, glossy, three- to five-nerved leaves, and small, funnel-shaped whitish flowers in small, terminal, paniculate cymes; the smooth, orange-colored berry is globular, and contains about five seeds. The tree is common in many parts of Hindostan, Farther India, some of the East India Islands, and as St. Lucida, *R. Brown*, is also found in Northern Australia. All parts of the plant possess a bitter taste, and are probably poisonous; the bark has at one time been sold in place of angustura-bark (see page 211). The white, gelatinous pulp of the fruit, it has been stated, is eaten in India by birds; it, however, contains strychnine (*Pharmacographia*). The seed is the only official portion.

Fig. 190.

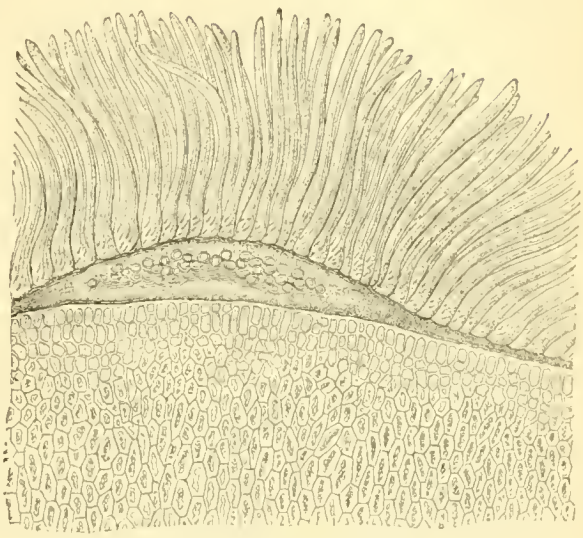


Nux Vomica: surface with raphe; longitudinal section, showing albumen and embryo; and transverse section, showing central cavity.

Description.—Nux vomica is in the form of an orbicular disk 25 Mm. (1 inch) or less in diameter, and 4 to 6 Mm. (⅛ to ¼ inch) thick, nearly flat, or convex on one side and concave on the other, with the margin frequently thickened. The surface is of a grayish or greenish-gray color, and has a slight silky lustre from the closely-appressed soft hairs, directed toward the circumference and forming a soft ridge on the edge. Where the hairs have been rubbed off the dull-brownish testa becomes visible. On the concave side is a slight ridge running from the hilum to a point on the circumference, where the radicle is located. The thin testa encloses a yellowish-gray, somewhat translucent, horny, and very hard albumen (endosperm), which is of the same form as the seed, but has within it a large, flat, circular cavity. After softening the seed in hot water the edge may be readily trimmed down with a knife and the albumen split into two disks, which were united with each other merely on the margin to the

width of about 2 Mm. ($\frac{1}{12}$ inch). The embryo is about 9 Mm. ($\frac{3}{8}$ inch) long, and has a thick, club-shaped radicle and a pair of pale-greenish delicately seven-nerved, heart-shaped cotyledons 5 Mm. ($\frac{1}{5}$ inch) in length, and projecting into the circular cavity. The seed is inodorous, but possesses a persistently bitter taste.

Fig. 191.



Nux Vomica: section through hilum and albumen, magnified 65 diameters.

Nux vomica is very difficult to powder, owing to the horny condition of the albumen. The powdering is considerably facilitated by drying the entire seeds for two or three days and breaking them up into several pieces, which are again dried for several days by means of warm air, and then reduced to powder of the desired fineness. If a drug-mill with chilled iron grinding-plates, admitting of regulation as to different degrees of fineness, be used, much labor may be saved in the final powdering in an iron mortar provided with a heavy pestle. Powdered nux vomica is of a light gray-greenish color.

Constituents.—The horny nature of nux vomica is probably due to protein compounds, of which it contains about 11.3 per cent. (*Pharmacographia*). Gummy matter, fat, sugar, and *igasuric* acid, besides the alkaloids, are also contained in it. The acid was discovered by Pelletier and Caventou (1819), and by Höhn (1873) was regarded as a kind of tannin; the latter obtained it as an amorphous, yellowish-white mass of a strongly acid and somewhat astringent taste; its solution is colored dark-green by ferric salts, precipitated yellow by lead acetate, and rapidly reduces an ammoniacal solution of silver.

The bitter and poisonous alkaloids *strychnine* and *brucine* are the medically important constituents of nux vomica, and are present in variable quantity; Dunstan and Short (1883) analyzed seven different commercial samples, in which the total amount of alkaloids varied between 2.74 per cent. in small Madras nux vomica and 3.90 per cent. in large silky Bombay nux vomica. (For an account of the first alkaloid, which is present to the amount of $\frac{1}{4}$ to $\frac{1}{2}$ per cent., see the article Strychnina in this work.)

Brucine, $C_{23}H_{26}N_2O_4$, likewise varies in quantity; Merck obtained only 0.12, Wittstein 0.5, Mayer 1.10 per cent.; by the latter it was estimated by means of potassio-mercuric iodide, and the presence of igasurine (see below) was not taken into account. The alkaloid was discovered by Pelletier and Caventou (1819) in the false angustura-bark, which was then supposed to be derived from Brucea antidysenterica, *Miller*, an Abyssinian shrub. It is one of the by-products of the manufacture of strychnine, and is obtained from the mother-liquor and alcoholic washings by neutralizing them with sulphuric acid, evaporating to crystallization, removing the mother-liquor, purifying the crystals by treatment with animal charcoal, precipitating with ammonia, and recrystallizing from boiling 80 per cent. alcohol; it contains then $4H_2O$. The anhydrous alkaloid dissolves in 850 parts of cold and 500 parts of boiling water (Pelletier and Caventou), while, according to Duflos, the crystallized alkaloid requires only 320 and 150 parts of water respectively. It is soluble in 7 parts of chloroform (Schlimpert), in 1.5 parts of alcohol, and in 70 parts of glycerin (Cap and Garot). It is soluble also in ammonia, creosote, amylic alcohol, and very slightly so in benzin, volatile and fixed oils, and is insoluble in ether. It fuses in its water of crystallization at a little over 100° C. (212° F.), and the anhydrous alkaloid, according to Claus and Roehre (1881), at 178° C. (352.4° F.), yielding a colorless liquid; at a higher heat it burns, leaving voluminous charcoal. In contact with strong nitric acid brucine acquires a blood-red color, which changes to orange, and finally yellow; if now stannous chloride be added, a beautiful violet-red is produced. A similar color is obtained by using sulphurous acid, and lustrous brick-red needles are formed by using ammonium sulphide in place of stannous chloride. These reactions are not interfered with by the presence of a little strychnine. A number of the colored compounds thus produced appear to possess little stability; but Roehre (1878, 1881) isolated the red compound, which is *dinitrobrucine*, forms a bright vermilion-red amorphous powder, and is insoluble in ether, very sparingly soluble in alcohol, but freely soluble in water.

The end-product of the reaction of nitric acid upon brucine was ascertained by Strecker (1854) to be a weak base, *kakoteline*, $C_{20}H_{22}N_4O_5$, which forms orange-colored scales insoluble in water, but dissolving with a yellow color in ammonia, becoming green and brown on heating. Commercial brucine generally contains traces of strychnine, as proven by Cownley (1876) and Shenstone (1877), and, according to the latter, may be completely freed from it by partial precipitation, brucine being precipitated from its solutions by strychnine.

Igasurine was discovered by Desnoix (1854) by concentrating the filtrate and washings of the lime precipitate in the decoction of nux vomica. The crystals thus obtained are stated by Schützenberger (1858) to be a mixture of not less than nine different alkaloids, which he distinguished by prefixing to igasurine the letters *a*, *b*, *c*, etc. However, Jörgensen (1871) and Shenstone (1877, 1881) found the supposed igasurine to be impure brucine, though it is not unlikely that one or more other alkaloids may be present. (See STRYCHNINA.)

Other Species of Strychnos.—STRYCHNOS TIEUTE, *Leschenault*, is indigenous in Java; the seeds closely resemble nux vomica, but are smaller and whiter in color. The decoction of the root-bark, evaporated to an extract, is the principal ingredient of the arrow-poison, *upas-tieute*; it contains strychnine and brucine.

STR. POTATORUM, *Linné*, is indigenous to India. The seeds are subglobose, brownish-gray in color, and of an insipid not bitter taste. They do not contain strychnine, and are used in India as *clearing nuts* for cleansing muddy water, also in diabetes and as an emetic. In 1871 they were sent to the United States as *Indian-gum nuts*.

STR. COLUBRINA, *Linné*. This yields the true *lignum colubrinum*, in place of which the branches of the nux vomica tree are often sold in India. It differs from the latter in being more crooked and knotty; the wood is harder and darker colored; the bark has bright rust-colored warts, is thicker, and has more scattered stone-cells of a bright-yellow color. All parts of the plant are bitter and poisonous; the wood was found by Pelletier and Caventou to contain strychnine and brucine.

STR. GAULTHIERIANA, *Pierre*. The bark is used in China as *hoàng-nàn*; it resembles nux-vomica bark, but is thinner, blackish-gray, more verrucose, and upon transverse section shows more irregular striæ and fewer stone-cells; it contains strychnine and brucine.

AKAZGA—*M'boundou*, *Boundou*, *Ikaju*, or *Quai*—is a shrubby plant indigenous to the equatorial region of Western Africa, and appears to be a hitherto unknown species of Strychnos. The dense hard wood is covered with a firmly-adhering bark having sometimes numerous yellow tubercles, of a yellowish-orange or light-red color, with a light-brown inner surface, and characterized by a continuous layer, three or four cells deep, of indurated parenchyma. The leaves are opposite and oval-acuminate in shape. The seeds are subglobular, downy, and consist of albumen, with a central cavity into which the embryo with its five-ribbed cotyledons projects. The bark has a strongly bitter, faintly aromatic taste, and a distinct bitterness is also perceived in the other parts of the plant.

Thomas R. Fraser (1867) has obtained an alkaloid, *akazgine*, which crystallizes from its alcoholic solution, is readily soluble in chloroform, carbon disulphide, benzene, and ordinary ether, is colored brown by concentrated mineral acids, and dissolves in dilute acids, yielding colorless salts, which are rather less persistently bitter than strychnine salts, and are precipitated by the bicarbonates of potassium and sodium; the precipitates occurring with the usual reagents for alkaloids are not crystalline. Heckel and Schlagdenhauffen (1881) obtained from the drug an alkaloid having the color-reactions of strychnine.

(See also CURARE.)

Allied Drug.—IGNATIA, U. S. 1880 (Semen Ignatiæ, Faba Ignatii).—Bean of St. Ignatius, *E.*; Fève de Saint-Ignace, *Fr. Cod.*; Fève igasurique, *Fr.*; Ignazbohne, *G.*; Haba de San Ignacio, *Sp.*—Strychnos Ignatia, *Lindley* (Str. Ignatii, *Bergius*, s. Str. philippensis, *Blanco*, s. Ignatiana philippinica, *Loureiro*, s. Ignatia amara, *Linné filius*). Bentley and Trimen, *Med. Plants*, 179.

FIG. 192.

Ignatia: vertical section of seed.

This is a large climbing shrub indigenous to the Philippine Islands and naturalized in Cochin China, with opposite ovate leaves and an oblong or subglobular berry-like fruit having a brittle pericarp and containing about twenty-four seeds imbedded in a bitter pulp. The seeds are from 25–31 Mm. (1 to 1¼ inches) long, 12–20 Mm. (½ to ⅘ inch) broad, oblong, ovate or roundish-ovate in shape, by mutual pressure irregularly angular; the hilum is on one of the edges in a small depression, and the surface of the seeds is of a dull reddish-gray or brownish, when old even blackish, color, and granular or partly covered by gray or light-brown silky hairs. Ignatia consists of a very hard, horny albumen, which is of the shape of the seeds and translucent at the edges, and surrounds an irregular cavity. The embryo projects into this cavity, and consists of a rather long radicle and oblong-ovate acute cotyledons. The seeds break under the hammer with a granular and irregular fracture, and soften after prolonged digestion. They are inodorous and have a very persistent bitter taste. Pelletier and Caventou (1819) found the seeds to contain the same constituents, though in different proportions, as nux vomica; they stated the yield of strychnine (still containing

brucine) to be 1.4 per cent. Geiseler (1837) likewise found 1.5 per cent. of this alkaloid. F. F. Mayer (1863), on assaying ignatia with his solution, obtained from 2 troyounces of the seeds 4.5 grains of strychnine and 13.73 grains of brucine, which correspond to 0.52 per cent. of the former and 1.43 per cent. of the latter. The dried seeds yield 1.78 per cent. of nitrogen, indicating about 10 per cent. of albuminoids (*Pharmacographia*).

Action and Uses.—The action and uses of nux vomica are identical in kind with those of strychnine, and will be treated of in connection with the latter. It may be mentioned in this place, however, that the action of nux vomica is too variable to render it eligible as a medicine. It may be prescribed in the *dose* of Gm. 0.06–0.30 (gr. i–v) three times a day, and gradually increased from the minimum quantity until its characteristic effects begin to be manifested. The extracts and the tincture are best adapted for its administration.

Ignatia.—This may be used like nux vomica, its *dose* ranging from Gm. 0.03–0.10 (gr. ss–ij).

Hoang-nan.—Dr. Livon has made some experiments upon animals with a bark brought from Thibet, from which is prepared *hoáng-nàn*, and which contains brucine. Vulpian (*Les Substances toxiques, etc.*, p. 613) declares that on frogs, at least, the action of hoàng-nàn is identical with that of strychnine and brucine. The conclusions of this eminent investigator and of Galippe in regard to the preparation as a medicine agree with what we have drawn from the published records concerning it (Lisserteur, 1879; Piffard; Barthélemy, etc.), "The reports of its virtues are, to say the least, greatly exaggerated. As to its use in rabies, one must have an inordinate dose of credulity to believe in it as a cure of this terrible affection." Several reports upon the subject have appeared since the last edition of this work, but they do not modify the estimate just given. That hoáng-nàn is a compound medicine, and that it contains arsenic, may very well account for its reported efficacy in certain diseases of the skin, and even in *leprosy*.

Akazga.—It appears from the narrative of Prof. Frazer of Edinburgh, who carefully investigated the nature and action of akazga, that it is used as an ordeal in West Africa: "The supposed witch is obliged to drink a certain quantity of the infusion prepared from the bark, and to step over a number of akazga-sticks placed parallel to one another at the distance of 2 feet. If this can be done, the person is pronounced innocent; if guilty, difficulty is experienced in stepping over the sticks; they appear like large logs, to surmount which suitable efforts are made, and these are rendered more and more difficult by spasmodic muscular twitches, nntil the victim staggers, and ultimately falls in tetanic convulsions. . . . . In those cases in which the trial is successfully undergone a copious flow of urine is described as occurring, and by this means the poison is supposed to be removed." The physiological action of the alcoholic extract of akazga, and that of the alkaloid akazgin, correspond to those of nux vomica and strychnine. Each grain of the alkaloid is equal to about 7 grains of the extract or 50 grains of the dried bark in physiological effects, which consist essentially of tetanic convulsions. As yet no therapeutical applications appear to have been made of akazga or its alkaloid.

M'Boundou was found by Testut to exhibit different modes of action according to its dose, the smaller doses causing convulsive, the larger paralytic, phenomena. He therefore concluded that it contained two principles—the one exciting the reflex function, the other paralyzing it (*Amer. Jour. Phar.*, li. 323). But Heckel and Schlagendauffen inferred that its only active constituent is strychnine, and that it occasions tetanic or paralytic phenomena according to the dose of it administered. Their conclusion agrees with the previous one of Richet (*Bull. de Thérap.*, c. 223), and is confirmed by the later observations of Vulpian (*Cours de Pathol. exper.*, p. 616), who found in experiments upon frogs that a period of relaxation preceded the convulsive phenomena, often by several hours or even days.

NYMPHÆA.—Water Lily, Pond Lily.

Néuuphar, Lune d'eau, Fr.; *Seerose, Wasserlilie*, G.; *Ninfea, Ninfa*, Sp.

Nymphæa Odorata, *Aiton.*

Nat. Ord.—Nymphæaceæ.

Description.—The *Sweet-scented water-lily* is indigenous to North America and has a horizontal immersed rhizome about 5 Cm. thick, marked on the upper side with broad subcircular or oblong leaf-scarfs, and on the lower side with the remnants or scars of the thick fleshy rootlets, brown externally, yellowish-white internally, fleshy, with irregular wood-bundles; after drying deeply wrinkled, spongy, and light. It is without odor, and

has a bitter mucilaginous somewhat astringent taste. The leaves are large, orbicular-cordate, and entire; the flowers are 10 or 12 Cm. (4–5 inches) broad, many-petalous, white, and very fragrant. The root and flowers (petals) have been employed.

Allied Plants.—Nymphæa alba, *Linné*, the European water-lily, resembles the preceding, the flowers, *Nénuphar blanc*, are recognized by the French Codex.

Nuphar advena, *Aiton* (Nymphæa, *Michaux*), *Yellow pond-lily*, *Spatterdock*. The leaves are heart-shaped at the base, and ovate or roundish in outline. The flowers have six yellow sepals and numerous small yellow petals, which resemble the stamens. From Colorado westward its place is taken by Nuphar polysepalum, *Engelmann*, which has eight or more sepals and numerous short dilated petals. The rhizomes of these species and of the European N. lutea, *De Candolle* (*Nénuphar jaune*, Fr. Cod.), resemble that of Nymphata in size and structure.

Constituents.—The rhizome of Nymphæa alba was examined by Morin (1819) and Carminati, and that of N. odorata by Bigelow. Tannin, mucilage, etc. were found, but the bitter principle was not isolated. W. Gruening (*Thesis*, Dorpat, 1881) examined the rhizome and seeds of Nymphæa alba and of Nuphar luteum, *Smith*. The principal constituents are tannin and gallic acid, besides starch, gum, resin, albumen, etc. The alkaloids previously observed by Dragendorff were obtained amorphous; that from Nymphæa was pale reddish-brown, readily soluble in alcohol, ether, and diluted acids; and by Fröhde's reagent colored red, then green. *Nupharine* is white, soft above 40° C. (104° F.), easily soluble in alcohol, chloroform, ether, amylic alcohol, acetone, and diluted acids; on heating the solution in diluted sulphuric acid in a steam-bath, it gradually turns brown, and finally blackish-green. The alkaloids appear to be not poisonous.

Action and Uses.—The root of our native pond-lily is astringent and demulcent, and is used internally for the cure of *bowel complaints*, topically in cataplasm for *ulcers*, and in decoction for *leucorrhœa* and *dysentery*. The European species, N. alba, was once reputed to be anaphrodisiac, and the juice of the fresh root is said to be acrid, and even capable of reddening the skin. An ointment prepared with it is used to stimulate the scalp when the *hair* tends to fall out.

ŒNOTHERA.—Evening Primrose.

Onagre, Fr.; *Nachtkerze*, G.

Œnothera biennis, *Linné*.

Nat. Ord.—Onagraceæ.

Description.—This very variable plant is common throughout North America in fields and waste places, and has been naturalized in Europe. It has a conical *root*, which is 12 to 25 Mm. (½–1 inch) thick at the base, 10 to 15 Cm. (4–6 inches) long, with spreading branches, externally pale-brown or sometimes reddish, with a thin bark, internally white, fleshy, inodorous, of a sweetish taste, and in the second year woody and tough. The *stem* is from 0.9–1.8 M. (3 to 6 feet) high, rough, hairy, often purplish. The *leaves* are alternate, ovate-oblong or oblong-lanceolate, 7–12 Cm. (3 to 5 inches) long, somewhat petiolate, acute, nearly entire, and short-hairy. The *flowers* are in terminal leafy spikes, have a sessile cylindrical ovary united with the long tubular calyx, four obcordate yellow petals, and eight stamens, and produce a four-valved capsule containing numerous seeds. The herb is inodorous and has a mucilaginous and mild astringent taste. The root and the flowering plant are used.

Constituents.—Diot Chicoisneau (1834) found the plant to contain much mucilage; his *œnotherin* was a mixture of several bodies, which have not been separated from one another. Braconnot found tannin in the stem.

Action and Uses.—The late Dr. R. E. Griffith, in his *Medical Botany*, after speaking of the mucilaginous and acrid qualities of the herb and leaves, states that he made use of it in several cases of *infantile eruptions* which had resisted other modes of treatment, and became satisfied that it was highly beneficial—a judgment which his subsequent experience confirmed. It is advised that about the flowering season the small twigs with the bark of the large branches and stem, retaining their leaves, should be dried in the shade. Of these a strong decoction is made, with which the eruptions should be bathed several times a day. It has also been used in *diarrhœa* and in *asthma*. We are not acquainted with any later and confirmatory reports upon this plant.

OLEA DESTILLATA.—Volatile Oils.

Olea ætherea s. volatilia, Ætherolea.—Essential (ethereal or distilled) oils, E.; *Huiles volatiles (éthérées, essentielles, distillées), Essences*, Fr.; *Flüchtige (Ätherische) Oele*, G.

Characters.—Volatile oils are those proximate principles to which in the majority of cases the odor of plants is due. They have no chemical, and but few physical, properties in common with the fixed oils, but, like the latter, they are generally soluble in ether, chloroform, carbon disulphide, etc., and when dropped upon paper leave a stain resembling that produced by fat, but which, unlike the latter, disappears upon the application of heat. Freshly-prepared volatile oils are generally freely soluble in petroleum benzin, but, according to Belohoubek (1882), after exposure and partial oxidation yield with this solvent a more or less turbid mixture. Their specific gravity usually ranges between 0.85 and 0.99; a few are still lighter, and some are heavier than water, one reaching the specific gravity 1.180. All are inflammable and burn with a bright but very sooty flame. They possess the odor of the plants from which they have been obtained, but are usually less fragrant, which is probably due to the presence in the plants of other odoriferous compounds, perhaps compound ethers, which, being more soluble in water, are removed during the distillation; it is on this account that medicated waters distilled from the drug, almost without exception, possess a more agreeable odor and taste than when prepared from the volatile oil.

When exposed to the air volatile oils become ozonized, and are more or less rapidly converted into a viscid oil or even solid resin; to the presence of ozone is due their bleaching effect upon corks, indigo solution, etc. (See a paper by Dr. J. L. Plummer in *Amer. Jour. Phar.*, 1853, pp. 398 and 508; also, 1860, p. 46.)

Origin.—Volatile oils are met with in a large number of plants, and may exist in every part thereof, from the root to the seed. If found in several parts of the same plant, the volatile oils obtained from them generally differ more or less, not only in odor and other physical properties, but frequently also in chemical composition. They are often separated in the plant in distinct cells, appearing as glands in the herbaceous portion, or distributed throughout the interior tissue, or forming tubes, as in the fruits of the Umbelliferæ. Very frequently they are associated with resins, and even exude either naturally or from incisions, holding resins in solution (oleoresins and many gum-resins). In a number of plants they are known to be produced under the action of a ferment, like emulsin and myrosin, upon other compounds, such as amygdalin and myronic acid; but in most cases it has been impossible to demonstrate either the precise tissue where they are produced or the compounds which yield them. There is, however, reason to believe that, at least in some cases, they result from the splitting of glucosides, resins, and similar principles. All volatile oils yield by spontaneous oxidation resinous compounds, which, however, have thus far been found to be entirely distinct from the resins with which the former have been naturally associated.

Among the products of the destructive distillation of organic bodies compounds are often found which possess the general characters of volatile oils, but usually have an empyreumatic odor persistently adhering to them; they are called *empyreumatic volatile oils*. Odorous compounds, sometimes known as *ferment oils* (*fermentolea*), are also produced during the fermentation of bruised vegetables or their expressed juice; they are probably alcohols or compound ethers.

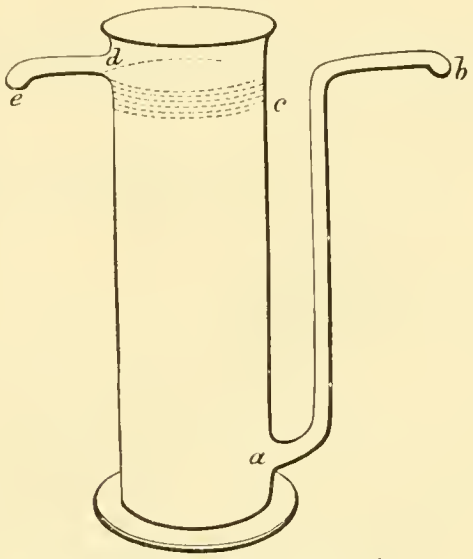
Preparation.—In a few instances, where the volatile oils are separated in cells of the epidermal tissue and not associated with resinous or fatty matters, as in the fruits of many Aurantiaceæ, they may be prepared by expressing that tissue after removing it by grating. By far the largest number, however, require to be distilled with water. Herbaceous plants, flowers, and leaves which are not of a leathery nature usually need no previous comminution, but firmer parts of plants, and those containing the volatile oil in the inner tissues, must be more or less ground or broken. Though fresh plants are usually readily softened and permeated by water, a short maceration before the distillation begins is rather advantageous, and may be regarded as very desirable if dried plants are employed; it is unnecessary in case the volatile oils are to be distilled off from resinous compounds; but whenever the volatile oil does not pre-exist, but is produced by the reaction of two principles in the presence of water, a prolonged maceration in cool or lukewarm water is required.

The *distillation* is accomplished in stills made of copper or iron, a sufficient quantity of

water being introduced to cover the material and prevent empyreuma; the latter object is more completely attained if a perforated false bottom is placed a few inches above the bottom of the still and the material packed upon it. Direct heat is then applied until the water boils briskly, and is maintained at this temperature until the distillate is no longer charged with volatile oil. Some volatile oils are obtained of better quality and greater fragrance if the direct application of fire to the still is avoided and the volatilization is accomplished by the introduction, near the bottom, of steam under pressure; a wooden tank may then be converted into a still by cutting a suitable aperture in the top and surmounting it with a still-head. Steam distillation is particularly applicable for flowers like those of the orange, lavender, chamomile, etc., and for the labiate and other herbs.

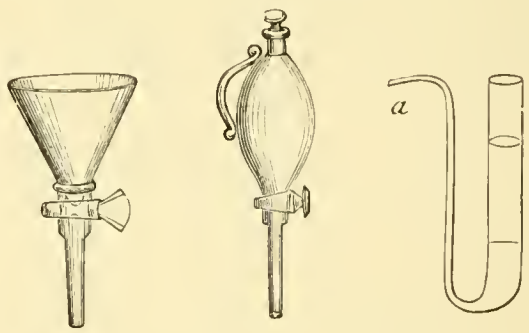
Although volatile oils have a higher boiling-point than water, the majority boiling above 140° C. (284° F.), their vapors diffuse readily in the vapors of water at the boiling temperature of the latter, and are thus easily carried over. Greater difficulty, however, is experienced with those volatile oils which have either an exceptionally high boiling-point or a specific gravity near or exceeding that of water; the addition to the water of about 3 per cent. of table-salt is then advisable, whereby the boiling-point is somewhat raised, and, as the water distils over, it may be gradually increased to about 109.5° C. (229° F.). The volatile oils of cloves, cinnamon, santal-wood, etc. are thus more readily obtained than with water alone.

Fig. 193.



Separator for heavy or light oils.

Fig. 194.



Separating-funnels and Tube-separator.

Cohobation is the returning of the aqueous distillate from which the volatile oil has been separated, either upon the same or upon fresh portions of material, and distilling again. The process is rendered necessary with cloves, santal-wood, etc., the firm tissue of which, containing the volatile oils, is not easily ruptured or thoroughly permeated by water, and with the petals of rose and similar articles which contain only a minute proportion of volatile oil.

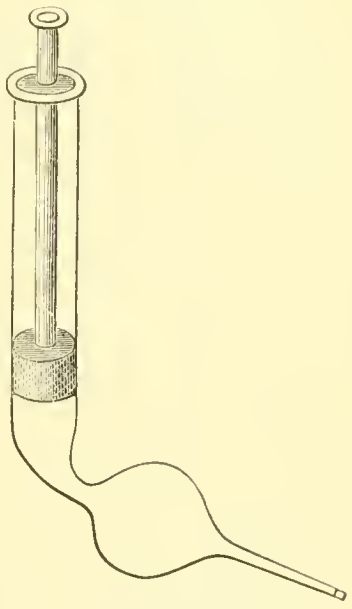
Separation.—On cooling, the distillate separates into two layers, one being a solution of the volatile oil in water, the other the pure oil. A tall cylinder or flask is used, which near the bottom has a glass or other tube inserted and curved upward to a short distance below the top. The heavy water separating at the bottom will commence to discharge through the lateral tube *b* as soon as the vessel is nearly filled with the distillate, upon which will float a layer of volatile oil; this layer may be withdrawn by means of a small siphon, or, better still, through a lateral tube *c* inserted near the top of the vessel. If the volatile oil, however, is heavier than water, the conditions will be reversed, and the oil will flow through *a* and run off at *b*. The last portions of volatile oil are removed from the water by means of a separating-funnel (Fig. 194), the separation being effected with a perforated glass stopper inserted in the neck or by inclining the vessel (Fig. 194) through the tube *a*. For very small quantities a bulb-pipette or syringe-pipette will be found useful, the tube of which is drawn out to a fine point. By a suitable arrangement the separated odorous water may be returned to the still while the distillation is progressing.

If volatile oils are present only in minute quantities, frequent cohobation is required, but even then too much is often lost by being retained in the water, as in the case of

violets, tuberoses, etc. To obtain these delicate perfumes, Millon and Commaille (1868) employed purified bisulphide of carbon, with which the material is exhausted, and on the spontaneous evaporation of which all the odoriferous compounds are left behind.

The process of *enfleurage* is likewise adapted for obtaining delicate perfumes: A number of trays or frames are covered with a layer of purified tallow or other inodorous fat, and then with flowers, the latter, if necessary, being replaced by fresh flowers in a few days; when the fat is sufficiently charged with the perfume it constitutes the *pommades* used by perfumers. Liquid fats may be used in a similar manner for extracting such perfumes, the liquid portion of oil of ben being employed, because it resists rancidity for a long time; the *huiles antiques* are obtained in this manner. By digesting the solid or liquid perfumed fat with pure alcohol the odorous principles are taken up by the latter, the spirit then constituting the *extracts* of perfumers; the small portion of fat entering solution separates on exposure to a low temperature.

Fig. 195.



Syringe-pipette.

L. Wolff (1877) proposed a process for preparing volatile oils whereby distillation may either be entirely avoided or materially shortened. Petroleum benzin dissolves from plants chiefly the volatile and fixed oils and wax which are left after evaporating the solvent. The volatile and fixed oils may then be separated either by distillation with water or by agitation with alcohol, removing the fat and wax, and separating the volatile oil from the alcohol by mixing with water.

Rectification is not unfrequently desirable, since resinous compounds and coloring matter may thereby be removed and the odor improved; it is best accomplished by mixing the volatile oil with half of its own weight of an inodorous liquid fat, and distilling the mixture from a solution of table-salt, as stated above.

Composition.—C and H, or C, H, and O, are the elements forming the large majority of the volatile oils; a few (oil of mustard, asafetida, etc.) consist of sulphuretted compounds, and are generally characterized by a disagreeable penetrating odor; some others (oil of bitter almonds, cherry-laurel, etc.) contain hydrocyanic acid, from which, however, they may be freed without otherwise altering their composition or modifying their odor. The first class mentioned, the hydrocarbons, are mostly *terpenes*, consisting of two or more isomeric modifications having the composition of $C_{10}H_{16}$ or a multiple thereof. The oxygenated volatile oils likewise consist proximately of at least two principles, boiling at different temperatures. The one having the lowest boiling-point is called *elæopten* and very often is a hydrocarbon of the composition $C_{10}H_{16}$ or $C_{10}H_{14}$. *Stearopten* is that portion which volatilizes last and congeals at about the ordinary temperature; in composition it is not unfrequently an oxide or hydrate of the hydrocarbon. The stearopten of oil of rose is a hydrocarbon, C_nH_{2n}, and has a lower boiling-point than the fragrant oxygenated portion. Stearoptens—or *camphors*, as they are sometimes called—crystallize from the volatile oils on exposure to a low temperature, the crystallizing-point depending partly on the fusing-point of the stearopten and partly on the amount of the solvent elæopten. The variation in the proportion of the two proximate constituents is due to the influence of climate, soil, and cultivation, and modifies to some extent the effect upon polarized light.

The *color* of volatile oils appears to be due to distinct compounds. Piesse (1863) separated from oil of wormwood, patchouly, etc. a volatile dark-blue body, *azulene* (according to Gladstone [1863] *cærulein*), of the composition $C_{16}H_{26}O$, which he stated to be present in all blue-colored volatile oils, while those having a different color are free from it or contain it in smaller proportion, mixed with more or less of yellow or brown resin.

Preservation.—Since volatile oils oxidize when in contact with air, and the oxidation is accelerated in the light, they should be kept in well-stopped vessels protected from the light. Various contrivances, which readily suggest themselves, have been recommended. Bottles of amber-colored glass, which excludes the actinic rays, are very suitable; and the addition of a small quantity of alcohol, which in our experience need not exceed 3 per cent., will prevent for a long time, if not the oxidation, at least the marked change of odor, which oils of orange, lemon, peppermint, and others undergo. Menigaut,

as early as 1835 proposed for the same purpose the addition of an equal weight of alcohol.

Restoration.—Resinified volatile oils, the flavor of which has not been impaired, may be restored to their former limpidity by rectification (see above). Small quantities of such volatile oils Curieux (1858) recommended to be agitated for fifteen or twenty minutes with a magma formed by mixing solution of borax with animal charcoal, when the resinified portion will unite with the borax, leaving the oil limpid and the odor restored.

Adulterations.—Among the numerous methods which have been recommended for detecting the principal adulterations to which volatile oils are subject, the following are simple, reliable, and easily executed:

(*a*) *Fixed oils* are indicated by the permanent greasy stain left upon paper or by the residue left on distilling the suspected oil with water. Since the fats are mostly insoluble, and the volatile oils mostly soluble in 85 per cent. alcohol, this solvent will leave the former behind; minute quantities of fixed oils, however, will escape detection by this method.

(*b*) *Alcohol* will cause a diminution of the volume of the volatile oil when this is agitated with an equal bulk of water or glycerin (according to Hager, 1888, diluted with 20 per cent. of water), in a graduated tube; the difference indicates approximately the amount of the adulteration. If olive oil is used in place of water, the alcohol, unless present in a very small quantity, will separate. Fused calcium chloride and dry potassium acetate are insoluble in volatile oils, but in the presence of alcohol become either soft or liquid. Tannin, which has been recommended for the same purpose, is soluble in oil of bitter almonds, cinnamon, and a few others. Dragendorff recommends metallic sodium, which produces a brisk evolution of gas in the presence of even 5 or 10 per cent. of alcohol, while hydrocarbons are not at all, and oxygenated oils but slightly, acted on in the cold. Aniline-red is soluble in alcohol and insoluble in volatile oils, but if the oils contain alcohol they are colored red by the dry aniline color.

(*c*) *Cheap volatile oils* are often difficult to detect. On rubbing a few drops of the volatile oil between the hands, or heating them gradually in a dish, or evaporating them from bibulous paper, and observing the odor from time to time, a marked difference of it is indicative of such adulteration. The hydrocarbons being mostly cheaper and less freely soluble in 85 per cent. alcohol than the oxygenated oils, an adulteration with the former will generally be recognized by the solvent mentioned.

The solubility of santal-red in some volatile oils (Voget), the different reaction of these oils with iodine (Tuchen), the change of color produced on heating oxygenated volatile oils with a little nitro-prusside of copper, and the prevention of this reaction by oil of turpentine and other hydrocarbons (Heppe, 1856), and the behavior of the volatile oils toward strong mineral acids, potassa, bromine, sulphide of lead, and other chemicals,—may, at least occasionally, be utilized for the purpose of detecting adulterations. (See *Proceedings Amer. Phar. Assoc.*, 1858, p. 344, and 1859, p. 338.)

OLEA PINGUIA.—Fixed Oils.

Fats, Fatty oils, E.; *Huiles grasses, Huiles fixes*, Fr.; *Fette, Fette Œle*, G.

Characters.—Fats are peculiar compounds obtained both from the animal and the vegetable kingdom. In their pure state they are often colorless, inodorous, and tasteless. Many are liquid at the ordinary temperature (*oils* or *fixed oils* proper), but by cautious cooling may generally be separated into fats of different fusibility. Others have a soft consistence (*fats* proper, or *butters*), and mostly yield liquid fats when subjected to a gradually increased pressure, while a fat of a higher fusing-point remains in the press-cloth. Those of a firmer consistence are sometimes termed *tallows*, and when hard and more or less brittle at the common temperature they are often popularly and commercially known as *waxes*. They are all lighter than water, and vary in specific gravity generally between .913 and .956, though some are as light as .860. They are insoluble in water, sparingly soluble in cold alcohol, but generally freely soluble in ether, chloroform, carbon disulphide, benzene, and light petroleum oils. The hot alcoholic solution of the solid fats separates them on cooling, generally in a crystalline form. When heated, the solid fats fuse to transparent oils and solidify again on cooling. Heintz observed that by raising the heat very slowly some fats show two fusing-points, which for pure stearin were found at 55° C. (131° F.) and 71.6° C. (160.9° F.), and also two congealing-points, the latter depending upon the temperature to which the fat had been heated and upon the rapidity with which it had cooled. After having been heated considerably beyond

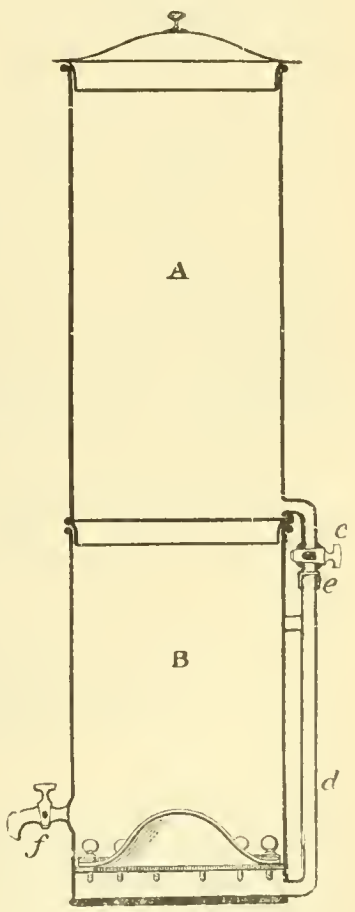
the fusing-point some solid fats remain liquid for a long time after cooling; at a higher temperature, usually in the neighborhood of 300° C. (572° F.), an ebullition is observed, accompanied by decomposition, the boiling-point gradually rises, and extremely acrid and irritating vapors are evolved, causing a copious flow of tears, and containing *acrolein*. (See GLYCERIN, p. 779.)

Fats are more or less unctuous to the touch, and when in a liquid condition dropped upon paper leave a permanent grease-spot unless they are crystalline and so hard that they may be rubbed off. They are not inflammable at the ordinary temperature, but when heated to incipient decomposition burn more or less readily by the aid of wick and with a sooty flame. When their surface is considerably increased by being spread over porous bodies they are rapidly oxidized, whereby the heat may be increased to such an extent as to ignite the entire mass.

Origin.—All plants, and perhaps all parts of plants, contain fat, though often in minute quantity. The liquid and solid fats are most likely generated from starch and other carbohydrates and allied compounds; De Luca (1862) proved that the fixed oil of olives increases in quantity as the mannit of the green olives disappears, and that the access of air and light facilitates the conversion. It is not unlikely that certain protein compounds may likewise be the source of fats. In the animal economy fats are, at least partly, produced in a similar manner.

Preparation.—From animal tissues rich in fat the latter is obtained by fusion either by itself or in the presence of water, and removal of the tissue by skimming or straining. Vegetable tissues containing notable quantities of fat yield it on being subjected to powerful pressure, either at the ordinary temperature or between plates which are heated to a little beyond the fusing-point of the fat; but since a certain quantity of the fat is mechanically retained by the tissues, a larger yield is had by the use of a solvent, such as carbon disulphide or petroleum benzin, which on being distilled off leaves the fat behind. When the bruised or cut vegetables are boiled with water, the fused fat rises to the surface, and may either be skimmed off or obtained by straining, expression, and subsequent separation from the water; such fats are usually inferior to those obtained from the dried article by pressure alone.

FIG. 196.



Warner's Oil-filter.

Purification.—The impurities contained in fats are protein and mucilaginous compounds derived from the vegetable tissue, and may be removed through a well-dried filter; the filtration is facilitated by a somewhat elevated temperature. An apparatus suitable for this purpose, and for filtering through flannel in an upward direction and under pressure of a column of the oil, was constructed by W. R. Warner (1861): A is the reservoir containing the oil; B, the recipient of the filtered oil. On the large scale the purification is effected by the gradual addition to the oil of ½ to 2 per cent. of sulphuric acid, whereby the impurities are carbonized; the oil is then agitated with water to remove adhering acid, decanted, and often filtered through charcoal, or through tow, moss, or similar material, upward filtration being preferred. The use of sulphuric acid for the purification of oils was introduced in England by Gowen (1790). Chloride of zinc has a similar effect, according to R. Wagner, if used in concentrated solution, 1 to 1½ per cent. being required; and Barreswill (1858) recommended for the same purpose the saponification of a small proportion of the fat by means of a weak solution of potassa or soda. From 1 to 2 per cent. of ammonia will often be effectual, and as mechanical agents for separating the impurities powdered clay and plaster of Paris have been found to serve a good purpose. The loss sustained in purification varies with the nature and amount of the impurities, and in some cases reaches 15 or 20 per cent. of the crude oil.

Bleaching.—The treatment of fats with sulphuric acid usually destroys also the coloring matter wholly or in part; treatment with animal charcoal renders the fats lighter, and many are bleached (and often become rancid) by exposure to the direct sunlight, a strip of lead being sometimes introduced into the fat if liquid, or this is occasionally agitated with an aqueous solution of ferrous sulphate. Palm oil is

bleached by being rapidly heated to 240° C. (464° F.) and keeping it at this temperature for ten minutes. The same effect is produced upon oil of poppy-seed by heating it for five hours to between 90° and 95° C. (194° and 203° F.). Oxidation of the coloring principle by means of permanganic or chromic acid or hypochlorites has likewise been recommended.

Composition.—Nearly all animal and vegetable fats are mixtures of two or more fats having a different fusing-point; those which are liquid at the ordinary temperature separate in the cold granular masses of the solid fats contained in them, while those which are solid at the common temperature often yield by expression a liquid oil. With comparatively few exceptions, fats are compound ethers of the triatomic alcohol glycerin (see page 778), and the acids contained in them belong to two series, the fatty acid group of the general formula $C_nH_{2n}O_2$, and the oleic acid group of the formula $C_nH_{2n-2}O_2$. The most important members of the first group are stearic ($C_{18}H_{36}O_2$), palmitic ($C_{16}H_{32}O_2$), myristic ($C_{14}H_{28}O_2$), lauric ($C_{12}H_{24}O_2$), and butyric ($C_4H_8O_2$) acids. To the second group belong, besides oleic acid ($C_{18}H_{34}O_2$), erucic ($C_{22}H_{42}O_2$) and hypogæic ($C_{16}H_{30}O_2$) acids, the former being found in oil of mustard, the latter in oil of ground-nut. All these acids are monobasic, and the neutral fats therefore contain 3 molecules of the acid to 1 of the ether radical, C_3H_5; these compounds are conveniently named from the acid by changing the termination to *in;* thus *stearin* or *tristearin* is $C_3H_5.(C_{18}H_{35}O_2)_3$, and *olein* or *triolein* has the formula $C_3H_5.(C_{18}H_{33}O_2)_3$. The fats most widely distributed are olein, stearin, palmitin, myristin, and laurin, which are inodorous when pure, while the fats of the volatile acids have a distinct odor, the most important being *butyrin*. Fats which on exposure to air gradually solidify through the absorption to oxygen, the so-called *drying oils*, are supposed to contain *olin*, the composition of which is not known; the drying fat of linseed oil has been named *linolein*.

The fusing-points of the above-named pure fats are as follows: Stearin, 55° C. (131° F.); palmitin, 48° C. (118.4° F.); myristin, 31° C. (87.8° F.); laurin, 44° C. (111.2° F.). The margarin of older chemists is a mixture of palmitin and stearin; olein and butyrin are liquid at common temperatures.

Preservation.—Fats should be kept in a dry place at a low temperature, and protected from light and air. On being exposed to the atmosphere the fats gradually become rancid, and this change is accelerated by the presence of animal and vegetable tissue, protein, and mucilaginous compounds; hence the importance of careful purification. The rancidity is due to the generation of odorous compounds, perhaps some acrolein and volatile fatty acids, besides some coloring matter. Rancid fats may be improved, and to a certain extent restored, by washing with warm water or by treating them with magnesia or other weak alkali, and afterward washing them well. Treatment with strong alcohol or agitation of the oil with a little powdered borax and exsiccated sodium carbonate has likewise been recommended.

Adulterations.—The higher-priced fats are not unfrequently adulterated with cheaper ones, and, owing to the similarity of composition, such admixtures are difficult to recognize. A change of the fusing-point in the solid and of the congealing-point in the liquid fats is not unfrequently produced by addition of other fats, and other criteria are afforded by the color, consistence, odor, and taste, sometimes also by the specific gravity. The non-drying oils when subjected to the influence of nitrous acid become solid, the olein being converted into the solid isomeric compound *elaidin*, which fuses between 25° and 28° C. (77° and 82° F.), and solidifies again on cooling. The test is made by agitating for a short time 1 part of copper in small pieces with about 5 parts each of nitric acid and the oil, and setting the mixture aside; the separation of elaidin commences in about an hour, and the solidification is generally completed in about 6 hours. Almond oil and olive oil are scarcely colored thereby, but become opaque; the drying oils (linseed, poppy-seed, hemp-seed, and nut oils) remain liquid, while the following become thicker, but not solid: castor, cotton-seed, sunflower-seed, and benne-seed oil, the latter acquiring also a red color.

On carefully placing a drop of oil or oleoresin upon the surface of chemically pure water contained in a perfectly clean glass vessel, distinct figures are formed, which were termed *cohesion-figures* by C. Tomlinson (1864), and which have a distinct character for the different liquids. These cohesion-figures have been recommended as a means of identifying the liquids, and possibly also of determining the presence of admixtures.

The character of the soda soap may likewise serve to indicate an adulteration with drying oils; for this purpose the oil is agitated with one-third of its weight or more of soda solution, specific gravity 1.33 (containing 30 per cent. NaOH), and the mixture boiled until saponification has been effected; after cooling, the soap of the drying oils will be

soft, and should oils of Cruciferæ (mustard, etc.) have been present, the aqueous filtrate will impart a black color to paper moistened with solution of lead acetate, owing to the sulphur present in the oil. The melting-point of the mixed fatty acids separated from the soap by hydrochloric acid has been suggested by O. Bach (1883) as a means for recognizing the purity of the fats; the results with the acids were as follows:

From cotton-seed oil,	melting at	38° C.,	congealing at	35° C.;
" sesame oil,	"	" 35° C.,	"	" 32.5° C.;
" ground-nut oil,	"	" 33° C.,	"	" 31° C.;
" olive oil,	"	" 26.5°–28.5° C.,	"	" 22° C.;
" sunflower oil,	"	" 23° C.,	"	" 17° C.;
" rape-seed oil,	"	" 20.7° C.,	"	" 15° C.;
" castor oil,	"	" 13° C.,	"	" 2° C.

Concentrated sulphuric acid produces with different fixed oils mixtures varying in color: 8 or 10 drops of the oil are placed upon a china plate, 2 or 3 drops of sulphuric acid are added, and after a few seconds mixed by stirring; the color of the mixture will be as follows: with *almond oil*, yellow, changing to pale brownish-yellow; with *olive oil*, yellow, turning brownish; with *lard oil*, yellow and brown; with *cotton-seed oil*, yellow and brown; with *ground-nut oil*, yellow and green-brown; with *benne oil*, brown-red, becoming gelatinous; with *sunflower oil*, red-brown and brown; with *hemp-seed oil*, brown, black, and solid; with *linseed oil*, brown-red to blackish-brown; with *rape-seed oil*, greenish-blue or brownish-green; with *poppy-seed oil*, yellow to brownish-green; with *castor oil*, brownish to gray-brown. When larger quantities of oil are mixed with sulphuric acid a rise of temperature takes place, which is not alike for different oils. According to Behrens (1852), when a cold mixture of equal parts of nitric and sulphuric acid is added to an equal weight of oil, *benne oil* acquires a green, *ground-nut oil* a red, and *olive oil* a yellow color. (See also Ol. Amygdal. Express.)

The effect of nitric acid upon the oils depends not only upon the composition of the latter, the presence of coloring matter, etc., but likewise upon the strength of the acid and the temperature. Bach (1883) recommends testing the oils by agitating for 1 minute 5 Cc. each of oil and nitric acid; the test-tube is afterward placed in boiling water for 5 minutes, and finally set aside for 18 hours at about 15° C.; the results obtained were, with—

Olive oil,	cold,	pale-green;	hot,	orange-yellow;	final result,	solid.
Cotton-seed oil,	"	yellowish-brown;	"	reddish-brown;	" "	butyraceous.
Sesame oil,	"	white;	"	brownish-yellow;	" "	liquid.
Ground-nut oil,	"	pale rose-color;	"	brownish-yellow;	" "	solid.
Sunflower oil,	"	dingy-white;	"	reddish-yellow.		
Rape-seed oil,	"	pale rose-color;	"	orange-yellow;	" "	solid.
Castor oil,	"	pale rose-color;	"	golden-yellow;	" "	butyraceous.

Lipowitz (1868) observed that the admixture of drying in non-drying oils may be detected by triturating 8 parts of the oil with 1 part of chlorinated lime; in the course of a few hours the mixture, if made with non-drying oils, will separate a layer of limpid oil, while no oily layer will separate from the mixture containing a drying oil. This appears to be due to the rapid oxidation of the latter.

Since most of the fats are without action upon it, polarized light does not afford a means of distinguishing them; of the official oils, only castor oil has a decided rotation to the right.

OLEANDER.—Oleander.

Laurier rose, *Laurose*, Fr.; *Oleander*, *Rosenlorbeer*, G.; *Adelfo*, Sp.

The leaves of Nerium Oleander, *Linné*.

Nat. Ord.—Apocynaceæ.

Origin.—This well-known ornamental shrub grows wild in Southern Europe, Northern Africa, and Western Asia, and thrives best in moist ground. It is arborescent, with a gray or greenish-gray nearly smooth bark, ternately-divided branches, and showy dark rose-colored or white flowers. All parts are reputed to possess poisonous properties.

Description.—The leaves are whorled in threes, leathery, smooth, dark-green and glossy above, nearly sessile, linear-lanceolate 10–15 Cm. (4 to 6 inches) long, finely pointed at the apex, entire on the margin, and delicately feather-veined. They are without odor and have a nauseous and bitter taste.

Constituents.—Lukowski (1861) obtained two alkaloids from the leaves and

branches by carefully precipitating their decoction with tannin; the tannate of pseudocurarine is soluble in an excess of tannin, and the alkaloid liberated by lead oxide. *Pseudocurarine* is amorphous, yellowish, tasteless, and inodorous, insoluble in ether, freely soluble in water and alcohol, and yields uncrystallizable salts. *Oleandrine* is a yellowish resinous body, slightly soluble in water, very soluble in alcohol, chloroform, and ether, of a strongly bitter taste, and poisonous. Its salts are uncrystallizable. Bitteli (1875) observed that oleandrine loses its poisonous properties when heated to 240° C. (464° F.), and that the hydrochlorate is crystalline; he regards the pseudocurarine as a mixture of different principles containing a little oleandrine. Schmiedeberg (1882) ascribes the poisonous action to oleandrine, while a second principle, *neriantin*, is stated to be a glucoside and to possess only a feeble action. Pelikan (1866) considered the poisonous principle to be a yellow acrid resin, which, according to Latour (1857), possesses acid properties. The latter chemist determined also the presence of tannin, fat, and other common principles.

Allied Plants.—Nerium odorum, *Aiton* (N. odoratum, *Lamarck*). It is indigenous to and cultivated in India, and resembles the oleander, but has longer leaves and fragrant flowers with a fringed paracorolla. The bark somewhat resembles mezereon-bark, but breaks with a short fracture. H. G. Greenish (1881) isolated a fixed oil and two bitter poisonous glucosides, both of which are insoluble in benzin, benzene, and carbon disulphide. *Neriodorin* is a transparent yellow tenacious mass, readily soluble in chloroform, colored deep reddish-brown by ferric chloride, and precipitated by basic lead acetate and by potassio-mercuric iodide. *Neriodorein* is a lemon-yellow powder, insoluble in chloroform, colored slightly brown by ferric acetate, and not precipitated by potassio-mercuric iodide nor by basic lead acetate until a little ammonia has been added.

Thevetia yccotli, *De Candolle* (Cerebera thevetioides, *Kunth*), is an elegant tree with dark-green foliage and golden-colored flowers, indigenous to the damp hot regions of the Mexican Cordilleras, where it is known as *joyote*. It bears an ovoid-globular crested and laticiferous drupe containing four (or by abortion two) seeds, which have a thin papery testa, a reticulate tegmen, two orbicular, unequal, crested cotyledons, and a short conical radicle. The joyote-seeds are extremely acrid, and, according to Herrera (1877), yielded by pressure 40 per cent. of oil resembling almond oil. The expressed seeds yielded to ether more oil, to distilled water albuminous and extractive matter, and to alcohol a crystalline acrid principle, *thevetosin*, which is sparingly soluble in ether, carbon bisulphide, and fixed and volatile oils, is insoluble in water, and on being treated with dilute nitric acid is split into glucose and a resinoid substance.

Thevetia (Cerbera, *Kunth*) cuneifolia and Th. ovata, *De Candolle*, are likewise known as joyote and as *narcisos amarillos*, and probably possess similar properties.

Thev. neriifolia, *De Candolle* (Cerbera Thevetia, *Linné*), is a West Indian shrub, the bark of which is used as an anti-periodic.

Parameria vulneraria, *Radlkofer*, a climbing plant of the Philippine Islands, furnishes *Cebu balsam*, which is prepared by boiling the bark and leaves in cocoanut oil, and is of a yellow color and of a peculiar odor. The root-bark yields, according to Zipperer (1885), 8.5 per cent. caoutchouc, 3 per cent. aromatic resin, and 14 per cent. of ash.

Geissospermum lævе, *Baillon*, known in Brazil as *pao pareira*, is a tree the intensely bitter bark of which has been much used in that country. Santos (1838) separated from it an alkaloid, *pereirine*, which in its impure state, as a brown-yellow amorphous powder, is employed in Brazil. Bochefontaine and De Freitas (1877) proposed to call it *geissospermine*, and Hesse (1877) adopted this name for the alkaloid, which is nearly insoluble in ether and water and readily soluble in alcohol and dilute acids, crystallizes in small white prisms, dissolves in strong nitric acid with a purple-red color, becoming orange-yellow on heating, and in concentrated sulphuric acid at first colorless, rapidly changing to blue, and gradually to a pale color; its composition is $C_{19}H_{24}N_2O_2.H_2O$. A second alkaloid, *pereirine*, is easily soluble in ether, forms a grayish-white amorphous powder, and is colored blood-red by nitric and violet-red by sulphuric acid; it appears to be present in larger proportion than the preceding one. The leaves of this tree, which were sent to Europe as *caroba-leaves*, have also a bitter taste, and probably contain the same alkaloids.

Action and Uses.—Oleander is one of the plants whose flowers are said to render honey poisonous, and experiments seem to show that its active principle is a heart-poison, It has been used in *epilepsy*, but fruitlessly.

Tanghine, the active principle of Tanghinia venenifera, an ordeal bean of Madagascar, contains an element which, according to Quinquaud, arrests the respiration and then the heart, destroying the muscular irritability, and causing death without convulsions, but with dyspnœa and vomiting. Gley, on the other hand, states that it differs from strophantine and ouabaine by causing convulsions. The poison, says Quinquaud, "appears likely to be useful in toxic paralysis, trembling palsy, and want of tone in the intestines, and in two cases of nocturnal incontinence of urine it has proved of service" (*Pharm. Jour. and Trans.*, Oct. 5, 1885). Quinquaud gave an extract of the seeds in doses of Gm. 0.06–0.10 (1 to 1½ grains).

Muriate of pereirine has had antiperiodic virtues ascribed to it, by Ferrara and by Baeker, when given to the extent of Gm. 2 (30 grains) a day (*Bull. de Thérap.*, cix. 238; cx. 319).

OLEATA.—Oleates.

Oléates, Olées, Fr.; *Oleate*, G.

This class of preparations was first proposed by Lhermite (*Jour. Phar. Chimie*, Oct., 1854, p. 301) but did not attract attention until recommended by Prof. John Marshall (1872). They are combinations of oleic acid with metallic bases or alkaloids, but as medicinally employed they are usually solutions of the true or normal oleates in an excess of oleic acid. In the case of the alkaloids the respective oleates are prepared by direct solution in oleic acid, and to facilitate which a moderate degree of heat may be employed. In the case of metallic oleates, however, mutual decomposition is frequently resorted to for which purpose either a specially prepared sodium or potassium oleate is employed, or a solution of castile soap, which latter, being a sodium oleo-palmitate, will of course yield also an impure oleate; but for all practical purposes this slight impurity may generally be disregarded, particularly in the case of lead, zinc, and copper. The proportion of alkaloids or metallic oxide to be dissolved in oleic acid may vary to suit the particular views of the practitioner, but since the union of oleic acid with the base results in a definite chemical compound, the limit set by nature cannot be exceeded; this limit represents the following proportions of base represented by normal oleates, calculated for anhydrous alkaloids and metallic oxides respectively: atropine 50.6 per cent., cocaine 51.8 per cent., morphine 50.3 per cent., quinine 53.46 per cent., strychnine 54.22 per cent., bismuth 22.2 per cent., copper 12.7 per cent., lead 29 per cent., iron (ferric) 8.9 per cent., mercury (mercuric) 28.4 per cent., zinc 12.9 per cent. Assuming the molecular weights of aconitine and veratrine (based on the formula given by Prescott) to be correct, the normal oleates of these two alkaloids would contain 69.6 and 61.15 per cent. respectively; but it must be remembered that the commercial aconitine and veratrine are both very impure. The solutions of alkaloidal oleates are usually made of the strength of 2 per cent., except morphine and cocaine (usually 5 per cent.) and quinine (25 per cent.); a typical formula for their preparation is given in the U. S. Pharmacopœia under Oleatum Veratrinæ. In the case of metallic oleates the use to which they are to be put must be considered in the choice of proper diluents: for mercuric oleates and all those intended for epidermic medication only oleic acid should be employed, as it is more readily absorbed than fats and solid hydrocarbons; for those oleates intended for use in skin diseases, petrolatum or benzoinated lard may be used. The more nearly oleic acid is saturated with mercuric oxide the better will the preparation keep, and hence either the normal or the official oleate should be kept in stock for dilution as wanted, the necessary oleic acid being readily incorporated. 10 parts of normal mercuric oleate diluted with 18.4 parts of oleic acid will produce the 10 per cent. oleate, and if diluted with 46.8 parts of acid the 5 per cent. oleate will be obtained.

Although a solution of castile soap has been strongly recommended for the preparation of normal metallic oleates, a purer product can be obtained by using sodium or potassium oleate prepared direct from oleic acid, as follows: Warm in a capacious vessel 2000 grains of purified oleic acid (U. S. P. 1890) to about 60° or 66° C. (140°–150.8°F.), and add slowly a solution of 320 grains of soda (U. S. 90 per cent.) in a mixture of 1½ fluidounces of alcohol and 4 ounces of water, stirring constantly until the acid is neutralized, and a small portion of the resulting soap dissolved in alcohol yields but a faint pink tint on the addition of a few drops of alcoholic solution of phenolphtalein. The soap is then dissolved in 6 pints of warm water and filtered; this neutral solution may be used for the decomposition of metallic salts, and will yield very satisfactory normal oleates; for instance, to the above quantity (6 pints) may be added, slowly and with constant stirring, a warm solution of 884 grains of cupric sulphate in 2 pints of water, or of 1350 grains of pure lead acetate in 4 pints of warm water, etc. More extended information, together with working formulas for the various oleates, will be found in the *Amer. Jour. Phar.* for 1881 and 1889, and *Drugg. Circ.* 1885.

Ointments of the Oleates. Manufacturers have for some time offered a class of preparations under the name of ointments of the various oleates, in regard to which some confusion exists, since the base used by different manufacturers varies, as well as

the proportion of oleate: physicians may therefore find these ointments of varying composition and consistence, as either benzoinated lard or petrolatum (soft or hard) has been used in their preparation. The term "ointment of any oleate, 5 or 10 per cent." can have but one meaning as far as the active ingredient is concerned—namely, that the finished product contains 5 or 10 parts of the respective normal oleates in every 100 parts of the ointment, and not 5 or 10 parts of the alkaloid or metallic oxide, as is frequently supposed: this of course makes a considerable difference in the strength of the oleate ointments, and should be borne in mind whenever they are prescribed. Ointments of oleates are not recognized in any of the pharmacopœias (except Unguentum Zinci Oleati, *Br. Phar.*, which see), and physicians may save themselves and the pharmacists much annoyance by either specifying the name of the manufacturer whose product they desire, or by designating the amount of oleate (normal or of a stated percentage strength), as well as the kind of base they wish to have used in the preparation of the ointments of the various oleates.

OLEATUM HYDRARGYRI, *U. S., Br.*—Oleate of Mercury.

Hydrargyrum oleicum, s. *oleïnicum*, s. *claïnicum.—Mercuric oleate*, E.; *Oléate mercurique*, Fr.; *Quecksilberoleat, Mercurioleat*, G.

Preparation.—Yellow Mercuric Oxide, thoroughly dried, 200 Gm.; Oleic Acid, 800 Gm.; to make 1000 Gm. Introduce the oleic acid into a capacious mortar, and gradually add to it the yellow mercuric oxide, by sifting it upon the surface of the acid and incorporating it by continuous stirring. Then set the mixture aside in a warm place, at a temperature not exceeding 40° C. (104° F.), and stir frequently until the oxide is dissolved.

To prepare 4 av. ozs. of the official mercuric oleate use 350 grains of well dried mercuric oxide and 1400 grains of oleic acid.

To 9 ounces of oleic acid gradually add 1 ounce of yellow mercuric oxide, and triturate occasionally until it is all dissolved.—*Br.*

The U. S. preparation constitutes a 20 per cent. oleate, and is of the consistence of firm butter with a yellowish color; when made by mutual decomposition between potassium oleate and mercuric nitrate, as first suggested in 1873 by Louis Dohme, it is of a pale cream color. Heat must be avoided as much as possible in its preparation, as it is readily decomposed at increased temperatures, but will keep for a long time in a cool place protected against light and air. The use of metallic spatulas should be carefully avoided, and only glass or porcelain utensils employed.

The 20 per cent. oleate of mercury may be readily converted into the 10 per cent. oleate by mixing with an equal weight of oleic acid, or into the 5 per cent. oleate by adding three times its weight of oleic acid.

Oleate of bismuth has been prescribed to some extent, and may be conveniently prepared by Beringer's method, as follows: Take of oxide of bismuth, dried at 100° C., until it ceases to lose weight, 480 grains; purified oleic acid, 1735 grains. Rub the oxide to fine powder, mix thoroughly with the oleic acid, add 2 parts of water, and boil the mixture until saponification is complete (replacing water as it evaporates), and a small quantity dropped into water yields an ointment-like mass without separation of oleic acid.

Action and Uses.—Oleate of mercury was proposed and introduced by Marshall (1872) for making an ointment more cleanly and at the same time more efficient than mercurial ointment, because more readily absorbed after its mere application to the integument without friction. It, however, was liable to the objection of smelling unpleasantly, and of irritating the skin in many cases unless diluted with olive oil or lard. In order to proportion the strength of the preparation to the susceptibility of the skin, it has been made with different percentages of the oxide of mercury, from 3 up to 20 per cent., and as the stronger were apt to produce pain, Gm. 0.06 (gr. j) of morphine was combined with each drachm of the preparation. It was painted on the affected part with a brush or mop, and not rubbed in like ordinary liniments or embrocations.

It was originally applied to *joints* affected with *chronic inflammations*, synovial or rheumatic; to indurations of the *mammæ* and *lymphatic glands;* to the pustules of *sycosis;* to the seat of itching in *pruritus pudendi et ani;* and to destroy *lice* infesting the genitals. A mass as large as a pea or bean of the 20 per cent. oleate was placed in the child's axilla in cases of congenital *syphilis;* the application, repeated night and morning for five or six days, produced its constitutional effects without any sign of uncleanliness. But,

on the whole, experience has proven this preparation to be inferior to mercurial ointment. In the non-ulcerated forms of *syphiloderma* affecting the face, neck, or hands the 10 per cent. solution was found a valuable adjunct to their treatment. This solution was also applied to non-ulcerated indurations and *condylomata*, to the eyelids in *syphilitic iritis*, and to hard *nodes* and certain forms of *syphilitic testicle*. It is alleged to have cured bromidrosis, or *fetid sweating* of the axilla (*Lancet*, May 8, 1880). Most of these results were soon after their announcement confirmed (Hill, Martini, 1873), but not those relating to non-syphilitic inflammatory affections. With the exception of a suggestion that it would form an excellent substitute for the ointment of yellow oxide of mercury in the treatment of diseases of the eye (1878), it does not appear that any favorable account has been published of this preparation, from which it may be inferred that experience has not confirmed the estimate of its value entertained by its proposer.

OLEATUM VERATRINÆ, *U. S.*—Oleate of Veratrine.

Veratrinum oleïcum.—Oléate de vératrine, Fr.; *Veratrinoleat*, G.

Preparation.—Veratrine, 2 Gm.; Oleic Acid, 98 Gm.; to make 100 Gm. Rub the veratrine with a small quantity of the oleic acid in a warm mortar to a smooth paste. Add this to the remainder of the oleic acid, previously warmed, and stir until it is dissolved.—*U. S.*

In like manner other alkaloidal oleates may be prepared, the above formula yielding a 2 per cent. solution; when a stronger oleate is ordered a decreased quantity of oleic acid should be taken; thus for 5 per cent. use 5 Gm. of alkaloid and 95 Gm. of oleic acid; for 25 per cent., use 25 Gm. and 75 Gm. respectively, etc. Since each minim of the 2 per cent. oleate weighs about $\frac{8}{10}$ of a grain, 100 grains of it will measure about 2 fluidrachms.

Action and Uses.—This preparation contains half as much of the alkaloid as veratrine ointment. Like that compound, it is useful as an application to neuralgic centres. It should be applied with a mop.

OLEATUM ZINCI, *U. S., Br.*—Oleate of Zinc.

Zincum oleicum.—Oléate de zinc, Fr.; *Zinkoleat*, G.

Preparation.—Zinc Oxide, 50 Gm.; Oleic Acid, 950 Gm.; to make 1000 Gm. Introduce the oleic acid into a capacious capsule, and gradually add to it the zinc oxide, by sifting it upon the surface of the acid, and incorporating it by continuous stirring. Set the mixture aside for a few hours, and then heat it on a water-bath, frequently stirring, until the oxide is dissolved.—*U. S.*

To prepare 4 av. ozs. of oleate of zinc 87½ grains of zinc oxide and 1662½ grains of oleic acid should be used.

Add 1 ounce of zinc oxide to 9 ounces of oleic acid, and allow the mixture to stand for two hours; then heat on a water-bath until the oxide is dissolved.—*Br.*

The U. S. preparation, being a 5 per cent. oleate, is of the consistence of a soft ointment, whereas the Br. oleate, containing twice as much oxide, is very much firmer. The so-called 20 per cent. oleate of zinc is a hard friable mass, containing a considerable excess of zinc oxide, the normal compound representing only 12.9 per cent.

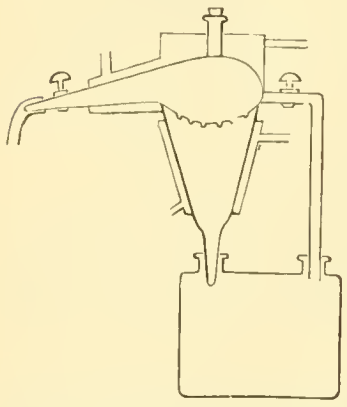
Powdered oleate of zinc may be prepared by either of the two following methods: Add a cold solution of 1 oz. of castile soap in 2 pints of water, slowly to a cold solution of 360 grains of zinc acetate in 4 pints of water, constantly stirring; wash the precipitate with cold water and dry without heat (Parsons). Make 6 pints of neutral soap solution from oleic acid and soda (see page 1097), warm to 43° C. (109.4° F.), and to it add slowly a solution of 1100 grains of zinc sulphate in 2 pints of water, stirring constantly—collect the precipitate on a moist filter, wash thoroughly with water, and dry on bibulous paper at a temperature not exceeding 38° C. (100° F.). It is important that the temperature during precipitation be maintained between 38° and 43° C. (100°–110° F.), so that the oleate when dry may be obtained in white friable masses which can easily be passed through a sieve as an impalpable unctuous slippery powder (Beringer).

OLEORESINÆ.—Oleoresins.

Oléo-résines, Extraits éthérés, Fr.; *Œlharze, Ætherische Extrakte*, G.

These preparations consist mainly of fixed or volatile oils associated with resin and some other constituents, and are directed to be prepared by exhausting the powdered drug with ether. The great volatility of this solvent renders it necessary to percolate in a well-closed apparatus, in which the pressure is equalized by connecting the receiving vessel with the top of the percolator by means of a tube (see page 642). The ethereal tincture is afterward transferred to a suitable still, and the ether distilled off from a water-bath with a moderate heat. Various apparatuses have been constructed to accomplish the exhaustion with the smallest possible quantity of ether by using the same liquid over again until the material has been exhausted; for this purpose the recipient is placed in water of about 50° C. (122° F.); the ether vapors ascending through the connecting tube mentioned above are condensed in a suitable refrigerator, and the ether is again passed into the percolator, the operation being repeated as often as required. The annexed cut, taken from Parrish's *Pharmacy*, represents such an apparatus, which is best made of tinned sheet iron, or preferably of copper well tinned on the inside; it explains itself, and it is merely necessary to state that the head is perforated at the bottom for the equal distribution of the menstruum, and jacketed above for the condensation of the ether. The percolator being likewise jacketed, it may be immersed in warm water, and the ether recovered which remains in the powder after exhaustion; or, if distillation be inconvenient, the greater portion of the ether may be displaced by means of alcohol.

Fig. 197.



Percolator, with still and condenser, for preparing oleoresins.

If the operation has been carefully conducted, the ether thus regained is not at all or but very slightly impregnated with volatile oil; nevertheless, it must be regarded as unfit for internal use, and should be reserved for a similar subsequent operation.

In 1892 Geo. M. Beringer suggested the use of acetone as a menstruum in place of ether, and made a series of experiments in which he established the value of the former solvent. As acetone can now be obtained of great purity at a cost considerably below that of pure ether, and as its boiling-point is at least 18° or 20° C. above that of ether, it seems a pity that the Pharmacopœia failed to recognize its merits.

The usual directions for the preparation of oleoresins are to continue percolation of the drug to complete exhaustion, but, as already pointed out by Procter nearly 30 years ago, the first portions of percolate contain practically the whole of the oleoresinous constituents, and hence 2 cubic centimeters of percolate for each gramme of drug operated upon would appear sufficient: in the case of capsicum even less (1.5 Cc.) has been found advantageous, in order to avoid the extraction of large quantities of fat.

OLEORESINA ASPIDII, *U. S.*—Oleoresin of Aspidium.

Oleoresina filicis, Extractum filicis liquidum, Br.; *Extractum filicis*, P. G.; *Oleum filicis maris.—Oleoresin or Liquid extract of male fern*, E.; *Extrait éthéré (Huile) de fougère mâle*, Fr.; *Wurmfarnextrakt, Wurmfarnöl*, G.

Preparation.—Aspidium, recently reduced to a No. 60 powder, 500 Gm.; Ether, a sufficient quantity. Put the aspidium into a cylindrical glass percolator, provided with a stopcock, and arranged with cover and receptacle suitable for volatile liquids. Press the drug firmly, and percolate slowly with ether, added in successive portions, until the drug is exhausted. Recover the greater part of the ether from the percolate by distillation on a water-bath, and, having transferred the residue to a capsule, allow the remaining ether to evaporate spontaneously. Keep the oleoresin in a well-stoppered bottle.

Note.—Oleoresin of aspidium usually deposits, on standing, a granular-crystalline substance. This should be thoroughly mixed with the liquid portion before use.—*U. S.*

The processes of the other pharmacopœias are essentially identical with the above, except that maceration instead of percolation is directed by the P. G. It should be remembered that only that portion of the rhizome is to be used which has still a greenish

color; the oleoresin will then have a greenish or brownish-green color, while the entire rhizome with the stipes yields a brown preparation, which not unfrequently forms a jelly, probably from the separation of pectin compounds. The official oleoresin separates a granular deposit of filicic acid, which must be well mixed with the liquid portion on dispensing. The yield is about 10 to 15 per cent.

"The oleoresin, well stirred and diluted with glycerin, should not show any starch-granules when examined under the microscope."—*P. G.*

Action and Uses.—Since the introduction into practice of this preparation, whose activity depends upon the filicic acid it contains, the treatment of *taniæ* has been rendered prompt and certain, at least so far as relates to the armed tænia and T. bothriocephalus. It appears to act as a poison to the parasites, which are discharged dead. The medicine may occasion nausea, griping, and even vomiting, but usually acts without causing either pain or uneasiness. It is well to prepare the patient by administering a purgative dose of castor oil or of calomel, or a saline cathartic, in order to remove the mucus in which the head of the parasite is imbedded. This should be done about twelve hours before the oleoresin is administered, and the diet at the same time restricted to milk and light broths. Duchesne advises that the extract should be administered along with calomel: ℞. Ol. resinæ aspidii ʒij, calomel gr. xij. S. Make 16 capsules, of which 2 are to be taken every ten minutes until all are used. The oleoresin is best prescribed in capsules each containing Gm. 0.40–0.46 (gr. vj–vij). Some advise that an equal quantity of ether should be contained in every one. Of these capsules two should be taken every fifteen minutes until Gm. 6–8 (fʒiss–ij) of the oleoresin have been used. In the course of two or three hours purging begins, and after several stools the worm is generally expelled, dead. It has been suggested that the patient should evacuate the bowel in a vessel nearly full of water, so that the parasite need not break and that its parts may be readily distinguished. The oleoresin of *Aspidium marginale*, a common fern of this country, has been successfully used for tape-worm in doses of Gm. 0.20 (gr. iij).

OLEORESINA CAPSICI, *U. S.*—Oleoresin of Capsicum.

Oléorésine (Extrait éthérée) de capsique, Fr.; *Spanischpfeffer-Oelharz*, G.

Preparation.—Capsicum, in No. 60 powder, 500 Gm.; Ether, a sufficient quantity. Put the capsicum into a cylindrical glass percolator, provided with a stopcock, and arranged with cover and receptacle suitable for volatile liquids. Press the drug firmly, and percolate slowly with ether, added in successive portions, until the drug is exhausted. Recover the greater part of the ether from the percolate by distillation on a water-bath, and having transferred the residue to a capsule, allow the remaining ether to evaporate spontaneously. Now pour off the liquid portion, transfer the remainder to a strainer, and when the separated fatty matter (which is to be rejected) has been completely drained, mix the liquid portions together. Keep the oleoresin in a well-stoppered bottle.—*U. S.*

It is a dark brown-red rather thick liquid, separating on standing a granular deposit of fat, which mechanically encloses a portion of the oleoresin, that may be recovered by washing several times with small quantities of ether. Instead of draining the fat, we prefer to decant the clear oleoresin and wash the remainder as stated. The yield is about 5 per cent., but as much as 10 or 12 per cent. has been obtained. The oleoresin has little odor, but possesses an extremely hot and fiery taste.

Action and Uses.—This preparation appears to be nearly superfluous as an internal medicine, since all the virtues it can exert in that manner are sufficiently exhibited by capsicum. It is occasionally added to liniments to increase their rubefacient action, but is more beneficially incorporated in plasters, such as soap or lead plaster, for a similar purpose. The *dose* may be stated at Gm. 0.06 (ɱj), well diluted.

OLEORESINA CUBEBÆ, *U. S., Br.*—Oleoresin of Cubeb.

Extractum cubebarum, P. G.; *Extractum cubebæ æthereum.—Oléorésine de cubébe*, Fr.; *Kubebenextrakt*, G.

Preparation.—Cubeb, in No. 30 powder, 500 Gm.; Ether, a sufficient quantity. Put the cubeb into a cylindrical glass percolator, provided with a stopcock, and arranged with cover and receptacle suitable for volatile liquids. Press the drug firmly, and percolate slowly with ether, added in successive portions, until the drug is exhausted. Recover the greater part of the ether from the percolate by distillation on a water-bath, and, having

transferred the residue to a capsule, allow the remaining ether to evaporate spontaneously. Keep the product in a well-stoppered bottle.

NOTE.—Oleoresin of cubeb deposits, after standing for some time, a waxy and crystalline matter, which should be rejected, only the liquid portion being used.—*U. S.*

The formula of *Br.* is practically identical with this.

The German Pharmacopœia has a similar preparation, made, however, by extracting the cubebs with a mixture of equal weights of ether and alcohol; it probably contains less volatile oil, a portion of which must volatilize with the last portions of alcohol. The oleoresin, as prepared by the above formula, is of a brown-green, or sometimes of a grass-green, color, the difference being due to the presence of more or less chlorophyll. On standing it deposits some waxy matter and cubebin, which are removed by decantation. The remaining liquid, amounting to between 18 and 25 per cent. of the cubebs used, consists mainly of fixed and volatile oils, the active resins, and chlorophyll. An alcoholic ether dissolves more brown coloring matter.

Action and Uses.—Investigations for the purpose of discovering upon which of the constituents of cubeb its medicinal value depends have not reached a perfectly definite conclusion, but it may be considered that its most active element is the soft resin, which, when taken in doses of from Gm. 4.60–6 (gr. lxx–xc), produces a lively sensation of heat in the stomach, increases the urine, and renders it hot and irritating. In the dose of Gm. 10 (gr. cl) it occasions also eructation, flatulence, a pervading sense of warmth, and some quickening of the pulse. The *dose* of the oleoresin is stated to be Gm. 0.30–2 (♏ v–xxx), which may be given on sugar or preferably enclosed in gelatin capsules.

OLEORESINA LUPULINI, *U. S.*—OLEORESIN OF LUPULIN.

Oleoresina lupulinæ, Extractum lupulini æthereum—Oléorésine de lupuline, Fr.; *Ätherisches Lupulinextrakt*, G.

Preparation.—Lupulin, 100 Gm.; Ether, a sufficient quantity. Put the lupulin into a cylindrical glass percolator, provided with a stopcock, and arranged with cover and receptacle suitable for volatile liquids. Press the drug *very lightly*, and percolate slowly with ether, added in successive portions, until the drug is exhausted. Recover the greater part of the ether from the percolate by distillation on a water-bath, and, having transferred the residue to a capsule, allow the remaining ether to evaporate spontaneously. Keep the oleoresin in a well-stoppered bottle.—*U. S.*

The yield is variable, often amounting to 50 or 60 per cent. It is of a dark reddish-brown color and semi-fluid in consistence, and has the odor and taste of the drug.

Action and Uses.—This preparation probably contains all the medicinal virtues of hop. It is, however, seldom used. It may be prescribed in *doses* of Gm. 0.10–0.60 (gr. ij–x), or more, in pill or capsule.

OLEORESINA PIPERIS, *U. S.*—OLEORESIN OF PEPPER.

Oléorésin de poivre noir, Fr.; *Ätherisches Pfefferextrakt*, G.

Preparation.—Pepper, in No. 60 powder, 500 Gm.; Ether, a sufficient quantity. Put the pepper into a cylindrical glass percolator, provided with a stopcock, and arranged with a cover and receptacle for volatile liquids. Press the drug firmly, and percolate slowly with ether, added in successive portions, until the drug is exhausted. Recover the greater part of the ether from the percolate by evaporation on a water-bath, and, having transferred the residue to a capsule, set this aside until the remaining ether has evaporated, and the deposition of crystals of piperin has ceased. Lastly, separate the oleoresin from the piperin by expression through a muslin strainer. Keep the oleoresin in a well-stoppered bottle.—*U. S.*

The official process yields from 5 to 6.5 per cent. of a greenish-black oleoresin, consisting of a mixture of volatile and fixed oil holding the pungent resin and some piperin in solution. It is an official substitute for the so-called *oil of black pepper*, which is obtained as a by-product in the manufacture of piperin, and has essentially the same composition, except that the volatile oil is present in small quantities only.

Action and Uses.—The medical uses of this oleoresin are probably few and unimportant, since it contains but a small proportion of piperine, which is of some value as a medicine. Its *dose* is Gm. 0.05–010 (♏ j–ij).

OLEORESINA ZINGIBERIS, *U. S.*—Oleoresin of Ginger.

Extractum zingiberis æthereum.—Oléorésine (Piperoïde) de gingembre, Fr.; *Zingiberin, Ätherisches Ingwerextrakt*, G.

Preparation.—Ginger, in No. 60 powder, 500 Gm.; Ether, a sufficient quantity. Put the ginger into a cylindrical glass percolator, provided with a stopcock, and arranged with cover and receptacle suitable for volatile liquids. Press the drug firmly, and percolate slowly with ether, added in successive portions, until the drug is exhausted. Recover the greater part of the ether from the percolate by distillation on a water-bath, and having transferred the residue to a capsule, allow the remaining ether to evaporate spontaneously. Keep the oleoresin in a well-stoppered bottle.—*U. S.*

Coated ginger yields between 8 and 10 per cent., and the uncoated (Jamaica) ginger between 5 and 7 per cent. of oleoresin, which, as prepared from the latter, is lighter in color, rather more limpid, and perhaps more agreeable in flavor. The appellation *piperoid* originated with Beral. Using acetone as a solvent, nearly 10 per cent. of oleoresin has been obtained, which was completely soluble in alcohol, ether, and chloroform.

Uses.—This oleoresin may possibly fulfil some useful purpose for which ginger in substance and its tincture are inadequate. It is, in fact, only a concentrated ethereal solution. The *dose* is Gm. 0.06 (♏j), largely diluted.

OLEUM ADIPIS, *U. S.*—Lard Oil.

Huile de graisse, Fr.; *Schmalzöl, Speeköl*, G.

A fixed oil expressed from lard at a low temperature.

Preparation.—Lard, enclosed in strong canvas bags, is kept for some time near the freezing-point of water, and then subjected to a gradually-increased pressure. About 60 or 62 per cent. of oil is obtained.

Properties and Tests.—Lard oil is a colorless or pale yellow, oily liquid, having a slightly fatty odor, a bland taste, and showing at 15° C. (59° F.), the specific gravity of 0.910 to 0.920. At a temperature a little below 10° C. (50° F.) it usually commences to separate a white granular fat, and at or near 0° C. (32° F.) it forms a solid, white mass. When it is brought in contact with concentrated sulphuric acid a dark reddish-brown color is instantly produced. If 5 Cc. of the oil be thoroughly shaken, in a test-tube, with 5 Cc. of an acidulated, 1 per cent. alcoholic solution of silver nitrate (made by dissolving 1 Gm. of silver nitrate in 100 Cc. of deodorized alcohol, and adding 0.5 Cc. of nitric acid), and the mixture heated for about five minutes in a water-bath, the oil should remain nearly or quite colorless, not acquiring a reddish or brown color, nor should any dark color be produced at the line of contact of the two liquids (absence of more than about 5 per cent. of cotton-seed oil). If 5 Cc. of the oil, contained in a small flask, be mixed with a solution of 2 Gm. of potassium hydroxide in 2 Cc. of water, then 5 Cc. of alcohol added, and the mixture heated for about five minutes on a water-bath, with occasional agitation, a perfectly clear and complete solution should result, which, after dilution with water to the volume of 50 Cc., should form a transparent, light yellow liquid, without the separation of any oily layer (absence of appreciable quantities of paraffin oils).—*U. S.*

Composition.—It consists mainly of olein, with variable quantities of palmitin and stearin.

OLEUM ÆTHEREUM, *U. S.*—Ethereal Oil.

A volatile liquid consisting of equal volumes of heavy oil of wine and ether.—*U. S.*

Heavy oil of wine is a complex mixture of ethyl sulphate, $(C_2H_5)_2SO_4$, and varying proportions of certain polymeric hydrocarbons (etherin and etherol), and no definite chemical formula can therefore be accepted for the same.

Preparation.—Alcohol, 1000 Cc.; Sulphuric Acid, 1000 Cc.; Distilled Water, 25 Cc.; Ether, a sufficient quantity. Add the acid slowly to the alcohol, mix them thoroughly, and allow the mixture to stand, in a closed flask, for twenty-four hours; then pour the clear liquid into a tubulated retort of such capacity that the mixture shall nearly fill it. Insert a thermometer through the tubulure, so that the bulb shall be deeply immersed in the liquid, and, having connected the retort with a well-cooled condenser, and also having connected with the receiver a bent glass tube for conducting the uncondensed gases into water, distil, by means of a sand-bath, at a temperature between

150° and 160° C. (302° and 320° F.), until the liquid ceases to come over or until a black froth begins to rise in the retort. Separate the yellow, ethereal liquid from the distillate, and expose it to the air for twenty-four hours in a shallow capsule. Then transfer it to a wet filter, and, when the watery portion has drained off, wash the oil which is left on the filter with the distilled water, which should be as cold as possible. When this also has drained off, transfer the oil to a graduated measure, and add to it an equal volume of ether.—*U. S.*

The reaction upon each other of alcohol and sulphuric acid in the production of ether is explained under ÆTHER, page 129, sulphovinic acid, $HC_2H_5SO_4$, being first formed.

When this acid is heated with a further supply of alcohol, ether distils over; if water instead of alcohol be added and then heat applied, alcohol distils over and sulphuric acid is set free; on heating the sulphovinic acid by itself, gas is copiously given off, consisting chiefly of *ethylene* (*æthene*, *elayl*, *olefiant gas*), C_2H_4, sulphuric acid being regenerated; $HC_2H_5SO_4$ yields C_2H_4 and H_2SO_4, while the free sulphuric acid determines further decomposition, the mass becomes charred, and carbonic and sulphur dioxides are met with among the gaseous products. On heating sulphuric acid to about 150° C. (302° F.) and adding slowly sulphovinic acid, heavy oil of wine is produced, besides other gaseous compounds and carbonaceous matter.

Instead of operating with pure sulphovinic acid, alcohol and sulphuric acid may be allowed to react upon each other, whereby the products must necessarily be still more complicated, owing to the presence of uncombined alcohol and sulphuric acid, together with water and sulphovinic acid, which have resulted from the reaction of the two former; in all cases the temperature to which such mixtures are heated exerts an important influence, determining, as it rises, further decomposition. On keeping sulphuric acid at a temperature of 160° C. (320° F.) and passing the vapors of absolute alcohol into it, Lose obtained ethylene, sulphurous acid, water, and heavy oil of wine, while the retort contained sulphuric, isæthionic, and thiomelanic acids; but on previously diluting the acid with water to the amount of 30 per cent. and using 80 per cent. alcohol, Mitscherlich obtained in the distillate only water and ethylene, with traces of alcohol and ether. The carbonaceous mass mentioned before has been named *thiomelanic acid;* it is a black, rather dense, glossy mass, forming with bases insoluble compounds, and having a complex composition, approaching the empirical formula $C_{28}H_{16}SO_7$. *Isæthionic acid*, $C_2H_5HSO_4$, is syrupy, and isomeric with sulphovinic acid.

The production of heavy oil of wine evidently depends upon the absence of water and the generation of sulphurous acid, the latter being accompanied by the production of thiomelanic acid. An excess of sulphuric acid is required for this purpose, and this is directed in the above formula, the quantity of acid being about four times greater than is theoretically necessary for the production of sulphovinic acid. On mixing the acid and alcohol a turbidity is seen, and subsequently a white precipitation takes place, consisting of lead sulphate, which was dissolved in the sulphuric acid; this should be removed to avoid the concussions, which would endanger the safety of the retort. When distillation begins, ether and water come over, which are followed by sulphur dioxide gas, ethylene, and heavy oil of wine, and the distillate finally consists of an aqueous solution of sulphurous acid and a yellowish ethereal solution of the oil. The gaseous acid should be conducted into the open air or may be utilized for the preparation of sulphites. By exposing the ethereal portion of the distillate to the air, the ether evaporates, leaving the oil contaminated with some acid watery liquid, which is removed by draining upon a wet filter and washing, after which the oil is measured and dissolved in an equal volume of ether. This has been found necessary to avoid the spontaneous decomposition and separation into two liquids which would otherwise take place.

The process now official is essentially that devised by Squibb (1858), with some modifications suggested by C. L. Diehl (1864). The proper management of the heat influences the yield very considerably; to reduce the formation of ether to its smallest quantity, the mixture should be rapidly heated to near the lowest temperature mentioned in the directions (302° F.), and should never be permitted to fall much below it; if it should arise above 160° C. (320° F.), there is great danger of foaming to such to such an extent that the mixture will run over and the charge be lost. Diehl found it of advantage to let the temperature rise to 157° or 158° C. (314.6° or 316.4° F.), then to dampen the fire and allow the distillation to proceed spontaneously until the temperature is reduced to 150° C., when heat is again cautiously applied as before, and then heating repeated four or five times until the charge is nearly exhausted, which requires from 10 to 12 hours when working with 5 to 7 gallons of the mixture. The attention required for smaller

quantities is nearly the same. With good management the yield varies between about 1.6 and 2.3 per cent., and averages about 2 per cent. of the weight of the alcohol employed. (See also a paper in *Amer. Jour. Phar.*, 1865, p. 100.)

Properties.—Pure heavy oil of wine is a yellowish, thickish, oily liquid of a peculiar aromatic odor and pungent, refreshing, bitterish taste somewhat like that of mint. It is neutral to dry paper, and has the specific gravity 1.129, or, according to Serullas, 1.133, when quite pure. It is very slightly soluble in water, but dissolves readily in alcohol and ether. On being kept for some time crystals of *etherin* are separated, which have the same elementary composition as ethylene, are nearly tasteless, and on warming have an odor similar to that of oil of wine; the crystals have the spec. grav. 0.98, melt at 110° C. (230° F.), and distil at 260° C. (500° F.) without leaving any residue. In contact with cold water the oil of wine is slowly, with warm water rapidly, decomposed into sulphovinic acid and light oil of wine containing etherin in solution. This light *oil of wine*, or *etherol*, has likewise the elementary composition of ethylene, but its formula is probably C_8H_{16}; it is yellowish, of a peculiar odor, specific gravity 0.921, insoluble in water, soluble in alcohol. It boils at 280° C. (536° F.), is tough like turpentine at —25° C. (—13° F.), and solid at —35° C. (—31° F.).

Diluted with ether, as directed by the Pharmacopœia, oil of wine is a pale-yellowish, nearly colorless liquid of an ethereal and aromatic odor, besides that peculiar to the pure oil, and of a pungent and refreshing taste. At 15° C. (59° F.) its spec. grav. is 0.910.

Composition.—The analyses of Serullas, Liebig, and others lead to the empirical formula $C_8H_{18}S_2O_7$. Serullas regarded heavy oil of wine as the double sulphate of ethyl and ethylene; Liebig, as ethylsulphate (sulphovinate) of etherol: the latter view appears to be the more correct one if the decomposition with water is taken into consideration. Alkalies also decompose it into sulphovinate of the alkali, liberating etherol. Or it may be related to *sulphuric ether* or *ethyl sulphate*, discovered by Wetherill (1848), which is a yellowish oil of the specific gravity 1.120, has a peppermint-like odor and pungent taste, and the composition of which is expressed by the formula $(C_2H_5)_2SO_4$. *Sulphurous ether* or *ethylsulphite*, $(C_2H_5)_2SO_3$, which was discovered by Ebelmen and Bouquet (1845), has the spec. grav. 1.17 at 0°, boils at 208° C. (406.4° F.), and is decomposed by potassa into potassium sulphite and alcohol.

E. C. Hartwig (1881) examined the oily liquid which may be obtained by distilling the acid residue left in the distillation of ether. This oil has been sold as oil of wine, but is totally different from both the heavy and light oils of wine mentioned above, and consists of hydrocarbons, ethers, and ketones, among them *ethylamylic ether*, $C_2H_5.C_5H_{11}O$, which boils at 112° C. (233.6° F.); *diisoamylene*, $C_{10}H_{20}$, boiling at 157° C.; *ethylamyl ketone*, $C_2H_5.C_5H_{11}.CO$, boiling near 155° C. (311° F.); and several others having a higher boiling-point.

Uses.—Ethereal oil is used in medicine only as an ingredient of the compound spirit of ether.

OLEUM AMYGDALÆ AMARÆ, *U. S.*—Oil of Bitter Almond.

Oleum amygdalarum (amararum) æthereum.—Essence d' amandes amères, Fr.; *Bittermandelöl*, G.

The volatile oil obtained from the seeds of Amygdalus communis, var. amara, *Linné*. *Nat. Ord.*—Rosaceæ, Amygdaleæ (see page 193).

Preparation.—Bitter almonds are deprived of most of their fixed oil by pressure between warm plates; the press-cake is powdered, mixed with about six times its weight of water, the mixture digested for a day or two at a temperature of about 50° C. (122° F.), and then distilled.

The oil does not pre-exist in the almonds, but is produced through the decomposition of amygdalin by emulsin, hydrocyanic acid and sugar being at the same time formed; $C_{20}H_{27}NO_{11}$ (amygdalin) and $2H_2O$ yield $C_{12}H_{24}O_{12}$ (glucose), C_7H_6O (oil of bitter almond), and HCN (hydrocyanic acid). This decomposition must first be effected before distillation is resorted to; but while digesting the mixture too high a heat must be avoided, which would coagulate the emulsin and render it ineffective. Distillation by superheated steam is preferable to the use of the naked fire, in order to avoid empyreuma. The water from which the volatile oil has been separated still retains notable quantities of it in solution, which may be recovered by fractional distillation. To avoid the troublesome concussions during distillation, and to bring all the amygdalin under the influence of emulsin, Michael Pettenkofer (1861) recommends the exhaustion of the greater portion

of the bitter-almond cake with boiling water, whereby the albuminoids are coagulated and the amygdalin is dissolved from the softened tissue; one-twelfth of the press-cake, unboiled, is then added to the cold mixture, and after sufficient maceration distillation is proceeded with. The yield varies considerably, but is usually over 1 per cent., and occasionally reaches 3 per cent. The importation of the oil into the United States amounted to 1602 pounds in 1877, and to 4093 pounds in 1883.

Properties.—Oil of bitter almond is colorless or yellowish, limpid, and strongly refractive, has a peculiar aromatic odor, resembling that of hydrocyanic acid, and a bitter and burning taste. Freshly prepared, it has in alcoholic solution a neutral reaction to test-paper, but old oil changes the color of blue litmus to red. It varies in spec. grav. between 1.06 and 1.075, and boils at about 180° C. (356° F.). When freed from hydrocyanic acid and rectified, its spec. grav. is lowered to 1.043 or 1.049, but it retains the aromatic almond odor. It is soluble in 300 parts of water at 15° C. (59° F.), and in all proportions of alcohol and ether. It also dissolves without change of composition in *cold* nitric or sulphuric acid, but with fuming or with warm nitric acid it is first converted into crystallizable nitrobenzaldehyde, and finally into benzoic acid, red nitrous vapors being evolved. With concentrated sulphuric acid bitter-almond oil turns deep-red, and on warming black, with evolution of carbonic acid gas. On being agitated with an aqueous solution of potassium bisulphite a crystalline compound is formed.

Composition.—Pure oil of bitter almond was formerly regarded as the hydride of the radical benzoyl (C_7H_5O), but in its chemical relation it is the aldehyde of *benzalcohol*, C_7H_8O, which was discovered by Cannizaro (1853), is a colorless, faintly aromatic oil, and by careful oxidation yields *benzaldehyde* or bitter-almond oil, C_7H_6O, and this, by further oxidation on exposure to the air or by means of oxidizing agents, is converted into benzoic acid, $C_7H_6O_2$. It is this latter compound which crystallizes from old oil of bitter almonds.

Pure benzaldehyde (*artificial oil of bitter almond*) is now largely made in Europe from *toluene*, C_7H_8, a liquid hydrocarbon contained among the products of the destructive distillation of coal.

The crude oil contains variable quantities of *benzimid*, *benzoin*, and *hydrocyanic acid*, from the latter of which it may be freed by agitation with mercuric oxide, or, preferably, ferrous hydroxide (a mixture of lime with solution of ferrous sulphate), and subsequent distillation. Potassa and other alkalies may likewise be employed, but an excess is apt to decompose the oil with the production of benzoic acid and benzalcohol. According to Volkel, hydrocyanic acid is contained in the crude oil in the form of a compound, $C_7H_6O.HNC$, which is a yellowish, nearly inodorous, bitter oil of spec. grav. 1.124, and boiling at 170° C. (338° F.). *Benzimid* has the composition $2C_7H_6O.C_7H_6(CN)_2$, and forms in the pure state colorless, pearly, inodorous crystals, which on being boiled with water and hydrochloric acid are decomposed into oil of bitter almond, formic acid, and ammonia. *Benzoin*, $C_{14}H_{12}O_2$, crystallizes in inodorous and tasteless, colorless prisms which are polymeric with oil of bitter almond, and are converted into the latter by passing their vapor through a red-hot tube.

Adulterations.—The principal adulterations are nitrobenzene, alcohol, and chloroform, the last two being sometimes used together to leave the specific gravity unchanged. By distilling a little of the suspected oil from a test-tube placed in a water-bath kept at a temperature not exceeding 65° C. (149° F.), the chloroform will distil over, while alcohol will distil at about 80° C. (176° F.), the distillates showing the behavior of these compounds. On dropping oil of bitter almond containing alcohol into water, the drops, while floating or subsiding in the water, will become milk-white. *Nitrobenzene* (see NITROBENZENUM) has an odor similar to that of bitter-almond oil and a sweet taste, and is nearly insoluble in water. We found it convenient (1857) to test for it by dissolving 15 grains of the oil in 2 drachms of alcohol, adding 15 grains of caustic potassa, heating for a few minutes, evaporating to one-third, and cooling. The pure oil will leave a brownish-yellow liquid, soluble in water, with but slight turbidity; while if nitrobenzene be present the residue will be dark-brown, sometimes crystalline, and not dissolve clear in water, depositing a brown-yellow sediment in proportion to the amount of the adulterant. The test depends upon the conversion of nitrobenzene, $C_6H_5NO_2$, into *azoxybenzid*, $C_{12}H_{10}N_2O$, which dissolves in alcohol and ether, but is insoluble in water. Wagner (1866) proposed to agitate 5 Cc. of the suspected oil with 10 Cc. of solution of sodium bisulphite spec. grav. 1.225, and dilute with water to 50 Cc. in a graduated tube; pure bitter-almond oil will dissolve, while the nitrobenzene (spec. grav. 1.20) will separate as an oily layer. More delicate tests for this substance depend upon its reduction to *aniline*. According

to Hoffmann (1845), the oil is diluted with ether and some alcohol, after which some zinc and hydrochloric acid are added; after the evolution of hydrogen has ceased the ethereal layer is evaporated spontaneously, and the residue mixed with a few drops of solution of chlorinated lime, when a purplish-blue color will be produced. Jacquemin (1876) recommended adding a few drops of the oil to a solution of stannous chloride in caustic soda, and afterward a drop of carbolic acid and some solution of chlorinated soda, when the blue color of sodium erythrophenate will appear. Boyveau (1879) noticed an adulteration with a substance of undetermined origin, which gives with an equal volume of sulphuric acid a red mixture, changing to brown, turbid, becoming thick, and in a few days solidifying, while a similar mixture with pure bitter-almond oil darkens in color, but remains liquid and clear.

Tests.—"If 10 drops of the oil, dissolved in a little alcohol, be shaken with a few drops of a strong solution of sodium hydroxide, then with a little ferrous sulphate test-solution, and finally mixed with a slight excess of hydrochloric acid, a blue precipitate will be produced (presence of hydrocyanic acid.) If a small strip of filter-paper, folded in the form of a taper, be saturated with the oil, and placed in a small porcelain capsule resting within a larger porcelain plate or dish, and, after the taper is ignited, there be immediately inverted over the capsule a large beaker, the inner surface of which is moistened with distilled water, the products of combustion will be absorbed by the latter. If the beaker be now rinsed with a little distilled water and the liquid filtered, the filtrate should yield no turbidity with silver nitrate test-solution (absence of artificial oil, containing chlorinated products). If 5 Cc. of the oil be vigorously shaken, in a flask, with 50 Cc. of a cold, saturated solution of sodium bisulphite, and the mixture heated for a few minutes on a water-bath, the odor of the oil should disappear, and a nearly clear solution result, without the separation of any oily drops on the surface of the liquid (absence of most other volatile oils and of nitro-benzene).—*U. S.*

Pharmaceutical Preparations.—Iodinized oil of bitter almonds was proposed by Dr. Blackwell (1878). It is prepared by leaving in contact for two or three months 1 part of iodine and 2 parts of oil of bitter almond, and dissolves easily in alcohol, ether, glycerin, fats, etc. It probably contains *benzoyl iodide*, C_7H_5OI, which was discovered by Liebig and Wöhler (1832), and when pure crystallizes in colorless fusible laminæ having a somewhat pungent aromatic odor.

Action and Uses.—Oil of bitter almond exceeds diluted hydrocyanic acid in its poisonous power, since 100 parts of the oil contain nearly 13 parts of anhydrous hydrocyanic acid, while the diluted acid contains but 2 per cent. of the latter compound. 1 drop of the anhydrous oil has been known to kill a cat. In man grave and even fatal effects have resulted from a dose of 17 drops, but on the other hand, recovery has taken place after the swallowing of ½ ounce or more when remedial measures were at once applied. Medicinally, it is one of the best forms in which hydrocyanic acid can be administered, owing to its comparatively stable composition. The proper occasions for its use are indicated under Hydrocyanic Acid. It may be prescribed in doses Gm. 0.015–0.05 (gtt. ¼–j.)

OLEUM AMYGDALÆ EXPRESSUM, *U. S.*—Almond Oil.

Oleum amygdalæ, Br.; *Ol. amygdalarum*, P. G.; *Ol. amygdalæ dulcis.—Expressed (sweet) oil of almond*, E.; *Huile d'amande (douce)*, Fr.; *Mandelöl, Süssmandelöl*, G.

The fixed oil expressed from the seed of Amygdalus communis, var. amara or dulcis, *Linné*.

Nat. Ord.—Rosaceæ, Amygdaleæ (see page 193).

Preparation.—Almond oil is made both from sweet and bitter almonds. To obtain an unobjectionable oil, the almonds are freed from adhering dust by agitating them upon a sieve and removing discolored pieces, after which they are ground or well bruised in an iron or stone mortar, enclosed in canvas bags, and subjected to considerable pressure between polished steel plates, which should not be heated beyond about 30° C. (86° F.). The oily edges of the press-cake may be powdered and again expressed, when an additional quantity of oil will be obtained. The yield is 40 to 45 per cent. from sweet, and 35 to 38 per cent. from bitter, almonds; a little more when a hydraulic press is used. Expressing the residue at a higher temperature will yield more oil, which, however, is of inferior quality. The expressed turbid oil is set aside in a cool place, and then decanted from the sediment, which may be filtered.

Properties.—The oil is nearly colorless or of a pale straw color, almost inodorous,

and has a bland slightly nutty taste. It is a thin oily fluid, remaining clear at—10° C. (18° F.), and not congealing until cooled to about—20° C. (—4° F.); its specific gravity is 0.915 to 0.920 at 15° C. (59° F.); exposed to air, it readily turns rancid, acquiring an acrid odor and taste, dissolving in all proportions in pure ether, chloroform, benzin, fixed oils, etc., and only sparingly in alcohol; it is not a drying oil. Alcohol on being agitated with the oil dissolves most of the coloring matter of the latter, together with a small proportion of the oil.

Composition.—It consists mainly of olein, with a minute quantity of palmitin. (See OLEUM OLIVÆ.)

Tests.—"If 2 Cc. of the oil be vigorously shaken with 1 Cc. of fuming nitric acid and 1 Cc. of water, a whitish not red or brownish mixture should be produced, which, after standing for some hours at about 10° C. (50° F.), should separate into a solid, white mass, and a scarcely colored liquid (distinction from the fixed oils of apricot- and peach-kernels and from sesamum, cotton-seed, and poppy-seed oils). If 10 Cc. of the oil be mixed with 15 Cc. of a 15 per cent. solution of sodium hydroxide and 10 Cc. of alcohol, the mixture allowed to stand at a temperature of 35° to 40° C. (95° to 104° F.), with occasional agitation, until it becomes clear, and then diluted with 100 Cc. of water, the clear solution thus obtained, upon the subsequent addition of an excess of hydrochloric acid, will separate a layer of oleic acid. This, when separated from the aqueous liquid, washed with warm water, and clarified in a warm-bath, will remain liquid at 15° C. (59° F.), although sometimes separating particles of solid matter and becoming turbid. 1 part of this oleic acid, when mixed with 1 volume of alcohol, should afford a clear solution, which, at 15° C. (59° F.), should separate no fatty acids, and which should not become turbid on the further addition of 1 volume of alcohol (distinction from olive, arachis, cotton-seed, sesamum, and other fixed oils)."—*U. S.*

Allied Drug.—TERMINALIA CATAPPA, *Linné*, has an almond-like edible seed, yielding by expression a bland fixed oil which does not readily turn rancid. At 5° C. (41° F.) it begins to separate stearin.

Action and Uses.—The expressed oil of almond is a singularly bland and agreeable oil and very useful as a demulcent. It was formerly used to allay *cough* and all irritations of the respiratory passages. It may be prescribed in doses of Gm. 4–16 (f℥ix) in an emulsion made with mucilage or yelk of egg and white sugar.

OLEUM ANETHI, *Br.*—OIL OF DILL.

Essence d'aneth, Fr.; *Dillöl*, G.

Preparation.—The volatile oil is obtained from the fruit of Anethum graveolens, *Linné* (nat. ord. Umbelliferæ), by distillation with water. The yield is about 3 to 5 per cent.

Properties.—Oil of dill has a pale-yellow color, gradually changing to reddish-brown, the peculiar aromatic odor of the fruit, and a sweetish and warm afterward pungent taste. Its specific gravity varies between .85 and .89, and its rotating power is about 206° to the right. It dissolves iodine with the evolution of some vapors, and is colored red-brown by sulphuric acid.

Composition.—The oil contains a hydrocarbon, *anethene*, $C_{10}H_{16}$, which has an odor resembling that of lemon, and an oxygenated portion which, according to Gladstone (1872), is isomeric with the *carvol* of oil of caraway. This carvol is obtained by treating the oil with alcoholic solution of ammonium sulphide and decomposing the crystalline compound with an alkali. Both fractions are dextrogyre. According to Nietzki (1874), the oxygenated oil is identical with carvol, and amounts to about 30 per cent., while the terpene consists of two compounds—one boiling between 155° and 160° C. (311° and 320° F.), and having the odor of turpentine: it amounts to about 10 per cent. of the oil; the remaining fraction of 60 per cent. boils between 170° and 175° C. (338° and 347° F.), has a mace-like odor, and acquires the characteristic dill odor on the addition of a little carvol.

Uses.—Oil of dill is very seldom used in this country; like anise oil, etc., it may be employed to relieve flatulent *colic* and externally as an anodyne. *Dose*, Gm. 0.10–0.30 (gtt. ii–v), in hot water and sugar.

OLEUM ANIMALE ÆTHEREUM.—Animal Oil.

Oleum animale Dippelii.—Dippel's animal oil, E.; *Huile animale de Dippel*, Fr.; *Ätherisches Thieröl*, G.

Preparation.—On the dry distillation of bones and other animal substances a fetid, brown, thick, oily liquid is obtained, known as *bone oil, crude*, or *fetid animal oil.* This is purified for medicinal use by distilling it in a retort or flask, which is heated by a sand-bath, as long as a thin oil passes over. This is then mixed with four times its weight of water, and rectified in a metallic still as long as the distillate is colorless or but slightly yellow. The oily liquid is separated from the water, and at once put into small vials, well corked and preserved in a dark place. Though previously known and medicinally employed, it was first prepared from dried blood by J. C. Dippel in 1711.

Properties.—*Rectified animal oil* is a colorless or yellowish, thin, oily liquid which has the average spec. grav. 0.80. It has a very penetrating empyreumatic and ethereal but not a fetid odor, and a pungent, acrid, afterward cooling and bitter taste. It has a slight alkaline reaction to test-paper, dissolves in about 80 parts of water, and is readily soluble in alcohol, ether, and fixed and volatile oils. Exposed to light and air, it rapidly darkens in color and acquires a thicker consistence.

Constituents.—This is a very complex mixture, containing a large number of volatile bases like *pyrrol*, C_4H_5N, *pyridine*, C_5H_5N, *picoline*, C_5H_7O, *lutidine*, C_7H_9N, *collidine*, $C_8H_{11}N$; also methylamine, propylamine, butylamine, and others. It contains also a neutral liquid which boils at 65.5° C. (150° F.), and different hydrocarbons.

Pyridine, C_5H_5N, a colorless liquid base obtained from crude bone-oil by treatment with sulphuric acid and subsequent decomposition with soda; the mixture of liberated bases is subjected to fractional distillation, and the distillate, freed from aniline by means of oxidizing agents is again fractionated. It has been prepared synthetically by action of phosphorus pentoxide on amyl nitrate, reduction of azoamidonaphtalene in alcoholic solution by means of stannous chloride, and also by union of hydrocyanic acid and acetylene. Pyridine when pure has a peculiar sharp empyreumatic taste, at 15° C. (59° F.) the specific gravity 0.980, and boils at 117° C. (242.6° F.). It is readily miscible with water, alcohol, ether, and fixed oils in all proportions, and forms salts with acids. Its chief use medicinally has been in the treatment of asthmatic affections, where it appears to have exerted a palliative action when administered by inhalation.

Pyridine should not be confounded with *Pyrodin*, the name given to an impure hydracetin, a coal-tar derivative, which occurs in form of a white powder, and for which antipyretic properties have been claimed.

Action and Uses.—Given to man in medicinal doses, it excites a sense of warmth in the abdomen, renders the pulse stronger and more frequent and increases the sweat and urine. A tablespoonful of it (Gm. 16), is said to have killed a man almost instantaneously, and 1½ ounces (Gm. 48), taken by a woman with suicidal intent, caused violent vomiting and intense pain. After death the mouth and throat were dry and shrivelled and the stomach inflamed and ecchymosed (Werber, *Archiv d. Heilkunde*, xi. 544). Formerly, the oil was used in the *typhoid state* of febrile affections, in *hysteria*, *chorea*, *epilepsy*, *paralysis*, chronic *rheumatism*, and *sciatica*, and to expel *tape-worms.* Internally, it was prescribed in doses of from 5 to 10 drops, and from that to Gm. 0.30–2.60 (30 or 40 drops), mixed with powdered sugar or in sulphuric ether or Hoffmann's anodyne. Externally, it was applied by friction, pure or in liniments.

Formerly, a preparation known as Chabert's oil, and which was procured from a mixture of impure empyreumatic oil with oil of turpentine by distillation, was in high repute as a cure for *tape-worm.* Its offensive taste and smell and harsh action caused it to be laid aside when the various tæniacide medicines now in use began to be employed.

Pyridine.—According to Sée, the special virtue of pyridine lies in its power of obtunding the reflex sensibility, and he adds that this attribute does not belong in a like degree to nicotine or to atropine, from which pyridine is derived. But this peculiar soothing, tranquillizing, and, in excess, paralyzing, effect belongs to tobacco, and is the very cause of its universal use. Sée further states that when an *asthmatic* employs the inhalation of pyridine several times, the dry rhonchi in his lungs give place to moist râles, the breathing and expectoration grow freer, and the attacks less frequent and severe. Naturally, the purely nervous cases of asthma are the most distinctly benefited, although a palliation may be gained in others attended with chronic bronchial, and even by cardiac, lesions (*Bull. de Thérap.*, cviii. 529; cix. 304). De Renzi has

advocated its use in *heart-failure* and *angina pectoris* (*Med. Record*, xxxiv. 647). These conclusions have been more or less confirmed by Lublinski (*Centralbl. f. Ther.*, iii. 547), who, however, has called attention to certain symptoms occasionally induced by the medicine, such as nausea, vomiting, vertigo, headache, fainting, and oppression at the præcordia; also by Neff (*New York Med. Jour.*, Mar. 1886) and by Silva, who, besides the untoward effects just enumerated, mentions bitterness of the mouth, salivation, coryza, and roughness of the throat (*Med. Record*, xxxi. 383), and also by Kelemin (*Ther. Gaz.*, xl. 189), and Zerner (*Centralbl. f. Med.*, vii. 214). Lemaire points out that its poisonous effects resemble those of antipyrine, and include cyanosis, general coldness, sweating, and collapse (1888), and the discharge of dark-red or brown urine containing bile-acids and salts, renal tube-casts, lymph-cells, and red blood-corpuscles. (Compare Egasse, *Bull. de Thérap.*, cix. 359.) Dreschfeld in 1888 pronounced pyridine a powerful antipyretic which was easily administered, stimulated the skin, and occasioned neither nausea, vomiting, nor collapse, and possessing over antifebrin and antipyrine the advantage of not requiring such frequent administration; but he admitted it to be more poisonous than those preparations (*Med. News*, liv. 74). Its destructive action on the red blood-disks, the element of the blood most essential to life, was insisted on by Zerner (*Centralbl. f. Ther.*, vii. 141, 214), who rejected its use in typhoid fever, and regarded it as useless in all other acute febrile diseases and as an analgesic, and therefore unworthy of being retained as a medicine. To these conclusions Pashkis subscribed (*ibid.*, viii. 55).

Pyridine has sometimes been administered by allowing Gm. 4–5 (gr. lx–lxxv) to evaporate in a small room occupied by the patient. Dreschfeld stated the dose at Gm. 0.12–0.24 (gr. ij–iv) for children, and at Gm. 0.50–0.75 (gr. viij–xij) for adults; but Liebreich pointed out that this dosage applies only to impure pyridine, while of the pure article (acetalphenylhydracin) the *daily* dose should, for children, not exceed Gm. 0.03–0.06 (gr. ½–j), and for adults Gm. 0.12–0.18 (gr. ij–iij), (*Therap. Monatsh.*, iii. 23). He reckons the pure preparation to be four times stronger than the commercial pyridine.

Pyridine tricarboxylic acid is represented by Rademacher (*Therap. Gaz.*, xi. 486) as lowering temperature and heart-action without causing muscular debility, and also as an antizymotic. It is claimed to act better than quinine in *malarial diseases*, causing none of the nervous symptoms occasioned by that drug, and that it is singularly efficient in nervous *asthma*, preventing or arresting its paroxysms. These statements, made in 1887, have not been confirmed.

OLEUM ANISI, *U. S., Br.*—Oil of Anise.

Essence d'anis, Fr.; *Anisöl*, G.

The volatile oil distilled from the fruit of Pimpinella Anisum, *Linné* (nat. ord. Umbelliferæ; see p. 214.

Preparation.—The oil is obtained by distillation of the fruit with water. The yield from anise is 1½ to 2½ per cent.; from star-anise, 2½ to 4 per cent.

Properties.—The oil of anise is colorless or pale-yellow, becoming darker by age, and has a sweet aromatic taste and an agreeable aromatic odor. The spec. grav. is 0.98 to 0.99, rising in old oils sometimes to 1.028 (Zeller). At a low temperature the oils solidify into a crystallizing mass, the freezing-point of the true anise oil being usually near 10° C. (50° F.). It varies, however, very considerably, not only in oils as obtained from different material, but because it changes on keeping and becomes lower. The volatile oil distilled from anise-chaff (pedicels, unripe fruit, etc.) is said to contain more stearopten and to congeal at a higher temperature than the oil of the ripe fruit (Martius). The reactions of the oils of anise and of illicium are so similar that they do not afford any reliable means for distinguishing them, the congealing point of the latter being, however, at 2° C. (35° F.). Both oils are entirely neutral to test-paper, have a very slight right or left rotating power, are freely soluble in alcohol, and with strong alcohol form clear solutions in all proportions.

Composition.—Oil of anise contains a small quantity of a hydrocarbon having the composition $C_{10}H_{16}$, but consists mainly of *anethol*, $C_{10}H_{12}O$, sp. grav. 0.98; this exists in two modifications—one liquid, the other solid, at the ordinary temperature and fusing at about 20° C. (68° F.), and both boiling between 220° and 225° C. (428° and 437° F.); they are present also in oil of fennel, and a liquid modification in the oil of Artemisia Dracunculus, *Linné*, or *tarragon*, has the spec. grav. 0.945 and boils at 206° C. (402.8° F.). Anethol has a fainter but more agreeable odor than oil of anise. It is not altered on being boiled with potassa solution; chromic acid converts it into colorless, inodorous, and

nearly tasteless crystals of *anisic acid*, $C_8H_8O_3$; nitric acid yields the same compound, or anisoic, anisylic, and oxalic acids, according to its concentration and duration of action. Sulphuric acid colors it red, and water separates afterward inodorous *anisoin;* this is isomeric with anethol, like *metanethol* and *metanethol camphor*, which are produced under certain conditions. Landolph (1875) found Russian oil of anise to contain 90 per cent. of a mixture of anisic aldehyde and anise camphor, to which he gives the formula $C_{10}H_{16}O$.

Adulterations.—Oil of anise has been met with adulterated with alcohol, camphor, wax, and spermaceti, the last three for the purpose of raising its congealing-point. Anise oil adulterated with alcohol becomes milk-white on being dropped into water. Camphor is detected in the pressed crystalline mass by its odor, the other two by their insolubility in 80 per cent. of alcohol. Leonhardi (1878) reports the oil to be sometimes largely adulterated with the stearopten of Russian fennel oil, which is detected by the fennel odor developed on heating.

Tests.—Soluble in an equal volume of alcohol, affording a clear solution (absence of most fixed oils and of oil of turpentine). This solution is neutral to litmus-paper, and should not assume a blue or brownish color on the addition of a drop of ferric chloride test-solution (absence of some volatile oils containing phenols). When the oil is dropped into water without agitation, it should not produce a milky turbidity (absence of alcohol). 1 drop of anise oil, triturated with sugar and afterward agitated with 500 Gm. of water, should impart to the latter the pure flavor of anise (absence of other volatile oils).—*P. G.*

Pharmaceutical Preparations.—Liquor ammonii anisatus, *P. G.* Dissolve 1 part of oil of anise in 24 parts of alcohol, and add 5 parts of ammonia-water. The liquid is yellowish and clear.

Action and Uses.—Like other aromatic essential oils, when given to animals in large doses it occasions lethargy and insensibility. In medicinal doses it acts as a local and general stimulant, and is used to expel *flatus*, allay *colic*, and prevent the griping of drastic purgatives. It has also been employed in the treatment of *chronic bronchitis*, associated with ammonium carbonate or muriate. It may be prescribed in *doses* of Gm. 0.12–0.40 (gtt. ij–vj), on sugar or in emulsion.

OLEUM ANTHEMIDIS, *Br.*—Oil of Chamomile.

Oleum chamomillæ romanæ.—Essence de camomille romaine, Fr.; *Römischkamillenöl*, G.

Preparation.—The volatile oil is obtained from the flowers of Anthemis nobilis, *Linné* (nat. ord. Compositæ), by distillation with water. The yield is variable, between about $\frac{1}{3}$ and $\frac{1}{2}$ per cent.

Properties.—Fresh flowers seem to yield a blue-colored oil, while that obtained from dried flowers has a green or yellow color, or if blue changes rapidly to green and yellow. It has the odor of the flowers and a warm, aromatic taste; it imparts a red color to litmus-paper, and begins to boil at about 160° C. (320° F.), the boiling-point rising gradually to above 200° C. (392° F.). It is sometimes distilled from the entire plant, and has then a greenish color, which on exposure changes to yellow. Its specific gravity is .90.

Composition.—The oil does not combine with sodium bisulphite. Potassa decomposes it, and B. Jaffé (1865) separated in this way 58 per cent. of impure and 30 per cent. of pure angelicic acid. Demarçay (1875) arrived at the conclusion that it is a mixture of several compound ethers, among which the butylic and amylic angelates and valerianates preponderate. Koebig (1873) did not find valerianic acid, but besides angelate isolated isobutylate and tiglinate of anthemol and of a new hexyl ether; these ethers appear to be present in the fresh oil. Demarçay had noticed that under the influence of heat angelicic acid is converted into the isomeric tiglinic acid.

Action and Uses.—Oil of chamomile is stimulant and anti-spasmodic, and is used to allay *vomiting* and relieve flatulent *colic* and to modify the irritant action of cathartics in pill or mixture. It is sometimes added to liniments used for *sprains*, *rheumatic pains*, etc. *Dose*, Gm. 0.05–0.30 (gtt. i–v.).

OLEUM AURANTII CORTICIS, *U. S.*—Oil of Orange-Peel.

Oleum aurantiorum.—Essence d'orange, Fr.; *Pomeranzenschalenöl*, G.

A volatile oil obtained by expression from the fresh peel of either the bitter orange, Citrus vulgaris, *Risso*, or the sweet orange, Citrus aurantium, *Linné*.

Nat. Ord.—Rutaceæ.

Preparation.—The volatile oils of both the bitter and sweet orange-peel are articles of commerce, and both are prepared in the southern part of Europe by superficially rupturing the ripe fruit, so as to puncture only the oil glands imbedded under the yellow rind; or the fresh peel is forcibly twisted, which operation causes the glands to discharge the oil, this being collected first upon a sponge, and by wringing the same when saturated in a suitable bowl. A third method of preparing oil of orange-peel consists in superficially grating the fruit, so as to remove only a thin layer of the rind containing the oil-glands; the grated mass is then deprived of the greater part of the volatile oil by pressure, and the residue is sometimes distilled with water, whereby it yields a less fragrant volatile oil.

Properties.—The volatile oils of the two orange peels are distinguished as—

Oleum aurantii dulcis.—Oil of sweet orange-peel, *E.;* Essence d' orange douce, Essence de Portugal, *Fr.;* Apfelsinenöl, Portugalöl, *G.*

Oleum aurantii amari.—Oil of bitter orange-peel, *E.;* Essence de Bigarade, *Fr.;* Pomeranzenöl, *G.*

The first one is usually employed in making elixir of orange, but, though it differs from the latter somewhat in flavor and in being more readily altered by exposure to air, the two oils are alike in chemical composition and in all their essential properties. Oil of orange is of a pale or greenish-yellow color, limpid, its specific gravity is about 0.850 at 15° C., (59° F.), boils near 180° C. (356° F.), and rotates polarized light considerably to the right. It has a neutral reaction to test-paper, an agreeable orange odor, and an aromatic slightly bitter taste. It dissolves freely in absolute alcohol and in carbon disulphide, in an equal volume of acetic acid, and requires about 4 parts of alcohol and about 8 or 10 parts of alcohol spec. grav. 0.850 for solution; oil of sweet orange-peel dissolves more readily than the bitter variety. Powdered iodine acts energetically upon the fresh oil, producing orange-colored vapors. Sulphuric acid causes a deep-red or red-brown color. Nitric acid colors greenish-yellow, and on warming leaves a brown-yellow resin. Exposed to the air, oil of orange gradually becomes thicker and acquires a terebinthinate odor. This change is prevented, or at least considerably retarded, by adding to the oil 5 per cent. of strong alcohol, and decanting or filtering, if necessary, from the precipitate.

Test.—When kept for some time, the oil should not develop a terebinthinate odor or taste (absence of oil of turpentine or of other oils containing pinene).

Composition.—Oil of orange consists mainly of the hydrocarbon *hesperidene*, $C_{10}H_{16}$, and contains a small portion of an oxygenated body, $C_{10}H_{16}O$, boiling near 220° (428° F.). Hesperidene yields with hydrochloric acid gas a crystallizable compound having the composition $C_{10}H_{16}2HCl$. C. R. A. Wright (1874) obtained also a liquid compound with hydriodic acid, and by oxidation with nitric acid a slowly-crystallizing hexabasic acid, *hesperisic acid*, $C_{20}H_{26}O_{17}.2H_2O$, was produced. By combining hesperidene with bromine and distilling the compound, *cymene*, $C_{10}H_{14}$, passes over, identical with that contained in cumin oil and with that obtainable from camphor. Wright found also small proportions of a substance, $C_{40}H_{64}O_5$, boiling above 240° C. (464° F.), and of a non-volatile resin, $C_{20}H_{30}O_3$.

Action and Uses.—The essential oil of orange-peel is irritant and narcotic. Persons employed in manufacturing it suffer greatly from erythematous, papular, and vesicular eruptions of the skin, especially of the hands and face, and also from nausea, vomiting, and other dyspeptic symptoms, headache, neuralgia, and a sort of intoxication denoted by confusion of the mind and senses, and impaired muscular power. Oil of orange-peel is used almost exclusively as a flavoring or perfuming ingredient of medicinal compounds.

OLEUM AURANTII FLORUM, *U. S.*—Oil of Orange-Flowers.

Oleum florum naphæ, Oleum neroli, s. *naphæ.—Oil of neroli,* E.; *Essence de fleur d'oranger, Néroli,* Fr.; *Pomeranzenblüthenöl, Neroliöl,* G.

A volatile oil distilled from the fresh flowers of the bitter orange, Citrus vulgaris, *Risso.*

Nat. Ord.—Rutaceæ.

Preparation.—This volatile oil is obtained in the preparation of orange-flower water, upon the surface of which it separates in small proportion. It is manufactured chiefly in the southern part of France from the flowers of the bitter orange, which yields about 0.6 per cent. of oil. The flowers of the sweet orange and of allied plants are far less aromatic and have a more or less different odor.

Properties.—According to Flückiger and Hanbury, pure oil of neroli is of brownish hue, a bitterish aromatic taste, neutral to test-paper, and of the density of 0.889 at 11° C. (51.8° F.). It shows a bright violet fluorescence when mixed with alcohol, or more distinctly by pouring a little alcohol on the surface of the oil and causing the liquid to gently undulate. The oil assumes an intense permanent crimson hue on being shaken with a concentrated solution of sodium bisulphite. Although very fragrant, the odor of the volatile oil differs somewhat from that of orange-flowers and of distilled orange-flower water. The oil dissolves, according to Zeller, in from 1 to 3 parts of alcohol spec. grav. .850, the solution becoming opalescent or turbid with more alcohol. Carbon disulphide likewise yields a turbid solution (Flückiger). Iodine acts energetically upon neroli oil, colored vapors being given off; sulphuric acid colors it dark orange-red or red-brown; nitric acid changes the color to yellow and rust-brown. The oil deviates polarized light somewhat to the right. The commercial oil is usually yellowish or reddish-yellow, and is frequently adulterated with oil of bergamot and orange-leaves. Old resinified oil is less fragrant, but may, in a measure, be restored by rectification with water.

Composition.—Oil of neroli is a hydrocarbon, $C_{10}H_{16}$, containing a small quantity of inodorous crystallizable camphor. The former distils between 185° and 195° C. (365° and 383° F.), displays the violet fluorescence in a marked manner, and retains the odor of the original oil (Flückiger). Neroli camphor was observed by Boullay (1828), and, according to Plisson (1829), may be obtained from the oil by treatment with alcohol of spec. grav. .850, in which it is nearly insoluble. It crystallizes from ether or hot alcohol in pearly needles or prisms, melts at 55° C. (131° F.), and when pure is inodorous and tasteless.

Uses.—Oil of orange-flowers belongs rather to the perfumer's than to the pharmaceutist's art, but it may be employed to mask the smell of mixtures, ointments, etc.

OLEUM BERGAMOTTÆ, *U. S.*—Oil of Bergamot.

Oleum bergamottæ.—Essence de bergamotte, Fr.; *Bergamottöl*, G.

The volatile oil obtained by expression, from the fresh rind of the fruit of Citrus Bergamia, *Risso et Poiteau*, s. C. Aurantium, var. Bergamia, *Wight et Arnott*. Bentley and Trimen, *Med. Plants*, 52.

Nat. Ord.—Rutaceæ.

Origin.—The fruit is of a lemon-yellow color, and grows upon a small tree in Southern Italy, evidently a variety produced by cultivation; it is by some botanists regarded as closely related to Citrus Limetta, *Risso*, or with this plant as a variety of C. Limonum, *Risso*, while others regard it as a hybrid of C. medica and C. Aurantium, *Risso*. The juice of the fruit has a bitter and acrid taste.

Preparation.—The oil-vessels contained in the rind of the fruit are ruptured by means of a machine wherein the fruit is subjected to a rotatory motion; the oil thus obtained deposits on standing a waxy matter, from which it is decanted. The amount imported into the United States was 40,460 pounds in 1858, and 51,782 pounds in 1882.

Properties.—Oil of bergamot has a green or greenish, sometimes a yellowish, color, and after rectification is colorless. Its specific gravity varies between 0.880 and 0.885 at 15° C. (59° F.), and its boiling-point between 180° and 195° C. (356° and 383° F.). It has a bitterish aromatic taste and an agreeable odor, less pleasant after rectification. It has a neutral or slightly acid reaction to test-paper. It dissolves 25 per cent. of carbon disulphide and 8 per cent. of alcohol 0.966, and is soluble in half its weight of alcohol sp. gr. 0.85, and in all proportions in strong alcohol and in glacial acetic acid; the alcoholic solution becomes dingy-brown with ferric chloride. It deviates polarized light to the right from 7° (*Pharmacographia*) to 40° (Gladstone), and reacts briskly with iodine, giving off purplish and yellow vapors.

Composition.—The amount of oxygen has been found to vary between 2.6 and 16.14 per cent. in different portions of the distillate. The oil appears to be a mixture of hydrocarbons of the formula $C_{10}H_{16}$ with various hydrates. Distilled with phosphoric anhydride, a volatile oil of the odor of turpentine is obtained. The waxy matter mentioned above crystallizes from alcohol in silky, colorless, inodorous, and tasteless needles; this *bergamot camphor* or *bergaptene* has the composition $C_9H_6O_3$.

Adulterations.—Oil of bergamot is often adulterated with oil of orange, and occasionally with oil of turpentine, and requires then a larger amount of alcohol for solution. The volatile oils obtained by distillation with water of the leaves and of the nearly exhausted rind, when mixed with oil of bergamot, render it less fragrant.

Tests.—2 volumes of the oil, when mixed with 1 volume of alcohol, should afford a clear solution of a slightly acid reaction, and this solution should not become turbid on the further addition of alcohol (distinction from the oils of orange and of lemon). The oil is also soluble, in all proportions, in glacial acetic acid. If about 2 Gm. of the oil be evaporated in a small, tared capsule, on a water-bath, until the odor has completely disappeared, a soft, green, homogeneous residue should be left, amounting to not more than about 6 per cent. of the oil (absence of fatty oils).

Action and Uses.—It is a stimulant like other volatile oils, but is seldom employed except for the purpose of scenting ointments and toilet tinctures.

OLEUM BUBULUM.—Neat's-foot Oil.

Oleum pedum tauri, Axungia pedum tauri.—Huile (Graisse) des pieds du gros bétail, Fr.; *Klauenöl, Ochsenklauenfett*, G.

Preparation.—It is made by boiling neat's feet, deprived of their hoofs, with water, skimming off the oil which rises to the surface, and keeping it for some time on warm water. After the impurities have settled it is ready for use.

Properties.—Neat's-foot oil is a pale-yellow and (when of good quality) nearly inodorous and bland, liquid oil, which has the specific gravity .915 at 15° C. (59° F.), is but slightly thickened on exposure, does not readily turn rancid, and requires to be cooled to below the freezing-point of water before it congeals to a soft white mass. On saponification it yields glycerin and oleic acid with a little stearic acid. Neat's-foot oil is turned brown by sulphuric acid or a mixture of sulphuric and nitric acids; nitric acid colors it yellow; and it gradually congeals when in contact with nitroso-nitric acid.

Action and Uses.—Neat's-foot oil is much used in softening leather and rendering it pliable. Perhaps this operation may have suggested its administration in medicine as a substitute for cod-liver oil. If it had been efficient, of which there is no proof, its singularly repulsive smell and taste as it is usually met with, and its tendency to cause diarrhœa, must speedily have condemned it.

OLEUM CADINUM, *U. S.*—Oil of Cade.

Oleum Juniperi Empyreumaticum.—Huile de cade, Fr.; *Kade Oel*, G.

A product of the dry distillation of the wood of Juniperus Oxycedrus, *Linné*.

Nat. Ord.—Coniferæ.

Description.—Oil of cade is an empyreumatic, brownish or dark-brown, clear, thick liquid possessing a tarry odor and an empyreumatic, burning, somewhat bitter taste. Its specific gravity at 15° C. (59° F.) is about 0.990. It is almost insoluble in water, but imparts to it an acid reaction; alcohol dissolves it only partially, but ether or carbon disulphide dissolves it completely. The empyreumatic oil of common juniper-wood is said to be often sold in its place.

Action and Uses.—*Oil of cade* is extensively used in Europe in the treatment of *psoriasis, pityriasis rubra, chronic eczema, prurigo*, etc. It is applied either in liniments or in soft potash soaps, pure or dissolved in alcohol. The preparations have the same effect as the analogous ones made with tar, but are less irritating, have less smell, and are less injurious to the clothing. Oil of cade has been given internally as an anthelmintic in doses of Gm. 0.15–0.30 (gtt. iij–vj) several times a day. *Haarlem oil*, which is said to be composed of equal parts of oil of cade and oil of juniper berries, has enjoyed a great vogue in chronic affections of the kidneys and bladder.

OLEUM CAJUPUTI, *U. S., Br.*—Oil of Cajuput.

Oleum cajeputi.—Oil of cajeput, E.; *Essence de cajeput*, Fr.; *Cajeputöl*, G.

The volatile oil obtained from the leaves of Melaleuca Leucadendron, *Linné*. Bentley and Trimen, *Med. Plants*, 108.

Nat. Ord.—Myrtaceæ.

Origin.—The species mentioned is a small tree, which has lanceolate entire leaves and terminal spikes of small white flowers with exserted stamens. It is indigenous to the East Indian Islands. Bentham regards it as a mere variety of M. Leucadendron, *Linné*, which extends into Farther India, the Philippines, and a considerable portion of Australia, and often attains a moderately large size, sometimes growing to the height of 27 M. (90 feet). The oil is prepared in Celebes, Bouro, and other islands of the Molucca Sea by distilling the leaves with water.

Properties.—Oil of cajeput is limpid, of a green or bluish-green color, a penetrating odor, suggesting that of camphor, rosemary, and mint, and a bitterish, aromatic, camphoraceous, afterward cooling taste. The specific gravity varies between 0.924 and 0.929; its boiling-point is near 173° C. (343.4° F.). It does not congeal at —25° C. (—13° F.), is freely soluble in alcohol, and affects blue litmus-paper. It dissolves iodine quietly or with the evolution of few reddish vapors; ammonia turns it yellowish, and sulphuric acid colors it brown, reddish, and finally purplish-brown. On heating 5 parts of cajeput oil to 50° C. (122° F.), and then adding 1 part of powdered iodine, the solution on cooling congeals to a magma of black crystals, which by recrystallization from alcohol or ether may be obtained as yellowish-green prisms having a metallic lustre, and which liquefy on keeping (Schmidl). By rectification the oil becomes colorless.

On shaking 5 Cc. of the green oil with 5 Cc. of water acidulated with a drop of diluted hydrochloric acid, the oil becomes nearly colorless. If to this acid liquid a drop of solution of potassium ferrocyanide be added, a red-brown color will usually be produced (presence of traces of copper).

Composition.—Blanchet determined its composition to be $C_{10}H_{16}.H_2O$. Schmidl (1860) obtained, between 175° and 178° C. (347° and 352.4° F.), two-thirds of the oil as a colorless distillate which has the composition stated, and is the hydrate of a hydrocarbon named *cajeputene*, the latter obtainable by repeated distillation over phosphoric anhydride. Cajeputene, $C_{10}H_{16}$, boils between 160° and 165° C. (320° and 329° F.), has an agreeable odor of hyacinth, and is slightly soluble in alcohol. Two other hydrocarbons of the same composition and sparing solubility in alcohol are obtained at the same time, of which *isocajeputene* boils at 176° C. (348.8° F.) and has a less agreeable odor, while *paracajeputene* is thick, yellow, and shows a blue fluorescence. Gladstone (1872) found the hydrate of cajeputene, or *cajeputol*, also in the volatile oils of Melaleuca ericifolia and linarifolia, *Smith*, and of Eucalyptus oleosa, *F. Mueller;* it is dextrogyre, its rotating power varying between 10° and 30°.

The green color of the oil is sometimes, at least, in part due to copper, the presence of which may be proven by agitating the oil with dilute hydrochloric acid, when its green color disappears, and testing the watery liquid with potassium ferrocyanide, when a red-brown color or precipitate will occur. However, cajeput oils have been observed which were entirely free from copper, the green being due to chlorophyll.

Adulterations.—The admixture of oil of turpentine is indicated by decreased solubility in alcohol and the more violent reaction with iodine. Imitations made by mixing various volatile oils are detected by the same means and by their different odor; such mixtures remain liquid when treated with one-fifth of iodine, as described above. The oils examined by Gladstone cannot, it seems, be distinguished from the official.

Action and Uses.—This oil has long been prized in the East as a stimulant and diaphoretic medicine, and employed in dropsy, flatulent colic, chronic rheumatism, paralysis, hysteria, etc. It may be used internally as a remedy for *flatulent colic*, particularly when it is produced by cold or by the retrocession of gout or rheumatism, in *dysmenorrhœa* occasioned by temporary uterine congestion, in *cholera morbus*, and in epidemic *cholera*. In the last-named disease it has been largely employed by Oriental physicians. It is of marked utility in cases of *nervous vomiting*, *nervous dysphagia*, *dyspnœa*, and *hiccough*. It has also been used as a *vermifuge*. As a local stimulant and rubefacient it is useful, when diluted with olive oil or added to camphorated liniments, in cases of *functional paralysis* and *muscular rheumatism*. With olive oil or glycerin it is introduced on cotton into the auditory canal for the relief of *otalgia* and of *deafness*. It is one of the best remedies for *toothache* depending upon caries, when a drop of it upon cotton is introduced into the hollow tooth, and a few drops of it rubbed upon the painful part relieve *nervous headache* and *local neuralgia*. It is a useful stimulant in chronic *scaly affections of the skin* and in *acne rosacea*. It may be given internally in *doses* of Gm. 0.10–0.60 (gtt. ij–x) on sugar, with Hoffmann's anodyne, or with tinctures or infusions of antispasmodic medicines. As a vermifuge it may be mixed with honey in the proportion of 1 part to 30 or more, and dessert-spoonful doses of the mixture may be given every hour or two. It may also be administered by enema.

Melaleuca flaviflora yields an oil which is closely analogous to cajuput oil, and is used for similar purposes by the people of New Caledonia—viz. externally for the relief of neuralgia, muscular rheumatism, and gout, and internally as a vermifuge, especially for rectal ascarides, in enema (*Bull. de Thérap.*, xcvii. 402). *M. paraguayensis* is said to be a sudorific. An extract prepared from it has been employed in the treatment of rheumatism, gout, syphilis, yellow fever, and cholera (*Med. Record*, xvi. 132).

OLEUM CARI, *U. S.*—Oil of Caraway.

Oleum carui, Br.; *Oleum carvi*, P. G.—*Essence de carvi*, Fr.; *Kümmelöl*, G.

The volatile oil distilled from the fruit of Carum Carui, *Linné*.

Nat. Ord.—Umbelliferæ.

Preparation.—The bruised fruit is distilled with superheated steam; the yield is variable, but averages about 4 per cent., and may be as high as 7 per cent. The fruit which is grown in northern countries is generally richer in oil than that from more southern localities. The first portion of the distillate contains mainly carvene, the odorous carvol coming over last. 3600 pounds passed into the United States in 1867, and 9143 pounds in 1882.

Properties.—Oil of caraway is limpid, colorless, or pale-yellow, becoming brown and viscid on exposure. Its specific gravity is usually between 0.91 and 0.92, at 15° C. (59° F.), but in old oil may rise to 0.97. When fresh it has no action on litmus; its odor is agreeable, its taste aromatic. It dissolves in an equal volume of alcohol, turns polarized light to the right, and commences to boil at 175° C. (347° F.). The German Pharmacopœia recognizes only oil of caraway which has been deprived of much of the carvene; such oil should have a specific gravity of not less than 0.910, and should boil briskly at 224° C. (435.2° F.); its solution in an equal weight of alcohol should acquire a reddish or pale-violet color on the addition of a drop of test-solution of ferric chloride; and a mixture of 10 parts of the oil, 8 parts of alcohol, and 1 part of ammonia-water, on being saturated with hydrosulphuric acid gas, should congeal to a white crystalline mass.

An inferior oil of caraway is made from the refuse or "chaff" of the fruit; it is less agreeable in odor, and not unfrequently mixed with oil of turpentine.

Composition.—By repeated fractional distillation Völkel (1840) separated *carvene*, $C_{10}H_{16}$, which has little odor and taste, boils at 173° C. (343.4° F.), and has a strong dextrogyrate rotation. The higher boiling fraction contains *carvol*, $C_{10}H_{14}O$, which is liquid, has an agreeable caraway odor, boils at 227° C. (440.6° F.) (Gladstone), or at 250° C. (482° F.) (Varrentrapp), and has a levogyrate rotation. In contact with alcoholic solution of ammonium sulphide carvol yields white silky needles of $(C_{10}H_{14}O)_2.H_2S$, from which it is again separated by potassa. Carvol (see also Ol. Anethi) is isomeric with menthol of spearmint, myristicol of nutmeg, thymol, cuminic alcohol, and *carvacrol;* the latter is a rather viscid, colorless, or yellowish oil resembling creasote in odor and taste, and may be obtained by distilling a mixture of oil of caraway and potassa until carvene has been expelled, decomposing the residue by sulphuric acid, and rectifying the oil.

Action and Uses.—The properties of this oil are nearly identical with those of oil of anise. Given to animals in large doses, it causes death by asthenia. It may be used in the treatment of *flatulent colic* and whenever a gastric stimulant or a carminative is required. Locally, it acts, like other essential oils, as an *anæsthetic*. It may be administered in sweetened water, ether, or Hoffmann's anodyne, in the *dose* of Gm. 0.05–0.60 (gtt. j–x).

OLEUM CARYOPHYLLI, *U. S., Br.*—Oil of Cloves.

Oleum caryophyllorum, P. G.—*Essence de girofle*, Fr.; *Nelkenöl*, G.

The volatile oil distilled from the flower-buds of Eugenia caryophyllata, *Thunberg*.

Nat. Ord.—Myrtaceæ.

Preparation.—The volatile oil is obtained from cloves by distilling them with water For this purpose the cloves require to be bruised; cohobation should be repeatedly resorted to, and salt may be added (see Olea Destillata) in order to raise the boiling-point. If the cloves have been properly bruised, the three or four times repeated distillation of the water from the same cloves is usually sufficient; but if the powder be very coarse the distillation will have to be repeated more frequntly. At present the distillation is usually effected with superheated steam. At first, the oil coming over is chiefly the light portion which floats on the water; afterward the heavy portion distils, and the two portions united constitute the commercial article. The yield is 15 to 20 per cent. Clove-stalks are said to be sometimes used in Europe in the distillation of this oil. In the United States cloves from South America are employed for distilling the oil, and the entire want is now supplied in this country. In 1867 the amount imported was 956 pounds, which decreased in 1877 and 1878 to 2 pounds, and was 302 pounds in 1881.

Properties.—When recently distilled, oil of cloves is somewhat thicker than most

other volatile oils, and has a pale-yellow color, but may be obtained colorless by rectification, and becomes thicker, darker, and finally yellowish-brown, on keeping. It has a strong odor of cloves, a burning aromatic taste, and boils at 240° C. (455° F.). Its specific gravity varies between 1.060 and 1.067; oil of clove-stalks, though agreeing in odor, has a density of about 1.009. Oil of cloves dissolves freely in alcohol, the solution having a slight acid reaction and yielding with ferric chloride a purplish-blue color. Sulphuric acid colors the oil blood-red, finally blue: and it acquires also a blue or violet color when exposed in a thin layer to bromine vapor; iodine dissolves in it quietly; strong potassa solution or strong ammonia-water converts it into a crystalline mass of potassium eugenol; a soft yellowish crystalline mass is also obtained on agitating the oil with an equal volume of stronger water of ammonia; fuming nitric acid acts violently upon the oil, sometimes with ignition. The oil is without action or with but slight action (—4°, Gladstone) upon polarized light.

Composition.—On distilling a mixture of cloves with excess of potassa the colorless distillate is the *light oil of cloves*, and has the composition $C_{15}H_{24}$; its odor is distinct from that of cloves—more terebinthinate; it has the density 0.918, and boils at 251° C. (483.8° F.) On decomposing the potassium eugenol with sulphuric acid and rectifying the separated oil, *eugenol*, $C_6H_3.C_3H_5(OH)(OCH_3)$, is obtained as a colorless oil having the odor of cloves, the specific gravity 1.076 (Stenhouse), 1.0785 (Pettit), and boiling at 247.5° C. (477.5° F.); it yields with bases crystallizable salts, which, with the exception of the barium compound, are decomposed by much water or alcohol, and are colored blue or purple by ferric salts. By fusion with potassa, eugenol is decomposed into protocatechuic and acetic acids. L. C. Pettit (1880) obtained 72 per cent. of eugenol, which became red, and then purple, with sulphuric acid; the potassium compound was found to be soluble without decomposition in alcohol and glycerin, and sparingly soluble in benzin. On boiling acetic anhydride with eugenic acid, *aceto-eugenol* is formed, and from this compound vanillin may be obtained by treating it carefully with a weak solution of potassium permanganate, rendering the liquid alkaline, concentrating, and acidulating, when the vanillin may be extracted with ether (Tiemann, 1878). By treating eugenic acid in an atmosphere of carbon dioxide with sodium, Scheuch (1863) obtained the sodium salt of *eugetinic acid*, $C_{11}H_{12}O_4$, which is crystallizable, soluble in water, colors ferric salts deep-blue, and is decomposed by heat into carbonic and eugenic acids. The same author proved likewise the presence in oil of cloves of salicylic acid, most probably in the form of an ether.

Several derivatives of eugenol have recently been brought to notice—namely:

Benzoyl-eugenol, $C_6H_3.C_3H_5(OCH_3)CO_2C_6H_5$, is obtained by a patented process, and occurs in neutral acicular crystals, without color and odor, and feebly bitter taste. It melts at 70.5° C. (158.9° F.), is scarcely soluble in water, but freely soluble in hot alcohol, chloroform, ether, and acetone.

Cinnamyl-eugenol, $C_6H_3.C_3H_5(OCH_3)CO_2(CH)_2C_6H_5$, forms lustrous needles, which are free from color, odor, and taste, and melt at 90°–91° C. (194°–195.8° F.). Its solubility corresponds to that of the preceding compound.

Eugenol-acetamide is a patented anæsthetic, analogous in action to cocaine; it occurs as a crystalline powder, and is obtained from eugenol-acetic-ethyl-ether by treatment with strong solution of ammonia.

Adulterations.—The determination of the boiling-point and the specific gravity are sufficient for detecting most adulterations to which oil of cloves is sometimes subject; on treating the suspected oil with alcoholic solution of potassa the odor of cloves disappears and the nature of the adulteration is established. For the detection of carbolic acid Jacquemin (1875) recommended adding a trace of aniline, shaking with water, and adding a little chlorinated soda, when a blue color will be produced. Flückiger (1870) proposed to shake 1 part of oil with 50 parts of hot water, concentrate the aqueous liquid by evaporation at a moderate heat, add a drop of ammonia and a little chlorinated lime; in the presence of carbolic acid a green color, passing into blue, will be produced. "Hot water, on being agitated with oil of cloves, should not acquire an acid reaction, and after cooling the clear filtrate should not turn blue or green on the addition of a drop of solution of ferric chloride (carbolic acid), but it should become yellow with lime-water. The oil should yield a clear solution with an equal weight or a little more of alcohol spec. grav. 0.894 (oil of turpentine, copaiva, etc.")—*U. S., P. G.* If 2 drops of the oil be dissolved in 4 Cc. of alcohol, and a drop of ferric chloride test solution added, a bright green color will be produced; and if the same test be made with a drop of dilute ferric chloride, prepared by diluting the test-solution with four

times its volume of water, a blue color will be produced, which soon changes to yellow. If 1 Cc. of the oil be mixed with 2 Cc. of a mixture of 2 volumes of alcohol and 1 volume of water, it should form a clear and perfect solution (absence of petroleum, most fatty oils, oil of turpentine, and similar oils)."—*U. S.*

Action and Uses.—The action and uses of oil of cloves are essentially the same as those of the oils of caraway and anise. It is seldom employed internally, but is sometimes used to allay the pain of *carious teeth* and of *earache*. The *dose* is Gm. 0.10–0.30 (gtt. ij–v).

Benzoyl eugenol has been proposed for treating tuberculous affections, but there is no clinical evidence of its value.

Eugenol acetamide is said to be a local anæsthetic applicable in minor surgery.

OLEUM CHENOPODII, *U. S.*—Oil of Chenopodium.

Oil of American wormseed, E.; *Essence de chénopode anthelmintique*, Fr.; *Chenopodiumöl, Amerikanisches Wurmsamenöl*, G.

The volatile oil is obtained from the fruit of Chenopodium anthelminticum, *Linné*. *Nat. Ord.*—Chenopodiaceæ (see page 446).

Preparation.—Distillation with water or by means of superheated steam yields this volatile oil. Much of it is distilled in Maryland and in some of the Western States. The fruit yields about 3 to 3½ per cent., the fresh herb ½ to 1 per cent. The Western oil is rather less pungent than the Baltimore oil of wormseed.

Properties.—Oil of wormseed is colorless or yellowish, limpid, becoming brown and thick on exposure. It has the peculiar odor of wormseed and a bitterish, pungent, and somewhat cooling, aromatic taste. Its specific gravity is about 0.970 (*U. S.*) (0.920 *U. S.*, 1880); when fresh it is 0.902 to 0.91, and increases by age to .960. It is readily soluble in alcohol, the solution having a neutral reaction. 1 Cc. of the oil should form a perfectly clear solution with 10 Cc. of a mixture of 3 volumes of alcohol and 1 volume of water.—*U. S.* It boils at 180° to 190° C. (356° to 374° F.), dissolves iodine slowly, and turns brown-red when boiled with nitro-prusside of copper.

Composition.—Garrigues (1854) found oil of wormseed to be a mixture of a hydrocarbon, $C_{10}H_{16}$, and a liquid oxygenated oil, $C_{10}H_{16}O$. The former has the density 0.932, boils near 176° C. (350.6° F.), and yields a liquid and a crystalline compound with chlorine. The specific gravity of the latter is 0.987, its boiling-point 245° C. (473° F.).

Action and Uses.—Many cases of poisoning by this oil are recorded. A child six years old took several successive doses of 15 drops each for worms. The symptoms were insensibility, stertor, rattling in the throat, a small, feeble, and frequent pulse, convulsions of one side of the body, cold extremities, and death in thirty-six hours (*Boston Med. and Surg. Jour.*, xlv. 373). Wormseed oil is chiefly used as an anthelmintic, although occasionally employed for the cure of *intermittent fever*, *hysteria*, *chorea*, and other *nervous affections*. In America it is one of the most popular remedies for *lumbricoid worms*, but it has also been used successfully to expel *tæniæ*. It is true that in Europe some observers have tended to discredit its efficacy, and even in this country there is more evidence of its utility in cases of gastro-intestinal *dyspepsia* among children, which is often mistaken for verminous disease, than of its direct vermifuge powers. It may be given to children in *doses* of Gm. 0.30–0.60 (gtt. v–x) on sugar, and twice daily for several days, when it should be followed by a dose of castor oil, or in an emulsion flavored with extract of licorice. (For a formula see *Amer. Jour. Phar.*, lx. 545).

OLEUM CINNAMOMI, *U. S., Br., P. G.*—Oil of Cinnamon.

Oil of Cassia, E.; *Essence de cannelle*, Fr.; *Zimmtöl*, G.

The volatile oil distilled from Cassia cinnamon.

Preparation.—The British and French Pharmacopœias recognize only the volatile oil of Ceylon cinnamon, which is almost exclusively prepared in Ceylon by distilling the chips and refuse bark with water, while the U. S. Pharmacopœia and the German Pharmacopœia have admitted only the oil of Chinese cinnamon. Judging from the custom-house entries, but little of the Ceylon oil is imported into the United States. Ceylon cinnamon yields ½ to 1 per cent., Cassia cinnamon ½ to 1½ per cent., of volatile oil.

Properties.—Oleum cinnamomi zeylanici.—Oil of Ceylon cinnamon, *E.;* Essence de cannelle de Ceylon, *Fr.;* Zeylonzimmtöl, *G.*—It is a pale-yellow or reddish liquid,

becoming red-brown and thicker on exposure, finally separating crystals of cinnamic acid. It has a strong but agreeable cinnamon odor and a sweet and at the same time hot, aromatic taste. Its specific gravity is about 1.035 (1.0097, Jackson, 1882), and increases by age. It remains clear at the freezing-point of water (at — 10° C. = 14° F., *U. S. P.*), but at a still lower temperature (at — 20° C. = — 4° F., Bizio) separates a stearopten; it has no action on polarized light or shows a slight left rotation, is readily soluble in alcohol, sparingly soluble in benzin, and has a neutral reaction on litmus-paper when fresh, and an acid reaction when old. It dissolves iodine almost quietly, and soon forms a thick mass; fuming nitric acid imparts to it a carmine color without causing effervescence; boiling with nitro-prusside of copper turns it red, then dark-brown; its alcoholic solution is somewhat darkened by ferric chloride. Good oil of cinnamon does not congeal when agitated with strong solution of potassa.

Oleum cinnamomi cassiæ, s. Oleum cassiæ.—Oil of Chinese cinnamon, Oil of cassia, *E.;* Essence de cannelle de Chine, *Fr.;* Zimmtkassienöl, *G.*—It resembles the preceding oil very closely in all its properties, except that its color is more brownish, its odor less delicate, its taste less sweet, and its specific gravity greater, being usually 1.055 to 1.065 (1.0366, Jackson, 1882); sometimes it is slightly dextrogyre. It is soluble in an equal volume of alcohol, and this sometimes shows an acid reaction; it is also soluble in an equal volume of glacial acetic acid. A saturated solution of sodium bisulphite when shaken with it causes solidification, due to the presence of cinnamic aldehyde.

Composition.—Both oils contain variable quantities of hydrocarbon, but consist chiefly of *cinnamic aldehyde*, C_9H_8O, and when old also resin and cinnamic acid, $C_9H_8O_2$. In its pure state cinnamaldehyde is a colorless oil, heavier than water, combines with strong nitric acid in the cold, forming crystals, which are soluble in alcohol and ether, decomposed by water, and when heated yield oil of bitter almond and benzoic acid. Oxidizing agents generally, when acting upon cinnamaldehyde generate the odor of bitter almonds, and finally produce benzoic acid; heated with solid potassium hydroxide, potassium cinnamate is formed, hydrogen being given off; $C_9H_8O + KOH$ yields $C_9H_7KO_2 + H_2$. *Cinnamic acid* crystallizes in shining, colorless prisms, which are inodorous, dissolve freely in alcohol, ether, and boiling water, fuse at about 130° C. (266° F.), boil and volatilize without decomposition at about 295° C. (563° F.), and it is oxidized by chlorinated lime and hot dilute nitric acid to oil of bitter almond and benzoic acid.

Adulterations.—An adulteration with oil of cloves or oil of cinnamon-leaves cannot be detected by the odor, except on heating, when acrid vapors will be given off. The behavior to ferric chloride, strong potassa solution, and cold fuming nitric acid affords additional means for detection.

"If 4 drops of the oil be diluted with 10 Cc. of alcohol, the subsequent addition of a drop of ferric chloride test-solution should produce a brown, but not a green or blue color (absence of oil of cloves or carbolic acid).—*U. S., P. G.* If 4 drops of the oil, contained in a test-tube, be cooled to 0° C. (32° F.), and then shaken with 4 drops of fuming nitric acid, crystalline needles or plates will be formed. If a portion of the oil be shaken with water, and the liquid passed through a wet filter, the clear filtrate should afford, with a few drops of basic lead acetate test-solution, a white turbidity, without a yellow color (absence of oil of cloves). If 1 Cc. of the oil be mixed with 3 Cc. of a mixture of 3 volumes of alcohol and 1 volume of water, it should form a clear solution; and if to the latter 2 Cc. of a saturated solution of lead acetate in a mixture of 3 volumes of alcohol and 1 volume of water be gradually added, no precipitate should be produced (absence of petroleum, or of colophony)."—*U. S.*

Allied Oils.—Oleum cinnamomi foliorum.—Oil of cinnamon-leaves, *E.;* Essence de feuilles de cannellier, *Fr.;* Zimmtblätteröl, *G.*—The leaves are distilled in Ceylon with sea-water. The oil is a rather viscid brown liquid, having the specific gravity 1.053 and a strong clove-like and faint nutmeg-like odor; after treatment with potassa the odor resembles that of cinnamon. Stenhouse (1854) found in the oil a terpene and eugenol, with a small quantity of benzoic acid; the latter could not be detected by Schaer (1882). N. A. Kuhn (1877) showed the presence of cinnamic acid.

Oleum cinnamomi radicis.—Oil of cinnamon-root, *E.;* Essence de racine de cannellier, *Fr.;* Zimmtwurzelöl, *G.*—It is yellow, lighter than water, and has an odor like that of a mixture of cinnamon and camphor and a camphoraceous taste.

Action and Uses.—The oil is much employed to impart an agreeable flavor to medicinal compounds and render them acceptable to the stomach. If the virtues attributed to cinnamon (see Cinnamomum) in uterine hæmorrhage are real, they would probably be displayed more efficiently by the oil than by any other preparation of the medicine. The *dose* is Gm. 0.05–0.10 (gtt. j–ij).

OLEUM COCOS.—Cocoanut Oil.

Oleum cocois.—Cocoanut butter, E.; *Beurre de coco*, Fr.; *Kokosnussöl*, G.

From Cocos nucifera, *Linné.*
Nat. Ord.—Palmæ.

Origin.—The cocoanut tree is now met with in all tropical countries. It has at the apex a tuft of leaves which are 3.6 M. (12 feet) and more long and have numerous narrow rigid and long leaflets. The yellowish-white flowers produce the well-known cocoanuts, which in their unripe state contain a sweetish liquid. The seeds contain much fixed oil, which is obtained by hot pressure or on being boiled in water. The seeds of Cocos butyracea, *Linné*, of Brazil, yield a similar oil.

Properties.—Cocoanut oil is of a butyraceous consistence, white, and has a peculiar not agreeable odor, which is also observed in the soap prepared with it; its taste is mild and bland, but on exposure to the air it becomes rancid and acquires an acrid taste. Its melting-point varies between 22° and 28° or 30° C. (71.6°–82.4°–86° F.); the cold pressed oil melts at 20° C. (68° F.) or less. The fused, thin, transparent, yellowish oil congeals between 18° and 12° C. (64.4° and 53.6° F.). After having been heated to 240° C. (464° F.) it remains liquid for several days. The oil is readily saponified at a low temperature, the soap being white, hard, and capable of uniting with much water near 18° C. (64.4° F.).

Composition.—By cold pressure it may be separated into a liquid and solid portion, both of which are glycerides. According to Görgey and Oudemans, the acids contained in cocoanut oil are palmitic and myristic, but principally lauric, acid, together with caprinic, caprylic, and capronic acids.

Action and Uses.—Cocoanut oil has been tried as a substitute for cod-liver oil, but, like other succedanea for that product, was found inefficient. It was given in doses of Gm. 16 (a tablespoonful). It is chiefly valuable for its economical and pharmaceutical uses. In Abyssinia and in India the juice and pulp of the cocanut are used to expel *tæniæ* (*Amer. Jour. of Med Sci.*, xcvii. 281).

OLEUM COPAIBÆ, *U. S., Br.*—Oil of Copaiba.

Oleum balsami copaivæ.—Essence de copahu, Fr.; *Copaibaöl*, G.

The volatile oil distilled from copaiba.

Preparation.—The oil is obtained by distilling copaiba with water, a metallic still being preferable to a glass retort; a considerable quantity of water, or preferably steam, should be used, or the distilled water returned to the still until all the oil has been obtained. All that is consumed in the United States is prepared here from Para copaiba, which yields 50 to 60 per cent., or even more.

Properties.—Oil of copaiba is limpid, colorless, or pale-yellowish, and on exposure becomes slowly thicker and yellow. It has the odor of copaiba, a pungent, aromatic and bitterish taste, neutral reaction to test-paper, spec. grav. 0.89 to 0.91, and increasing with age; it boils at about 250° C. (482° F). It is soluble in ten times its volume of alcohol (*U. S. P.*), dissolves in about 40 parts of alcohol spec. grav. 0.85, mixes with iodine without violent reaction, and yields with hydrochloric acid gas a liquid and a crystallizable compound. It deviates polarized light to the left.

Composition.—The oil has the elementary composition of oil of turpentine, and consists of several isomeric modifications of $C_{15}H_{24}$, differing in boiling-point, in the behavior to polarized light, and probably in other properties.

Adulterations.—The addition of oil of turpentine is detected by the odor and by the more violent reaction with iodine.

Action and Uses.—Oil of copaiba acts upon the human skin very feebly as an irritant. When taken internally it is excreted by the urine, which then furnishes a precipitate with nitric or muriatic acid. It is very doubtful whether it exerts any efficient control over *gonorrhœa*, the disease for which copaiba itself is chiefly employed. It probably is more useful in chronic pulmonary catarrh or *chronic bronchitis*, since it is apparently through the lungs that the odorous constituent of all oleoresins is eliminated. But clinical evidence upon this point is wanting, unless, indeed, the negative proof afforded by the silence of all competent authorities be accepted as sufficient. The *dose* of the oil is Gm. 0.60–1 (gtt. x–xv).

OLEUM CORIANDRI, *U. S., Br.*—Oil of Coriander.

Essence de coriandre, Fr.; *Koriander öl*, G.

The volatile oil distilled from the fruit of Coriandrum sativum, *Linné*.
Nat. Ord.—Umbelliferæ.

Preparation.—Coriander-fruit is ground, and then distilled with water or by means of steam. The yield varies between $\frac{2}{3}$ and 1 per cent.

Properties.—It is colorless or pale-yellow, has a mild and agreeable aromatic odor of coriander, and a warm, spicy taste, a spec. grav. of 0.87 to 0.885, at 15° C. (59° F.) commences to boil at about 150° C. (302° F.), and dissolves readily in alcohol and glacial acetic acid. Iodine and fuming nitric acid act energetically upon it, the latter producing a greenish resin.

Composition.—The oil has the composition $C_{10}H_{18}O$, and is isomeric with borneol. From Kawalier's investigations (1852) it appears sometimes to contain also a hydrocarbon, $C_{10}H_{16}$.

Adulteration.—Leonhardi (1878) mentions oil of orange, which is detected by its insolubility in an equal bulk of 85 per cent. alcohol.

Action and Uses.—Like oil of anise, fennel, etc., this oil is aromatic and carminative, and is used in flatulent *colic*, to relieve the pain of *rheumatism*, *neuralgia*, etc., and to mitigate the griping operation of certain purgatives. It corrects the odor and taste of fluid extract of senna better than any other aromatic. *Dose* Gm. 0.05–0.25 (gtt. j–v).

OLEUM CUBEBÆ, *U. S., Br.*—Oil of Cubeb.

Oleum cubebarum.—Oil of cubebs, E.; *Essence de cubèbe*, Fr.; *Kubebenöl*, G.

The volatile oil distilled from the fruit of Cubeba officinalis, *Miquel* (nat. ord. Piperaceæ).

Preparation.—Cubebs are ground, and then distilled with steam or hot water, when repeated cohobation is necessary. The yield is about 10 per cent., but varies considerably with the quality of the fruit. It is distilled in the United States, little being imported —558 pounds in 1867, and only 5 pounds in 1877.

Properties.—Oil of cubebs has a greenish or yellowish tint, but after rectification is colorless, and on exposure becomes thick like olive oil. It has the odor of cubebs, a warm, camphoraceous, aromatic taste, spec. grav. 0.92, at 15° C. (59° F.) a natural reaction, boils at about 250° C. (482° F.), dissolves in 25 parts of alcohol sp. gr. 0.85, and turns polarized light to the left. Iodine dissolves in the oil quietly, but evolves some vapors; concentrated sulphuric acid colors it yellow, and, on warming, red. It is soluble in an equal volume of alcohol, the solution being neutral to test paper.

Composition.—Oglialoro (1875) showed the oil to be a mixture of three levogyrate hydrocarbons, of which one $C_{10}H_{16}$, is present in small quantity and boils between 158° and 163° C. (316.4° and 325.4° F.); the remaining two have the composition $C_{15}H_{24}$, and boil between 262° and 265° C. (503.6° and 509° F.); only one of these yields a crystallizable compound with HCl, melting at 118° C. (244.4° F.). At a low temperature the oil sometimes separates inodorous crystals of *cubeb camphor*, which has the formula $C_{30}H_{48}2H_2O$, and fuses at 65° C. (149° F.).

Action and Uses.—Oil of cubeb produces symptoms almost identical with those of oil of copaiva, but more strongly marked. It causes, occasionally, an eruption, as copaiva does. It displays no curative virtues in gonorrhœa. The *dose* is Gm. 0.60–1 (gtt. x–xv) or more.

OLEUM ERIGERONTIS CANADENSIS, *U. S.*—Oil of Canada Erigeron.

The volatile oil distilled from the fresh flowering herb of Erigeron canadense, *Linné*.
Nat. Ord.—Compositæ.

Preparation.—The fresh herb is distilled in the United States with water or by means of steam.

Properties.—Oil of erigeron is a limpid, pale-yellow liquid of a peculiar aromatic, persistent odor, somewhat like that of hemlock (Abies canadensis), and of an aromatic not very pungent taste. It has the spec. grav. 0.850, and commences to boil at about 155° C. (311° F.), the largest part distilling between 175° to 180° C. (347° F.); the

redistilled oil is colorless, and neutral to test-paper. It dissolves iodine without explosion, is gradually colored reddish by potassa, and slowly acted on in the cold by fuming nitric acid. The oil becomes thick and reddish-brown by age, dissolves freely in ether and absolute alcohol, but is only moderately soluble in 80 per cent. alcohol. "Soluble in an equal volume of alcohol (distinction from the oil of fireweed derived from Erechthites hieracifolia, *Rafinesque*, nat. ord. Compositæ, and from oil of turpentine), this solution being neutral or slightly acid to litmus; also soluble in an equal volume of glacial acetic acid."—*U. S.*

Composition.—The oil contains oxygen, as ascertained by Procter (1854), but, according to Beilstein and E. Wiegand (1882), it consists mainly of a terpene, $C_{10}H_{16}$, boiling at 176° C. (349° F.), and yielding a crystalline compound with HCl, which melts near 48° C. (118.4° F.).

Action and Uses.—This oil has had a certain reputation for controlling *uterine hæmorrhage*, and the plant from which it is derived was held by the aborigines to quicken *uterine contractions*. The evidence respecting its virtues is conflicting, and seems, on the whole, not adapted to inspire much confidence. Like other nervo-vascular stimulants, it is said to have been useful in the *typhoid state*. The *dose* is Gm. 0.30–0.60 (gtt. v–x).

OLEUM EUCALYPTI, *U. S.*, *Br.*—Oil of Eucalyptus.

Essence d'eucalyptus, Fr.; *Eucalyptusöl*, G.

The volatile oil distilled from the fresh leaves of Eucalyptus globulus, *Labillardière*, E. oleosa, *F. V. Mueller*, and some other species of Eucalyptus.

Nat. Ord.—Myrtaceæ.

Origin and Preparation.—The first species mentioned above is described on page 626. Bosisto states (see *Am. Jour. Phar.*, 1876, p. 372) that 1000 pounds of the fresh leaves of the following species yield the quantities of oil stated: E. obliqua, *L'Heritier*, called *stringy bark*, 80 oz.; E. globulus, *Labillardière*, 120 oz.; E. sideroxylon, *Bentham*, called *iron bark*, 160 oz.; E. oleosa, *Mueller*, known as *mallee*, 200 oz.; while E. amygdalina yields 500 oz. of volatile oil.

Properties.—These volatile oils are colorless or pale-yellow, thin liquids, becoming thicker and somewhat darker by age. They are neutral to test-paper, are more or less pungently aromatic and camphoraceous in odor and taste, that of Euc. persicifolia, or *peach gum*, like the oil of bitter almonds, with which it agrees in containing hydrocyanic acid. The specific gravity of these oils varies between 0.915 and 0.925 at 15° C. (59°F.) and their boiling points between about 130° and 200° C. (266° and 392° F.).

The oils are soluble in alcohol, carbon disulphide, or glacial acetic acid in all proportions. The alcoholic solution being neutral or slightly acid to litmus-paper. "If 1 Cc. of the oil be mixed with 2 Cc. of glacial acetic acid, and 1 or 2 Cc. of a saturated, aqueous solution of sodium nitrite gradually added, the mixture, when gently stirred, should not form a crystalline mass (distinction from oils of eucalyptus containing a considerable proportion of phellandrene)."—*U. S.*

Composition.—The dextrogyre oil of E. globulus was examined by Cloëz (1870) and by Faust and Homeyer (1874). Cloëz regarded the oil as being chiefly composed of *eucalyptol*, $C_{12}H_{20}O$, boiling at 178° C. (352.4° F.), and yielding with phosphoric anhydride two compounds, $C_{12}H_{18}$, of which *eucalyptene* boils at 165° C. (329° F.), and *eucalyptolene* at above 300° C. (572° F.). Faust and Homeyer, however, obtained from the oil about 60 per cent. of a *terpene*, $C_{10}H_{16}$, boiling between 172° and 175° C. (342.6° and 347° F.), 30 per cent. of *cymene*, $C_{10}H_{14}$, the remainder being a *terpene* boiling at 150° C. (302° F.), and an oxygenated compound, probably $C_{10}H_{16}O$, which they named *eucalyptol*, Cloëz's compound of the same name being a mixture of the first two hydrocarbons, which rapidly combine with oxygen. The oil of E. amygdalina does not appear to contain eucalyptol.

Action and Uses.—For an account of the virtues ascribed to this oil the reader is referred to the article Eucalyptus. The *dose* of the oil is Gm. 0.10–0.25 (gtt. ij–v).

OLEUM FŒNICULI, *U. S.*, *P. G.*—Oil of Fennel.

Essence de fenouil, Fr.; *Fenchelöl*, G.

The volatile oil distilled from the fruit of Fœniculum vulgare, *Gaertner*.

Nat. Ord.—Umbelliferæ.

Preparation.—Bruised fennel is distilled with water, or, preferably, by means of

superheated steam. The yield is about 3½ or 4 per cent. The oil used in the United States is chiefly procured from Germany and France.

Properties.—Oil of fennel is colorless or yellowish, has a neutral reaction, an agreeable fennel odor, a sweetish aromatic taste (*oil of sweet fennel*), and is of the spec. grav. 0.90 to 0.99 (not less than 0.900, *U. S.*); it congeals below 10° C. (50° F.), sometimes not until cooled below the freezing-point of water, and Zeller obtained an oil which remained liquid at —20° C. (—4° F.); moreover, the congealing-point of the oil becomes lower by age. An oil which does not congeal between 5° and 10° C. (41° and 50° F.) cannot, for this reason alone, be considered impure. (See also Ol. Anisi.) Boiled with nitro-prusside of copper, oil of fennel turns yellowish-brown or red-brown; on the addition of iodine it becomes thick like an extract, or even brittle. It is soluble in alcohol in all proportions in an equal volume of glacial acetic acid, and turns the ray of polarized light to the right.

Composition.—The difference in the physical properties is due to the variable proportion of liquid and solid *anethol* contained in it. (See Ol. Anisi.) The oil also contains a hydrocarbon isomeric with oil of turpentine.

Tests.—The solution in alcohol should not become dark-colored on the addition of a little ferric chloride (phenol, etc.). 1 drop of the oil, triturated with sugar and afterward with 500 Gm. of water, should impart to the latter the pure flavor of fennel (other volatile oils).—*P. G.* If the oil be dropped into water without agitation, it should not produce a milky turbidity (absence of alcohol).

Action and Uses.—The action of fennel oil when given to animals in large doses appears to be identical with that of oil of anise. In medicinal operation it closely resembles the same oil. It is used in *flatulent* disorders and to qualify the action of harsh purgatives, and is sometimes employed as a *galactagogue* and as an *emmenagogue*. The *dose* is Gm. 0.30–0.60 (gtt. v–x).

OLEUM GAULTHERIÆ, *U. S.*—Oil of Gaultheria.

Oil of Wintergreen, E; *Essence de gaulthérie*, Fr.; *Bergtheeöl*, G.

A volatile oil, consisting almost entirely of methyl salicylate, distilled from the leaves of Gaultheria procumbens, *Linné*.

Nat. Ord.—Ericaceæ.

Preparation.—The entire plant is generally collected, and while fresh distilled with water or with the aid of steam. It is largely made in New York, Pennsylvania, and some of the New England States. The average yield is about .5 per cent., and varies between .4 and .8 per cent. G. W. Kennedy (1882) showed that much of the commercial oil of wintergreen is obtained from Betula lenta (see page 338), the young shoots being distilled after having been cut into short pieces and subjected to brief maceration with water; the yield is about .23 per cent.

Properties.—Oil of gaultheria is usually of a reddish color, but may be obtained colorless by rectification. According to I. E. Leonard (1884), the color is usually due to the presence of a little iron, and is readily removed by citric acid. It has a strong and agreeable aromatic odor and a sweetish, warm, aromatic taste, and begins to boil at 218° to 221° C. (424.4° to 429.8° F.). It is the heaviest of the volatile oils, its density being 1.175 to 1.185 at 15° C., which is also that of oleum betulæ volatile, now official in the Pharmacopœia. Occasionally, oil of gaultheria is lighter (1.170), in consequence of containing a light hydrocarbon, but the extent of this variation has not been fully determined. The oil is neutral or faintly acid to test-paper; has a slight dextrogyre rotation, and dissolves readily in alcohol and but to a small degree in water: the solutions acquire a dark-purple color on the addition of ferric chloride. The pure oil is not colored on the addition of strong nitric acid, but soon congeals into colorless crystals of a nitro-compound. A solid crystalline mass is also obtained on agitating the oil with concentrated solution of potassa or soda. When oil of gaultheria is prescribed, the Pharmacopœia permits the use of methyl salicylate or of oil of sweet birch.

Composition.—Procter (1842) recognized the presence in this oil of salicylic acid. Cahours subsequently (1843) proved it to consist to the amount of about 90 per cent. of *methylsalicylic acid* (*methyl salicylate* or *mono-methylsalicylic ether*), $CH_3.C_7H_6O_3$, which with some other salicylic ethers is now also artificially prepared for use in the arts. H. P. Pettigrew (1883) showed the oil of sweet birch to be pure methyl salicylate, to boil constantly at 218° C. (424.4° F.), and on saponification to yield methyl alcohol and salicylic acid. Pure methyl salicylate is a colorless oil, has the spec. grav. 1.18, boils at 222° C.

(431.6° F.) (Cahours), and forms crystalline compounds with the alkalies. The remaining constituent of oil of wintergreen—of which Pettigrew (1884) obtained only 0.3 per cent.—is *gaultherilene*, a colorless thin hydrocarbon of the formula $C_{10}H_{16}$, boiling at 160° C. (320° F.), and having a strong peculiar odor, described as pepper-like by Cahours. Volatile oils of similar composition have been obtained from Gaultheria hispidula, G. punctata, G. leucocarpa, Polygala pauciflora, and Monotropa Hypopitys.

Adulterations.—The great density of this volatile oil prevents its adulteration with most cheaper ones, which would reduce its specific gravity. A mixture of alcohol and chloroform has been employed for the purpose, but is readily detected by the low boiling-point and the character of the first fractional distillate. The most common adulterant is oil of sassafras, which is colored dark-red and converted into a brown-red resinous mass by strong nitric acid. The pure oil yields nearly colorless crystals of *methyl nitrosalicylate*. When heated to about 80° C. (176° F.) the oil should not yield a colorless distillate having the characteristics of chloroform or of alcohol. On mixing 5 drops of the oil with 5 drops of nitric acid the mixture should not acquire a deep-red color, and should not solidify to a dark-red, resinous mass (absence of oil of sassafras).

For other properties and tests see the article Methyl Salicylas.

Oleum Betulæ Volatile, *U. S.*, Volatile oil of betula, Oil of sweet birch, *E.* A volatile oil, identical with synthetic methyl salicylate, obtained by distillation from the bark of sweet birch, Betula lenta, *Linné*. *Nat. Ord.* Betulaceæ.

Action and Uses.—Mixed with putrescible liquids, this oil is said to preserve them from putrefaction. Its action in large doses closely resembles that of other aromatic essential oils. A woman who had swallowed half an ounce of oil of wintergreen, with as much cod-liver oil, was presently seized with drowsiness, delirium, congestion of the head, and throbbing of the arteries. The face was swollen, the eyes bright, the pupils contracted; visual hallucinations occurred, with a tendency to sleep or coma, and yet there was "extreme irritability of the nervous system." Buzzing noises were in the ears; there was profuse salivation; the hands and feet were cold; and there was paresis of the left side. Impaired vision and slight hallucinations remained during convalescence. Gastric symptoms were almost entirely wanting (Hamilton, *New York Med. Jour.*, xxi. 602). Besides the symptoms above detailed there have been noted in certain cases profuse perspiration, extreme thirst, dilated pupils, feeble vision, ringing in the ears, tonic spasms, hemiparesis, painful or involuntary urination. Death has followed taking one ounce of the oil in fifteen hours, and apparently in less time after half an ounce had been swallowed (Pinkham, *Boston Med. and Surg. Jour.*, Dec. 1887, p. 548). In one of these cases after death the blood was black and fluid, and the stomach, duodenum, and kidneys were congested.

A mixture of oil of sassafrass and oil of gaultheria used as a flavoring ingredient of "sarsaparilla syrup" has produced severe gastro-intestinal disorder and drowsiness (*Boston Med. and Surg. Jour.*, May, 1885, p. 471). A radical difference between the actions of the salicylates and oil of gaultheria is that the latter causes death in the human race by coma, while the former produce it by asthenia. In the lower animals, according to Wood and Hare, the oil induces convulsions without stupor (*Therap. Gaz.*, x. 73).

In 1880, Perier made use of a mixture of essence of wintergreen and tincture of quillaia in the direct treatment of chronic cystitis, and a 1 per cent. solution of the former in vaseline as an antiseptic (*Med. Record*, xviii. 262). In 1881, Gosselin and Bergeron determined that, like alcohol and salicylic acid, this oil prevents putrefactive fermentation, and that when duly diluted with an alcoholic solution it does not irritate the tissues, but hastens the healing of their wounds and other lesions. These surgeons made use chiefly of a solution consisting of 100 parts each of alcohol and water with 2½ parts of oil of gaultheria (*Archives gén.*, Jan. 1881, p. 16). The analgesic power of this oil was shown by its efficacy in a case of *neuralgia* (tic douloureux) of the face which for years had resisted other remedies. The oil was prescribed in 15-minim doses every three hours (Dercum, *Phila. Med. Times*, xvii. 471). The large proportion of methyl salicylate contained in the oil naturally led to its employment in *rheumatism*. It was apparently first used for this purpose by Casamayor (*Ephemeris*, i. 30), and next by Kinnicutt (*Med. Record*, xxii. 505). Twelve cases of acute [articular] rheumatism treated by the latter gave an average duration of the pyrexia of three and a half days; of the joint-pains, four and a half days; of the stay in hospital, twenty-four and a half days. The oil was given at first in doses of 10 minims every two hours until eight doses had been taken, and afterward the doses were increased as well as their frequency. The reporter

believed that his cases presented less than the usual proportion of heart-complications, but if so the oil must differ in its effects from its active element, salicylic acid. The late Dr. Flint (*Phila. Med. Times*, xiii. 846), Gottheil (*Med. Record*, xxiv. 258), and Seelye (*New York Med. Jour.*, Nov. 1884) have reported analogous results. Seelye admits that the oil is as apt as salicylic acid to induce depression and disorder of the nervous system, especially in the intemperate. Indeed, there seems to be no clinical ground for employing it as a substitute for salicylic acid and sodium salicylate. Its use, or that of the oil of birch, has been advocated upon the ground of its chemical composition, as a methyl-salicylate (Squibb), although an exception is made in the case of acute articular rheumatism. In nine out of twenty cases of gonorrhœal rheumatism in its early stage, large doses of this oil were found decidedly beneficial (Taylor, *Boston Med. and Surg. Jour.*, Jan. 1887, p. 558). This oil forms a useful addition to liniments employed for muscular and articular *rheumatism* and other local pains. It is sometimes used as a carminative, but most frequently to conceal the taste of nauseous medicines. It assists in flavoring the compound syrup of sarsaparilla. The dose may be stated at Gm. 0.30–0.60 (ɱ v–x) every three to six hours, and gradually increased until some ringing in the ears is perceived. It may be given in powdered sugar or floated on water, or in gelatin capsules. It does not readily cause disgust. The *poisonous* effects of this oil may be combated by stimulant emetics, ammonia, and hypodermic injections of alcoholic liquors or ether.

OLEUM GOSSYPII SEMINIS, *U. S.*—Cotton-seed Oil.

Oleum gossypii.—Cotton oil, E.; *Huile de coton, Huile de semences de cotonnier*, Fr.; *Baumwollsamenöl*, G.

A fixed oil expressed from the seed of Gossypium herbaceum, *Linné*, and of other species of Gossypium, and subsequently purified.

Nat. Ord.—Malvaceæ.

Origin and Preparation.—(For remarks on the cotton-plant see page 790). After the seeds have been deprived of the cotton they are about 8 Mm. (⅓ inch) in length and 4 Mm. (⅙ inch) in width, of an irregular ovoid shape, have a brown, hard, somewhat brittle testa with a prominent raphe along its entire length, and contain a whitish embryo with large, folded cotyledons and numerous blackish resin-glands imbedded in its tissue. For obtaining the oil the testa is crushed in a suitable machine and removed by winnowing; the kernels (embryo) are then ground, and, enclosed in bags, are subjected to hydraulic pressure. A bushel of seeds yields about 2 gallons of oil, or, by weight, 100 parts of seeds give shells and cotton-fibre 47, press-cake 38, and oil 15 parts. The air-dry seeds contain oil 21.5, albuminoids 28, other organic substances 33.5, ash 9, and water 8 per cent. The average composition of the press-cakes is oil 7.5, albuminoids 20, other organic compounds 51, ash 8.5, and moisture 13 per cent.

Purification.—The crude oil is of a more or less deep-brown color, turbid, thickish, and contains a large percentage of albuminous matter. On standing, a portion of the impurities subside, and the oil, now termed "clarified," becomes clear and of an orange color. On treating it with boiling water or superheated steam the albuminoids are coagulated, and a still lighter colored or refined oil is obtained. The final bleaching is effected by agitating the oil well with a small portion of alkali solution and heating.

Properties.—Bleached cotton-seed oil is perfectly transparent, and has a pale straw-yellow color, a bland nut-like taste, and a neutral reaction. Its specific gravity at 15° C. (59° F.) is .925–.927 (.920–.930 *U. S. P.*); that of the crude oil, .930–.932. It is very sparingly soluble in alcohol, but dissolves readily in ether, chloroform, benzin, etc. Near 12° C. (56° F.) the oil begins to deposit palmitin, but it does not congeal until cooled to 0° or —5° C. (32° or 23° F.). Exposed to the air, the oil gradually thickens, but it does not solidify; by the elaidin test it is converted into a yellow or brownish soft mass. Sulphuric acid, sp. grav. 1.75 or more, imparts at once a dark, reddish-brown color, and gradually forms a thick jelly-like mass; weaker sulphuric acid applied in the cold causes a deeper yellow or orange color. Nitric or hydrochloric acid scarcely affects the color, but fuming nitric acid colors orange-brown. Warmed with concentrated solution of zinc chloride, a brown color is produced. When agitated with concentrated solution of lead subacetate, S. S. Bradford (1882) noticed after some time the production of a red tint, and considers this behavior as a reliable test for the detection of cotton-seed oil in olive oil. The oil is readily saponified by strong solutions of alkali, with the exception of a bright-yellow coloring matter, which may be obtained by agitating the soap with benzin.

Composition.—Cotton-seed oil consists chiefly of olein and palmitin, and about 1.8 per cent. of a bright-yellow liquid hydrocarbon. According to O. Bach (1883), the fatty acids of this oil melt at 38° C. (100.4° F.) and congeal again at 35° C. (95° F.). From that portion of the oil saponified in the bleaching process F. Kuhlmann (1861) obtained a pigment by heating the soapy sediment with 4 per cent. of sulphuric acid for several hours to 100° C. (212° F.), washing with water, and dissolving in alcohol. This *cotton-seed blue*, $C_{17}H_{24}O_4$, is amorphous, readily destroyed by oxidizing agents, insoluble in water, diluted acids, and alkalies, sparingly soluble in carbon disulphide and chloroform, soluble in 77 parts of alcohol and 8.4 parts of ether, and dissolves with a purple color in sulphuric acid; it is bleached on exposure to light and air.

Pharmaceutical Uses.—The oil is used by the U. S. P. for liniments in the place of olive oil.

Tests.—"If 6 Gm. of the oil be thoroughly shaken, in a test-tube, for about two minutes, with a mixture of 1.5 Gm. of nitric acid and 0.5 Gm. of water, then heated in a bath of boiling water for not more than fifteen minutes, the oil will assume an orange or reddish-brown color, and, after standing for twelve hours at the ordinary temperature, will form a semi-solid mass. If 5 Cc. of the oil be thoroughly shaken, in a test-tube, with 5 Cc. of an alcoholic solution of silver nitrate (made by dissolving 1 Gm. of silver nitrate in 100 Cc. of deodorized alcohol and adding 0.5 Cc. of nitric acid), and the mixture heated for about five minutes in a water-bath, the oil will assume a red or reddish-brown color."—*U. S.*

Allied Oils.—Oleum fagi.—Beech oil, *E.*; Huile de faines, *Fr.*; Buchelöl, Bucheckeröl, *G.*—The fruit of the European beech tree, Fagus sylvatica, *Linné* (nat. ord. Cupuliferæ), is in some parts of Europe used for the preparation of oil, of which, after the removal of the integuments, about 22 per cent. is obtained. The press-cake is said to have a deleterious effect when eaten by cattle or horses, but is used for feeding hogs and poultry. The oil is yellow and of a mild odor and taste, or, if expressed with heat, somewhat acrid, but becomes mild by age. It does not easily turn rancid, has the spec. grav. .921 to .923, congeals at about −17.5° C. (.5° F.), consists mainly of olein with little palmitin and stearin, and behaves to nitric, fuming nitric, and sulphuric acids in a similar manner as cotton-seed oil, but assumes a flesh color with zinc chloride. On saponification it yields a rather soft soap.

Oil of Brazil Nuts. Bertholletia excelsa, *Humboldt et Bonpland* (nat. ord. Lecythidaceæ), is a large tree indigenous to Brazil, where it is known as *castanheiro de Para*. The globular fruit is about 10 inches (25 Cm.) in diameter, and contains sixteen to twenty seeds, called *Brazil nuts* or *Para nuts*—Chataigne du Brésil, *Fr.*; Paranuss, *G.* These are 1¼ to 2 inches (3–5 Cm.) long, three-edged, convex upon the back, have a rough, brown-gray, hard testa, and contain a white kernel of an almond-like taste and yielding about 60 per cent. of fixed oil. This is pale-yellow, bland, easily turns rancid, congeals at −1° C. (30° F.), becomes red and red-brown by sulphuric acid and rose-colored by zinc chloride, and consists of olein with palmitin and stearin. A similar oil is yielded by the *Sapucaya nuts*, the seeds of Lecythis Zabucajo, *Aublet*, of Brazil.

Action and Uses.—This oil has been substituted for olive oil in several officinal preparations, and may be employed in all the surgical manipulations in which the latter was originally used. It is extensively used as food and is esteemed digestible and wholesome.

OLEUM HEDEOMÆ, *U. S.*—Oil of Hedeoma.

Oil of pennyroyal, E.; *Essence de pouliot américain*, Fr.; *Poleiöl*, G.

The volatile oil distilled from the fresh herb of Hedeoma pulegioides, *Linné*.

Nat. Ord.—Labiatæ.

Preparation.—The fresh herb (p. 806) is distilled with water or by means of steam.

Properties.—The oil is a limpid, colorless, or yellowish volatile liquid of a peculiar pungent, mint-like odor and taste, and has a specific gravity of 0.93 to 0.94 at 15° C. (59° F.). It has a neutral or slightly acid reaction, is soluble in an equal volume of alcohol and also in carbon disulphide or glacial acetic acid. It dissolves iodine with a brisk explosive reaction, yielding a viscous liquid. A mixture of the oil with chloral hydrate and sulphuric acid acquires a brownish-green color.

Fresh European pennyroyal (Pouliot, *Fr.*; Polei, *G.*), Mentha Pulegium, *Linné*, s. Pulegium vulgare, *Miller* (Bentley and Trimen, *Med. Plants*, 201), yields about 1 per cent. of a volatile oil having a similar odor, according to Kane a density of .925 to .927, a boiling-point near 185° C. (365° F.), and the composition $C_{10}H_{16}O$. The volatile oil of Pulegium micranthum, *Claus*, of Southern Russia, examined by Buttlerow (1854), has the same composition, but a greater density and higher boiling-point.

Composition.—Oil of hedeoma contains oxygen, but its exact composition has not been ascertained.

Action and Uses.—It has essentially the same action and virtues as the associated volatile oils; that is to say, it is an aromatic stimulant, carminative, and emmenagogue under fit conditions, and is added to embrocations to increase their anodyne and rubefacient action. The *dose* is from Gm. 0.10–0.60 (2 to 10 drops).

OLEUM JUNIPERI, *U. S., Br., P. G.*—Oil of Juniper.

Oleum fructus (vel baccæ) juniperi.—Oil of juniper-berries, E.; *Essence de genièvre*, Fr.; *Wachholderbeeröl*, G.

The volatile oil distilled from the fruit of Juniperus communis, *Linné* (see p. 906).

Nat. Ord.—Coniferæ.

Preparation.—Ripe or nearly ripe juniper-berries are well bruised, mixed with table-salt and water, and distilled either over the naked fire or by the aid of steam. The yield is usually ½ to ¾ per cent., and sometimes exceeds 1 per cent.

Properties.—Oil of juniper-berries is colorless or pale greenish-yellow, limpid, but on exposure rapidly thickens and turns yellow, and ultimately reddish-brown, at the same time acquiring an acid reaction; the fresh-distilled oil from old juniper-berries is thickish and light-yellow. Its specific gravity is about 0.850 to 0.890 at 15° C. (59° F.); it begins to boil at 155° C. (311° F.), or if obtained from ripe berries at 205° C. (401° F.) (Blanchet), has the peculiar odor of the berries, and a warm, aromatic, somewhat sweetish and terebinthinate taste, shows a neutral reaction to test-paper, turns polarized light slightly to the left, and is soluble in four times its volume of alcohol, forming a more or less turbid solution; but it yields clear mixtures with carbon disulphide or glacial acetic acid in all proportions. Iodine dissolves slowly in the limpid oil, but acts more energetically upon the thickened oil, sometimes producing fulmination; sulphuric acid colors it brown and red. Old oil of juniper contains formic acid, from which it may be freed by sodium carbonate and rectification.

Composition.—The oil is a mixture of hydrocarbons of the general formula $C_{10}H_{16}$, which differ in their boiling-point (see above), a portion boiling at 282° C. (539.6° F.) (Souberain and Capitaine). It yields with hydrochloric acid gas a liquid compound.

Adulteration.—The similarity of oil of juniper and oil of turpentine in specific gravity, boiling-point, and behavior to solvents and reagents renders the detection of an adulteration with the latter rather difficult, except by the formation of a solid compound with hydrochloric acid gas, and by its different odor, particularly after exposure. "1 drop of the oil, triturated with sugar and agitated with 500 Gm. of water, should not impart a sharp taste to the latter."—*P. G.*

The *oil of juniper-wood*, obtained by distillation with water, has a different, more terebinthinate odor, and is at first limpid and colorless, but on exposure becomes thick, yellow, and finally dark-brown.

Action and Uses.—Oil of juniper is stomachic, carminative, and diuretic. In large doses it occasions in animals the same effects upon the nervous and vascular systems as other essential oils, with the addition of diuresis. The last-mentioned operation is evident in man as an effect of medicinal doses. It reddens, and may even blister, the skin. It is an efficient ingredient of diuretic infusions and mixtures, is much used to promote urination in the form of Holland gin, and when inhaled from an atomized solution its diuretic virtues are sometimes promptly and distinctly manifested. The *dose* is Gm. 0.30–1 (gtt. v–xv).

OLEUM LAVANDULÆ FLORUM, *U. S., Br., P. G.*—Oil of Lavender-flowers.

Essence de lavande, Fr.; *Lavendelöl*, G.

The volatile oil distilled from the fresh flowers of Lavandula officinalis *De Candolle* (see p. 932).

Nat. Ord.—Labiatæ.

Preparation.—Oil of lavender is distilled in Great Britain and France from the flowers alone or from the flowering-tops or the entire plant, steam heat being usually resorted to. The flowers yield about ½ per cent. of the oil; the quantity, however, varies, and seems to increase in plants grown in southern localities. Stem and leaves yield a small portion of less fragrant oil.

Properties.—The oil is very limpid, colorless, yellowish or greenish-yellow, and neutral, and acquires by age an acid reaction and viscid consistence. Its specific gravity is 0.885 to 0.897 at 15° C. (59° F.); it commences to boil at about 185° C. (365° F.). It has a levogyre action, reacts briskly and with some detonation on the addition of iodine, and acquires a brown color when agitated with corrosive sublimate. Exposed to a low temperature, it sometimes separates stearopten. Its fragrance varies with the part of the plant used for distillation; its taste is bitterish and pungent. The better quality is known in commerce as *oil of garden lavender*.

Composition.—The most volatile portion is a hydrocarbon of the formula $C_{10}H_{16}$. The stearopten is stated by Dumas to be identical with camphor. According to Lallemand (1859), the terpene boils at 175° C., and a second one between 200° and 210° C. (392° and 410° F.); the oxygenated fraction of the oil contains acetic, and probably also valerianic, acid in combination as ethers. Bruylants (1879) found the terpene to boil at 162° C. (323.6° F.), and ascertained the presence of formic and acetic acids, of 10 per cent. of resin, and of 65 per cent. of borneol and camphor. Shenstone (1882) ascertained that the boiling-point of the terpene is raised by continued heating, and suggests that the oxygenated compound is not camphor, but easily converted into it by oxidizing agents.

Adulteration.—The admixture of oil of turpentine is detected by the decreased solubility in alcohol. *Oil of spike lavender* has a deeper green-yellow color and a more terebinthinate, camphoraceous odor, but agrees with oil of lavender in solubility; according to Lallemand, it contains a dextrogyre hydrocarbon boiling at 175° C. (347° F.), and a stearopten apparently identical with camphor; but Bruylants (1879) regards it as differing from oil of lavender, mainly in containing a larger proportion of terpene.

Tests.—The oil is soluble in all proportions of alcohol (distinction from oil of turpentine), and in 3 times its volume of a mixture of 3 volumes of alcohol and 1 volume of water (distinction from, and absence of, oil of turpentine); it is also soluble in glacial acetic acid; but with an equal volume of carbon disulphide it forms a turbid mixture. When heated on a water-bath, in a flask provided with a well-cooled condenser, the oil should yield no distillate having the character of alcohol.—*U. S.*

Action and Uses.—This preparation is very seldom prescribed alone, but it may be used to calm *nervous headache* by rubbing a few drops of it upon the temples or by its internal use in the *dose* of Gm. 0.30 (gtt. iv–v). Its carminative and general stimulant operation is usually obtained through the simple and compound spirit of lavender.

Oil of lavender-flowers is more fragrant than the oil distilled from the herb and flowers, but its action, uses, and *dose* are about the same.

OLEUM LIMONIS, *U. S.*, *Br.*—Oil of Lemon.

Oleum citri, P. G.; *Oleum de cedro*, *Oleum limonum*.—*Essence de citron*, *Essence de limon*, Fr.; *Citronenöl*, *Limonenöl*, G.

The volatile oil extracted by expression from the fresh peel of Citrus Limonum, *Risso*. *Nat. Ord.*—Rutaceæ.

Preparation.—The fresh rind of nearly ripe lemons is pressed between the fingers in such a manner that the oil-cells are ruptured, the exuding oil being received upon a sponge, which when saturated is expressed; or the oil-cells are ruptured by a process of superficial grating, the oil being drained off. An oil of inferior fragrance is obtained by grating the outer rind completely off and distilling the magma with water. Oil of lemon is manufactured in Southern France and Italy.

Properties.—Oil of lemon has a pale-yellow color, is limpid, neutral, of a very agreeable fragrance and mild, aromatic, bitterish taste. As received in commerce, it is usually turbid, but becomes clear on standing; by age it acquires a thicker consistence and a pungent terebinthinate odor and taste, which change is prevented or retarded by the addition of 5 per cent. of alcohol and decantation of the clear oil from the sediment; this treatment was recommended by the last Pharmacopœia for the preservation of the oil. Its specific gravity is about 0.857 to 0.863 at 15° C. (59° F.); it commences to boil at about 160° C. (320° F.), rotates polarized light to the right, produces a brisk fulmination with iodine, yields with Fröhde's reagent a deep orange-brown color (Dragendorff, 1876), and by hydrochloric acid gas is converted into a liquid and a solid compound, which, distilled over lime, yield again colorless oils, the former *citrylene*, the latter *citrene* (or *citronyl*), having a lemon-like odor. Oil of lemon yields with 7 volumes (3 volumes, *U. S.*) of alcohol a solution, but is soluble in all proportions in carbon disulphide, abso-

lute alcohol, or glacial acetic acid. When kept for some time it should not acquire a terebinthinate odor or taste (absence of turpentine or of other oils containing pinene).

Composition.—Aside from a small quantity of an oxygenated compound, oil of lemon consists of several hydrocarbons having the general formula $C_{10}H_{16}$. W. A. Tilden (1879) states that at least 76 per cent. of the oil consists of *citrene*, $C_{10}H_{16}$, boiling at 176° C. (348.8°F.), having an odor like hesperidene; 6 per cent. consists of *cymene*, $C_{10}H_{14}$, and the remaining portion contains several hydrocarbons, an alcohol, $C_{10}H_{18}O$, boiling above 200° C. and its acetic ether.

Adulterations with the volatile oils of other fruits of the genus Citrus are very difficult to detect; odor and taste must be chiefly relied upon. "1 drop of the oil triturated with sugar and agitated with 500 Gm. of water, should impart to the latter the pure odor of lemon."—*P. G.*

Uses.—Oil of lemons is used almost exclusively as a flavoring agent and as a perfume.

OLEUM LINI, *U. S., Br., P. G.*—Flaxseed Oil.

Linseed oil, E.; *Huile de lin*, Fr.; *Leinöl, Leinsamenöl*, G.

The fixed oil, expressed without heat, from the seed of Linum usitatissimum, *Linné. Nat. Ord.*—Linaceæ.

Preparation.—This oil is made on the large scale by thoroughly drying the seed with the aid of heat, crushing and forcibly expressing it. The yield by cold pressure is 16 to 20 per cent., by hot pressure 25 to 28 per cent. It is largely manufactured in this country.

Properties.—Expressed in the cold, linseed oil is limpid, neutral to test-paper, yellowish or yellow, and of a peculiar bland and unpleasant odor and taste. For use in the arts linseed oil is obtained by hot pressure, is somewhat thicker, brownish, has more odor, and a somewhat acrid taste. Its specific gravity is 0.930 to 0.940 at 15° C. (59° F.). It imparts a yellow color to alcohol on being agitated with it, dissolves in 40 parts of cold and 5 parts of boiling alcohol, in 10 parts of absolute alcohol, ether, and in all proportions of oil of turpentine, chloroform, ether, benzin and carbon disulphide. It does not congeal above —20° C. (—4° F.) to a yellowish mass. It yields with alkalies a very soft soap. In contact with fuming nitric acid it ignites, but when agitated with nitric acid of specific gravity 1.33 it turns green, and afterward brown; it does not solidify in contact with nitrous acid. Exposed to the air, it gradually thickens, becomes rancid, and finally solidifies; if spread in a thin layer on glass and exposed for some time, it should not remain soft (absence of non-drying oils); linseed oil thickened by exposure is completely soluble in alcohol. Crude oil which is mixed with mucilaginous matters quickly turns rancid and acquires an acid reaction; to obviate this change, the seed before expression is completely deprived of water. Linseed oil begins to boil at about 130° C. (266° F.), the boiling-point gradually rising, and when it has lost about 5 or 8 per cent. of its weight it constitutes *boiled linseed oil*, which is darker in color, thicker, and dries more rapidly than the unboiled oil.

Composition.—According to Mulder (1865), linseed oil is a mixture of about 80 per cent. of *linolein* with palmitin, myristin, and some olein, all being glycerides. *Linoleic acid* has the formula $C_{18}H_{32}O_2$ (Reformatzky, 1890); by treatment with strong HI, and subsequently with Zn and HCl, stearic acid $C_{18}H_{36}O_2$ is obtained, and is a colorless acid liquid readily soluble in alcohol and ether, and on exposure to air is converted into the hydrate of *oxylinoleic acid*, which more rapidly if frequently moistened with ether, is transformed into *linoxyn*, $C_{32}H_{54}O_{11}$. This latter compound is insoluble in ether, and is produced in a few days on the exposure of boiled linseed oil. The acrid taste of linseed oil seems to be due to the presence of a little resin; according to others, to traces of volatile fatty acids.

Tests.—"It should not more than slightly redden blue litmus-paper, previously moistened with alcohol (limit of free acid). If 2 Cc. of the oil be shaken with 1 Cc. of fuming nitric acid and 1 Cc. of water, it should neither completely nor partially solidify, even after standing for one or two days (absence of non-drying oils). If 10 Cc. of the oil contained in a small flask, be mixed with a solution of 3 Gm. of potassium hydroxide in 5 Cc. of water, then 5 Cc. of alcohol added, and the mixture heated for about five minutes on a water-bath, with occasional agitation, a dark-colored but clear and complete solution should result. If this liquid be diluted with water to the measure of 50 Cc., then cooled and shaken with 50 Cc. of ether, the clear, ethereal layer, after having sepa-

rated, should not show a bluish fluorescence, and, when carefully removed, and allowed to evaporate spontaneously, should leave not more than a slight, and not oily residue (absence of paraffin oils)."—*U. S.*

Pharmaceutical Preparations.—Oleum lini sulfuratum, s. Balsamum sulphuris. 6 parts of linseed oil are intimately mixed in an iron vessel with 1 part of sublimed sulphur, and the mixture boiled over a slow fire in an iron vessel, with constant stirring, until the whole has united into a homogeneous mass. It has about the consistence of a thick syrup, and is of a dark red-brown color. Diluted with three times its weight of oil of turpentine, it constitutes Oleum terebinthinæ sulfuratum, s. Balsamum sulphuris terebinthinatum.

Other Drying Oils.—The drying oils of walnut-, hemp-, sunflower-, poppy-, and pumpkin-seeds are described elsewhere in connection with the drugs.

Grape-seed Oil.—Huile de raisin, *Fr.*; Traubenkernöl, G.—The seeds of the different varieties of Vitis vinifera, *Linné* (nat. ord. Vitaceæ), yield from 10 to 20 per cent. of fixed oil, which is light-yellow or brownish, inodorous, faintly bitter, and congeals near −16° C. (3.2° F.). It dries very slowly, and consists, besides palmitin and stearin, chiefly of the glyceride of *erucic acid*, $C_{22}H_{42}O_2$; this acid melts at 34° C. (93.2° F.), and yields acetic and arachic acids on being fused with potassa.

Madia Oil is obtained from Madia sativa, *Molina* (nat. ord. Compositæ, Tubulifloræ), an annual herb, native of Chili and cultivated in Europe, Africa, and Asia. The brownish-gray, quadrangular, four-ribbed akenes, which are destitute of pappus, yield about 40 per cent. of fixed oil. This is yellow, bland, of a peculiar odor, and has the spec. grav. .930, and congeals near −20° C. (−4° F.). On exposure to air it becomes rancid and slowly acquires a soft-solid consistence. By nitric acid it is colored brown-red, by sulphuric acid greenish and brown. Besides palmitin and stearin, it contains an olein, which seems to differ from that of other oils.

Niger-seed Oil. Guizotia oleifera, *De Candolle*, s. Verbesina sativa, *Roxburgh* (nat. ord. Compositæ, Tubulifloræ), is indigenous to and cultivated in India and Eastern Africa. The subcylindrical, black, and glossy akenes yield about 40 per cent. of a thin yellow oil having a nutty flavor and congealing below −10° C. (14° F.). It is colored orange-yellow by nitric acid, and gray-green and brown by sulphuric acid, dries to a soft varnish, and consists of myristin, palmitin, and apparently two oleins, one of which is closely related to linolein.

Candle-nut Oil, Kekune Oil, Bankul Oil. The candle-nut-tree, Aleurites triloba, *Forster*, s. A. moluccana, *Willdenow*, is extensively cultivated in the islands of the Pacific and Indian Oceans and in India. The whitish kernels have a bland nutty flavor and yield about 60 per cent. of nearly colorless oil, which dries rapidly and is colored dark orange-red by nitric acid and yellow to brown by sulphuric acid. It consists of an olein resembling linolein, besides myristin, palmitin, and stearin.

Action and Uses.—Flaxseed oil is a laxative in the *dose* of Gm. 32–64 (f℥i–ij). It has been recommended to be given in this manner as a remedy for *hæmorrhoids*. Only cold-pressed oil should be used internally. Its most important application is in the treatment of *burns* when mixed with an equal quantity of lime-water. The same mixture is also applied with advantage in *impetigo*.

OLEUM MENTHÆ PIPERITÆ, *U. S.*, *Br.*, *P. G.*—Oil of Peppermint.

Essence de menthe poivrée, Fr. Cod.; *Pfefferminzöl*, G.; *Esencia de menta piperita*, Sp.

The volatile oil distilled from Mentha piperita, *Linné*.

Nat. Ord.—Labiatæ.

Preparation.—The fresh herb is distilled with water, or preferably with steam. For medicinal purposes the oil should be rectified by steam distillation. It is largely produced in Michigan, New York, and other States of the Union, and to some extent is exported to Europe, while, on the other hand, some European rectified oil of peppermint is imported into the United States. In Great Britain the yield is stated to be from 8 to 12 pounds of oil per acre (*Pharmacographia*); in the United States it is said to be sometimes as high as 20 pounds (Stearns, 1858).

Properties.—Oil of peppermint is a colorless, or more frequently yellowish or greenish-yellow, liquid, which on exposure becomes brownish and viscid. Its specific gravity is from 0.90 to 0.920 at 15° C. (59° F.). It commences to boil near 190° C. (374° F.), and at a low temperature sometimes deposits crystals of menthol. It has a peculiar pungent odor and a warm, aromatic, somewhat camphoraceous, and when old also bitterish, taste, followed by a sensation of cold, which is most noticed on drawing air into the mouth. It dissolves clear in 1 part of alcohol, the solution usually becoming opalescent with more alcohol, and depositing slowly a minute white precipitate. It is neutral to test-paper when fresh, and turns polarized light to the left. In its action

toward reagents it shows very considerable differences. Some oils of peppermint yield with sodium bisulphite a solid compound which has not been further examined (Flückiger). John (1873) observed that chloral hydrate produces with this oil a rose- and cherry-red color, and Dragendorff (1875) proved that this reaction is occasioned by some unknown constituent of impure chloral hydrate, and becomes less distinct the purer the reagent is. If a little sugar be added to an alcoholic solution of the oil, then a few drops of hydrochloric acid, and the mixture gently heated, a deep blue color is produced. Strong nitric acid colors it purplish to brown, but when from 50 to 70 drops of the oil are mixed with 1 drop of nitric acid specific gravity 1.2, the mixture is gradually changed from yellowish to brownish, and finally to a permanent violet, blue, or greenish blue when viewed in transmitted light, while in reflected light the mixture is of a red-copper color and opaque; the reaction, which is not prevented by oil of turpentine, may be hastened by warming the mixture or by decreasing the oil (Flückiger, 1871). The Pharmacopœia has applied this test as follows: 5 Cc. of the oil are mixed with 1 Cc. of glacial acetic acid, and thus 1 drop of nitric acid is added. The color produced is the same as just stated. Schack (1878–81) observed that an alcoholic solution of the oil and salicylic acid gradually becomes copper-green, and that the melted acid becomes at once blue-green on the addition of the oil; phenol and most acids, but not carbonic acid, have a similar effect, and a mixture of 1 Cc. of glacial acetic acid and 5 drops of oil of peppermint, slightly warmed, shows a blue color in transmitted light and a blood-red in reflected light; but menthol or oil of crisped mint does not yield the reaction. Picric acid dissolves in oil of peppermint with a yellow color, gradually, or when slightly heated more rapidly, changing to green; in presence of water and air a reddish-yellow color is afterward produced (Frebault, 1874). Iodine does not act energetically with the oil, but dissolves and renders it thicker. With ethereal or chloroformic solution of bromine a rose-red or violet color is produced, changing gradually to a dirty pink or purplish color. In consequence of insufficient weeding of the mint-fields, American oil of peppermint is not unfrequently mixed with oil of erigeron, acquires a rank "weedy" smell, and seems to be disposed to resinify more rapidly.

Composition.—Oil of peppermint owes its peculiar odor to *menthol* (mint camphor, mint stearopten), $C_{10}H_{20}O$, which is chiefly contained in the last portions obtained on subjecting the oil to fractional distillation. It forms colorless prisms which fuse at 42° C. (76° F.), and boil at 212° C. (414° F.). Distilled with phosphoric anhydride, it yields *menthene*, $C_{10}H_{18}$, which is a colorless liquid of an agreeable odor. According to Moriga (1881), oil of peppermint contains probably also an oil of the formula $C_{10}H_{18}O$, which may be prepared from menthol by oxidation with potassium dichromate; but by treatment with fuming nitric acid menthol yields at first an explosive oil, afterward crystals of an acid, $(C_5H_8O_4)_2H_2O$, melting at 97° C. (206.6° F.); this compound is not identical with pyrotartaric acid, with which it agrees in composition. A compound isomeric with borneol had been found by Beckett and Wright (1875) in the liquid portion of Japanese peppermint oil, but, according to Flückiger and Power (1880), is not present in the oil distilled at Mitcham, which contains, besides menthol, several hydrocarbons of the formulas $C_{10}H_{16}$ and $C_{15}H_{24}$, and having a terebinthinate somewhat lemon-like odor.

Adulterations and Tests.—Besides oil of erigeron, alcohol, castor oil, and oil of turpentine have been employed for the purpose; the presence of the last two bodies renders the oil not readily soluble in 80 per cent. alcohol, and the last one mentioned causes it to be acted on with more violence by iodine. "If to 5 Cc. of nitric acid 1 drop of the oil be added, the mixture gently agitated, and allowed to stand for about three hours, it should have a yellowish, but not a bright red color (absence of the oils of camphor and of sassafras). If a portion of the oil, contained in a test-tube, be placed in a freezing mixture of snow (or pounded ice) and salt for fifteen minutes, it should become cloudy and thick, and, after the addition of a few crystals of menthol, being still exposed to cold, it should soon form a crystalline mass (distinction from dementholized oil). When heated on a water-bath, in a flask provided with a well-cooled condenser, the oil should not yield a distillate having the characters of alcohol.—*U. S.*

Menthol is sometimes met with in commerce as *Japanese* or *Chinese oil of peppermint*, and is obtained from a plant which, according to Holmes, is nearly related to Mentha canadensis, *Linné*. On one occasion it was largely adulterated with magnesium sulphate.

Action and Uses.—Elsewhere (see MENTHA PIPERITA) are described the carminative and anodyne virtues of peppermint, which belong to all its preparations, and especially to its essence (*Spiritus menthæ piperitæ*), which is merely an alcoholic solution of the oil. The latter appears to possess in a remarkable degree the analgesic properties

of its class. The sensation of cold produced by its application to the skin or mucous membrane is subjective only. Braddon highly praised this oil as a surgical antiseptic (*Therap. Gaz.*, xii. 358). Anciently peppermint was employed by the Romans as an application to the temples for the relief of headache, and within a few years it became known that the oil (stearopten) was used by the Chinese for a similar purpose. In imitation of their practice it has been a good deal employed as a local anodyne in *neuralgia* and *neuralgic headache*, applied over the supraorbital, the temporal, or other nerves in which the pain is most severe. A small wad of compressed cotton saturated with the oil should be laid upon the painful spot, covered with a piece of sheet caoutchouc, and bound firmly in its place. Merely painting the skin with the oil by means of a brush or a tuft of cotton will sometimes answer the purpose. In local *rheumatic* affections the latter method is often very efficient. It has also been used successfully as a topical anodyne in superficial *burns* and *scalds* and in *zona*. In several forms of *pruritus* caused by ascarides, in *urethral caruncle*, and various affections of the *uterus* and *vagina* it forms an efficient addition to solutions of soda, borax, etc. According to Duncan, it is, like its homologue *thymol*, antiseptic (*Practitioner*, xxiii. 47). Lober recommends the addition of the oil or the essence of peppermint to mixtures given internally in the treatment of gonorrhœa. It is said to allay urethral pain (*Bull. de Thérap.*, xcii. 105).

In *dental caries* this oil is quite as efficient in relieving pain as oil of cloves, and more permanent in its effects than chloroform. For internal use oil of peppermint may be prescribed in *doses* of Gm. 0.05–0.15 (gtt. j–iij), but the officinal spirit is to be preferred.

OLEUM MENTHÆ VIRIDIS, *U.S., Br.*—Oil of Spearmint.

Essence de menthe verte, Fr.; *Römisch-Minzöl*, G.; *Esencia de menta*, Sp.

The volatile oil distilled from Mentha viridis, *Linné*.

Nat. Ord.—Labiateæ.

Preparation.—The fresh herb is distilled in the United States and Great Britain with water or by means of steam; the yield is about ¼ to ½ per cent.

Properties.—It resembles oil of peppermint in color, specific gravity, changes produced by exposure, and behavior to iodine and to polarized light, but differs from it in odor and the slight cooling taste. Its spec. grav. at 15° C. (59° F.) is from 0.93 to 0.94. We have noticed that fresh oil of spearmint usually dissolves clear in all proportions, while old oil yields a turbid solution with more than 3 parts of 80 per cent. alcohol. As to solubility of the oil the Pharmacopœia states that with an equal volume of alcohol it forms a clear solution, which is neutral or slightly acid to litmus-paper. When somewhat further diluted with alcohol, it becomes turbid. It also affords a clear solution with an equal volume of glacial acetic acid and with half its volume of carbon disulphide; but with an equal volume of the latter it forms a turbid mixture. Its boiling-point, according to Kane, is 160° C. (320° F.). Its odor, like that of oil of peppermint, is preserved for a long time by the addition of 3 or 4 per cent. of alcohol.

Composition.—Gladstone (1863) separated from the oil a hydrocarbon, $C_{10}H_{16}$, and an oxygenated oil, $C_{10}H_{14}O$, to which the odor is due, and which has the density .9515 and boils at 225° C. (437° F.).

Uses.—Oil of spearmint is less used than the oils of peppermint and horsemint. It appears to be less powerful than those oils, and may be prescribed in *doses* of from Gm. 0.10–0.30 (2 to 0 drops), diluted with sweetened water or in the form of spirit of spearmint.

OLEUM MORRHUÆ, *U. S., Br.*—Cod-Liver Oil.

Oleum jecoris aselli, P. G.; *Oleum hepatis morrhuæ.—Cod oil*, E.; *Huile de morue, Huile de foie de morue*, Fr. Cod.; *Leberthran, Stockfischleberthran*, G.; *Aceite de higado de bacalao*, Sp.

The fixed oil obtained from the fresh liver of Gadus Morrhua, *Linné*, and of other species of Gadus (Class Pisces; Ord. Teleostia; Fam. Gadida).

Origin.—The *common cod*, formerly called Asellus major, inhabits the Northern Atlantic, and is frequently met with on the North American coast on and near the Banks of Newfoundland, where it seems the *hake*, G. Merluccius, *Linné*, s. Merluccius communis, *Cuvier*, *pollack*, G. (Merlangus, *Cuvier*) pollachius, *Linné*, and *haddock*, G. æglifinus, *Linné*, are likewise used to some extent for the same purpose. On the Norwegian coast, accord-

ing to De Jongh (1843), cod-liver oil is mainly produced from the *dorse*, G. Callarius, *Linné*, but also from the *pollack*, the *coal-fish*, G. (Merlangus, *Cuvier*) carbonarius, *Linné*, the *whiting*, Merlangus vulgaris, *Cuvier*, s. G. Merlangus, *Linné*, and the *ling*, Gadus (Lota, *Cuvier*) Molva, *Linné*.

Preparation.—On the coast of Norway the carefully-cleaned livers are placed in baskets or barrels exposed in a sunny place, where the oil slowly exudes, and is removed and filtered; or the livers are slowly heated in a steam- or water-bath, or sometimes boiled with water, the oil being skimmed off from the surface. (See *Proc. Amer. Phar. Assoc.*, 1876, p. 810.) On the coast of North America cod-liver oil is now generally very carefully prepared. The introduction of ice as a means of preserving has developed the business of transporting codfish fresh to the inland cities during the catching season, from December to March, and likewise that of the proper preparation of cod-liver oil from fresh livers on shore by means of gradually applied steam-heat, whereby the oil is separated from the tissues, the watery portion subsiding; the oil is placed in butts in the cooling-room until it freezes solid, when it is put into canvas bags and expressed; the hard, yellowish residue, consisting of stearin and liver débris, is sold to soapmakers, while the clear oil is bottled or put into dry barrels. (See *Amer. Jour. Phar.*, 1854, p. 1; 1870, p. 214; 1883, p. 471; *Proc. Amer. Phar. Assoc.*, 1875, p. 659.)

Properties.—The purest cod-liver oil is of a pale-yellow color, never quite colorless unless artificially bleached; it is limpid, has a slight fishy but not rancid odor, a bland slightly fishy taste, and a faint acid reaction; but if prepared at a high temperature, or if the livers are allowed to more or less putrefy, it has a more decided reaction and a pale or darker reddish-brown color, the darkest varieties being transparent only in thin layers, and having a repulsive fishy odor and a bitterish acrid taste. The acridity and fishy smell are less marked in the light-brown oil, and still less in the yellow or white oil, which is nearly bland. At 15° C. (59° F.) the spec. grav. of light cod-liver oil is 0.920 to 0.925, of the dark-colored about 0.930. Cold alcohol dissolves not over 2.5 per cent. from the yellow, but about 6 per cent. from dark-brown, cod-liver oil; boiling alcohol dissolves 1 or 2 per cent. more. Ether, chloroform, and carbon disulphide dissolve it in all proportions; the oil is soluble in 2.5 parts of acetic ether. At a low temperature a granular crystalline deposit is separated, in largest proportion from the darker-colored oil, but good medicinal cod-liver oil should at 0° C. (32° F.) deposit very little or no stearin (*P. G.*). On the addition of sulphuric acid a violet color, soon changing to brown-red, is produced, due to the presence of biliary compounds; the violet color is also produced on shaking a solution of 1 drop of cod-liver oil in 20 drops of chloroform with 1 drop of sulphuric acid, but the color is very transient and becomes pale-red and brownish. Nitric acid colors cod-liver oil purple, afterward violet and brown. In contact with nitrous acid the oil becomes thicker, but does not solidify.

Composition.—Cod-liver oil has been repeatedly analyzed, and found to be a mixture of several glycerides, the principal one being olein, with variable quantities of stearin, palmitin, and myristin, increasing with the darker color. Hopfer de l'Orme (1837) first proved the presence of iodine, which, according to L. Gmelin (1840), was supposed to be in combination with potassium; however, hot and cold water and alcohol fail to extract it, and the precise form in which iodine is present is still unknown. The same may be said of bromine, phosphorus, and sulphur. Chevallier, Donovan, Herberger, Marder, and others did not find iodine in all samples of cod-liver oil; some investigators have found it in the ashes of soap prepared from it, others in the mother-liquor after separating the soap. De Jongh determined its amount to vary between .029 in dark and .040 per cent. in light-brown oil. Mitchell Bird (1882), however, ascertained that 10,000 parts of pale Norwegian oil contained only between .21 and .18 parts; pale Newfoundland oil, .12 parts; and the pale-brown oils, .16 and .14 parts of iodine. Winckler's (1852) statement that glycerin could not be obtained from cod-liver oil, which he regarded as an organic whole containing oxide of propyl, has not been corroborated by other investigators. P. Carles (1882) determined the amount of free acid, calculated as acetic acid, to be 0.01 and 1.80 per cent. in pale and brown cod-liver oils respectively. De Jongh regards the acid reaction of cod-liver oil as being due to butyric and acetic acids, and has recognized the presence in it of several biliary acids, coloring principles, and *gadoin*. The latter, according to Gautier and Mourgues (1888), is identical with *morrhuic acid*, which exists in the oil in the form of an unstable compound resembling lecithin, which decomposes in contact with acids and alkalies, yielding glycerine, phosphoric acid, and morrhuic acid. $C_9H_{13}NO_3$. The latter is oily, becoming solid, dissolves in alcohol, hot water, and to some extent in ether; decomposes carbonates and forms also a hydrochloride, which is decomposed by

water with the formation of an emulsion. *Gadic acid* is the name given by Luck (1857) to a deposit obtained from a light-brown cod-liver oil; recrystallized from hot alcohol, it fused between 63° and 64° C. (145.4° and 147.2° F.).

Adulterations are very difficult to detect, because the colors mentioned above are but slightly modified by the presence of other oils, and the oils obtained from the livers of some other fishes show similar reactions. Some fish oils, however, are but slightly colored by sulphuric acid; others do not become violet at first, but at once turn brown-red or dark-brown. Such substitutions may be detected by this test. An adulteration with resin, noticed by Böttger in 1858, may be detected by the solubility of the adulterant in alcohol. In other respects the physical properties, as detailed above, still afford the best criterion of the purity and quality of cod-liver oil.

Tests.—"Cod-liver oil should not be more than but very slightly acid toward litmus-paper, previously moistened with alcohol (limit of free fatty acids). When the oil is allowed to stand for some time at 0° C. (32° F.), very little or no solid fat should separate (absence of other fish oils and of many vegetable oils). If to 10 or 15 drops of the oil, contained in a watch-glass, 2 or 3 drops of fuming nitric acid be added by allowing it to flow in on the side, a red color will be produced at the point of contact, which, on stirring the mixture with a glass rod, becomes bright rose-red, soon changing to lemon-yellow (distinction from seal oil, which shows at first no change of color, and from other fish oils, which become at first blue, and afterward brown and yellow.)"—*U. S.*

Allied Oils.—Oleum squali.—Shark oil. *E.:* Huile de requin, de selache, *Fr.:* Haileberthran, *G.*—It is made from the liver of the shark, Squalus Carcharias, *Linné*, and one or two allied species, and is the lightest of the fish-oils, its density at 15° C. (59° F.) being .870 to .880. It is light-yellow, has an acrid taste, and remains limpid at −6° C. (21.2° F.).

Oleum rajæ.—Ray oil, skate oil, *E.:* Huile de raie, *Fr.:* Rochenthran, *G.*—It is made from the liver of Raja Batis, *Linné*, and is employed in France and Belgium. The oil is pale- or bright-yellow, neutral, has the spec. grav. .928 at 15° C., a slight fishy odor and taste, and dissolves in 2 parts of ether. It is stated to contain more iodine than cod-liver oil. Oil is also extracted from the liver of the American *stingray*, Pastinaca hastata, *De Kay*.

Fish Oils.—These are in part obtained from different fishes, like the Alosa Menhaden, *Cuvier*, which is caught on the New England coast and yields *menhaden oil*, principally employed in leather-dressing. But among fish oils are also included the so-called *train oils*, obtained from the fleshy parts of different cetacean mammals; the principal ones are:

Oleum ceti.—Sperm oil, *E.:* Huile de cachalot, *Fr.:* Pottfischthran, *G.*—From Physeter macrocephalus, *Linné:* it is yellow or brown-yellow, of spec. grav. .920, and in the cold deposits spermaceti and stearin (see also page 439).

Oleum balenæ.—Whale oil, *E.:* Huile de baleine, *Fr.:* Walfischthran, *G.*—From Balæna mysticetus, *Linné*, and B. australis, *Desmoulins*, the Greenland or right, and the cape or southern, whale. The oil has a peculiar fishy odor and unpleasant taste, a density of .926, and begins to deposit a sediment at about 10° C. (50° F.).

Dugong Oil, from Halicore Dugong, *Cuvier*, which inhabits the waters of Eastern Australia and the Indian Archipelago, has been used in place of cod-liver oil in Australia.

Pharmaceutical Preparations.—Oleum morrhuæ ferratum has been recommended for some years. Bernbeck (1875) published a process of which the following is an outline: A solution of 1 part of well-dried neutral olive oil soap in 20 parts of hot water is precipitated by the gradual addition of a similar solution of 1 part of ferrous sulphate; the precipitated iron soap is rapidly collected on muslin, washed, and expressed to remove the water. This cake, though oxidizing superficially, will internally retain its whitish color for a long time. 4 parts of this soap are melted, and 96 parts of previously warmed cod-liver oil are added, and the heat continued for half an hour or more. This oil is of a dark-brown color, and contains 1 per cent. of metallic iron, mostly as ferrous oleate. A similar product is obtained by dissolving 1 or 1½ parts of ferric benzoate in 100 parts of cod-liver oil.

Oleum morrhuæ iodatum. Dissolve 1 part of iodine in a little ether, and add 1000 parts of cod-liver oil.

Extract of cod liver is the watery liquid obtained from the livers in preparing the oil, and evaporated; it yields 12½ to 15 per cent. of extract, which is said to consist of biliary constituents 60.6, water 21.8, the remainder being various salts. It was at one time (1866) recommended as a substitute for cod-liver oil.

Action and Uses.—Cod-liver oil is essentially a fat-producing agent, and thereby it retards the waste of nitrogenous tissues which is a characteristic of the diseases in which it is most serviceable. In this connection it should be borne in mind that among the various agents vaunted from time to time as remedies for consumption the most efficient have been oils and fats—*e. g.* asses' milk, cream, butter, fat pork, buffalo marrow,

etc. But cod-liver oil has the advantage over all of these articles that it excels them in digestibility. On what the latter quality depends is not fully determined, but the most plausible opinion is that it is due to the portion of biliary matter which the oil holds in solution. It has been shown experimentally that different oils vary extremely in their diffusibility through membranes, and that cod-liver oil is six or eight times more diffusible than other oils, vegetable or animal. Such appears to be the simple fact, but the explanation of it is not easy. It has been ascribed to the presence in the oil of a certain proportion of bile, and it is asserted that when this bile is removed the oil loses its diffusibility in the same proportion. But, on the other hand, it is alleged that the process employed to remove the bile has not really that effect, but eliminates certain other constituents of the oil. However this may be, no more satisfactory theory has been proposed. Moreover, this view is corroborated by the experiment in which an animal with a biliary fistula became more and more emaciated as long as it used only its ordinary food, but regained flesh and strength when a due proportion of cod-liver oil was added. It has been maintained that cod-liver oil owes its peculiar digestibility to the fatty acids it contains, and that the superiority of the dark over the light varieties is due to the larger proportion of these acids contained in the former (Hauser, *Zeitsch. klin. Med.*, xiv. 543).

From time immemorial cod-liver oil was a popular remedy for chronic gout and rheumatism, rickets, and scrofula in Great Britain and the countries bordering on the German Ocean, but it was not until about 1841 that it became generally known and used as a remedy for pulmonary consumption. The enthusiasm which inevitably attends the introduction of a new medicine of real efficacy exaggerated the benefits conferred by cod-liver oil in these diseases, but time and well-considered experience have nevertheless proved it to be a valuable remedy. Its curative powers in *chronic rheumatism* have been strikingly shown in cases of that disease prolonged by a cachectic state of the system—cases in which the muscles grow rigid and the joints stiff, and when to the debilitating influence of these infirmities is added the influence of dampness, crowding, bad ventilation, and coarse and insufficient food, especially in persons of an originally scrofulous constitution. In regard to *scrofula* itself, the medicine is singularly efficacious when the disease affects the internal lymphatic glands and the bones under the bad hygienic conditions just enumerated. Yet it is by no means to be depended upon in cases of supposed mesenteric disease—not only because the enlargement of the abdomen which is thought to indicate its existence in children is commonly a result of splenic or hepatic disorder, but, still more, because true *tabes mesenterica* is most apt to be associated with incurable tuberculosis of the intestines. It is of little use in scrofulous enlargement of the parotid, thyroid, and submaxillary glands, or of the glands of the neck, axillæ, and groins; but its efficacy is seen in the cure of the ulcers left after the discharge of softened scrofulous matter from these parts. Its utility in *scrofulous ophthalmia* is far from being established; at least one-half of the cases receive no benefit from it. It is a more valuable remedy in all forms of idiopathic *strumous caries*, especially when it affects the epiphyses of the long bones; and it is still more evidently beneficial in *rachitis*. It is also said to be an efficient remedy in "*laryngismus stridulus*" (*Practitioner*, xxxvii. 426). In the treatment of *white swelling* and other forms of *chronic arthritis*, and of *fistulæ* and *abscesses* in the neighborhood of joints, its powers are sometimes signally displayed. The various diseases of the skin to which scrofulous persons are peculiarly liable are often most favorably influenced by this medicine. Among them, *lupus vulgaris* is reputed to have been cured by it more frequently than by any other internal remedy, while some high authorities declare that no cure of existing lupus ever results directly from any kind of internal treatment whatever. It is true also that even when given for this disease it is generally associated with other and active medicines. In several scrofulous diseases of the skin, and especially of the scalp, this oil appears to have been used with success both internally and topically. Such diseases are *impetigo*, *chronic eczema*, *psoriasis*, and *favus*. Even *ichthyosis* is said to have been cured by similar means.

The great success which cod-liver oil at one time was believed to have gained as a cure for *pulmonary consumption* has tended more than any other cause to maintain the reputation of the medicine. It is now determined that it exerts little if any direct influence upon the structural elements of that disease, and that it can be said to cure only those rare cases in which other and especially hygienic methods have also restored consumptive patients to apparently good health. Such are those in which the patient is of a sluggish, lymphatic temperament and the tubercular deposit is strictly limited to a small portion of one lung. The efficiency of the medicine is much more notable when a cavity is

already formed than when the deposit is in a crude state. It plainly acts by maintaining the general health of the system while the local disease undergoes retrogression, for it constantly happens that although the latter process fails to occur, but on the contrary the destruction of the lung advances, yet the patient for a time gains weight and strength. In the more favorable examples the symptoms which depend upon the local lesion are mitigated, and even suspended, such as fever, sweating, cough, and expectoration. Yet in proportion as these symptoms prevail the oil fails to do good or is not tolerated. Although cod-liver oil is no longer claimed to be a cure for consumption, it still remains incomparably the most efficient medicine in prolonging the lives of the victims of this disease, and enabling them to take advantage of the hygienic measures upon which the main reliance should be placed. *Chronic bronchitis*, which is so apt to be mistaken for tubercular phthisis, is often signally benefited by this medicine and by the same mode of action. A like remark is applicable to numerous diseases of the *nervous system* due to or maintained by an exhausted condition of its functions.

In all diseases its use is contraindicated when it cannot be retained by the stomach or when it is not well digested, but causes eructation, heartburn, diarrhœa, etc., and generally when fever is present.

The average *dose* of cod-liver oil is Gm. 4 (℥ss) three times a day an hour or two after meals. It is better to begin with half of this quantity. Various means have been employed to disguise the taste and smell of the oil and render it acceptable to the stomach. These means are generally superfluous among children, who often become fond of it, and also among persons whose taste is not fastidious. The use of ether, naphtha, peppermint, and similar agents is objectionable, since they become volatilized in the stomach and renew the taste of the oil by eructation. Less apt to produce this effect is alcohol in the form of some distilled spirit, with which the mouth should first be washed, after which the oil, floating upon another portion of the liquor, may be rapidly swallowed, Malt liquor which froths readily is an excellent article for enveloping the oil and concealing its taste. Floated on iron-rust water, with some of which the mouth and fauces have just been washed, is another available means of effecting the same purpose. But the best of all is chewing a small fragment of smoked herring. As acid condiments are eaten with fishy food, so it has been proposed to administer cod-liver oil with a modicum of walnut or tomato catsup. The various emulsions made for concealing the taste of the oil become more objectionable to most patients than the oil itself; they are also too bulky, by reason of the proportion of the excipient they require. When the stomach tends to reject the oil this effect can sometimes be prevented by preceding each dose by one of a solution of potassium cyanide containing not more than Gm. 0.008 (⅛ grain) of the cyanide. But the possible dangers of the misuse of this solution forbid its ordinary employment. It is better, as well as safer, to swallow a tablespoonful of lime-water or Gm. 0.30 (gr. v +) of bismuth subnitrate or subcarbonate a few minutes before the oil is taken. The oil has sometimes been mixed with arrowroot or with spermaceti, forming a bolus which may be taken enclosed in a wafer.

Cod-liver oil may be efficiently administered by injunction. It is, however, a filthy method. Dr. H. A. Hare (*Boston Med. and Surg. Jour.*, March, 1887, p. 279) claims that the bile salts, sodium taurocholate and glychocholate, added to the oil, materially promote and hasten its absorption by the skin, and thereby render the practice less objectionable.

"*Morrhuol*," considered by Lafage to contain the active elements of cod-liver oil, is analogous to the *extract* above described. It is alleged to contain ten times more phosphorus, iodine, and bromine than the oil, but medicinally it is a very different substance and must act differently. It has been proposed as a substitute for the oil, however, and, owing to its acrid taste, has been administered in capsules containing about 4 grains, of which from two to ten are stated to be the proper daily dose. It is said to improve the appetite and digestion, and with them the state of the lungs in phthisis, and not to derange any function whatever (*Bull. de Thérap.*, cix. 417).

"*Oolachan*" oil, derived from a small fish (Thalicthys Pacificus or Candle-fish) that is caught on the north-western coast of North America, is said to form an efficient substitute for cod-liver oil (*New York Med. Jour.*, Nov. 29, 1884).

OLEUM MYRCIÆ, *U. S.*—Oil of Myrcia.

Oil of bay, E.; *Essence de myrcie (de bay)*, Fr.; *Myrcienöl, Bayöl*, G.

The volatile oil distilled from the leaves of Myrcia acris, *De Candolle*, s. Myrtus

(Eugenia, *Wight et Arnott*, Pimenta, *Wight*, Amomis, *Berg*) acris, *Swartz*. Bentley and Trimen, *Med. Plants*, 110.

Nat. Ord.—Myrtaceæ.

Origin.—This medium-sized tree is known as *wild clove*, *wild cinnamon*, and *bayberry*, and is indigenous to the West Indies and Venezuela. The quadrangular branches bear opposite, shortly-petiolate, coriaceous, broadly oval, nearly obtuse, entire, strongly-veined, and pellucid-punctate leaves, which when bruised exhale an agreeable aromatic odor, somewhat similar to cloves. The flowers are small, reddish, and stalked; the fruit is a globular-ovoid smooth berry, resembling allspice. Much of the oil and the spirit (bay rum), particularly the latter, are now distilled in the United States, about 200 pounds of the oil being annually imported.

Preparation.—The leaves are distilled with water or by the aid of steam; at first a light oil, floating upon water, comes over, afterward an oil heavier than water; the light and heavy fractions, united, constitute the commercial oil. The yield is very variable (Markoe, 1877).

Properties.—Oil of myrcia recently distilled is of a light-brownish color, but becomes darker on exposure. It has an aromatic odor, resembling that of cloves and allspice, but more fragrant, and a warm pleasantly spicy taste. Its specific gravity at 15° C. (59° F.) is 0.975 to 0.990. It forms a turbid mixture with an equal volume of alcohol, the solution having an acid reaction. With an equal volume of glacial acetic acid it also yields a turbid mixture, but dissolves clear in the same quantity of carbon disulphide. Strong soda or potassa solution converts it into a crystalline mass of potassium or sodium eugenol.

Tests.—"If 2 drops of the oil be dissolved in 4 Cc. of alcohol and a drop of ferric chloride test-solution be added, a light-green color will be produced; and if the same test be made with a drop of diluted ferric chloride test-solution, prepared by diluting the test-solution with four times its volume of water, a light-bluish coloration will be produced, which soon disappears. If to 3 drops of the oil, contained in a small test-tube, 3 drops of concentrated sulphuric acid be added, and, after the tube has been corked, the mixture be allowed to stand for half an hour, a resinous mass will be obtained. On subsequently adding 4 Cc. of diluted alcohol, vigorously shaking the mixture, and gradually heating to the boiling-point, the liquid should remain nearly colorless, and should not acquire a red or purplish-red color (distinction from the oils of pimenta and of cloves). If 1 Cc. of the oil be shaken with 20 Cc. of hot water, the water should not show more than a scarcely perceptible acid reaction to litmus-paper. If after cooling the liquid be passed through a wet filter, the clear filtrate should afford, with a drop of ferric chloride test-solution, only a transient grayish-green, but not a blue or violet color (absence of phenol or carbolic acid."—*U. S.*

Composition.—Prof. Markoe (1877) showed the oil to be a mixture of hydrocarbon having at 15.5° C, (60° F.) the specific gravity .8356, and of eugenol, spec. grav. 1.055. L. C. Pettit (1880) obtained 41 per cent. of eugenol, which gave a crimson-red color with sulphuric acid. (For accounts of this volatile oil see *Amer. Jour. Phar.*, 1861, p. 297, and *Proceedings of Amer. Jour. Phar.*, 1877, p. 435.)

Uses.—This oil is chiefly used as a perfume, and especially as an ingredient of bay rum (*Spiritus myrciæ*).

OLEUM MYRISTICÆ, *U. S., Br.*—Oil of Nutmeg.

Oleum nucistæ æthereum.—*Volatile oil of nutmeg*, E.; *Essence de muscade*, Fr.; *Ätherisches Muskatöl*, G.; *Esencia de nuez moscada*, Sp.

The volatile oil distilled from the seed of Myristica fragrans, *Houttuyn*.

Nat. Ord.—Myristicaceæ.

Preparation.—Ground nutmegs are distilled by the aid of steam. The yield is between 2 and 3 per cent., but selected nutmegs yield sometimes as much as 8 per cent. Cloëz (1864) suggested exhaustion with carbon bisulphide and distilling the extract by means of steam.

Properties.—The oil is colorless or pale-yellowish, limpid, of specific gravity 0.87 to 0.90 at 15° C. (59° F.), of an agreeable aromatic odor, a warm somewhat camphoraceous taste, and dextrogyre to polarized light. It is readily soluble in alcohol, also in glacial acetic acid and carbon disulphide, commences to boil at 160° C. (320° F.), fulminates when brought into contact with iodine, is energetically acted on by nitric acid, becomes dark-red with Fröhde's reagent, and violet by hydrochloric acid (Dragendorff, 1877).

Composition.—The most volatile portion, after treatment with sodium, was found by Cloëz to be a left-rotating hydrocarbon, $C_{10}H_{16}$, having the odor of nutmeg and of lemon, and boiling at 165° C. (329° F.). It is the *myristicene* of Gladstone (1872), who named the oxygenated portion *myristicol*, $C_{10}H_{14}O$; this is dextrogyre, boils at 224° C. (435° F.), and does not, like menthol and carvol, yield a crystalline compound with H_2S. The *nutmeg camphor* of John (1821) or *myristicin* of Gmelin, which separates sometimes on standing, was ascertained by Flückiger (1874) to be myristic acid. (See below.)

Uses.—Oil of nutmeg is seldom used in medicine; it may be employed for the same purposes as nutmeg in *doses* of Gm. 0.10–0.15 (gtt. ij–iij).

OLEUM MYRISTICÆ EXPRESSUM, *Br.*—Expressed Oil of Nutmeg.

Oleum nucistæ, P. G.; *Adeps (Butyrum) myristicæ, s. nucistæ.—Nutmeg butter*, E.; *Beurre de muscade*, Fr.; *Muskatnussöl, Muskatbutter*, G.; *Aceite (manteca) de nuez moscada*, Sp.

Preparation.—This fixed oil is obtained in the East Indies by beating nutmegs into a paste, which is expressed between heated plates. The yield is about 28 per cent., and the annual importation into the United States is usually between 300 and 500 pounds; in 1880 it was 1964 pounds. The oil is incorrectly called *oil of mace*.

Properties.—It is found in commerce in the shape of blocks about 2½ inches (6 Cm.) thick and 10 inches (25 Cm.) long, and is wrapped in palm-leaves. It is solid and firm, unctuous to the touch, of a mottled appearance, orange-brown and whitish in color, of specific gravity .995, and has the fragrance and aromatic but bland taste of nutmegs. It melts at about 45° C. (113° F.), and is soluble in 2 parts of warm ether and 4 parts of boiling strong alcohol (Lecanu).

Constituents.—Cold alcohol dissolves about 6 per cent. of volatile oil (see above) and 24 per cent. of fat, accompanied by brown-yellow resinous matter, which has not been further examined. The remaining pulverulent white fat is *myristin*, $C_3H_5(C_{14}H_{27}O_2)_3$, which crystallizes from hot alcohol or ether and fuses at 31° C. (87.8° F.). Heintz (1854) found the melting-point of *myristic acid* at 53.8° C. (128.8° F.). Schmidt and Rœmer (1883) found 3 to 4 per cent. of free myristic acid, with a little stearic acid.

Adulterations.—Artificial mixtures made from animal fats are not soluble in the same amount of hot alcohol, and the portion insoluble in cold alcohol would be more or less greasy. "On warming 1 part of nutmeg butter with 10 parts of alcohol a solution should be obtained which, after cooling and filtering, is clear and pale-yellow, and with the addition of ammonia should become brownish, but not red (turmeric); ferric chloride should color the solution merely dingy-brown."—*P. G.*

Ceratum myristicæ, s. Balsamum nucistæ, *P. G.* Melt together yellow wax 1 part, olive oil 2 parts, and expressed oil of nutmeg 6 parts; pour into paper capsules and cut into square cakes.

Allied Fats.—Becuiba Tallow is expressed from the seeds of Myristica Becuhyba, *Schott*, s. M. officinalis, *Martius*, which is indigenous to Brazil. The fat resembles the officinal article, but has a sharp acidulous taste, melts at 47° C. (116.6° F.), and on treatment with cold absolute alcohol leaves 45 per cent. of yellow pulverulent residue undissolved.

Otoba Butter is prepared from Myristica Otoba, *Humboldt et Bonpland*, indigenous to Northwestern South America. It is yellowish, becomes brown by age, melts at 38° (100.4° F.), and has then an unpleasant odor. Its myristin melts at 46° C. (114.8° F.), and contains *otobit*, which is sparingly soluble in cold alcohol, crystallizes in colorless, inodorous, and tasteless prisms, and melts at 133° C. (271.4° F.) (Uricoechea, 1854).

Virola Tallow, Ocuba Wax, is prepared from Virola (Myristica, *Swartz*) sebifera, *Aublet*, indigenous to Guiana. The fat is yellowish, somewhat crystalline, completely soluble in alcohol, and melts at 45° to 50° C. (113°–122° F.).

Uses.—The fixed oil of nutmeg is sometimes used for the friction of *rheumatic* parts, but chiefly as a bland and smooth fatty substance that does not easily grow rancid, and is therefore suitable as an excipient of more active topical medicines.

OLEUM OLIVÆ, *U. S., Br.*—Olive Oil.

Oleum olivarum, P. G.—*Sweet oil*, E.; *Huile d'olive*, Fr.; *Olivenöl*, G.; *Aceite de olivas*, Sp.

The fixed oil expressed from the fruit of Olea europæa, *Linné*. Bentley and Trimen, *Med. Plants*, 172.

Nat Ord.—Oleaceæ.

Origin.—In its wild state the olive is almost shrubby, much branched, and thorny, but under cultivation it is a medium-sized tree. It is indigenous to Western Asia, particularly Syria, and has been cultivated for a long time in the countries bordering on the Mediterranean. It has been introduced into the Southern United States, California, and several South American and other countries. The tree has evergreen, opposite, shortly-petiolate leaves, which are lanceolate, acute at both ends, entire and revolute on the margin, and densely scaly, silvery gray, brownish- or glaucous-green beneath. The numerous small white flowers are in axillary racemes, diandrous, have a two-celled and four-ovuled superior embryo, and produce a purplish-black ovate drupe with a greenish, firm sarcocarp and an obliquely oblong keeled putamen containing a single albuminous seed.

The leaves and bark have been employed in France as a febrifuge. De Luca (1861, etc.) found the leaves and green fruit to contain mannit, which diminishes in the latter as the fruit ripens, and disappears entirely when it becomes perfectly ripe. It contains then the largest amount of oil, equal in weight to nearly 70 per cent. of the sarcocarp.

Fig. 198.

Olea europæa, *Linné.*

Preparation.—The finest quality of olive oil is obtained by crushing the recently-collected ripe olives in a suitable mill to a pulpy mass, care being taken in some districts not to break the putamen containing the seed; the pulpy mass is then subjected to moderate pressure, the oil, called *virgin oil* (Huile vierge, *Fr.;* Jungfernöl, *G.*), being collected in cisterns containing water, from the surface of which it is subsequently skimmed. The press-cakes are afterward thoroughly mixed with water and the marc again expressed, using an increased pressure, whereby a second quality of oil is obtained; in some places cold water is first used for softening the press-cakes, and is followed by hot water. However, with the improvements in the construction of powerful presses this portion of the process is much simplified, and a larger yield of oil of fine quality is obtained. The oil still remaining in the marc is said to amount to between 9 and 12 per cent., and is extracted by means of carbon disulphide; or the marc is thrown into cisterns, which in Southern France are called *enfer*, and where an oil called *huile d'enfer*, having a disagreeable odor, separates upon the water. A larger amount of oil, but much inferior in quality, is yielded by expressing olives which have been kept in heaps and undergone a kind of fermentation; this oil is known in France as *huile fermentée;* and a still more inferior oil is prepared by again mixing the residue with boiling water and expressing. Though the seeds have a bitterish taste, Flückiger found the oil to be quite bland, to be a non-drying oil, and, if extracted with the oil of the fruit, to constitute about one-fortieth of the latter.

Olive oil enters commerce put up in bottles of various sizes, also in stone jugs and in barrels. The importation of olive oil into the United States amounts annually to over 400,000 gallons, fully three-fifths of which quantity is *salad oil.*

Properties.—Olive oil is a pale-yellow or greenish-yellow oily liquid, having a neutral reaction, a slight agreeable odor, and a bland taste, leaving, even in its freshest condition, a slight sense of acridity (*Pharmacographia*), which is somewhat increased on keeping. Its specific gravity at 15° C. (59° F.) is 0.9178, or between 0.915 and 0.918 (*U. S., P. G.*). At and below 10° C. (50° F.) olive oil separates white crystalline granules; near 2° C. (35.6° F.) it is of a butyraceous consistence; and it congeals completely at or below the freezing-point of water, yielding, however, by strong pressure, from 67 to 72 per cent. of liquid oil, which remains fluid at — 10° C. (14° F.), and is nearly pure *olein.* The solid portion fuses between 20° C. (68° F.) (Pelouze and Boudet) and 28° C. (82.4° F.) (Lecanu), and is easily soluble in ether. Olive oil is sparingly soluble in alcohol, freely soluble in ether, soluble in all proportions in chloroform, benzene, benzin, and carbon disulphide, and in about 5 parts of acetic ether. It does not readily become rancid, and belongs to the non-drying oils. When heated to 120° C. (248° F.) it becomes lighter, and at 220° C. (428° F.) nearly colorless, and at the same time rancid; it commences to boil at about 315° C. (600° F.).

Inferior qualities of olive oil are of a deeper hue, become cloudy, and congeal more easily, have a more decidedly acrid after-taste, and turn rancid on exposure.

The German Pharmacopœia recognizes two qualities of olive oil—the one intended for internal use and for ointments, the other used for the preparation of plasters:

Oleum olivarum, s. Oleum provinciale.—Best olive oil, *E.;* Huile d'olive fine, *Fr.;* Provenceröl, *G.*—It is the oil described above.

Oleum olivarum commune.—Olive oil, *E.;* Huile d'olive ordinaire, *Fr.;* Baumöl, G.—This is the second quality of salad oil, has a brownish-yellow or green-yellow color, and, except a somewhat less pleasant odor and taste, agrees with the preceding.

Composition.—The liquid portion is *triolein* (olein), $C_3H_5(C_{18}H_{33}O_2)_3$, and is identical with the liquid portion of most non-drying fats, as far as they have been examined. The solid part was called *margarin* by Chevreul, which was proven by Heintz (1852) to be a mixture containing chiefly *palmitin*. Palmitic acid, $C_{16}H_{32}O_2$, was obtained from olive oil by Collett (1854), and also by Heintz and Krug (1857), who likewise isolated *arachic (butinic) acid*, $C_{20}H_{40}O_2$, and probably stearic acid. On saponification glycerin is obtained. The fats composing olive oil are, therefore, triolein, tripalmitin, triarachin, and possibly tristearin. Beneke (1862) announced also the presence of a small quantity of *cholesterin*, $C_{26}H_{44}O$, which is soluble in alcohol (see page 714).

Adulterations.—Olive oil is frequently adulterated with other bland oils, some of which are occasionally even substituted for it. The determination of its purity has been the subject of much research, but from the chemical identity of the constituent compounds of many oils, and the natural variation of their relative proportions in the same fat, it is evidently attended with many difficulties. A higher specific gravity than given above points to an admixture of other fats. The detection of drying in non-drying oils, and the testing by means of sulphuric acid, etc., have been described above.

Tests.—"If 1 part of olive oil be agitated in a test-tube with 2 parts of a cold mixture prepared from equal volumes of strong sulphuric acid and of nitric acid of sp. gr. 1.185, and the mixture be set aside for half an hour, the supernatant oily layer should not have a darker tint than yellowish (a dark color indicating the presence of other fixed oils). Olive oil remains pale-yellow or becomes greenish; benne oil turns reddish or red; sunflower oil, orange-yellow; ground-nut oil, reddish-brown; cotton-seed oil, dark red. If 1 Gm. of the oil be shaken for a few seconds with 1 Gm. of a cold mixture of sulphuric acid (sp. gr. 1.830) and nitric acid (sp. gr. 1.250) and 1 Gm. of carbon disulphide, no green or red layer should separate on standing. Foreign oils give the tints mentioned above. If 10 Cc. of the oil be shaken frequently, during two hours, with a freshly prepared solution of 1 Gm. of mercury in 3 Cc. of nitric acid, a perfectly solid mass of pale straw color will result. If 6 Gm. of the oil be thoroughly shaken, in a test-tube, for about two minutes, with a mixture of 1.5 Gm. of nitric acid and 0.5 Gm. of water, then heated in a bath of boiling water for not more than fifteen minutes, the oil should retain a light yellow color, not becoming orange or reddish-brown, and, after standing at the ordinary temperature for about twelve hours, it should form a perfectly solid, light yellowish mass (absence of appreciable quantities of cotton-seed oil and most other seed oils). If 5 Cc. of the oil be thoroughly shaken, in a test-tube, with 5 Cc. of the alcoholic solution of silver nitrate (prepared by dissolving 1 Gm. of silver nitrate in 100 Cc. of deodorized alcohol, and adding 0. 5 Cc. of nitric acid), and the mixture heated for about five minutes in a water-bath, the oil should retain its original pale yellow color, not becoming reddish or brown, nor should any dark color be produced at the line of contact of the two liquids (absence of more than about 5 per cent. of cotton-seed oil and of many other oils). If 5 Cc. of the oil be shaken, in a test-tube, with 5 Cc. of concentrated hydrochloric acid, the latter should not acquire a green color, and, on the subsequent addition of about 0.5 Gm. of sugar, and again shaking the mixture, no violet or crimson tint should be produced in the acid layer within fifteen minutes (absence of sesamum oil)."—*U. S.* "If 15 parts of olive oil be well shaken with 2 parts of water and 3 parts of fuming nitric (nitroso-nitric) acid, the mixture should be whitish, not red or brown (oils of ground-nut, benne-seed, and cotton-seed), and in one or two hours should separate into a slightly-colored liquid and a white solid mass."—*P. G.* The elaidin test is conveniently applied in the manner described under Olea Pinguia, where also the result with different oils is stated and the colors produced by sulphuric acid and other reagents. If 5 drops of the oil are let fall upon a thin layer of sulphuric acid in a flat-bottomed capsule, no brown-red or dark-brown zone should be developed within three minutes at the line of contact of the two liquids (absence of appreciable quantities of other fixed oils of similar physical properties).

According to Cailletet (1877), the greenish color is occasionally produced by the pres-

ence of copper, in which case the oil will be colored brown on being agitated with an ethereal solution of pyrogallol.

Pharmaceutical Uses.—Oleum chlorinatum, *Chlorinated oil*, is prepared by Dr. L. Wolff by passing chlorine gas into olive oil; it is a yellowish oil, and has been used in itch and other cutaneous diseases. According to Lefort (1852, 1853), olive oil, thus treated, contains chlorine substitution-products, the *chloroleic acid* having the formula $C_{18}Cl_2H_{32}O_2$, a brown color, the specific gravity 1.082, and containing 20.6 per cent. of chlorine.

Olea cocta, Olea infusa.—Oleoinfusions, Oleols, *E.;* Oléolés, Elæolés, Huiles médicinales, *Fr.;* Gekochte Oele, *G.*—These preparations were formerly much employed in Europe, and several of them have retained a place in the French Codex. They are made from herbs or flowers, either aromatic or narcotic, by digesting 1 part of the dry drug in 10 parts of olive oil, or by boiling 1 part of fresh narcotic herb in 2 parts of olive oil until the moisture has been dissipated. Ointment of stramonium was formerly prepared in a similar manner.

Action and Uses.—From time immemorial olive oil formed an important article of food in countries where the olive tree flourishes, and was used as butter is elsewhere. In the dose of one or two ounces it acts as a very mild laxative, but it is seldom administered for this purpose except to infants, for whom a sufficient dose is a teaspoonful. It has been used as an antidote to the poisonous effects of *cantharides*, and is probably efficient by protecting the stomach, as well as by occasioning vomiting, notwithstanding the theoretical objection that cantharidin is soluble in sweet oil. It has been extensively and efficiently employed by workmen in white-lead factories to keep the bowels free and prevent the absorption of the metal. Large doses of olive oil have seemed to cause the discharge of *gall-stones*, and in proof of the statement a great number of bodies resembling these concretions has been found in the stools. On examination, however, they were often found to consist of the partially saponified oil (*Boston Med. and Surg. Jour.*, Sept. 1881, p. 261). This explanation has been confirmed both by chemical and physical examination (*Med. Record*, xxxiii., 215; xxxv., 599; *Med. News*, lii., 519), as well as by the inordinate number of concretions alleged to have been evacuated under the use of the oil, such as 60, of which 6 were as large as an olive (*Med. Record*, xxxiii, 217, or, again, 629; (*Med. News*, lii., 696). That the remedy is sometimes efficient does not, however, admit of doubt, since the concretions passed in some instances consisted of biliary solids, as reported by Rosenberg, who also proved experimentally that oil is the most powerful stimulant of the secretion of bile, which he regards as the immediate agent for carrying away the concretions (*Ther. Monatsh.*, iii., 542). Large doses of oil are required, say from Gm. 124–126 (4–6 fl. oz.), in divided doses within from one to four hours. It may be made into emulsion with yolk of egg and flavored with essence of peppermint. Olive oil is used in some places in Europe to prevent the poisonous effects of *vipers' bites*, both internally and locally, and by the latter method it is familiarly applied to allay the swelling and pain of *insects' bites and stings*. It is often poured into the *auditory canal* to destroy insects concealed therein, and large doses of it have been known to kill and expel a *tænia*. Externally, it is a convenient and efficient protective and lenitive for superficial *wounds*, *excoriations*, *burns*, *bruises*, and *sprains*. In the two last-mentioned injuries it should be applied warm, and in them also it affords a convenient vehicle for the application of camphor, morphine, and various other anodynes or stimulants. The same is true in regard to several local inflammations, especially *earache*. With lime-water it forms the liniment so useful in burns (*Linimentum calcis*). Anciently, the custom of anointing the body with oil was practised, as it still is in Oriental countries, after warm bathing, and also as a protective against the plague. It is now occasionally used to moderate excessive *sweating*, and has even been imagined to have some influence on the progress of pulmonary *phthisis* when given with the addition of 6 per cent. of oleic acid. It was used by the ancients to anoint the skin in various affections of the chest. Warm oil is a soothing and efficient application, when made with appropriate pressure or friction, in lessening the pain and swelling of enlarged glands, particularly when they are actively engorged, as the *mammæ* during pregnancy and after parturition. It is sometimes injected into the rectum in *dysentery* and to destroy rectal *ascarides* (oxyures), and it is habitually employed to facilitate the introduction of *sounds*, *catheters*, *bougies*, *specula*, *pessaries*, etc., into the natural cavities of the body. It was an old custom to dip cutting surgical instruments in hot oil before incising the flesh.

The *dose* of olive oil as a laxative is Gm. 32–64 (f℥j–ij) for adults, and for infants Gm. 4–8 (f℥j–ij).

OLEUM PALMÆ.—Palm Oil.

Huile (Beurre) de palme, Fr.; *Palmöl, Palmbutter*, G.; *Aceite de palma*, Sp.

From the fruit of Elæis guineensis, *Jacquin*.

Nat. Ord.—Palmæ.

Origin.—The oil-palm is a tall tree indigenous to Western Africa and introduced into other tropical countries. It has large pinnate leaves with spiny petioles and long narrow linear leaflets. The fruit is a yellow mottled drupe about 25 Mm. (one inch) long, and contains a leathery very oily sarcocarp, from which the fat is obtained by pressure or by boiling with water. The kernel yields likewise a bland oil which is white and melts at 25° C. (77° F.).

Properties.—Palm oil is solid at low temperatures, butyraceous, of a reddish-yellow color, and when fresh of an agreeable violet-like odor, and fuses at 27° C. (80.6° F.). On keeping, it becomes lighter in color and acquires a rancid odor, a portion of the fat being decomposed into free acids and glycerin, the fusing-point rising at the same time, sometimes to 42° C. (107.6° F.). When rapidly heated to 240° C. (464° F.) it is bleached. It is partly soluble in alcohol, but entirely so in ether. Its specific gravity is .945.

Composition.—It consists chiefly of tripalmitin and triolein, and contains a peculiar ferment, inducing its decomposition. It is largely used in the preparation of soap; and to obtain the latter white, the oil is bleached by treating it with a solution of potassium dichromate and adding sufficient sulphuric and hydrochloric acids to form potassium sulphate and chromic chloride.

Other Palm Oils.—(See also Oleum cocos.) Macaja Butter, obtained from the seeds of Cocos aculeata, *Jacquin*, of tropical America, has a yellowish color and a violet-like odor.

Tucum Oil, from the fruit of Astrocaryum vulgare, *Martius*, of South America, has a bright-red color and an agreeable odor.

Action and Uses.—Palm oil has hardly any peculiar virtues to distinguish it from other vegetable oils, except that it is less drying and more emollient. It is supposed to be especially adapted for bathing *bruises* and *sprains*. Its agreeable odor recommends it.

OLEUM PHOSPHORATUM, *U. S., Br., F. Cod.*—Phosphorated Oil.

Huile phosphorée, Liniment phosphoré, Fr.; *Phosphorhaltiges Oel*, G.

Preparation.—Phosphorus, 1 Gm.; Expressed Oil of Almond, Ether, each, a sufficient quantity, to make 100 Gm. Introduce a sufficient quantity of expressed oil of almond into a flask, heat it on a sand-bath to 250° C. (482° F.), and keep it at that temperature for fifteen minutes. Then allow it to cool, and filter. Put 90 Gm. of the filtered oil, together with the phosphorus, previously well dried by filtering paper, into a dry, tared bottle capable of holding about 120 Cc., insert the stopper, and heat the bottle in a water-bath until the phosphorus melts. Then agitate it until the phosphorus is dissolved, allow it to cool and add enough ether to make the mixture weigh 100 Gm. Lastly, transfer the solution to small glass-stoppered vials, which should be completely filled and kept in a cool and dark place.—*U. S.*

The process of the British Pharmacopœia differs from this in heating the almond oil only to 149° C. (300° F.), and in directing 16 grains of phosphorus to be dissolved in 4 fluidounces (Imperial) of the oil at a temperature of about 82° C. (180° F.). The U. S. P. has adopted Méhu's process (1868), who, however, directs heating the oil for 15 minutes to 150° C. (302° F.), and then to raise the heat for 10 minutes to 250° C. At first, air and moisture are given off; afterward certain organic matters are volatilized or destroyed; the oil becomes nearly colorless, and on cooling separates a little flocculent matter, which is separated by filtration. A piece of translucent phosphorus is then weighed out, well dried, and dissolved as directed. The French Codex directs phosphorus 1 Gm., almond oil 95 Gm., ether 4 Gm. The oil contains 1 per cent. (*U. S., F. Cod.*), (.99 per cent. *Br.*) of phosphorus, the solubility of which in fixed oils is generally stated to be 1 in 100. According to Dr. Squibb (1876), phosphorus should be dissolved in oil only in an atmosphere of carbon dioxide, and at once transferred into small dry and well-stoppered bottles; he recommends to thus prepare a solution of well-dried phosphorus 1 part in cod-liver oil 99 parts.

Properties.—Phosphorated oil is a clear yellowish oil having the odor of phosphorus and of ether, the presence of which prevents phosphorescence in the dark. The phos-

phorated oil of the British Pharmacopœia is strongly phosphorescent, and produces white vapors in contact with air, due to the oxidation of phosphorus.

Action and Uses.—In so far as phosphorus is useful as a medicine it may be conveniently administered in this oil in the dose of 1–10 minims. It is very convenient as an addition to cod-liver oil in cases of *scrofula, chronic phthisis, paralysis* without central lesion of substance, *sexual debility*, and diseases referred to under PHOSPHORUS.

OLEUM PICIS LIQUIDÆ, *U. S.*—OIL OF TAR.

Huile (Essence) *de goudron*, Fr.; *Theeröl, Pechöl*, G.; *Esencia de alquitran*, Sp.

A volatile oily liquid distilled from wood-tar.

Preparation.—Wood-tar is subjected to distillation, and that fraction of the distillate which is lighter than water collected by itself. (See CREOSOTUM and PIX LIQUIDA).

Properties.—Oil of tar, recently distilled, is colorless, but gradually darkens, becoming yellowish, brownish, and dark red-brown, and depositing a black product. The oil has a strong tar-like odor and taste, an acid reaction, and a density of about 0.970 at 15° C. (59° F.); these properties are, however, subject to variation from differences in the composition of the tar. Alcohol readily dissolves it, yielding an acid solution.

Composition.—The oil is a mixture of various hydrocarbons, of acetic and other acids, and of undetermined empyreumatic products present in tar; prepared from tar of coniferous woods, the oil consists largely of oil of turpentine.

Action and Uses.—This preparation has the same action as tar itself, and, like it, is used largely in the treatment of squamous and some other *diseases of the skin*. In Europe the oil of cade, obtained from Juniperus oxycedrus, is held in higher esteem than oil of common tar. Oil of tar may be applied directly to the affected part, more or less diluted with some bland oil, or in an ointment. It has the advantage over tar ointments of being less unsightly and less destructive to clothing.

OLEUM PIMENTÆ, *U. S., Br.*—OIL OF PIMENTA.

Oil of allspice, E.; *Essence de piment de la Jamaïque*, Fr.; *Pimentöl, Nelkenpfefferöl*, G.; *Esencia de pimiento gorda*, Sp.

The volatile oil distilled from the fruit of Eugenia Pimenta, *De Candolle* (nat. ord. Myrtaceæ).

Preparation.—Allspice is ground, and then distilled with water or by means of steam, the volatile oil coming over usually in two fractions—a lighter and a heavier one, which are mixed. The average yield appears to be about 4 per cent., but is often much lower. Bonastre (1827) states that the seeds contain 5 per cent. and the remaining part of the fruit 10 per cent. of volatile oil.

Properties.—Oil of pimenta is colorless or pale-yellow, becoming darker and thicker by age. Its specific gravity is 1.045 to 1.055 at 15° C. (59° F.). In taste and in behavior to solvents and chemicals, (alcohol, test-paper, ferric chloride, potassa, iodine, etc.) it closely resembles oil of cloves; its odor, however, is more pleasant.

"With an equal volume of alcohol it forms a clear solution, which is slightly acid to litmus-paper. It also forms a clear solution with an equal volume of glacial acetic acid, and a nearly clear solution with an equal volume of carbon disulphide. When mixed with an equal volume of a concentrated solution of sodium hydroxide, it forms a semi-solid mass. If 2 drops of the oil be dissolved in 4 Cc. of alcohol, and a drop of ferric chloride test-solution added, a bright green color will be produced; and if the same tests be made with a drop of diluted ferric chloride test-solution, prepared by diluting the test-solution with four times its volume of water, a blue color will result, changing to green, and soon becoming yellow. If 1 Cc. of the oil be shaken with 20 Cc. of hot water, the water should not show more than a scarcely perceptible acid reaction to litmus-paper. If, after cooling, the liquid be passed through a wet filter, the clear filtrate should afford, with a drop of ferric chloride test-solution, only a transient, grayish-green, but not a blue or violet color (absence of phenol or carbolic acid)."—*U. S.*

Composition.—Gladstone has corroborated the observation of Bonastre concerning the presence of *eugenic acid* and the close similarity of this oil to oil of cloves. L. C. Pettit (1880) obtained 61 per cent. of *eugenol*, which became red, and afterward purple, with sulphuric acid.

Uses.—The oil of pimenta is used for the same purposes, local and general, as other aromatic stimulants. The *dose* is from Gm. 0.10–0.30 (2 to 6 drops).

OLEUM RICINI, *U. S., Br., P. G.*—Castor Oil.

Oleum e semini ricini, F. Cod.; *Oleum Palmæ Christi.—Huile de ricin*, Fr.; *Ricinusöl*, G.; *Aceite de ricino*, Sp.

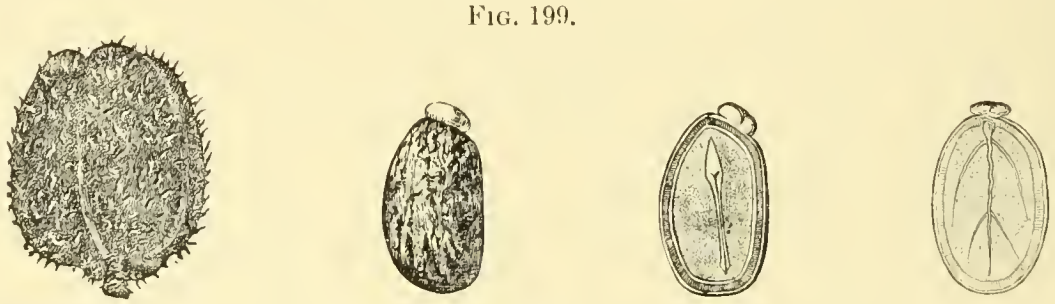
The fixed oil expressed from the seeds of Ricinus communis, *Linné*. Bentley and Trimen, *Med. Plants*, 237.

Nat. Ord.—Euphorbiaceæ.

Origin.—The castor-oil plant appears to be indigenous to Southern Asia, but was early introduced into all tropical and subtropical countries, in many of which it has become naturalized. It is often cultivated in temperate countries for ornament and other purposes, remaining a large annual. Numerous varieties are now known, differing from one another in size and color of the stem and foliage, as well as of the fruit and seeds. The leaves are alternate, peltate, palmately seven- or nine-lobed; the inflorescence is paniculately spicate, terminal, finally axillary; the flowers are monœcious, apetalous, the staminate ones at the base of the panicle. The fruit is a subglobular, somewhat triangular, and grooved tricoccous capsule, which is sometimes nearly smooth, but mostly spinescent; each cell encloses a single oval or elliptic seed, which is from 8 to 16 Mm. ($\frac{1}{3}$ to $\frac{2}{3}$ inch) long, 4 to 8 Mm. ($\frac{1}{6}$ to $\frac{1}{3}$ inch) broad, flattened on one side, smooth, shining, of a gray color variegated with yellowish, brown, or reddish spots and lines, with a slightly-raised raphe along the flattish side and a prominent caruncle near one end; this, when detached, leaves a slight depression above the hilum. The testa is hard, but brittle; the inner seed-coat is thin, white, and has a brownish chalaza; the embryo is straight, white, has broad, foliaceous heart-shaped cotyledons, and is imbedded in an oily albumen having a bland scarcely acrid taste.

Preparation.—Nearly all the castor oil which is at the present time consumed in the United States is manufactured from seeds grown in the country or imported. While in the year ending June 30, 1867, the importation of castor oil was 82,800 gallons and of the seeds 60,588 bushels, the quantities imported in 1882 were 904 gallons and 2,389,200 pounds respectively. The seeds, after having been crushed and freed from the integuments, or without removing the latter, are kiln-dried and subjected to powerful pressure; the oil thus obtained is heated with water to remove albuminous matters, and when clear drawn off into barrels or other suitable vessels. The yield is stated to be

Fig. 199.



Ricinis communis, *Linné:* fruit, seed, and two longitudinal sections of seeds, showing embryo and albumen; natural size.

between 38 and 45 per cent., by cold pressure 25 to 30 per cent. More oil, but of inferior quality, is obtained by again expressing the mare and using a higher temperature and greater power; the additional yield is 6 to 8 per cent. The older method of obtaining the oil by boiling the seeds with water and skimming it from the surface has probably been abandoned in most countries. L. Boerner (1876) extracted from the press-cake with ether 14 per cent. of oil having a light-yellow color, while alcohol dissolved 21 per cent. of dark oily matter.

Purification.—Cold-pressed castor oil is nearly transparent, and requires no further purification. If opaque, the oil is filtered, either through paper or felt, or, as recommended by Pavesi (1857), is previously treated for several days with 1 per cent. of magnesia and 2.5 per cent. of purified animal charcoal; which treatment renders it nearly colorless and inodorous.

Properties.—Castor oil is viscid, transparent or nearly so, almost colorless or pale greenish-yellow, of a faint, mild, mawkish, but not repulsive odor, and a bland, afterward slightly acrid and generally offensive taste. Its specific gravity varies between 0.950 and

0.970. At a low temperature it becomes thicker, and usually deposits white granules of solid fat; near—18° C. (0° F.) it congeals to a yellowish mass. It is only partly soluble in petroleum benzin, yielding at 15° C. (59° F.) a turbid mixture, but at 17° (65.6° F.) a clear solution with an equal volume, but is soluble in all proportions in absolute alcohol, ether, and glacial acetic acid, and at 15° C. (59° F.) in about 4 parts of alcohol, spec. grav. 0.835. The oil has a neutral reaction to test-paper, but when exposed to the atmosphere in thin layers it becomes rancid, has an acid reaction, and slowly dries to a transparent varnish. In contact with nitrous acid, however, castor oil becomes much thicker, and finally congeals, requiring for this a longer time than the non-drying oils. Polarized light is by some samples turned to the right, by others to the left. It commences to boil at about 265° C. (509° F.), yields an oily distillate containing *œnanthol*, $C_7H_{14}O$, and *œnanthylic acid*, $C_7H_{14}O_2$, and leaves a black mass which is soluble in potassa. Castor oil, agitated with equal weights of water and nitric acid, yields a whitish mixture, turning yellow in the presence of nitrous acid; but when heated with dilute nitric acid or with potassium bichromate and sulphuric acid, œnanthylic acid is obtained. The oil is very readily saponified by alkalies.

Composition.—1. The Oil. Castor oil is composed of several fats, the acids of which have been the subject of repeated investigations. The solid, fatty acid is probably identical with, or closely related to, *palmitic acid;* the liquid one has been named *ricinic* or *ricinoleic acid*, $C_{18}H_{34}O_3$, and forms a colorless or wine-yellow, inodorous liquid, of a disagreeable acrid taste, solidifying below 0° C. (32° F.) to a granular mass, and under the influence of nitrous acid is converted into *ricinelaidic acid*, which has the same composition and crystallizes in silky needles. These acids differ from oleic acid in containing one more atom of oxygen, but they do not, like the latter, yield sebacic acid among their products of destructive distillation. Œnanthol or *œnanth-aldehyde*, is a thin, colorless, strongly refractive liquid, having an agreeable odor and boiling at 154° C. (309.2° F.). Œnanthylic or *œnanthic acid* is oily, of a codfish-like odor, and, dissolved in strong alcohol and treated with hydrochloric acid gas, yields *œnanthic ether*, $C_2H_5.C_7H_{13}O_2$, which has a pleasant fruity odor, a specific gravity of 0.873, boils at 188° C. (370.4° F.), and is one of the constituents of wine. The acrid principle of castor oil has not been isolated.

2. The Seeds. Besides the oil, of which the seeds contain about one-half their weight, a considerable amount of protein compounds, some sugar, and mucilage are met with in them. Among the proteids is one which H. Bower (1854) regards as related to *emulsin*, inasmuch as it generates, with amygdalin, the odor of hydrocyanic acid. This observation was confirmed by Boerner (1876). The proteid is obtained by agitating the emulsion of the seeds with ether and precipitating the aqueous liquid with alcohol.

In 1864, Tuson announced the discovery of an alkaloid, *ricinine*, which is isolated by preparing an extract with boiling water, freeing it from the fat, exhausting with alcohol, filtering when cool, and crystallizing by concentrating the liquid. It is described as crystallizing in rectangular prisms and scales, possessing a slight bitter-almond taste, being sublimable, and containing nitrogen. Boerner (1876) found it necessary to treat the alcoholic liquid with magnesia; the crystals obtained by him resembled in behavior those of Tuson, but did not react with the usual reagents for alkaloids. Wayne (1874) isolated apparently the same principle from the leaves, and opposed its claim to be considered an alkaloid. Werner (1870) regarded it as a magnesium salt.

The seeds, freed from oil by pressure, are violently purgative, but the principle to which this action is due has not been isolated. On mixing the marc with water and allowing the mixture to ferment, Boerner obtained butyric and probably other volatile acids, but no acetic acid. These results were confirmed by Raab (1879). Flückiger obtained 10.7 per cent. of ash from the testa, but only 3.5 per cent. from the exsiccated kernel of the seed.

Tests.—Soluble in an equal volume of alcohol, and, in all proportions, in absolute alcohol, or glacial acetic acid; also soluble, at 15° C. (59° F.), in three times its volume of a mixture of 19 volumes of alcohol and 1 volume of water, equivalent to alcohol of about the specific gravity 0.833 (absence of more than about 5 per cent. of most other fixed oils). If 3 Cc. of the oil be shaken for a few minutes with 3 Cc. of carbon disulphide and 1 Cc. of sulphuric acid, the mixture should not acquire a blackish-brown color (absence of many foreign oils)."—*U. S.*

Allied Oil.—Tambor Oil of Central America, has purgative effects, but does not gripe like castor oil. Hemsley (1882) ascertained it to be prepared from the seeds of Omphalea oleifera. *Hemsley* (nat. ord. Euphorbiaceæ).

Action and Uses.—Castor oil derives its purgative properties chiefly from an acrid

principle contained in castor beans, which, when taken designedly or accidentally, have repeatedly occasioned violent pain, vomiting, purging, collapse, and even death, after which evidences of severe inflammation have been found in the mucous membrane of the stomach and intestines. Later examples of severe symptoms caused by them may be found (*Therap. Gaz.*, x. 214; xi. 503; *Med. News*, xlix. 304; lii. 364). An acrid principle exists also in the leaves of the plant. When castor oil was injected into a vein its taste was presently perceived in the mouth, and there followed nausea, eructation, rigidity of the muscles of the tongue, loss of speech, anxiety, and faintness, with general dulness and depression. At the end of three hours an unsuccessful motion to evacuate the bowels occurred, followed by feverishness and an indisposition of several weeks' duration. Given to nursing mothers, it invariably purges their infants. Rubbed upon the skin of the abdomen in young children, it has procured one or two loose stools. Taken in medicinal doses, it sometimes nauseates, seldom gripes, but is apt to cause a tendency to sleep. The first evacuations which follow are generally liquid, and contain more or less of the oil, either unchanged or converted into cheesy flakes or a soap-like scum floating on the surface of the dejection. It has long been observed that when used as an habitual laxative the dose may be progressively diminished. Indeed, unless this is done it is very apt to occasion constipation with all its attendant evils. In a case of hydræmia with venous pulsation castor oil, given by the mouth, did not purge, but exuded through the skin.

Castor oil is used as a purgative whenever the intention is simply to overcome *constipation*, or, on the other hand, to cure *diarrhœa* depending upon the presence of irritating substances in the bowel, or upon congestion, irritation, and excessive secretion produced by cold. In not a few cases, especially of infantile diarrhœa, the intestine is irritated at once by the presence of undigested food and by the decomposed secretions of its lining membrane; the patients are distressed by colic, tenesmus, and frequent stools, which are watery, mucous, and bloody in different proportions; the mouth is apthous and the anus inflamed. In such cases the first step shoul be thoroughly to cleanse the intestine by means of castor oil in small and repeated doses, preceded or not by a small dose of calomel or of mercury with chalk. The rest of the treatment may be confided to medicines of a different kind and to dietetic regimen. Similar remarks apply to a large group of cases in which constipation is the efficient cause of *urticaria*, *erythema*, *roseola*, and other diseases of the skin, and also of follicular affections af the *tonsils* and *pharynx*. Indeed, this condition, as a cause or aggravation of brain, lung, heart and liver disorders, is often more safely relieved by castor oil than by other purgatives. This purgative has the advantage over most others of analogous qualities that it has no tendency to exhaust the strength. Hence it is most used during *pregnancy*, and especially immediately before *labor*. There is a popular notion that it tends to relax the maternal organs. Castor oil has been highly recommended in *colica pictonum*, or Poitou colic, produced by acid drinks containing lead, and in *colica pictorum*, or painter's colic, caused by the habitual absorption of the metal. In the former affection it affords prompt relief; in the latter it has no superiority over other, and especially saline, cathartics. It sometimes suffices to expel *lumbricoid worms*, but cannot be at all depended upon for the removal of *tæniæ* unless they are previously killed by a proper tænicide. In the forming stage of *laryngeal or bronchial inflammatian* a laxative dose of castor oil is far superior to any other evacuant in promoting the bronchial secretion and thereby tending to hasten the cure. It is usually given after parturition when *milk fever* threatens, and later when *mammary abscesses* arise. It is also commonly prescribed after wounds and surgical operations to mitigate *traumatic fever;* it is said to palliate the pain caused by *renal calculi*. The local uses of castor oil were mainly suggested by the custom among African aborigines and their American descendants of applying castor-leaves to the mammæ to excite the flow of *milk*. They produce a slight irritation of the skin. A fluid extract prepared from the leaves and applied in the same manner is said to have a like effect, and a decoction has been used for the cure of *amenorrhœa*. Elsewhere abundant illustrations of this statement may be found (Stillé, *Therapeutics*, 4th ed., ii. 504), and more recently (1880) Boucher and Fonssagrives have claimed the re-establishment of the secretion of milk by bathing the breasts with a decoction of the leaves, after which a poultice made of the same leaves was applied to the nipples (*Phila. Med. Times*, x. 415). On the other hand, it is alleged that the internal use of castor oil arrests the secretion of milk, and that for this reason there is a prejudice against using it before or during the pueperal state by the French peasant women. This notion is confirmed by Mr. Shelby (*Practitioner*, xxxv. 101). The same practitioner also believes that it palliates *night-sweats* and *engorgement of*

the liver. It is said that the daily application of castor oil to *warts*, accompanied with friction, will remove these excrescences in from two to six weeks (Dumm). The oil enters into numerous liniments, etc. for the cure of *alopecia.* Of these one of the best is composed of suet ʒij ; castor oil ʒvj ; gallic acid ʒss. Mix, and scent with essence of vanilla. Castor oil is often prescribed in emulsion with yelk of egg, mucilage, etc., but its activity is thereby diminished. Its taste may be disguised by giving with it an equal quantity of glycerin to which a few drops of oil of cinnamon have been added. The glycerin has been thought to increase its laxative powers. It should not be taken in milk, coffee, hot soup, or any other articles of food, lest they become repugnant afterward. If the mouth and fauces are washed with an alcoholic liquid, or even with glycerin, the oil will not adhere, and therefore will not excite disgust ; or it may be floated upon fresh orange-juice in a wine-glass, and covered with another layer of the juice, and so tossed down the throat without its taste being perceived. Probably the best expedient of all is to envelop the oil with the froth of beer, ale or porter in a wineglass ; it may then be swallowed without even its presence being detected. The average *dose* of castor oil for an adult is Gm. 16–32 (ʒss–j), taken at once or in separate portions according to the nature of the case. The *dose* for an infant is about Gm. 4 (fʒi). For an enema Gm. 32–64 (fʒi–ij), may be given in ½ pint of mucilage or soap and water.

Oil of Anda Assu, a product of Brazil, closely resembles castor oil in its operation. The seeds are said to have been used from a remote period as a purgative ; the oil acts thoroughly and gently in doses of Gm. 8–12 (ʒii–iij), but in larger quantities is apt to purge harshly and profusely. A griping principle is said to reside in the embryo and the skin of the seed, both of which should be removed in preparing an emulsion of the seeds. The oil has not the nauseous taste of castor oil, and does not adhere so closely to the palate (*Edinb. Med. Jour.*, xxvii, 556, 646).

OLEUM ROSÆ, *U. S., P. G.*—Oil (Attar or Otto) of Roses.

Oleum rosarum.—Huile volatile (*Essence*) *de rose*, Fr. ; *Rosenöl*, G. ; *Esencia de rosa*, Sp.

The volatile oil distilled from the fresh flowers of Rosa damascena, *Mueller.*

Nat. Ord.—Rosaceæ, Roseæ.

Origin and Production.—Roses are largely cultivated in India and various parts of Northern Africa for the production of rose-water and attar, which, however, are consumed in those countries. Large quantities of rose-water are distilled in Southern France, but little oil is obtained there. Commerce is almost exclusively supplied with oil of rose from the southern slope of the Balkan Mountains in Roumelia, the principal dépôt being the town of Kizanlik. The species of rose cultivated in that district, according to Baur (1867), is a variety of Rosa damascena, *Miller*, which grows to the height of over 1.8 M. (6 feet) and is raised in hedge-like rows. The flowers appear in May and June, and are collected before sunrise for distillation on the same day. The still used is made of copper, conical in shape, and has its globular head connected with a straight tin tube passing through a tub filled with water. The charge for each still is about 10 okes (or 27 pounds) of flowers and 20 okes of river-water, and the distillation is completed in 2 hours. The distillate is again distilled, the first sixth being set aside to allow the oil to separate, while the remainder, together with the water pressed from the exhausted flowers, is used for fresh roses in place of water. The average annual production of oil of rose is about 4000 pounds, of which quantity over 10,000 ounces are imported into the United States; in the year ending June 30, 1882, the importation amounted to 21,933 ounces.

Properties.—Oil of rose is pale-yellow, transparent, solidifies if slowly cooled above 10° C. (50° F.) to a perfectly transparent mass composed of scale-like crystals, which on rapid cooling are narrow, feathery, resembling prisms, and fuse again at a somewhat higher temperature (at 12°–15° C. = 53.6°–59° F., *P. G.*). The congealing- and fusing-points vary to some extent; the former is given by Baur at between 11° and 16° C. (51.8° and 60.8° F.); the latter, by Hanbury (1859), as lying between 16.1° and 18.3° C. (61° and 65° F.), and for English oil of rose was found as high as 32.8° C. (91° F.). Zeller observed the fusing-point of German oil of rose to be even 37.5° C. (99.5° F.). Oil of rose has a neutral reaction to test-paper, but Zeller found it to have an acid reaction (see *Adulterations* and *Tests* below); its specific gravity may vary between about .84 (0.87, *Pharmacographia*) and 0.89, the Pharmacopœia giving 0.865 to 0.880. The odorous portion is quite freely soluble in alcohol, while the inodorous stearopten is sparingly soluble in this liquid ; absolute alcohol yields with the oil a clear solution (Baur). The oil

has the odor of the flowers in a high degree, and when suitably diluted with alcohol is very fragrant. Its taste is sweetish and rather mild.

Composition.—When oil of rose is mixed with about 3 parts of alcohol, and the undissolved portion repeatedly dissolved in a little ether and reprecipitated by alcohol, it is finally obtained as transparent, iridescent, inodorous scales, which, according to Saussure (1820), Blanchet (1833), and Flückiger (1868), have the formula C_nH_{2n}, fuse at 35° C. (95° F.), and distil above 280° C. (536° F.) (Blanchet). Flückiger gives the melting-point at 32.5° C. (90.5° F.) and the boiling-point at 272° C. (521.6° F.). This stearopten requires about 500 parts of alcohol for solution (Saussure), and is present in Turkish oil of rose to the amount of 6 or 7 per cent. (Hanbury), but in much greater proportion in oil obtained from roses grown in other parts of Europe. The elæopten of oil of rose contains oxygen, but its exact composition has not been ascertained; it remains liquid at —15° C. (5° F.) (Baur, 1872), and, according to Gladstone (1872), has the density .881 and boils at 216° C. (420.8° F.).

Adulterations.—The oil which is mostly employed for adulterating oil of rose is known in commerce as *Turkish oil of geranium*, and was shown by Hanbury (1859) to be entirely different from the volatile oil of pelargonium. It is obtained in India from Andropogon Schœnanthus, *Linné*, known as *roshé* or *rosé* or *rusa oil*, in Turkey as *idris yaghi* or as *entershah*, and in English commerce also as *oil of ginger-grass*; it is imported into Turkey for the purpose of adulterating oil of rose, but, according to Baur, first subjected to a refining process, which consists in agitating the oil with lemon-juice and water, and in bleaching it by exposure to the sun and air, whereby a little copper is removed, the color changed from brownish to pale-yellowish, and the originally harsh and sharp odor rendered mild; or the oil is, in Roumelia, sometimes distilled with rose-petals. The adulterations used outside of Turkey are *oil of rhodium*, distilled from the root of Convolvulus (Rhodorrhiza, *Webb*) Scoparius and floridus, *Linné*, which grow in the Canary Islands; and *oil of rose-geranium*, or French oil of geranium, distilled from the cultivated *rose-geranium*, Pelargonium roseum, *Willdenow*. These oils have an acid reaction; oil of rhodium also a bitter taste and an odor resembling that of a mixture of rose, cubeb, and copaiba.

Tests.—The most certain criteria of the purity of the oil of rose are, according to Baur—1, the odor, by which oil of rose-wood, sandal-wood, and others may be detected; 2, the temperature at which it congeals; and 3, the manner of crystallizing. Pure oil of rose exposed to a temperature of 12.5° C. (54.5° F.) should congeal in a few minutes; the crystals should be transparent, scaly, iridescent, and float in the liquid, while spermaceti, being heavier, is deposited as a solid opaque crust. "If a solution of 1 part of oil of rose in 5 parts of chloroform be diluted with 20 parts of alcohol, the mixture should separate crystalline scales and should not redden moist litmus-paper. 1 drop of oil of rose triturated with sugar and afterward agitated with 500 Gm. of water, should impart to the latter the pure odor of rose."—*P. G.* "If to 5 drops of the oil, contained in a test-tube, 5 drops of concentrated sulphuric acid be added, a reddish-brown, thick mixture will be produced, but no white fumes or a tarry odor should be developed, and the fragrant odor of the oil should not be destroyed. If this mixture be then shaken with 2 Cc. of alcohol, the resulting liquid may be turbid, but should be nearly colorless, and not at once assume a red or reddish-brown color (absence of oil of ginger-grass or Turkish oil of geranium, from Andropogon Schœnanthus, *Linné* (*nat. ord.* Gramineæ), and oil of rose geranium, from Pelargonium Radula (*Cavanilles*), *Aiton*, Pelargonium capitatum (*Linné*), *Aiton*, and Pelargonium odoratissimum (*Linné*), *Aiton*; (*nat. ord.* Geraniaceæ)."—*U. S.*

Uses.—It is used in medicine exclusively for perfuming ointments and lotions.

OLEUM ROSMARINI, *U. S., Br.*—Oil of Rosemary.

Oleum anthos.—Huile volatile (Essence) de romarin, Flood; *Rosmarinöl*, G.; *Essence de romero*, Sp.

The volatile oil distilled from Rosmarinus officinalis, *Linné*.

Nat. Ord.—Labiatæ.

Preparation.—This volatile oil is obtained from the flowering-tops, or more frequently from the entire plant, by distilling them with water or steam. Commerce is chiefly supplied with the oil of rosemary from Southern France and Italy. About 20,000 pounds of it are annually imported.

Properties.—Oil of rosemary is a colorless or yellowish limpid liquid, varying in

specific gravity between 0.895 and 0.915, has a pungent somewhat camphoraceous odor and taste, boils at 165° C. (329° F.), and is soluble in less than its own weight of 80 per cent. alcohol; old oil requires a larger quantity for solution. Mixed with iodine, it gives off reddish vapors, and strong sulphuric and nitric acid render it thick and brown-red. Fröhde's reagent colors it yellowish-brown. The oil deviates polarized light to the left.

Composition.—The presence of oxygen in oil of rosemary was proven by Saussure (1820). Gladstone (1863) regarded it as consisting almost entirely of a hydrocarbon very similar to that contained in the oil of Myrtus communis, *Linné*. Lallemand (1859), however, obtained by fractional distillation a hydrocarbon boiling at 165° C. (329° F.) and a liquid boiling at 200° C. (392° F.), from which a stearopten was obtained having the composition and most of the properties of camphor; treatment with diluted nitric acid increases the yield of camphor. Bruylants (1879) obtained about 8 per cent. of camphor, $C_{10}H_{16}O$, melting at 176° C. (348.8° F.), and about 5 per cent. of borneol, $C_{10}H_{18}O$; the hydrocarbon, $C_{10}H_{16}$, boils near 160° C. (320° F.).

Pharmaceutical Preparations.—Unguentum rosmarini compositum, s. Ung. nervinum, *P. G.* Melt together lard 16, suet 8, yellow wax 2, and expressed oil of nutmeg 2 parts, and while cooling add oil of rosemary and oil of juniper-berries each 1 part.—*P. G.* *Baume nerval* of the French Codex is a similar preparation.

Action and Uses.—This oil is poisonous to insects, and to rabbits in the dose of 20 grains. The skin and mucous membranes it irritates in the same manner as oil of turpentine. A case is recorded in which, along with oil of wormwood, it caused the death of a child. Internally, it is a powerful stimulant, and may be employed for the same purposes as other stimulant oils to relieve *colic*, promote *menstruation*, and allay *nervous disorder* due to debility. In ointments and liniments it is a useful ingredient for relieving *rheumatic* pains; it promotes the removal of swellings due to *rheumatism*, *sprains*, *bruises*, etc., and stimulates the growth of the hair in *alopecia* following febrile affections. Its vapor, when inhaled, reduces the animal temperature and gives the urine a violaceous odor (*Edinb. Med. Jour.*, xxiv. 1042), and when cautiously allowed to act on the conjunctiva sometimes improves *vision* impaired by nervous exhaustion. Internally, the *dose* is Gm. 0.05–0.10 (gtt. i–ij).

OLEUM RUTÆ, *Br.*—Oil of Rue.

Huile volatile (*Essence*) *de rue*, Fr.; *Rautenöl*, G.; *Esencia de ruda*, Sp.

The volatile oil distilled from Ruta graveolens, *Linné*.

Nat. Ord.—Rutaceæ.

Preparation.—This volatile oil is distilled with water or steam from the fresh and cut herb. Lewis obtained from the fresh flowering herb .82 per cent., and after the fruit had matured 2.6 per cent., of volatile oil; Zeller's yield was from dry herb about ¼ per cent., from fresh herb $\frac{1}{20}$, and from the seeds 1 per cent.

Properties.—Oil of rue is a colorless or greenish-yellow liquid having the peculiar odor of the plant, a pungent somewhat acrid and bitterish taste, a neutral reaction, and congealing at a low temperature in shining scales. The freezing-point varies in different samples—according to Geiss (1861), between — 2.5° and — 22.5° C. (27.5° and — 8.5° F.), that from the seeds congealing first. The specific gravity varies between .86 and .91. The oil is soluble in an equal weight of alcohol. Iodine dissolves quietly in the oil; sulphuric acid dissolves it with a brown-red color; and sodium bisulphite yields with it a crystalline compound. By the action of nitric acid *caprinic*, *pelargonic*, *caprylic*, and *œnanthylic acids* are produced, the products varying with the strength of the acid and its prolonged action.

Composition.—Aside from a small quantity of a hydrocarbon, $C_{10}H_{16}$, boiling below 200° C. (390° F.), oil of rue consists mainly of an oxygenated portion, which Cahours and Gerhardt (1845) stated to be *caprinic aldehyde*, $C_{11}H_{22}O$. Harbordt (1862) showed that it could not be an aldehyde, and regarded it as *methyl-caprinol*, $C_{10}H_{19}.CH_3.O$, and Strecker as a ketone having the formula $CH_3.CO.C_9H_{19}$. The latter view has been proven to be correct by the simultaneous observations made by Gorup-Besanez, F. Grimm, and A. Giesecke (1870). This *methyl-nonyl ketone*, when pure, is a colorless liquid with a bluish fluorescence, boiling at 225° C. (437° F.), crystallizing in scales near 5° C. (41° F.), and fusing again at 15° C. (59° F.).

Action and Uses.—An experimenter, having taken within an hour three doses of oil of rue of 10 minims each, suffered uneasiness in the stomach, oppression and confusion of mind, aching in the loins, an urgent desire to urinate—the urine smelling of the oil—

flushes of heat, unsteadiness of gait, a tendency to sleep, and increased frequency, with diminished tension, of the pulse (Hélie, *Ann. d'Hygiène*, xx. 180). These phenomena are essentially those produced by oil of wormwood and numerous other essential oils, and the therapeutic uses of oil of rue are the same as theirs—viz. in the treatment of *colic*, *amenorrhœa*, *dysmenorrhœa*, *uterine hæmorrhage*, and *verminous complaints*. It may be given in *doses* of Gm. 0.05–0.30 (gtt. j–v).

OLEUM SABINÆ, *U. S.*, *Br.*—Oil of Savin.

Essence de sabine, Fr.; *Sadebaumöl*, G.; *Esencia de sabina*, Sp.

The volatile oil distilled from Juniperus Sabina, *Linné*.

Nat. Ord.—Coniferæ.

Preparation.—Oil of savin is obtained by distilling the fresh branches with water or steam. The yield is between 1½ and 2½ per cent.; Voget obtained from the berries nearly 10 per cent. of volatile oil.

Properties.—The crude oil has a yellowish or yellow color, and is obtained colorless on rectification. It has the peculiar terebinthinate odor of savin, a pungent, camphoraceous, and bitterish taste, and when fresh a neutral reaction; on exposure to air it becomes thicker, reddish or brown. It dissolves in absolute alcohol in all proportions, but yields an opalescent solution with 3 parts of 80 per cent. alcohol. The Pharmacopœia states that the oil is soluble in an equal volume of alcohol, by which it is distinguished from the oils of juniper and of turpentine. It is also soluble in glacial acetic acid. Dragendorff (1876) found the fresh oil at 28° C. (82.4° F.) to dissolve in 0.9 parts, and after rectification in 3.7 parts of 85 per cent. alcohol. Its specific gravity is about 0.91, but varies somewhat. It commences to boil near 160° C. (320° F.), but the greater part of the oil boils above 200° C. (390° F.). Mixed with powdered iodine, a brisk detonation results, and on the addition to the oil of an ethereal solution of bromine the color of the latter disappears instantly. The oil does not appear to yield a solid compound with hydrochloric acid gas. It rotates polarized light to the right.

Composition.—Dumas (1835) found it to agree with oil of turpentine in elementary composition. But W. A. Tilden (1877) showed the lower-boiling portion to have the composition $C_{10}H_{16}O$, while the remaining portion does not contain a terpene, but consists of hydrocarbons, which are easily polymerized by heat.

Action and Uses.—Oil of savin acts on the gastro-intestinal canal as a violent irritant, causes vesical tenesmus and strangury, and produces a general intoxication in which the nervous system is excited, fever is lighted up, and ultimately coma and death may ensue. In medicinal doses it occasions congestion of the pelvic organs. It is an appropriate medicine in all of the cases to which savin itself is applied; that is to say, in *amenorrhœa* depending upon a torpid condition of the organs of generation, and in *dysmenorrhœa* occurring under similar conditions. Its repute as a remedy for *sterility* arises from its stimulant influence upon those organs, and the same is true of its power to control passive *uterine hæmorrhage* and *leucorrhœa*, especially of uterine origin. In all of these cases its efficacy depends upon its power of stimulating. Locally, oil of savin has been applied to benumb the sensibility of exposed nerves in *dental caries* and to promote the shrivelling of *condylomata*.

The *dose* of this oil is from Gm 0.10–0.60 (gtt. ij–x). It may be given in emulsion, pill or alcoholic solution.

OLEUM SANTALI, *U. S.*, *Br.*—Oil of Santal.

Oleum ligni santali.—Oil of Sandal-wood, E.; *Santal citrin* (*huile volatile*), F. Cod.; *Santelöl*, *Sandelöl*, G.; *Esencia* (*Aceite volatile*) *de sandalos cetrina*, Sp.

The volatile oil distilled from the wood of Santalum album, *Linné* (nat. ord. Santalaceæ).

Origin.—The white santal is a small tree indigenous to Southern India and some of the East Indian islands, and cultivated in other parts of tropical Asia. Santalum Yasi, *Seemann*, of the Fiji Islands, S. Freycinetianum, *Gaudin*, and S. pyrularium, *A. Gray*, of the Sandwich Islands, and several other species, yield likewise sandal-wood.

The leaves of white sandal are opposite, and vary in shape between oval and lanceolate, and are smooth and glaucous beneath. The flowers are small, numerous, in paniculate cymes, very variable in color, and without odor. In India the trees are felled or dug up when the trunk is about 30 Cm. (1 foot) in diameter, the branches are cut off, and the

trunk is left on the ground until the sap-wood has been mostly eaten away by ants, when it is trimmed, the heart-wood alone being used. Santalum lanceolatum, S. obtusifolium, S. ovatum, and other Australian species yield a wood of inferior odor.

SANTALUM ALBUM, LIGNUM SANTALI ALBUM, S. CITRINUM.—Santal-wood, Yellow (White) sanders-wood, *E.;* Bois de santal citrin, *Fr.;* Gelbes (Weisses) Santelholz, Sandelholz, *G.*—Santal-wood is in billets varying in thickness from about 7 to 22 Cm. (3 to 9 inches) and in color from whitish to brownish-yellow, the deeper-colored being more highly valued than the paler varieties. The wood is hard and heavy; when cut transversely it has a somewhat waxy lustre and irregular concentric zones alternately lighter and darker in color, sometimes rather indistinct, with very fine vessels and delicate medullary rays. When rubbed or rasped it has an agreeable aromatic somewhat roseate odor; its taste is aromatic, bitterish, and slightly acrid. Odor and taste, however, vary much with the origin of the wood.

Preparation.—The wood is distilled with water or steam, and yields from 2 to 5 per cent. of oil; in India, with imperfect stills, 2.5 per cent. is obtained (*Pharmacographia*). Dr. Bidie states that the roots yield the largest amount and finest quality of oil. Between 2500 and 3000 pounds of the oil are imported into the United States.

Properties.—Oil of santal is a thick, light-yellow liquid having in a high degree the aromatic odor of the wood from which it has been distilled, and a pungently aromatic taste; its reaction is neutral or slightly acid, and its behavior to polarized light either left- or right-rotating. Its density is usually about 0.96, and it is said to be occasionally heavier than water; the Pharmacopœia recognizes an oil having at 15° C. (59° F.) the spec. grav. 0.970 to 0.978. The oil begins to boil at 214° C. (417° F.), the boiling-point quickly rising to 255° C. (492° F.) (*Pharmacographia*). Chapoteaut's oil boiled between 300° and 340° C. (572° and 644° F.). Dragendorff (1876) found oil of santal distilled from different varieties of wood to be soluble in all proportions of 91 per cent. alcohol, but East Indian oil yielded with 11 parts of 80 per cent. alcohol an opalescent solution, while the solutions of other varieties of oil were clear with 1.2 to 1.8 parts of the same alcohol. Old oil seems to be less soluble than that which has been recently distilled. Oil of santal is lævorotary, which distinguishes it from Australian and West Indian sandal-wood oil; these are dextrorotary, and show the spec. grav. 0.953 and 0.965 respectively.

Constituents.—The physical differences pointed out indicate that oils prepared from different woods vary in their composition, but they appear to be oxygenated oils. Chapoteaut (1882) isolated two fractions, $C_{15}H_{24}O$, boiling near 300° C. (572° F.), and $C_{15}H_{26}O$, boiling at 310° C. (590° F.). Distilled with phosphoric anhydride, they yield the hydrocarbons $C_{15}H_{22}$ and $C_{15}H_{24}$, of which the former resembles the hydrocarbon of oil of cedar-wood, and the latter seems to be identical with oil of copaiba.

Santal-wood contains also a resinous principle, and a tannin which is colored green by ferric salts.

Adulterations.—Oil of santal is said to be adulterated with oil of copaiba and oil of cedar-wood; the former is sparingly soluble in alcohol sp. gr. 0.85. For detecting the latter Durand (1878) recommends agitating 1 Gm. of the oil with 1 Gm. of concentrated cuprammonium solution and 4 Gm. of water; after 24 hours' rest pure oil of santal gives a white opaque soap, while that with oil of cedar-wood is greenish. "If to 1 Cc. of the oil, at 20° C. (68° F.), there be added 10 Cc. of a mixture of 3 volumes of alcohol and 1 volume of water, a perfectly clear solution should result (test for cedarwood oil, castor oil, and other fatty oils, etc.)"—*U. S.*

Action and Uses.—About 1865 oil of sandal-wood was introduced as a substitute for copaiva in the treatment of *gonorrhœa*. In some cases it was found to produce nausea or disturbance of the stomach, in some diarrhœa, in some, also, irritation of the kidneys and bladder, and, finally, in certain patients, erythematous eruptions. The odor it communicated to the urine was described as sickening. Its smell upon the hands and breath was also said to be extremely persistent. But the more frequent statement was that it had a far less disagreeable smell than copaiva, and was generally preferred to it. In some cases it agreed with patients who could not tolerate copaiva. The general result, however, appears to be that while it is inferior to that medicine in the acute disease, it is fully equal to it in the chronic forms. Like copaiva, it must be given for some time after the urethral discharge has ceased. Like that medicine also, it is very serviceable in chronic *cystitis* and *pyelitis*, chronic *diarrhœa*, especially of the mucous variety, and in chronic *bronchitis*, even when accompanying bronchial dilatation and fœtor.

Oil of sandal-wood may be given in *doses* of from Gm. 0.30–1.30 (5 to 20 drops) three

times a day, according to the degree of inflammation present. It has been administered in capsules, and in mixtures such as the following: ℞. Oil of sandal-wood fʒss; dilute alcohol fʒijss; oil of cinnamon ♏xxv.—M. S.—1 or 2 teaspoonfuls two or three times a day. It may also be given mixed with powdered liquorice in wafers.

OLEUM SASSAFRAS, *U. S.*—Oil of Sassafras.

(*Essence*) *de sassafras*, Fr. Cod.; *Sassafrasöl*, G.; *Esencia de sasafrás*, Sp.

The volatile oil distilled from the wood of Sassafras officinale, *Nees.*

Nat. Ord.—Lauraceæ.

Preparation.—Oil of sassafras is distilled in Maryland and various other parts of the United States, mostly in the neighborhood of those places where a supply of the root may be obtained without requiring much transportation. The stills used are made of copper or iron, and usually connected with a lead condenser. The roots, together with the adhering bark, are cut into chips, about 10 bushels of which constitute a charge, and yield on an average about 4 pounds of the oil, the distillation requiring about twelve hours (Procter, 1866). If the root is dug up shortly after the tree has been cut, it appears to yield a colorless or yellow oil, but if the stumps are permitted to remain in the ground for some time they acquire a red color and yield a brown-red oil.

Properties.—As stated, oil of sassafras is either colorless or more frequently of various shades of yellow or brown-red, a difference which does not affect its quality. When carefully rectified it may be obtained colorless, but on exposure again becomes colored. It has the odor of sassafras in a high degree, a warm aromatic taste, a neutral reaction, and a slightly dextrogyre rotatory power. Its specific gravity is from 1.070 to 1.090, and increases somewhat by age. It dissolves in small quantities of water, becoming lighter thereby. It is freely soluble in alcohol, and dissolves in 4 or 5 parts of 80 per cent. alcohol; it is also soluble in all proportions in glacial acetic acid and in carbon disulphide; is violently acted on by bromine, but dissolves iodine quietly. 5 drops of the oil treated with 5 drops of nitric acid cause a violent reaction, resulting in the formation of a red color and gradually a red resin. Treated with sulphuric acid, the oil assumes a deep-red color, which turns blackish.

Composition.—According to Grimaux and Ruotte (1869), potassa solution extracts from oil of sassafras a body which appears to be a phenol, has the odor of eugenol, and assumes a bright-green color with ferric chloride. By fractional distillation a hydrocarbon, *safrene*, $C_{10}H_{16}$, is obtained, which boils between 155° and 157° C. (311° and 314.6° F.), and is dextrogyre. The oxygenated portion, *safrol*, $C_{10}H_{10}O_2$, constitutes nine-tenths of the oil, is without action on polarized light, distils between 230° and 235° C. (446° and 455° F.), remains liquid at — 20° C. (— 4° F.), and yields with bromine crystals of $C_{10}H_5Br_5O_2$. On cooling the oil in a freezing mixture Saint-Evre (1843) obtained crystallized *sassafras-camphor*, $C_{10}H_{10}O_2$, which remained solid at 5° C. (41° F.), and after being fused congealed again at 7.5° C. (45.5° F.).

Action and Uses.—The action and uses of this oil do not differ materially from those of numerous other essential oils in its anodyne and stimulant qualities. Like them, it may act poisonously (Hill, *Trans. Med. Faculty of Maryland*, 1884; Allbright, *Med. Record*, xxxv. 66), and, like menthol, it has been found to allay the pain of *neuralgia* when applied over the affected nerve (*Brit. Med. Jour.*, June 22, 1889). It is alleged to prevent the usual effects of tobacco when mixed with it and smoked, and also the narcotic action of hyoscyamus when associated with that drug. The *dose* is from Gm. 0.10–0.60 (gtt. ii–x).

OLEUM SESAMI, *U. S.*—Oil of Sesamum.

Benne oil, *Gingili oil*, *Teel oil*, E.; *Huile de sésame*, Fr.; *Sesamöl*, G.; *Aceite de ajonjoli*, Sp.

The fixed oil expressed from the seeds of Sesamum indicum, *Linné.* Bentley and Trimen, *Med. Plants*, 198.

Nat. Ord.—Pedaliaceæ.

Origin.—Benne is an annual herb which is indigenous to India, but is now not found in the wild state; it is largely cultivated in most tropical countries and in the warmer portions of the temperate zone. It grows from 0.6–1.5 M. (2 to 5 feet) high, and has an erect, branching, bluntly quadrangular, and hairy stem, alternate or sub-opposite leaves, and short-stalked axillary flowers, with large white bell-shaped five-lobed and

somewhat two-lipped corollas. The fruit is capsular, two-valved, four-celled, quadrangular and linear-oblong in shape, and contains numerous seeds, which are small, flattened, oval or ovate, smooth and shining, vary in color between whitish, yellow, reddish-brown, and blackish, have a sweetish oily taste, and contain a straight embryo with a short radicle and large plano-convex oily cotyledons. Sesamum orientale, *Linné*, is now regarded as being identical with this species.

Sesamum, *Ajonjolé*, *Alegnia*, Sp.—Benne, Sesame-leaves, *E.;* Feuilles de sésame, *Fr.;* Sesamblätter, *G.*—The leaves are mostly employed in the fresh state. They are long-petiolate, ovate or lance-oblong in outline, narrowed or rounded or somewhat heart-shaped at the base, more or less pointed above, entire on the margin or irregularly toothed, and the lower ones frequently cut into three-toothed lobes or distinct leaflets. The leaves are prominently veined on the lower surface, are smoothish or somewhat pubescent, and have a mucilaginous taste. Their principal constituent is mucilage, which is precipitated from its aqueous solution by alcohol.

Preparation.—Oil of benne is obtained by subjecting benne-seeds to pressure; the yield is in the neighborhood of 50 per cent. of the weight of seeds.

Properties.—Benne oil has a yellowish or yellow color, usually of a deeper hue than expressed almond oil, is thinner at ordinary temperatures than most other fixed oils, is nearly inodorous, and has a bland and agreeable peculiar taste, and the specific gravity 0.919 to 0.923 at 15° C. (59° F.). At —3° C. (26.6° F.) it becomes thick, and congeals usually at about —5° C. (23° F.), while the oil extracted by solvents congeals at about 5° C. (41° F.), forming a yellowish-white mass; when heated to between 150° and 200° C. (302° and 392° F.) it is decolorized. At 300° C. (302° F.) it assumes a brown color, and at 335° C. (635° F.) it commences to boil. It is a non-drying oil, and on exposure to air does not readily turn rancid. Concentrated sulphuric acid converts it into a brown-red gelatinous mass; nitric acid specific gravity 1.18 colors it gradually orange-yellow, and when of greater strength, red; with a mixture of nitric and sulphuric acid it is transiently colored green, afterward red and brown-red; in contact with nitrous acid it becomes reddish and brown-red, and gradually forms a semi-solid mass.

Fig. 200.

Sesamum indicum, *Linné: a*, flowering branch; *b*, section of seed

"If 5 Cc. of the oil be shaken with an equal volume of concentrated hydrochloric acid, the latter will usually assume a bright emerald-green color, especially if the oil has been exposed for some time to the action of air and light; and, on the subsequent addition of about 0.5 Gm. of sugar, and again shaking the mixture, a blue color, changing to violet, and finally to deep crimson, is produced."—*U. S.*

Composition.—Flückiger (*Pharmacographia*) found benne oil prepared by himself to contain 76 per cent. of olein; the acids of the solidifying portion appear to be stearic, palmitic, and myristic acids. A small quantity of a peculiar, probably resinous, substance may be extracted from the oil by agitation with glacial acetic acid or with alcohol; the acetic solution acquires a greenish-yellow, the alcoholic solution a blue afterward greenish-yellow, color on the addition of a cold mixture of equal weights of sulphuric and nitric acids. (See also p. 1093.)

Allied Oils.—The following four oils are obtained from seeds of the natural order Leguminosæ:

Kurung Oil is thickish, yellow, of the specific gravity .945, and begins to become turbid near 7° C. (44.5° F.). It comes from an East Indian tree, Pongamia glabra, *Ventenat*, s. Dalbergia arborea, *Roxburgh*, the odorous root and leaves of which are also used medicinally. The seeds are gray and kidney-shaped.

Ground-nut Oil, Pea-nut Oil.—Huile de pistache de terre, *Fr.;* Erdnussöl, *G.*—It is prepared from Arachis hypogæa, *Linné* (Bentley and Trimen, *Med. Plants*, 75), an annual herb indigenous to tropical America and now cultivated throughout the tropics; it is known in Brazil as *amendoim* or *mandobim*. The seeds contain about 45 per cent. of oil. This is pale-yellow, thin, has the density .920, and a peculiar nutty flavor, becomes turbid at about 3° C. (37.4° F.), and congeals near — 5° C. (23° F.). Nitrous acid causes the oil to congeal to a whitish mass; nitric acid colors it reddish, and sulphuric acid grayish-yellow, then green-brown. It consists of the glyce-

rides of palmitic, *arachic*, and *hypogæic acids*. The latter is $C_{16}H_{30}O_2$, and crystallizes in needles which melt near 35° C. (95° F.). Arachic acid, $C_{20}H_{40}O_2$, melts at 75° C. (167° F.). Under the name of *katchung oil* this oil is largely used in India in the place of olive oil.

Soy Oil is prepared from Soja hispida, *Moench*, s. Dolichos Soja, *Linné*. The plant is indigenous to Japan, and largely cultivated in Southern Asia for its brownish or whitish ovate-reniform seeds, which are used as food, and for preparing a sauce called *soy*; when fresh they contain 14 to 16 per cent. of moisture and from 16 to 18 per cent. of a bland yellowish oil.

Nicker-seed Oil, from Cæsalpinia (Guilandina, *Linné*) Bonducella, *Roxburgh*. The seeds of this tropical climber, which are also known as *bonduc nuts*, are somewhat compressed, subglobular, or oblong, bluish or ashy gray, slightly rigid, and have a bitter taste. The expressed oil is used for embrocations. The seeds are used in India as a tonic and anti-periodic; they contain a white bitter principle soluble in ether and alcohol and slightly soluble in water (*Pharmacographia*). The bark of bonduc-root is likewise employed as a tonic.

Ben oil, Behen Oil, is expressed from the seeds of Moringa pterygosperma, *Gaertner* (Mor. oleifera, *Lamarck*, Guilandina Moringa, *Linné*), and one or two allied East Indian trees of the nat. ord. Moringaceæ. The bark of the root has an odor and taste resembling horseradish. The seeds, known as *ben nuts*, are triangular-globose, pitted, and have elongated membranous wings on the angles; the seeds of Moringa aptera, *Gaertner*, are without wings; both are acrid, bitter, and emetic. They yield about 30 per cent. of fixed oil, which is yellowish, inodorous, bland, or if expressed at an elevated temperature somewhat bitter, acrid, and purgative. It retains its neutral reaction for a long time. It solidifies at about 0° C. (32° F.), but below 7° C. (44.6° F.) it deposits solid fats; the portion remaining liquid is used for extracting delicate perfumes from flowers. Oil of ben consists of the glycerides of moringic, oleic, myristic, palmitic, stearic, and behenic acids. *Moringic acid*, $C_{15}H_{28}O_2$, is liquid, and crystallizes at 0° C. (32° F.). *Behenic acid*, $C_{22}H_{44}O_2$, is crystalline, melts at 76° C. (168.8° F.), and solidifies at 70° C. (158° F.).

The slowly-drying bland or slightly-pungent oil expressed from the seeds of Camelina sativa, *Crantz*, s. Myagrum sativum, *Linné* (Leindotter, *G.*), is sometimes called *German sesame oil*.

Action and Uses.—Sesamum was anciently ranked among the most nutritious grains, and as tending especially to fatten, but it was also considered difficult of digestion. Hippocrates recommended consumptives to use bread made of it instead of wheat, and in pulmonary catarrhs prescribed an emulsion prepared with sesame, almond, and melon-seeds. To this day it serves to make bread in the East. Its oil was anciently used, and in India continues to be employed, for the same purposes as olive oil, but it has always been regarded as less agreeable and as less digestible. Externally, the bruised or ground seeds were applied in maturative poultices, and a decoction prepared with them was held to be emmenagogue and abortive. Dr. F. P. Porcher informs us that the seeds may be used "as a substitute for mustard-seed and as a mechanical irritant laxative." No mention is made by ancient writers of the mucilage of the young leaves. The seeds of sesame are used by the negroes of South Carolina in making broths, and are also eaten by them parched. The oil, which is very bland, is applied to the same purposes as olive oil. The mucilage is generally prepared from the fresh young leaves by infusing them in cold water. It is justly esteemed as a demulcent drink in *cholera infantum*, *dysentery*, and other disorders of the bowels.

Pongamia glabra furnishes the *kurung oil* which is employed in Hindostan in the treatment of various *skin diseases*. Pityriasis versicolor is mentioned as one of those in which it is efficient (*Amer. Jour. Phar.*, May, 1883, p. 267).

OLEUM SINAPIS VOLATILE, *U. S.*—Volatile Oil of Mustard.

Oleum sinapis, Br., P. G.; *Oleum sinapis æthereum.—Oil of mustard*, E.; *Essence de moutarde*, Fr.; *Ätherisches Senföl*, G.

A volatile oil obtained from the seeds of Sinapis (Brassica, *Koch*) nigra, *Linné*, by maceration with water and subsequent distillation.

Nat. Ord.—Cruciferæ, Siliquosæ.

Preparation.—Black mustard-seeds are ground, deprived of most of their fixed oil by pressure, macerated with water at the common temperature, and then distilled. A small quantity of ground white mustard-seed is usually added to supply any possible deficiency of myrosin and ensure the decomposition of all the myronic acid. Since oil of mustard is soluble in water, the aqueous portion of the distillate is used in macerating a fresh portion of mustard. The yield is usually about $\frac{2}{3}$ per cent., but occasionally as high as 1 per cent. Dircks (1883) obtained the following yield: black mustard-seed cake, 1.39 per cent.; rape-seed, 0.018 to 0.037; rape-seed cake, 0.020 to 0.109; yellow mustard-seed cake, 0.018; turnip-seed, 0.038; seed of Sinapis arvensis, *Linné*, 0.006. According to A. W. Hofmann (1882), the oil is best prepared artificially by boiling sulpho-urea with concentrated phosphoric acid.

Properties.—The crude oil has a yellow color; after rectification it is colorless or nearly so. It is neutral to test-paper, has the specific gravity 1.017 (1.016–1.022 *P. G.*, 1.018–1.029 *U. S.*), is strongly refractive, boils at 148° C. to 150° C. (298.4°–302° F.), is somewhat soluble in water, freely so in alcohol and ether, carbon disulphide, and has a very pungent and acrid odor and taste. If to 3 Gm. of oil 6 Gm. cold concentrated sulphuric acid be added, the mixture retains a light-yellow color and remains perfectly transparent, sulphur dioxide is given off, the liquid becomes thicker, sometimes crystalline, and the piercing odor of mustard oil disappears; in the presence of other volatile oils a brown or red color is produced. Ammonia converts the oil into *thiosinamine* or *allylsulpho-urea*, $C_3H_5.NH.NH_2.CS = C_4H_8N_2S$, which crystallizes in colorless rhombic prisms having a bitter taste, melting at 70° C. (158° F.), and easily soluble in water, alcohol, and ether. This reaction was recommended by Flückiger (1880) as a quantitative test for the oil (see below).

Composition.—Oil of mustard is *allyl sulphocyanate*, $C_3H_5.CNS$. Sometimes it contains also allyl cyanide and carbon disulphide, the latter, according to A. Hofmann, not exceeding .56 per cent., while Johanson (1881) found from .76 to 2 per cent.; both these compounds boil at a lower temperature. The oil is artificially prepared by decomposing allyl bromide or iodide by means of an alcoholic solution of potassium sulphocyanate. Using an allyl iodide obtained from glycerin and phosphorus iodide, Gerlich (1875) obtained a mustard oil which consisted of *isopropyl sulphocyanate*, C_3H_7CNS, the density of which is 0.974. Mylius (1877) found in the artificial oil of commerce, besides 92.2 per cent. of allyl-mustard oil, some hydrocyanic acid, carbon disulphide, and polysulphides.

Tests.—"If a portion of the oil be heated in a flask connected with a well-cooled condenser, it should distil completely between 148° and 150° C. (298.4° and 302° F.), and both the first and the last portions of the distillate should have the same specific gravity as the original oil (absence of alcohol, chloroform, carbon disulphide, petroleum, and fatty oils). If a small portion of the oil be diluted with five times its volume of alcohol and a drop of ferric chloride test-solution be added no blue or violet color should be produced (absence of phenols). If a mixture of 3 Gm. of the oil and 3 Gm. of alcohol be shaken, in a small flask, with 6 Gm. of ammonia-water, it will become clear after standing for some hours quietly at 50° C. (122° F.), and usually deposit, without becoming colored, crystals of thiosinamine (allyl-thio-urea, $CS.N_2H_3(C_3H_5)$). To determine the proportion of thiosinamine obtainable from the oil, decant the mother-water from the crystals and evaporate it gradually in a tared capsule, on a water-bath, adding fresh portions only after the ammoniacal odor of the preceding portion has disappeared. Then transfer the crystals, including those remaining in the flask, which may be rinsed out with a little alcohol, to the capsule, and heat the latter on a water-bath, until its weight remains constant. The amount of thiosinamine thus obtained from 3 Gm. of the oil should be not less than 3.25 Gm., nor more than 3.5 Gm. After cooling, thiosinamine forms a brownish, crystalline mass, fusing at 70° C. (158° F.), and having a leek-like, but not at all pungent odor. The mass should be soluble in 2 parts of warm water, and this solution, which should not redden blue litmus-paper, possesses a somewhat bitter, not persistent taste." —*U. S.*

Action and Uses.—Volatile oil of mustard is a powerful and almost caustic irritant, which, for fear of accident, should never be prescribed internally. It is said that it may sometimes be applied as an external counter-irritant upon parts to which a blistering plaster cannot readily be adapted, but there are none upon which cantharidal collodion cannot as readily be painted as this oil. As a rubefacient it may be used dissolved in olive oil or alcohol in the proportion of about Gm. 0.30 in Gm. 4 (5 drops to the fluidrachm).

OLEUM SUCCINI.—Oil of Amber.

Huile volatile de succin, Fr.; *Bernsteinöl*, G.

The volatile oil obtained by the destructive distillation of amber and purified by rectification.

Origin.—Succinum, Ambra flava.—Amber, *E.*; Succin, Ambre jaune, *Fr.*; Bernstein, Agtstein, *G.*—This fossil resin is the exudation from a number of extinct coniferous trees of the sub-orders Abieteæ and Cupresseæ, the principal source of the Baltic amber being Pinites succinifer, *Goeppert*, s. Pityoxylon succiniferum, *Kraus*. It is principally obtained on the southern and south-eastern coast of the Baltic, where it is cast ashore or

dug out of beds. It has also been found in the interior of Europe and in Siberia, Greenland, and North America. It is hard, somewhat brittle, whitish, yellow, or red-brown, transparent, translucent, or opaque, breaks with a conchoidal fracture, and frequently encloses vegetable fragments and insects. It is fragrant when heated, melts at about 287.5° C. (550° F.), dissolves in chloroform, but is insoluble in water, and only partly soluble in alcohol, ether, and volatile oils. Its density varies between 1.05 and 1.10. The annual production of amber in Prussia is estimated at 100,000 kilos. From 4000 to 7000 pounds of oil of amber are annually imported by the United States.

Preparation.—The oil is obtained by the dry distillation of amber, succinic acid being formed at the same time (see page 97). The crude oil is mixed with six times its volume of water, and distilled as long as oil is found in the distillate. The yield is usually stated to be from 60 to 70 per cent. of the crude oil; but Ebert (1865), who prepared the crude oil, obtained from 29 troyounces of amber 21 fluidounces of oil specific gravity 0.985, and on rectifying this with water only 2½ fluidounces, or about 12 per cent. of rectified oil specific gravity 0.903, while the density of the residue had increased to 1.019. Marsson (1850) obtained from amber 6 per cent. of rectified oil, 3.5 per cent. of succinic acid, and 58.3 of residuary resin (amber colophony). Döpping (1847) observed that the crude oil, after having been treated with potassa solution, dilute sulphuric acid, caustic potassa, and calcium chloride in succession, distilled between 140° and 170° C. (284° and 338° F.) and left a dark-brown residue. On again treating the distillate with burned lime, and repeating the distillation, the liquid had a higher boiling-point (up to 190° C., 374° F.) and was colorless.

Properties.—Crude oil of amber is a thick brown liquid of a strong empyreumatic and fetid odor, and variable specific gravity approaching the density of water; Marsson found it to be .922. Very similar products are obtained from copal, dammar, and other resins. In this state it is rarely employed in medicine, but is used in preparing

Oleum succini rectificatum, *Rectified oil of amber.* This is thin, colorless or yellowish, becomes darker and thicker on exposure, has a spec. grav. of about .920, but varies in density between 0.88 and 0.99, and in the boiling-point as stated above. It has a pungent, empyreumatic, and somewhat balsamic odor, which is more pleasant than that of the crude oil, and a warm, acrid taste. It has a neutral or faint acid reaction, dissolves, according to Anthon (1835), in 2 parts of absolute alcohol, but requires at about 35° C. (95° F.) 30 parts of alcohol spec. grav. .855 for complete solution. Ebert found it soluble in 4 parts of alcohol spec. grav. .817, and in 17 parts of alcohol spec. grav. .835. It is readily soluble in ether, fixed and volatile oils, dissolves iodine, and, when heated, sulphur and caoutchouc. It absorbs some hydrochloric acid gas without forming a crystalline compound, and in contact with cold fuming nitric acid acquires a red afterward dark red-brown color, and is converted into a brown resinous mass having a peculiar musk-like odor, and formerly known and medicinally employed under the name of *artificial musk*. It was discovered by Marggraf (1759), and may also be obtained from oil of amber and ordinary or diluted nitric acid on the application of heat.

Composition.—In its purest state oil of amber is a mixture of several oils having the composition of oil of turpentine, $C_{10}H_{16}$.

Adulterations.—Oil of amber is not unfrequently adulterated with oil of turpentine and with coal oil; the former is recognized by the brisk reaction with iodine, and by the formation of terpin when left in contact with alcohol and nitric acid; the latter by the decreased solubility in alcohol.

Action and Uses.—Oil of amber is a powerful irritant of the skin. When taken internally it is said to be stimulant and antispasmodic. In large doses it acts as acrid and neurotic poison, and has been employed to produce criminal abortion (*Therap. Gaz.*, x. 214). It has been given in various *mucous profluvia* of the lungs and urinary organs, in *retrocedent gout* and *rheumatism*, *eruptive fevers*, *hysteria*, *whooping cough*, and *amenorrhœa*. Externally, it may be employed in stimulating liniments for *rheumatism* and *paralysis* and rubbed upon the spine in the *convulsive disorders* of children. It has been applied as a stimulant disentient to *hæmorrhoidal tumors*. The *dose* is Gm. 0.30–0.60, (gtt. v–x), and on account of its acrid and offensive taste the oil should be enclosed in gelatin capsules.

OLEUM TEREBINTHINÆ, *U. S., Br., P. G.*—Oil of Turpentine.

Essence de térébenthine, Fr.; *Terpentinöl*, G.; *Esencia de treventina*, Sp.

The volatile oil distilled from turpentine. (See Terebinthina.)

Preparation.—Oil of turpentine is obtained by distilling the oleoresinous exudation of various species of Pinus. The crude turpentine is put into a large still, heat is applied, and a little water added from time to time to the contents of the still. The distillation is continued as long as oil passes over, when the resinous mass is run off through a stopcock placed at the bottom of the still, is passed through several strainers, and then constitutes *rosin*. (See RESINA.) On condensing the distillate the oil of turpentine separates from the water and is dipped into barrels, in which it enters commerce.

Properties.—Oil of turpentine is a colorless, thin, volatile oil, the density of which varies between 0.855 and 0.87. When recently rectified it boils at about 150° C. (302° F.), but the temperature usually rises as the distillation progresses, and old oil generally boils between 155° or 170° C. (311° or 338° F.). As procured from different sources, oil of turpentine shows great differences in its optical behavior, and on fractional distillation with or without water oils are obtained differing in the degree of their influence upon polarized light. American and German oil of turpentine are dextrogyre, while the French oil has a levogyre action. Odor and taste are peculiar, strongly terebinthinate, differing to some degree according to the source from which the oil has been obtained. When recently distilled, particularly after rectification with water, the oil has a neutral reaction and its odor is rather mild, but after exposure to air it becomes stronger, more unpleasant, and pungent; the oil then contains ozone, and gradually acquires a yellowish color and thicker consistence; at the same time resin and formic and acetic acids are produced, and in the presence of moisture, also a hydrate of the oil. The aqueous solution of such oxidized oil has been used under the name of *sanitas* as an antiseptic; on evaporating it Kingzett (1880) obtained a dark-colored adhesive mass, $C_{10}H_{18}O_3$, which with sulphuric acid gave a dark-red color. Oil of turpentine dissolves in $\frac{1}{2}$ or $\frac{3}{4}$ part of alcohol sp. gr. 0.816, in 1½ or 2 parts of alcohol sp. gr. 0.820, in 4 or 5 parts of alcohol sp. gr. 0.830, and in from 8 to 12 parts of alcohol sp. gr. 0.845; the solubility of oil of different origin and age varies more or less, and occasionally oil of turpentine has been observed which even with strong alcohol would not yield a perfectly clear solution. It is also soluble in an equal volume of glacial acetic acid. Bromine and powdered iodine act violently upon oil of turpentine: nitric acid oxidizes it, the violence of the action and the final products being influenced by the strength of the acid. Gaseous hydrochloric acid unites with oil of turpentine, forming two compounds: one, having the composition $C_{10}H_{16}HCl$, is known as *artificial camphor*, is crystallizable, and has the odor and taste of ordinary camphor, but is less pungent and somewhat terebinthinate. Three compounds with water are known; one, which is called *turpentine camphor* or *terpin*, has the composition $C_{10}H_{20}O_2$, and is obtained by leaving the oil in contact with alcohol and nitric acid. If a small quantity of the oil be evaporated in a small capsule on a water-bath, only a very slight residue should remain (absence of petroleum, paraffin, oils or resins).

Purification.—The partially resinified oil is best purified by rectification with water, or it may be repeatedly agitated with small portions of alcohol, which dissolves the resin, and afterward with water.

OLEUM TEREBINTHINÆ RECTIFICATUM.—Rectified oil of turpentine, *E.*; Essence de térebenthine rectifiée, *Fr.*; Gereinigtes Terpentinöl, *G.*—Oil of turpentine, a convenient quantity; lime-water, a sufficient quantity. Shake the oil thoroughly with six times its volume of lime-water, and introduce the mixture into a copper still connected with a well-cooled condenser. Then distil over an open fire, until about three-fourths of the oil have passed over, and separate the clear oil from the water. Keep the product in well-stoppered bottles, in a cool place, protected from light. Rectified oil of turpentine should always be dispensed when oil of turpentine is required for internal use. "It forms a thin, colorless liquid, having the specific gravity, 0.855 to 0.865 at 15° C. (59° F.), and the boiling-point about 160° C. (320° F.). Its alcoholic solution should be neutral to litmus-paper. If about 10 Cc. of the oil be evaporated in a capsule on a water-bath, no weighable residue should be left.—*U. S.*, *P. G.*

Composition.—When perfectly pure, oil of turpentine is free from oxygen and has the composition $C_{10}H_{16}$. On being distilled in the presence of sulphuric acid it is converted into several isomeric or polymeric oils, among which are *terebene* and *colophene*, the latter boiling at 310° C. (590° F.) and showing a blue fluorescence; it is also obtained on the dry distillation of rosin. By acting with sodium on turpentine hydrochlorate Letts (1879) obtained *turpenyl*, $C_{10}H_{17}$, a solid white volatile compound, and *diturpenyl*, $C_{20}H_{34}$, which is liquid and has a higher boiling-point.

Allied Products.—TEREBENE, $C_{10}H_{16}$. It is a derivative of oil of turpentine, produced by the action of heat and of concentrated sulphuric acid or phosphoric anhydride. It is a colorless

volatile oil, without influence on polarized light, has a rather agreeable thyme-like odor, the density .864 at 8° C. (46.4° F.), and the boiling-point 156° C. (312.8° F.), and acquires with iodine a dark-green, opaque appearance. It combines with hydrochloric acid gas, forming two liquid oils, one of which is heavier than water.

Abietene, C_7H_{16}. This is the volatile oil obtained from the terebinthinate exudation of Pinus Sabiniana, *Douglas*, the *nut pine* or *digger pine* of California. According to Wenzell (1872), the crude oil is colorless, and commences to boil at 101° C., the thermometer gradually rising to 115° C. (239° F.). Pure abietene boils at 101° C., has a strong penetrating orange-like odor, is highly inflammable, very volatile, of the spec. grav. .694 at 16.5° C., soluble in 5 parts by measure of 95 per cent. alcohol, dissolves freely iodine and bromine, and yields with chlorine a substitution-compound boiling at 260° C. Thorpe (1879) found it to have the composition of *heptane*, C_7H_{16}, to boil at 98.42° C., and to be slightly dextrogyre.

The volatile oil of Pinus ponderosa, *Douglas*, of California, which was examined by Sadtler (1879), seems to have the same composition.

Action and Uses.—Its local operation is that of an irritant, causing pain, redness, and even vesication. A case is recorded in which friction of the sound skin with the oil produced an erythematous eruption in parts not rubbed, and also was detected in the urine (*Arch. gén.*, Apr. 1886, p. 477). In man the prolonged inhalation of its vapors produces vertigo, impaired vision, pain in the loins, strangury, and bloody urine, and, if they are very concentrated, collapse. In females menorrhagia and dysmenorrhœa are sometimes added. Workmen when first exposed to its emanations suffer from headache, unsteady gait, irritability, smarting of the eyes, and lachrymation, impaired vision (particularly by artificial light), coryza, cough, granular pharyngitis, vomiting, and indigestion. Gradually, however, these symptoms subside and a tolerance of its action is established (*Bull. de thérap.*, xcvi. 508). The internal administration of large doses of the oil has produced heat in the stomach, vertigo, confusion of mind, extreme thirst, strangury, and a frequent discharge of urine exhaling an odor of violets. It is secreted with the milk. Prevost and Binet include this oil and its derivatives, terpinol and terpine, among the substances that increase the secretion of bile. The bowels are not disturbed. Sometimes it causes itching and diaphoresis, and occasionally a roseolous or erythematous eruption. Excessive or poisonous doses occasion graver symptoms. Thus, when 6 ounces were taken by a woman her body was found in a state of opisthotonos, the pupils were dilated, and the brain, lungs, stomach, and heart were gorged with blood. Yet a child aged fourteen months recovered after swallowing 4 ounces of the oil. It is recorded that the air of a cellar where turpentine was stored, and in which a boy was nearly asphyxiated, was found to be nearly deprived of its oxygen. Many instances of its narcotic action are on record. (Compare Begbie. *Works*, p. 283).

Oil of turpentine has been used in almost every form of *hæmorrhage*, but most successfully when the bleeding was passive. The special affections include *epistaxis*, *hæmaturia*, *menorrhagia*, *post-partum* hæmorrhage, *purpura*, and the multiple hæmorrhages occurring under the influence of the *hæmorrhagic diathesis*. Even in external and *traumatic* hæmorrhages it has proved efficient. For example, in *epistaxis* when applied on pledgets of lint. In the treatment of bleeding *wounds* a mixture of equal parts of this oil and of linseed or olive oil should be applied after thoroughly cleansing the part, which should then be sealed by appropriate dressings. Its efficacy justifies the opinion of John Hunter, who termed it "the best, if not the only true, styptic." A cure of *aneurism* has even been attributed to its internal administration (*Times and Gaz.*, Nov. 1883, p. 543).

In *puerperal fever* this medicine once enjoyed a high repute, which it has in a great measure lost at the present time. For the varying estimates of its value a reason may probably be found in the indiscriminate manner of its employment. When it was prescribed in cases marked by a typhoid state in which excessive tympanites existed, there is no reasonable ground for doubting that it often successfully combated the nervous and cardiac depression of the disease, and, by lessening the distension of the abdomen, diminished the mechanical hindrance to hæmatosis. For the latter purpose it was applied as an epithem to the abdomen, as well as administered internally. This judgment appears to be justified by its recognized effects in other febrile affections of a typhoid type. In *typhus*, for example, it is of great utility both internally and externally—not only for its power of arousing the sluggish functions generally, but especially for combating the pulmonary congestion which is the gravest of the usual incidents of the disease. In *typhoid fever*, besides the general influences already mentioned, it is not only one of the most efficient remedies for intestinal tympanites, as in the cases referred to, but it also favorably controls the bronchial catarrh, and, in the advanced stages, probably exerts a local

stimulant action upon the intestinal ulcers and checks the tendency to hæmorrhage from them. So, too, in *yellow fever* of a low type it may operate not only by its general stimulation, but also by its direct action upon the stomach, tending to control the hæmorrhage which is so grave a symptom in that disease. Its possible action in promoting the urinary secretion in this fever should not be overlooked. In *tympanites*, from whatever cause arising, it may become a valuable auxiliary in the treatment, whether administered by the mouth and rectum or applied to the skin of the abdomen. When given internally for the relief of this symptom it should generally be associated with a purgative, and especially with castor oil. The various disorders of the alimentary canal in children attended with diarrhœa, colic, and flatulence are often benefited by this oil, and particularly the subacute or the chronic form of *cholera infantum*. It is most efficient in the treatment of *tæniæ*, and indeed in that of other *intestinal worms*, when a full dose of it is shortly followed by one of castor oil. A disadvantage of this treatment is, however, that as large doses of the oil are required they are apt to give rise to colic, if not to strangury.

Oil of turpentine has been supposed to dissolve *biliary concretions*, and in some cases it has, when associated with sulphuric ether, appeared to favor their discharge. It seems more probable that it should tend to prevent the formation of gall-stones than to dissolve them when once formed. Experiments appear to show that the oil increases the secretion of bile, and in this manner it may promote the discharge of retained calculi. Its diuretic virtues have caused it to be occasionally used to promote the expulsion of *urinary concretions*, and for this purpose it is said to have been efficacious in the form of baths of the vapor of oil of turpentine (Brémond). Impregnating the urine, it becomes a suitable remedy for *catarrh of the urinary passages* and for debility or *paralysis of the bladder*; and, very probably, in females this stimulation has served to cure *amenorrhœa* and to excite *uterine contractions* during labor. For these purposes, however, the oil is best administered by the rectum; but for the former of the two, as well as for *menorrhagia* depending upon general atony, the medicine may be given by the lungs or by the stomach.

Although the *modus operandi* of this medicine in *sciatica* is totally unknown, its curative power is none the less certain. It has stood the test of a century's experience. Probably no other remedy is comparable with it in chronic examples of this painful and crippling affection. Some difference of opinion exists concerning the proper dose which should be given, some prescribing ½ ounce of it at bedtime for several successive nights, and others a dose of 30 drops three times a day. The latter is to be preferred at first. It may be gradually increased if necessary. The cases which are benefited by this treatment are more apt to occur in feeble than in robust persons, and are the effect of a prolonged rather than an abrupt action of cold and dampness. It has also been used in *facial neuralgia*, but apparently with inferior results. Its utility in *syphilitic iritis* is well established; it has generally been employed as a substitute for mercury in cases for which this medicine was ill adapted.

In all forms of *chronic bronchitis* oil of turpentine has, like other terebinthinates, been largely used, formerly by internal administration, and more recently by inhalation. It is especially useful in both ways in cases of *fetid bronchitis* and *gangrene of the lung*, in both, doubtless, by stimulating the tissues to a more healthy action rather than by its disinfectant virtue. The superiority of oil of turpentine in the latter affection is certainly due to its stimulant action. An atomized solution of 15 drops of oil of turpentine in sufficient water is recommended to be inhaled for about 10 minutes every hour, day and night, in the treatment of *diphtheria* (Edel). Bosse claims to have treated this disease very successfully by oil of turpentine given internally in doses of 2 or 3 drachms a day (*Times and Gaz.*, Jan., 1881, p. 101). Satlow states that the first effect of the oil is to remove the fetor, and then to render the exudation looser, softer, and thinner, and cause it to be thrown off, leaving no trace behind it. The full action of the remedy occupies three or four days. Of forty-three cases treated by Satlow, only one died, and that was of a paralytic sequel of the disease. He advises that only freshly-prepared oil be employed, and that doses to the extent of a teaspoonful daily should be given to children under two years of age, and of a dessertspoonful to those between that age and five years, and to adults a tablespoonful, and that each dose should be followed by a draught of milk (*Centralbl. f. d. ges. Therapie*, i. 447). It is worthy of remark, first, that the use of this mode of treatment was discovered through a child affected with diphtheria having accidentally swallowed a tablespoonful of oil of turpentine; and, second, that the most plausible explanation of its utility is, that it not only acts directly upon the membrane, but also as

a stimulant to the whole system, as it does in adynamic states generally. It has naturally been referred to the power of oil of turpentine to destroy disease-germs, but the explanation is as inadequate as it is unnecessary. Moreover, it is not clear that either these alleged results or more recent ones are incontrovertible. Thus, while Roesse reported (*Therap. Monatsheft.*, Oct. 1887) that this oil in drachm doses three times a day was very useful in a large number of cases of diphtheria, it appears that along with it he prescribed sodium salicylate internally, ice-bags to the throat, and strong liquid food and wine, thus rendering very doubtful whether the oil of turpentine promoted or hindered the result. The vapors of this oil are also reported to be very efficient in *whooping cough*. The accidental discovery of the power of oil of turpentine to prevent *phosphorus-poisoning* has saved many lives. The immediate administration of the antidote is of course desirable, not only to check the local action of the phosphorus, but also to prevent its absorption in a dangerous form. About twelve hours has been assigned as the limit within which the oil is efficacious. It is alleged that oil of turpentine which has become oxygenated by long exposure to the air is the most efficient, but results do not entirely agree upon this point. It must not be prescribed in an oily or albuminous vehicle, such as white of egg, milk, soup, etc., and neither mucilaginous nor alcoholic drinks should be allowed, but only water. If possible the oil should be given pure, floated on water or in capsules. If it cannot be retained by the stomach, it may be thrown into the rectum, and its absorption by the skin from liniments and epithems, and by the lungs from an atomized preparation or simply from the air of the chamber saturated with the fumes of the oil, may be employed as supplementary means. The *dose* of oil of turpentine in the cases now considered is about Gm. 0.60 (gtt. x) every hour.

Oil of turpentine has long been employed *externally* as a stimulant, rubefacient, and counter-irritant in *neuralgia* and in *acute and chronic rheumatism*. It is generally mixed with olive oil, chloroform, camphor, narcotic extracts, etc. Baths of the vapor of the oil are the most efficient means of applying it, or baths of hot watery vapor (104° to 113° F.) with which a fine spray of oil of turpentine is mingled. Warm water baths in which has been dissolved a mixture of 8 ounces of turpentine and 2 pounds of washing soda have also been used with good effect. The oil is of singular virtue in relieving *tympanites* and *colic* in various diseases, but especially when the intestinal distension is owing chiefly to atony of the bowels, as in typhoid fever. It is best applied, mixed with olive oil, to the abdomen, which should then be covered with flannel dipped in hot water and wrung nearly dry. In the treatment of *burns* this oil is most efficient. The affected part should first be bathed with the oil, and then covered with soft lint saturated with liniment of turpentine or ointment of turpentine, so as thoroughly to exclude the air. It is useful in the treatment of *rhus poisoning*. Turpentine epithems are also of marked utility in inflammations of the respiratory organs, including *laryngitis*, *bronchitis*, *pneumonia*, and *pleurisy*. They probably act both as revulsives and through the absorption of the oil. They have also been found efficient in the treatment of *phlegmasia alba dolens*. Traumatic *erysipelas* has been treated advantageously by the ointment just mentioned, and also by simple lotions of oil of turpentine. The same method is equally applicable in cases of *frost-bite* and of superficial *gangrene*. It is also of use in relieving engorgement of the *mammæ* at the commencement of lactation, and perhaps of preventing the formation of *abscess*. It appears to lessen the secretion of milk. An emulsion containing equal parts of oil of turpentine and tincture of camphor is said to be an efficient dressing for *carbuncles*. Indeed, there are few ulcers of an indolent character that are not benefited by this oil, applied either alone or in an ointment or cerate, as in the simple or compound resin cerate. Ulcers resulting from *mercurial salivation* tend to heal after being touched by the pure oil or washed with an emulsion containing it. It is one of the best stimulant applications to sinuses, especially to *fistula in ano*. It has been used successfully in the treatment of *scabies* and in *ringworm of the scalp*, in the one case destroying the Acarus scabiei, and in the other the Microphyton tonsurans. In the latter affection the part ought to be first washed with the oil of turpentine, and then with carbolic-acid soap, after which the growth may be touched with tincture of iodine. Scrofulous *ozæna* is benefited by applications of this oil in the form of a liquid or a vapor. Foulis states that the fetor of putrefying substances will not adhere to the hands if they are anointed with oil of turpentine (*Edinb. Med. Jour.*, xxvi. 133).

The dose of oil of turpentine as a stimulant is from Gm. 0.30–2 (gtt. v–xxx) three times a day. Such doses are conveniently administered in gelatin capsules. As an anthelmintic from Gm. 8–16 (fʒij–iv) may be given at intervals of half an hour until three or four doses are taken. These doses are usually prescribed in an emulsion, with

the addition of oil of cinnamon, cajeput, or rosemary to diminish nausea. Besides the rubefacient preparations above mentioned, a very efficient one may be made with equal weights of oil of turpentine, acetic acid, and liniment of camphor.

OLEUM THEOBROMATIS, *U. S.*, *Br.*—Oil of Theobroma.

Oleum theobromæ, U. S., 1880; *Oleum concretum e semine theobromæ cacao*, F. Cod.; *Oleum (Butyrum) cacao*, P. G.—*Butter of cacao*, E.; *Beurre de cacao*, Fr.; *Kakaobutter*, G.; *Manteca (Accite) de cacao*, Sp.

The fixed oil expressed from the seed of Theobroma Cacao, *Linné*.

Nat. Ord.—Sterculiaceæ, Buettnerieæ.

Preparation.—In the manufacture of chocolate a portion of the cacao-seeds are deprived of their fat by removing the shells, heating the kernels to about 70° C. (158° F.), and pressing them between hot iron plates; the expressed fat is usually run into rectangular moulds and allowed to congeal. The yield from the different varieties of cacao is from 35 to 45 per cent.

Properties.—Cacao butter is a yellowish-white fat, gradually turning white by age. It is sufficiently hard at ordinary temperatures to be broken into smaller pieces, but softens by the warmth of the hand and melts when taken in the mouth. It has an agreeable odor and a bland chocolate-like taste, dissolves in ether, acetic ether, and 100 parts of cold absolute, and in 20 parts of boiling, alcohol, separating again from the latter solution on cooling, with the exception of a small portion which remains dissolved. Its specific gravity is 0.97 to 0.98, but is given by some authors as low as 0.900. It is brittle at 15° C. (59° F.), and melts between 30° and 35° C. (*U. S. P.*, *P. G.*), forming a pale-yellow, transparent liquid which congeals at 20.5° C. (69° F.), the temperature rising to about 26.5 C. (79.7° F.). The fusing-point of cacao butter obtained from different commercial varieties of seeds has been determined by Trojanowski (1875) and Lamhofer (1877), and found to vary between 30° C. (86° F.) and 33° C. (91.4° F.) Pelouze and Boudet observed it in one instance as low as 29° C. (84.2° F.)

Composition.—Cacao butter is easily saponified, and yields glycerin, oleic, stearic, and a little palmitic acid (Stenhouse, Specht, and Gossman). Kingzett (1877) pointed out the existence in this fat of an acid having the composition $C_{64}H_{128}O_2$, for which he proposed the name of *theobromic acid*. This acid could not be detected by Vander Becke (1880) and C. Traub (1883); the latter, in addition to the acids mentioned above, determined also the presence of lauric and arachic acids, and regards the firm consistence and low melting-point to be due to the proportions in which these glycerides are combined.

Adulterations.—When mixed with other solid fats the fusing-point and specific gravity do not afford reliable tests for determining such admixtures. The presence of tallow may be detected by burning the oil with a wick for a short time, and then extinguishing the flame, when a peculiar tallow-like odor will be observed. For the detection of adulterations Björkland (1864) proposed the test incorporated into the Pharmacopœia, as follows: "If 1 Gm. of oil of theobroma be dissolved in 3 Cc. of ether, in a test-tube at a temperature of 17° C. (63° F.), and the tube subsequently plunged into water at 0° C. (32° F.), the liquid should not become turbid nor deposit a granular mass in less than three minutes; and if the mixture, after congealing, be exposed to a temperature of 15° C. (59° F.), it should gradually form a perfectly clear liquid (absence of paraffin, wax, stearin, tallow, etc.)." If pure, cacao butter will separate granules in not less than 3 minutes; if adulterated with tallow or suet, a turbidity will appear at once or within 2½ minutes, according to the quantity of the adulterant, of which 5 per cent. may thus be detected. When the congealed mixture is exposed to a temperature of about 15° C. (59° F.), it will gradually become clear again if the cacao butter was pure, but not if it was adulterated. Trojanowski and Lamhofer proved the value of this test. According to Lamhofer, petroleum benzin may be substituted for the ether with nearly identical results, except that the pure oil separates rather more slowly and is always granular, while other fats render the entire liquid cloudy. "The solution of 1 part of oil of theobroma in 2 parts of ether should remain clear if kept for a day at a temperature of 12° to 15° C. (53.6° to 59° F.)"—*P. G.*. This is a modification of the test proposed by Ramsperger (1876), who states also that aniline shows adulterations with tallow and wax almost as well as ether does.

Allied Fats.—More or less odorous fats are expressed from the seeds of several species of Bassia (nat. ord. Sapotaceæ). Bassia longifolia, *Linné*, yields the greenish *elloopa* or *elloopa oil*. Bassia butyracea, *Roxburgh*, gives the tallow-like *fulwa butter*. The *mahwah butter* melts at about 45°

C. (113° F.), is greenish or yellowish, and comes from Bassia latifolia, *Roxburgh*. These fats come from India. The *shea butter*, *galam butter*, or *bambuk butter* is obtained from Bassia (Butyrospermum, *Kotschy*) Parkii, *De Candolle*, of tropical Africa. It is pale-greenish or grayish, has a cacao-like odor and mild taste, and melts at about 28° C. (82.4° F.). The fleshy mahwah-flowers are used as food and for distilling a spirit; when dry they are said to contain 50 per cent. of sugar.

Mafura Tallow has also a cacao-like odor and a mild taste, but it is a yellowish color and melts at 42° C. (107.6° F.). It is obtained by boiling the seeds of Trichilia emetica, *Vahl*, s. Mafureira oleifera, *Bertero* (nat. ord. Meliaceæ), of tropical East Africa.

Action and Uses.—Oil of theobroma has been used internally, in doses of Gm. 1–2 (gr. xv–xxx), as a nutrient and emollient remedy in cases of chronic affections of the *lungs* and *bowels*, and externally as a dressing for excoriated surfaces, *wounds*, etc. Its mildness renders it superior to lard for the latter purposes, and it is more emollient than spermaceti. It is the most eligible material for making suppositories. Its slight tendency to become oxidized fits it to protect surgical and other steel instruments from being corroded by exposure to the air.

OLEUM THYMI, *U. S.*, *P. G.*—Oil of Thyme.

Huile volatile (*Essence*) *de thyme*, Fr.; *Thymianöl*, G.; *Esencia de tomilla*, Sp.

The volatile oil distilled from the leaves and flowering tops of Thymus vulgaris, *Linné*.

Nat. Ord.—Labiatæ.

Preparation.—The flowering herb is distilled with water or steam. The yield varies between ¼ and 1 per cent. The oil is largely produced in France, and enters commerce either in the crude state as *huile rouge de thyme* (*red oil of thyme*) or rectified as *huile blanche de thyme* (*white oil of thyme*). The red oil is frequently sold as *oil of origanum*.

Properties.—Crude oil of thyme is of a deep reddish-brown color; the rectified oil is colorless, yellowish, or yellowish-red, and is the kind directed by the pharmocopœias. It has a strong aromatic odor and a pungent, warm, and afterward cooling taste, dissolves in one-half its weight of alcohol, forming a clear solution, neutral to test-paper. It is soluble in all proportions in carbon disulphide and glacial acetic acid. It varies in density between 0.900 and 0.930. It does not fulminate with iodine.

Composition.—The more volatile portion of oil of thyme consists of two hydrocarbons—*cymene* $C_{10}H_{14}$, and *thymene* $C_{10}H_{16}$. The former is also a constituent of oil of cumin (see p. 559). The latter boils between 160° and 165° C. (220° and 329° F.), is levogyre, and yields with hydrochloric acid gas a liquid compound. The stearopten is *thymol*, $C_{10}H_{14}O$, which is probably formed by oxidation; at least, Lallemand (1854) reports having received considerable quantities of thymol by passing air through the mixed hydrocarbons for several months. By agitating the commercial oil with soda solution, Gerrard (1878) obtained only variable quantities of an oily liquid, but no solid compound, and on exposure to a low temperature no thymol could be obtained; he concludes from this that the thymol is probably frequently extracted from the oil. A similar experience was reported by J. L. Lemberger (1882), who obtained from the rectified oil less than 1 per cent., while two samples of red oil yielded 16.67 and 38.75 per cent. of crude thymol.

Tests.—The presence of thymol, according to Hager (1882), is conveniently ascertained by spreading half a drop of it, by means of a small cork, upon a glass slide, so as to occupy 4 or 5 square Cm. The thymol begins to separate within three or four minutes in the central portion of this liquid, in numerous minute bodies recognizable by the naked eye; subsequently they appear also toward the margin, but less numerous. Under the microscope they are at first amorphous, but after an hour or two are easily recognized as crystals. "The solution of oil of thyme in alcohol should not be colored yellowish-brown on the addition of a drop of test-solution of ferric chloride."—*P. G.* "With a drop of ferric chloride test-solution the oil yields a greenish-brown color, which changes to reddish. If 1 Cc. of the oil be shaken with 10 Cc. of hot water, and, after cooling, the liquid be passed through a wet filter, the filtrate should not assume, with a drop of ferric chloride test-solution, a bluish or violet color (absence of phenol or carbolic acid).—*U. S.*

Action and Uses.—Garden thyme and wild thyme have long been used, the one as a condiment to promote the digestion of pork, goose, and other fatty meats, and to flavor insipid dishes; the other as a stimulant in various nervous disorders. Exter-

nally it was applied in fomentations, baths, fumigations, etc., to relieve muscular rheumatism and chronic gout, to cure scabies, indolent ulcers, etc.

According to Campardon (*Bull. de Thérap.*, cvii., 490), when given to animals its primary action is that of a diffusible stimulant; but if the dose be increased it causes vomiting, depression, coldness, and death by exhaustion. In man also, the daily dose of 5 or 6 drops acts as a general stimulant, and when the oil is continued in increasing doses it renders all the functions more active and energetic. The urine increases and acquires a violet odor, the stools grow firmer and less frequent, and all morbid discharges are diminished. If the daily quantity be gradually augmented from 6 to 12 drops, the effects are apt to be intensified, and the odor of the medicine may be perceived on the breath and the skin. Sometimes the latter presents erythematous or papular eruptions and the fauces become dry.

The author cited finds this oil a powerful aid, in the treatment of *chlorosis*, to the more radical remedy, iron, particularly in cases of which the dominant character is torpor rather than excitability. In this, as on the points that follow, he is only reproducing the long-established views of treating chronic and subacute *rheumatism* of the fibrous coverings of the joints and muscles, and the closely related cases of *neuralgia* from cold. The substitutive action of the oil is shown in its cures of *bronchitis*, *diarrhœa*, *gonorrhœa*, *gleet*, *leucorrhœa*, and *vesical catarrh*, in all of which affections it resembles copaiba in its action. Externally the oil is applied in baths and lotions (by mixing with water or alcohol a sufficient quantity of powdered sodium carbonate previously impregnated with the oil) to the treatment of *scabies*, *muscular rheumatism*, etc.; and injections for profluvia of the genital organs; to correct the *fœtor* of certain secretions, of *gangrene*, etc. Applied on cotton, it mitigates the pain of *toothache*, *earache*, etc.

The essential oil is most conveniently given in capsules, owing to its acrid taste and the eructations it causes. Campardon advises a pill containing oil of thyme and almond soap, of each 2 grains, and marshmallow in powder, q. s.; the pill to be covered with balsam of Tolu.

OLEUM TIGLII, *U. S.*—Croton Oil.

Oleum crotonis, Br., P. G.; *Huile de croton*, *Tiglium*, F. Cod.; *Crotonöl*, G.; *Aceite de grano tiglia*, Sp.

The fixed oil expressed from the seeds of Croton Tiglium, *Linné*, s. Tiglium officinale, *Klotzsch*. Bentley and Trimen, *Med. Plants*, 230.

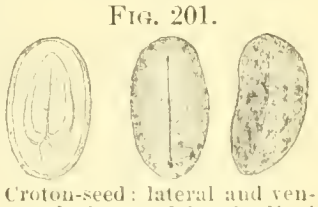
Nat. Ord.—Euphorbiaceæ.

Origin.—This species of croton is common in the wild state as well as cultivated throughout Hindostan and some of the East Indian and Phillipine islands, and has been introduced into Japan and other countries. It has alternate petiolate, acutely-ovate, serrulate leaves, and terminal racemes of unisexual flowers. The fruit is a tricoccous capsule, each cell containing a single seed.

Semen (Grana) tiglii, Semen crotonis—Croton-seeds, *E.*; Graine de tilly, Graine des Moluques, Petits pignons d'Inde, *Fr.*; Granatill, Purgirkörner, *G.*; Grano tiglio, Sp.

The seeds are about 12 Mm. (½ inch) long, oblong, flattened upon the ventral surface, and marked longitudinally by the slightly elevated raphe. The dorsal surface is rounded. Externally the seed is of a gray-brown color, mostly more or less mottled, or of a nearly uniform blackish color where the outer coat has been removed. The testa is brittle, and encloses an oily albumen of the shape of the seed and the thin foliaceous embryo. The seed is without odor, and has an oily afterward very acrid taste.

Fig. 201.



Croton-seed: lateral and ventral view, and longitudinal section, showing embryo.

Preparation.—The fixed oil is obtained in India and in Great Britain by subjecting the seeds to pressure. The yield is between 50 and 60, or, according to other statements, between 30 and 40 per cent.; the former amount probably refers to the kernels, the latter to the seeds, which are stated to yield from 33 to 36 per cent. of their weight of integuments.

Properties.—Croton oil from India is of a pale-yellow color; that made in England is of a more or less deep reddish-brown hue, the darker color being probably due to the greater age of the seed and to the higher temperature at which the oil is expressed. It is somewhat viscid and slightly fluorescent. It has a slight, peculiar, somewhat rancid odor, and a taste which is at first mild, but afterward acrid and burning. Its reaction to test-paper is distinctly acid, and its consistence rather viscid. It dissolves freely in ether,

chloroform, carbon disulphide, and fixed and volatile oils, and varies in its behavior to alcohol, according to Warrington (1865) being more soluble in that menstruum when old and partly oxidized; fresh croton oil requires about 60 parts of alcohol for solution. H. Senier (1878) ascertained that alcohol dissolves from freshly-expressed croton oil 20 per cent., and from such over three years old 60 per cent., and in 1883 showed that the portion insoluble in alcohol contains the purgative principle, while the vesicating principle is soluble in alcohol. When gently heated with twice its volume of absolute alcohol, it yields a clear solution from which on cooling the oil usually separates. The oil has a specific gravity of about 0.940 to 0.960. At a low temperature it separates white granules of fatty acid and congeals at about — 16° C. (3.2° F.). Exposed to air it becomes more viscid, perhaps from the separation of fatty acids, and not from the presence of a drying oil, although, like the latter it is not solidified when in contact with nitrous acid; this test is being used by the pharmacopœia for the detection of other non-drying oils. The application of the test is as follows: 2 Cc. of the oil are treated with 1 Cc. of fuming nitric acid and 1 Cc. of water, and the mixture vigorously shaken.

Composition.—The fats present in croton oil are glycerides of stearic, palmitic, myristic, and lauric acids, and of several volatile acids of the same series, like acetic, butyric, and valerianic acid; also the volatile *tiglinic acid*, $C_5H_8O_2$, which was recognized by Geuther and Frölich (1870), but had previously been observed by Schlippe (1858), who considered it to be identical with angelicic acid. However, it melts at 64° C. (147° F.), boils at 198.5° C. (389.3° F.), and is identical with Frankland and Duppa's methylcrotonic acid. In the fraction boiling above the temperature named, capronic, œnanthylic, or similar acids are probably present. They did not succeed in obtaining from croton oil an acid having the composition of Schlippe's *crotonic acid*, $C_4H_6O_2$. E. Schmitt (1879) corroborated these statements, and found among the volatile acids also formic acid. Schlippe's *crotonol*, $C_{18}H_{28}O_4$, has likewise not been obtained by other chemists; it was stated to be a yellowish viscid mass of a faint odor, and to be the rubefacient principle of croton oil. The drastic rubefacient properties, according to Buchheim (1873), reside in *crotonoleic acid*, which is present in the free state and as glyceride, and which seems to be related to ricinoleic acid, since, like the latter, it yields with nitric acid œnanthic acid, and on the distillation of its sodium salt gives œnanthol. But H. Senier has shown (1883) that the oil may retain its purgative action and may be deprived of vesicating properties (see above); the latter do not reside in the free acids present, nor in any basic constituent, but exist in a fat which is not readily saponifiable, and yields an acid of low melting-point and forming a lead salt soluble in ether.

Tests.—The process of Schlippe for preparing crotonol afforded us (1860) the means of detecting croton oil in other oils. The suspected oil is agitated with a solution of soda or potassa in dilute alcohol; the alcoholic liquid is separated, neutralized with hydrochloric acid, and a little of the oily layer separating is applied upon the arm, when in a few hours redness and the peculiar pustular eruption will appear. Should the quantity be small, the liquid is acidulated, agitated with ether, the ether evaporated, and the residue applied. Senier's observations explain the rationale of this process. The *Br. P.* requires croton oil to be entirely soluble in alcohol.

Allied Oils.—(See CURCAS, page 567.) The oil obtained by carbon disulphide from the seeds of Euphorbia Lathyris, *Linné*, has been recommended by Zander (1878) as a cheaper substitute for croton oil.

Action and Uses.—A croton-seed, when chewed, has a sweet and oily taste, followed by a bitter and acrid savor and salivation; nausea, eructation, flatulent distension of the abdomen, colic, and diarrhœa follow. A single seed is reported in one case to have proved fatal, and a portion estimated at 1 grain, and taken on an empty stomach, caused burning in the throat, severe colic, and frequent watery stools (*Therapeut. Monatshefte*, iii. 89). The oil, in the dose of 1 drop, occasions more or less of an acrid and burning sensation in the fauces and œsophagus, a sense of warmth in the stomach, nausea, and sometimes vomiting. In an hour or two some gurgling or slight colic is perceived in the bowels, followed somewhat suddenly by a watery stool with tenesmus, and heat about the anus. Within twenty-four hours eight or ten more stools follow, and there is but little general disturbance of the economy, except through weakness. Sometimes, instead of producing evacuations, the oil causes epigastric uneasiness and oppression, palpitation of the heart, headache, feverishness, perspiration and sleep. It would appear that the acrid principle of the oil is not the sole cause of its cathartic operation, for even after being thoroughly washed with alcohol and rendered mild to the taste, as well as incapable

of pustulating the skin, it is still strongly purgative. (Senier, *Am. Jour. Phar.*, lvi. 22). When given in enema in the dose of 3 or 4 drops croton oil operates purgatively.

In excessive doses this oil may act as a violent and fatal poison, producing severe pain and general collapse, without loss of consciousness. After death no lesion of the stomach or intestines may be found.

Externally, croton oil rubbed upon the skin occasionally produces purgation. Its ordinary effects are, however, local. In general, it brings out, after a few hours, an eruption of minute red pimples, which are always more numerous in proportion to the vascularity and delicacy of the skin, and are gradually converted into pustules, generally of an acuminated or rounded shape, but some are flattened and umbilicated; many are confluent. A red areola surrounds each of them, and they cause severe burning and itching. They augment for three or four days, and then remain stationary. Some break and others wither away. If numerous, they may form thick and extensive crusts. These are thrown off between the sixth and the twelfth day, and leave no cicatrix behind them. The endermic inoculation of the oil causes small but painful abscessess. Applied to one part of the body, it is often carried elsewhere by the fingers, and thus sometimes causes pustulation of the genitals, eyes, etc.

In obstinate *constipation* of the bowels, and when there exists no contraindication arising from inflammation or structural alteration, croton oil is an appropriate purgative. But the observance of these conditions is very important. The oil is most appropriate when bulky doses are objectionable, and when the patient resists the administration of more usual cathartics. Of the former sort are cases of intestinal obstruction from accumulated fæces produced by simple torpor of the bowels, diseases of the nervous centres, the poison of lead, etc. Of the latter are the frequent instances of a refusal to take medicine among children and insane persons, but the oil should rarely be given to children. It is customary to administer it to the insane in milk or broth—a most vicious and inhuman practice, since it arouses suspicion or an aversion to articles upon which the patient's life may depend. In *lead colic* it has, to a great extent, superseded other purgatives. It should be given in the dose of Gm. 0.06 (gtt. j) daily or twice a day, and need not interfere with the simultaneous use of narcotics internally or externally. Like other active purgatives, it has been employed to expel *tæniæ*, and it is even said to have done so when mixed with olive oil and rubbed upon the abdomen; but many surer remedies for these parasites exist. When used to expel tæniæ or other intestinal worms it should be dissolved in chloroform (1 drop in ʒj) and given after purgation with a saline laxative. It has been used successfully as a drastic purgative in different forms of *dropsy*, but it is unnecessarily harsh. Its irritant substitutive action has been invoked in *dysentery*, but safer and milder remedies are to be preferred. In *apoplexy* it is customary to employ it for its depletory revulsive action and for the convenience of its administration during the stupor of the attack. If the attack is one of congestive apoplexy, denoted by turgor of the face, laboring heart and pulse, etc., purgation is generally required, but in an opposite condition it is contraindicated.

Externally, croton oil has been used to relieve cerebral symptoms following the suppression of a cutaneous eruption and other causes; and in the various forms of *meningitis* it is the most efficient agent for counter-irritation of the scalp. It is less painful than tartar emetic pustulation, and more permanent in its action than cantharides. It may be used as a counter-irritant in spinal *neuralgia*, but is objectionable on account of the difficulty of restricting its action to a definite area. It has been more successful in *sciatica* than in any other form of neuralgia. For this affection it has also been recommended internally, but upon less substantial grounds. It has been applied locally in chronic articular *rheumatism*, and is undoubtedly one of the best of the topical remedies for the disease. Its moderate but steady counter-irritation renders it peculiarly valuable in cases of *chronic bronchitis* and *chronic laryngitis*.

Tinea tonsurans, or ringworm of the scalp, has been treated successfully by croton oil, which is applied pure until the characteristic eruption appears, when a poultice is used to soften and remove the crusts of the original disease and those produced by the oil. It is recommended, when a large portion of the scalp is involved, that a small portion only should be treated at a time, on account of the irritation and fever which usually are excited. The conditions favorable to the success of this treatment are, however, far from definite; and moreover croton oil sometimes causes suppuration of the hair-follicles and incurable alopecia.

Croton oil may be given in emulsion or mixed with some other oil or in pill. Of these forms the last is to be preferred. The *dose* is Gm. 0.016–0.13 (♏¼–ij). The following

is a safe and convenient prescription: Add to Gm. 0.12 (gtt. ij) of croton oil enough alcohol to dissolve them, and then bread-crumb in sufficient quantity. Make from four to eight pills, and direct one to be taken every hour or two. Externally, the oil may be applied by means of a feather, brush, or other convenient instrument, and friction made with a rag until the skin becomes dry. It may be used pure or mixed with castor oil, olive oil, soap liniment, alcohol, or ether: or a piece of muslin somewhat smaller than one of adhesive plaster may be attached to the latter, and moistened with the oil before being applied to the skin. A mixture of 1 part of croton oil with 7 of oil of turpentine is more rapid in its action than the croton oil alone.

As antidotes to the *poisonous* effects of this oil, milk, olive oil, mucilage, gelatin soup, etc. may be given to envelop the acrid substance, and if it cause a tendency to collapse, opium and alcoholic liquids and warm stimulating baths should be employed.

OLEUM VALERIANÆ.—Oil of Valerian.

Essence de valériane, Fr.; *Baldrianöl*, G.

The volatile oil distilled from the root of Valeriana officinalis, *Linné*.

Nat. Ord.—Valerianaceæ.

Preparation.—The volatile oil is obtained by distilling the crushed root with water or steam. The yield varies between ½ and 2 per cent., and is largest from valerian grown in dry localities. 5 pounds of oil of valerian were imported into the United States in 1876, and 167 pounds in 1878.

Properties.—When recently distilled from fresh root the oil of valerian is of a greenish or yellowish color, limpid, of a mild odor, and of a neutral reaction. On exposure to air it becomes deeper yellow and brown, viscid, and acquires a strong odor and an acid reaction. Old roots yield at once a dark, acid, and strongly odorous oil. Its taste is aromatic, somewhat camphoraceous, not burning; its density is near 0.94. It is readily soluble in alcohol, does not fulminate with iodine, and becomes purplish-black with ethereal solution of bromine, dark-red with sulphuric acid, purplish-red with hydrochloric acid gas, and blue with nitric acid.

Composition.—The latest investigation is by G. Bruylants (1878), who ascertained some new facts. The hydrocarbon, $C_{10}H_{16}$, was named *borneene* by Gerhardt (1841) and *valerene* by Pierlot (1859). The *valerol* of the latter differed from Gerhardt's valerol, $C_6H_{10}O$, which he believed to become oxidized in contact with air to *valerianic acid*, carbon dioxide being given off at the same time. Bruylants explains the generation of valerianic acid in old oil of valerian from the decomposition of $C_{10}H_{17}C_5H_9O_2$, which is the valerianic ether of borneol; besides this one, it contains the corresponding ethers of formic and acetic acids, the alcohol *borneol*, $C_{10}H_{18}O$, and its ether, $(C_{10}H_{17})_2O$. Gerhardt assumed the production of borneol from the hydration of borneene. (See Oleum Camphoræ, page 388.)

Action and Uses.—In experiments upon animals with poisonous doses of this oil it appeared to blunt the reflex excitability after having primarily stimulated it, and to produce a similar effect when the same function was previously excited by strychnine. It has been used with advantage in *hysteria*, *chorea*, and even in *epilepsy;* but it is most efficient in the first-named disease, and in the various functional nervous derangements which, without constituting hysteria, are nevertheless hysterical. It may be prescribed in *doses* of Gm. 0.06 (gtt. j) and upward in pill, emulsion, or alcoholic solution.

OLIBANUM.—Frankincense.

Gummi resina olibanum, *Thus.—Oliban*, *Encens*, Fr.; *Weihrauch*, G.; *Incienso*, Sp.

From Boswellia Carterii, *Birdwood*, and other species of Boswellia. Bentley and Trimen, *Med. Plants*, 58.

Nat. Ord.—Burseraceæ.

Origin.—The genus Boswellia is confined to India, Southern Arabia, and Eastern Africa. It comprises trees with imparipinnate leaves, serrate leaflets, small, racemose, decandrous flowers, and three-celled drupaceous capsules containing three seeds. The different species are still imperfectly known. B. Carterii may possibly be a polymorphous species, or several forms at present regarded as mere varieties may be distinct species, which grow only in two limited districts in South-eastern Arabia and in the Somali country of Eastern Africa. B. papyrifera, *Richard*, indigenous to Nubia and Abyssinia, yields a similar product, which, however, is not collected. B. thurifera, *Colebrook* (B.

serrata and B. glabra, *Roxburgh*), affords a soft odorous resin which is used in India as incense. The fragrant resin of B. Frereana, *Birdwood*, of the Somali country, is used in the East as a masticatory.

Collection.—The collection of olibanum in the Somali country was described by Cruttenden (1846), and in Arabia by Carter (1847), who had visited these countries three years previously. Deep incisions are made from which a milk-white exudation flows, which gradually hardens, and is then collected. Olibanum enters commerce by way of Bombay.

Description.—Olibanum consists of roundish, oblong, or irregular-shaped separate tears. These vary in diameter between 3–12 Mm. ($\frac{1}{8}$ and $\frac{1}{2}$ inch) or more, and are nearly colorless, pale-yellowish, or of a reddish hue, and covered with a whitish powder, resulting from the attrition of the pieces. When broken they exhibit a flat scarcely conchoidal fracture and a waxy lustre. Olibanum has a balsamic somewhat terebinthinate odor, softens between the teeth, and has a balsamic and slightly bitter taste. Triturated with water, it yields a white emulsion; alcohol dissolves the greater part of it. When heated it becomes soft and burns, diffusing an aromatic odor.

Olibanum of inferior quality is more deeply colored, often opaque, and more or less mixed with fragments of bark and other impurities.

Constituents.—By distillation with water a volatile oil is obtained varying in quantity from 4 (Stenhouse, 1840) to 7 per cent. Kurbatow (1871) found it to consist of *olibene*, $C_{10}H_{16}$, and an oxygenated portion boiling above 175° C. (347° F.). Olibene is the chief constituent of the oil, boils at about 157° C. (314.6° F.), has a turpentine-like odor, and yields with hydrochloric acid gas a crystalline compound. The resin amounts to 56 (Braconnot, 1808), or as much as 72, per cent. (Kurbatow), and, according to Hlasiwetz (1867), has the composition $C_{20}H_{30}O_3$. The gummy matter contained in olibanum was found by Hekmeijer (1858) to agree in behavior with gum-arabic.

Pharmaceutical Uses.—Olibanum is a constituent of most *fumigating powders*, for which there are a large number of formulas in existence; they contain also benzoin, storax, mastic, amber, cascarilla, orris-root, santal-wood, or other odoriferous drugs, which are reduced to a coarse powder, and when used thrown upon a heated surface. *Fumigating pastilles* are made of a similar composition, and should contain about 40 per cent. of ligneous material or charcoal and from 5 to 8 per cent. of potassium nitrate; the finely-powdered ingredients are well mixed, formed into a mass with mucilage of tragacanth, and then moulded into the desired shape.

Action and Uses.—Although no longer official in either the United States or the British Pharmacopœia, olibanum is one of the most ancient, as it once was one of the most valued, of medicines. It was the frankincense of which so much is said in the Old Testament, and which was used by the Egyptians in embalming; it is spoken of in the Hippocratic writings as an expectorant in bronchial catarrh and in infantile asthma, as useful in expelling the lochia and promoting menstruation, as an ingredient of injections for leucorrhœa, and of ointments for various ulcers, including those caused by burns. Later it was applied in ointments to *chilblains*, *cutaneous eruptions*, and *inflammations of the eyes*. More recently it was an ingredient of various stimulating plasters, and its fragrant fumes were used to conceal *unpleasant smells*. The *dose* is stated to be Gm. 2–4 (gr. xxx–lx), given in emulsion.

Hedwigia balsamifera has been used hypodermically in an alcoholic and also as a watery extract of the stalk and root. The former was the more active. Gaucher, Cambemale, and Marestang concluded from their experiments that this plant is a poison of the nervous system, lowering the temperature, inducing paralysis and convulsions, rendering the respiration irregular, and arresting the heart. They found in it an alkaloid and a resin, of which the former is mainly convulsing, while the latter rather causes paralysis and lowers the temperature (*Annuaire de Thérap.*, 1889, p. 25).

OPIUM, *U. S., Br., Fr. Cod., P. A., P. G.*—Opium.

Meconium, *Succus thebaicus.*—*Opium*, E., Fr., G.

The concrete milky exudation obtained in Asia Minor by incising the unripe capsules of Papaver somniferum, *Linné*. Bentley and Trimen, *Med. Plants*, 18.

Official Forms of Opium.—Opii pulvis, *U. S.*—Powdered opium, *E.;* Poudre d'opium, *Fr.;* Opiumpulver, *G.*—Opium dried at a temperature not exceeding 85° C. (185° F.), (60° C. = 140° F., *P. G.*), and reduced to a very fine (No. 80) powder. Powdered opium for pharmaceutical or medicinal uses, should contain not less than 13 nor

more than 15 per cent. (not less than 10 per cent., *P. G.*) of morphine when assayed by the process given under OPIUM. Any powdered opium of a higher percentage may be brought within these limits by admixture with powdered opium of a lower percentage in proper proportions.—*U. S.*

OPIUM, *U. S.*, *Br.*, *F. Cod.*, *P. G.* Opium in its normal moist condition yielding not less than 9 per cent. (after drying, 9.5 to 10.5 per cent. *Br.*) of morphine.—*U. S.*

OPIUM DEODORATUM, *U. S.*, OPIUM DENARCOTINATUM.—Deodorized Opium, Denarcotized opium, *E.*; Opium denarcotiné, *Fr.*; Denarcotinirtes Opium, *G.*—Denarcotized opium should yield 13 to 15 per cent. of morphine.

Origin and Production.—The poppy-capsule, which is described elsewhere (see PAPAVER), contains under the epidermis a large number of laticiferous vessels which are variously branched and interlaced, and in the unripe state of the fruit are filled with a white milk-juice, which escapes when an incision is made. For its successful cultivation the poppy requires a deep, rich, and well-manured soil, and considerable attention until the plant has sufficiently matured to permit of the collection of the milk-juice. A few days after the petals have fallen the green capsule is scarified, with the precaution of not cutting entirely through the capsular integuments, as the juice would then flow into the capsule and be lost. In Asia Minor and Egypt one or two incisions are made transversely near the middle of the capsule, so as to run spirally around it. In India three or four vertical incisions are made from the base to the apex and on different sides of the capsule, the instrument used for the purpose, called *nushtur*, being a three- or four-bladed knife protected by means of twine, so as to prevent the blades from penetrating too deeply. The scarifications being made in the afternoon, the milk-juice is ready for collection the next morning, when its color will have changed from white to brown. The juice is then carefully scraped off with a knife, which is moistened from time to time with water, or in Asia Minor by drawing it through the mouth; in Persia oil is used to prevent the juice from adhering to the scraper.

In Asia Minor the juice is transferred to a poppy-leaf and formed into cakes varying greatly in size—from a few ounces to 2 pounds or more in weight. These soft cakes are subsequently often mixed together for the purpose of obtaining larger cakes, which are surrounded by one or two wilted poppy-leaves, afterward packed with a considerable quantity of the dry fruits of a species of Rumex, thus preventing the cakes from adhering to one another, and then transported to Smyrna or Constantinople, whence the European and American markets are chiefly supplied.

In *Egypt* opium is collected and prepared for the market in a manner similar to that just described. The production in that country at one time considerably declined, but has increased since Gastinel Bey (1865) proved that opium equal in quality to that of Asia Minor could be gathered by bestowing sufficient care upon the cultivation of the plant.

The juice gathered in *India* is usually quite soft in consequence of dew, and after collection separates a dark-colored fluid called *passewa*, which, together with the washings of vessels and some opium, is evaporated to a thick liquid called *lewa*, and this is employed in agglutinating the poppy-petals together, so as to form an envelope, and, after drying, a rather hard shell for the protection of the opium. The opium, which is moulded into spherical balls, requires much attention until it has been sufficiently dried for preservation. Each ball weighs a little over 4 pounds; forty of these are packed in separate compartments in a case, and are mostly exported to China. In the commerce of India this is known as *provision opium*; for home consumption the juice is evaporated by the heat of the sun and formed into square or sometimes circular cakes, which are wrapped in oiled paper.

Persian opium is formed into cylindrical sticks about 6 inches long, each of which is wrapped in paper, or into cones or small balls about 1½ inches in diameter, the wrapper of which is sometimes marked with Chinese characters. Since 1856, Persian opium has been sent to Constantinople, and there worked over so as to resemble that of Asia Minor. At the present time it is frequently seen in European commerce, and it is imported in considerable quantity into the United States to be used in the manufacture of morphine. It often comes in cakes weighing 1 or 1½ pounds, which are oily and always packed in *poppy trash—i. e.* the dried stalks and capsules ground into coarse powder.

China produces a large quantity of opium, all of which is consumed in that country: in addition it consumes notable quantities imported from Persia, as well as by far the largest portion of the opium which is exported from India. The samples which we have seen were flattish-globular in shape and wrapped in white paper; one specimen was oily,

though less so than Persian opium, and another, to judge from its black-brown color, was prepared by the aid of artificial heat, though free from empyreuma.

In *Japan* the milk-juice is obtained by the longitudinal scarification of the poppy-capsules, and the opium is formed into flat cakes which are wrapped in paper.

Numerous experiments have been made in *Europe*, and opium of excellent quality has been obtained as far north as Sweden; but European opium is not an article of commerce, and its production appears to be very limited. It is stated that Aubergier calls the opium raised by him in France *affium*, and that it is formed from the agglomeration of tears exuded from the incisions and entirely free from foreign admixture.

In *Algeria* opium has been produced since 1828—in limited quantities, however, and insufficient to be of any commercial importance. Rohlfs (1866) found an extensive culture of opium in the oasis of Tuat in the northern part of the great African desert.

Opium has also been raised experimentally in Victoria, *Australia*, and was stated by Mr. Bosisto (1876) to be of good quality.

About the year 1812 opium of fair quality was produced in the *United States*, chiefly, if not exclusively, in New England. After the close of the war the cultivation had to be abandoned—as it appears, mainly because the product became unsalable in consequence of extensive adulterations; more recently, however, opium-culture again attracted attention, more particularly during the late Civil War, when the drug was successfully produced in Virginia, Tennessee, and South Carolina. Prof. Porcher (*Resources of the Southern Fields and Forests*, p. 26) states that in the climate of South Carolina and Georgia the poppy should be planted in September; the plants are not killed during the winter; they thrive in the early spring, and the capsules are ready for incision in May. Several attempts made to obtain the poppy by planting in April and May failed, the seeds not coming up. A "garden square" yielded him 330 grains of very dry opium of excellent quality.

In Asia Minor the poppy-seed is sown at intervals from November to March. By following this course failure from frosts or other causes is guarded against, and the maturing of the poppy-heads is extended over a certain length of time. Since by the circular incisions made there all or nearly all the laticiferous vessels are cut, a second scarification is generally unprofitable, while an additional quantity of milky juice is usually obtained on repeating the vertical incisions after a day or two.

The *variety of poppy* cultivated in Asia Minor is the black, which has usually purple flowers and black, though occasionally white, seeds. This variety is that also which, in the experience of Aubergier in France and of Behr and Biltz in Germany, yields opium richer in morphine than that produced from the white-flowering and white-seeded poppy. The latter is, however, by some persons considered more advantageous for collection, and appears to be the only kind cultivated in Egypt, Persia, India, China, and Japan.

Description.—Opium is in subglobular, usually more or less flattened, irregular cakes, which are externally of a chestnut-brown or somewhat darker color, and bear on the surface the impressions of the veins of the poppy-leaf in which they had been enveloped; fragments of the leaf and some fruits of a Rumex are generally adhering to the surface. The whole mass is usually plastic, but on keeping a harder external crust is formed, while the interior portion retains its moist condition for a long time. When broken, some tears are usually observed in the interior, together with fragments of vegetable tissue which have been detached in scraping off the milk-juice. The cakes weigh from about 4 ounces to 2 pounds. The odor of opium is heavy and narcotic, its taste disagreeable and bitter. Examined under the microscope, some needle-shaped crystals are observed, but most of it consists of an amorphous or granular mass, aside from the vegetable tissue present. The crystals are best observed after the dry opium has been well moistened with benzene.

Smyrna, Turkey, or Constantinople opium is the only variety recognized by the different pharmacopœias and met with in American commerce. It has been stated above that Persian opium is often imported for the manufacture of the alkaloids. It is oily from the manner in which it has been collected. Its other distinctive characters and those of East Indian opium have already been briefly described. Both varieties contain usually a larger number of crystals than Turkey opium, and these crystals may not unfrequently be seen with the naked eye or by the aid of a lens.

Adulterations.—The principal admixtures observed by us in Turkey opium were pebbles, shot, and lead balls introduced into the interior of the cakes. When present these admixtures generally amount to several ounces, but are only occasionally seen. Of greater importance appears to be the introduction of excessive quantities of vegetable tissue during the collection of the juice, but it is impossible to estimate its quantity or

state its allowable limits. Coarse adulterations, such as the aqueous extract of the poppy-plant and of the herb Glaucium luteum—which, according to Landerer, is sometimes made in Turkey—are rarely, if ever, seen in the imported opium, and are readily detected by the darker color and the hygroscopic nature of the product, and by the uninterrupted streak which it leaves on being drawn over paper, while good opium makes an interrupted mark. Such partly factitious opium, or fraudulent substitution of an extract having a narcotic odor, for opium said to have been of American origin, was noticed by Procter (1869) and Ebert (1873). Various kinds of resinous, saccharine, mucilaginous, and amylaceous substances, ashes, clay, gypsum, litharge, and sand, have been employed for like purposes, and occasionally opium has been met with in the market which contained so little morphine and other alkaloids as to lead to the inference that these principles had been extracted. Another impurity is an excessive amount of moisture. Squibb (1860) estimated the average loss in drying to be 19.5 or 20 per cent., and in drying and powdering 20 to 21 per cent. From a record of nearly 12,000 pounds of opium, nearly the whole of which was directly obtained from importers, we find the average loss to have been 21.2 per cent.; in some exceptional cases as high as 28 or as low as 15 per cent. Bengal provision opium contains 30 per cent. of moisture.

Examination.—Hager suggested the following course for determining the presence of adulterations: The sample is dried and powdered, and 25 grains of the powder are triturated with ½ ounce of boiling water; the formation of a stiff paste or mucilaginous liquid would indicate the presence of starch, flour, gum, or salep. 2 ounces of water are added, and the liquid filtered; the filtrate should be of a wine-yellow color, indicating the absence of liquorice or other aqueous extracts, which would impart to the filtrate a brown color; the liquid should likewise have an acid reaction, otherwise the admixture of chalk, litharge, or ashes may be inferred. On evaporating the filtrate to 1 ounce, potassium ferrocyanide or the addition of twice its bulk of alcohol should not cause any precipitate; the former test would indicate the presence of salts of heavy metals; the latter an adulteration with gum or certain salts. The insoluble residue of opium left on the filter after washing and drying should weigh between 10 and 11½ grains; should it weigh more, sand, clay, or other insoluble substances may be present, and in case it weighs less, sugar, gum, or other soluble impurities are indicated. On agitating powdered opium with chloroform the mineral impurities and starch settle to the bottom, and the latter acquires a blue color on the addition of a little iodine. Mineral impurities are likewise indicated by the amount of ash left, which for genuine powdered opium is about 6 per cent., varying, however, between 4 and 8 per cent. The U. S. Pharmacopœia directs the estimation of the extract prepared with cold water from 100 parts of opium previously dried at 105° C. (221° F.); when evaporated to dryness the extract should weigh between 55 and 60 parts.

Constituents.—Opium is entirely free from starch and tannin. Among the principles ordinarily found in plants the following have been observed in opium: An odorous principle soluble in ether, benzene, and petroleum benzin; glucose, gum, pectin, a compound resembling caoutchouc, wax, fat, a small amount of resin, coloring matter, and that indefinite substance usually designated as extractive. The mineral constituents average 6 per cent., and 55 or 60 per cent. of dry opium is soluble in water, but the pure milk-juice, entirely free from vegetable tissue, yields a larger percentage to water.

The most important as well as the most interesting constituents of opium, however, are the alkaloids; in fact, the first vegetable alkaloid discovered was obtained from opium. In 1816, after a patient investigation extending over 11 years, Sertürner, apothecary at Eimbeck in Northern Germany, announced the discovery of *morphium*. He recognized this principle as a salifiable base, in some respects related to ammonia. A crystalline powder, probably morphine or containing it, was obtained by Ludwig as early as 1688, and was named *magisterium opii;* and in 1803, Derosne obtained this principle by precipitating the aqueous infusion of opium with ammonia, but regarded it as identical with his *salt of opium* (narcotine), which crystallized from the concentrated infusion. Seguin (1804) had likewise observed it. Since Sertürner's discovery a large number of alkaloids have been isolated from opium, which, arranged in the order in which their isolation was announced, are as follows:

1. Narcotine, $C_{22}H_{23}NO_7$, was discovered by Derosne (1803), but its basic nature was first shown by Robiquet (1817). It may be extracted with ether from the precipitate produced by ammonia in the aqueous infusion of opium, and from the insoluble residue of the latter by exhausting it with hot acetic acid. It crystallizes in colorless shining rhombic prisms or white needles, which are tasteless and dissolve at about 15° C. (59°

F.) in 100 parts of 85 per cent. alcohol, 33 parts of absolute ether, 2.7 parts of chloroform, 310 parts of amylic alcohol, or in 22 parts of benzene. The alkaloid requires 7000 parts of boiling water for solution, is insoluble in cold dilute acetic acid, is a weak base, and yields mostly unerystallizable salts, which have a bitter taste and an acid reaction. Chloroform dissolves the alkaloid from the aqueous solutions of its salts (Dragendorff). Its solution in cold sulphuric acid is colorless, but turns slowly to yellow, orange, and red; it gives a blood-red color with a mixture of sulphuric and nitric acids. The alkaloid melts at 176° C. (349° F.). When boiled for a long time with water or heated with nitric acid, it is decomposed into *meconin*, $C_{10}H_{10}O_4$, and *cotarnine*, $C_{12}H_{13}NO_3$, which is a stronger base, soluble in ammonia, fusible in boiling water, and, on being boiled with very dilute nitric acid, is converted into *cotarnic* and *apophyllic acids*, the latter containing nitrogen. On heating narcotine with manganese dioxide and dilute sulphuric acid, cotarnine is obtained and in addition thereto *opianic acid*, $C_{10}H_{10}O_5$, which crystallizes in needles and fuses at 140° C. (284° F.). When heated with hydrochloric or hydriodic acid, it parts with one, two, or three methyl groups (CH_3), and yields new bases. Wright and Beckett (1876) showed that it may be converted into *vanillin*. According to Wegscheider (1883), opianic acid, heated above its melting-point, yields an anhydride, $C_{30}H_{28}O_{14}$, which by moderate fusion with potassa is converted into meconin and *hemipinic acid*, $C_{10}H_{10}O_6$, and on treating the latter under pressure with HCl, isovanillic and protocatechuic acids are obtained.

2. Morphine, $C_{17}H_{19}NO_3$, discovered by Sertürner (1816), is described in another place (see page 990); also its derivative, *apomorphine* (page 234). On heating its hydrochlorate with silver nitrate to 60° C. (140° F.), *oxymorphine* or *pseudo-morphine* is formed (see below). In the presence of ammonia and air morphine is oxidized to *oxydimorphine*, $C_{34}H_{36}N_2O_6$, which is also obtained from morphine by the action of potassium permanganate, potassium ferricyanide, or nitrites (Broockmann and Polstorff, 1880).

3. Codeine, $C_{18}H_{21}NO_3$, was discovered by Robiquet (1832), and by Grimaux (1881) prepared from morphine by heating it with methyl iodide and soda; it is therefore *methylmorphine*. (For description see page 514.) A number of interesting derivatives have been prepared from this alkaloid, which, however, with the exception of apomorphine, have not been medicinally employed. The melting-point of codeine is 155° C. (311° F.), as given by the U. S. Pharmacopœia, not 150° C., as determined by Robiquet (Hesse, 1883).

4. Narceine, or *narceia*, $C_{23}H_{29}NO_9$, discovered by Pelletier (1832), is in long quadrangular prisms or white silky needles, which have a slight bitter taste, melt at 145.2° C. (291.6° F.), are insoluble in ether, and are sparingly soluble in cold alcohol and water. Fröhde's reagent renders it brown-green, yellow, afterward reddish. Erdmann's test produces a deep-yellow, brown-yellow, and finally a deep-orange color. Iodine not used in excess produces a blue color, nitric acid a rapidly-fading yellow color. The blue color obtained by Pelletier on the addition to narceine of strong hydrochloric acid and a small portion of water is not observed with the pure alkaloid, according to Winckler, Anderson, and others. Narceine is a weak base, and yields crystallizable salts which are mostly not freely soluble in water or are decomposed by water, the hydrochlorate yielding a highly basic salt (Wright and Beckett, 1876).

5. Pseudomorphine, also called *phormine* and oxydimorphine, $C_{34}H_{36}N_2O_6$, was discovered by Pelletier and Thiboumery (1835), and is probably present in opium after exposure to ammoniacal vapors. It is a derivative of morphine, and is readily formed by warming an aqueous solution of morphine nitrite to 60° C. (140° F.) and crystallizing from ammonia-water. Hesse (1883) gives to the alkaloid the formula $C_{17}H_{17}NO_3$, and states that it absorbs water on exposure. It is a fine crystalline powder, is insoluble in water, alcohol, ether, and chloroform; dissolves in acetic acid; yields with hydrochloric acid a salt sparingly soluble in cold water; it is colored red by nitric acid and blue by ferric chloride, in which behavior it resembles morphine.

6. Thebaine, or *paramorphine*, $C_{19}H_{21}NO_3$, was discovered by Thiboumery (1835). It forms silvery scales or hard prisms; is soluble in ether, more freely soluble in alcohol, amylic alcohol, benzene, and chloroform, but nearly insoluble in water and alkalies. It is colored blood-red, afterward yellow, by sulphuric acid, yellow by nitric acid, orange-red by Erdmann's test, orange-yellow and finally colorless by Fröhde's reagent, and red-brown by chlorine-water and ammonia. The salts of thebaine crystallize readily. Diluted acids readily alter the alkaloid, yielding two amorphous isomeric bases, *thebenine* and *thebaicine*, which are sparingly soluble in hot alcohol and insoluble in other simple solvents (Hesse).

7. Papaverine, $C_{21}H_{21}NO_4$, discovered by Merck (1848), forms colorless needles or

prisms, which are slightly soluble in cold ether and alcohol, but readily soluble in hot alcohol, amylic alcohol, chloroform, and benzene. It melts at 147° C. (296.6° F.). Nearly all its salts are sparingly soluble in cold water and dilute acids, and its solutions part with the alkaloid on being agitated with chloroform. Warm sulphuric acid colors it deep-purple or violet-blue. Fröhde's reagent renders it bright violet-blue, then blue, yellowish, and finally colorless.

8. Rhœadine, $C_{21}H_{21}NO_6$, discovered by O. Hesse (1865), is in white tasteless prisms which are nearly insoluble in ether, alcohol, benzene, chloroform, water, and ammonia, and which yield with dilute acids tasteless and colorless solutions, acquiring an intense purple color on the addition of strong hydrochloric or sulphuric acid. Besides the coloring matter, an isomeric bitter, colorless base, *rhœagenine*, is formed in this reaction. The color produced by acids with Merck's *porphyroxin* (1837) depends on the presence of some rhœadine.

9. Cryptopine, $C_{21}H_{23}NO_5$, was discovered by T. and H. Smith (1867). It crystallizes in minute prisms, is sparingly soluble in water, ether, benzene, and cold alcohol, dissolves in potassa and chloroform, and forms bitter salts, which have a pungently cooling taste, and when dissolved in hot water usually produce a jelly-like mass, which is gradually changed to crystals. Sulphuric acid colors it yellow, soon turning violet-color, but in the presence of minute traces of ferric salt or of chlorine a dark violet-blue color is at once produced, which on warming turns dingy green.

10. Oxynarcotine, $C_{22}H_{23}NO_8$, was isolated from the mother-liquors of narceine by Wright and Beckett (1876). It dissolves in alkaline liquids, but is nearly insoluble in benzene, chloroform, and hot alcohol and water. Like narceine and nicotine, it yields *hemipinic acid*.

11. Gnoscopine, $C_{34}H_{36}N_2O_{11}$, was found by T. and H. Smith (1878) in the mother-liquors of narceine. It forms thin needles of a woolly appearance, melts with decomposition at 233° C., is soluble in chloroform and carbon disulphide, slightly soluble in benzene, and is insoluble in petroleum and in fusel oil. Sulphuric acid dissolves it with a yellowish color, becoming carmine-red with a trace of nitric acid.

The following alkaloids were discovered by O. Hesse (1870 and 1871), and may be prepared from the mother-liquors left in the preparation of morphine by Gregory's method:

12. Lanthopine, $C_{23}H_{25}NO_4$, is crystalline, tasteless, sparingly soluble in acetic acid, alcohol, ether, and benzene; is readily soluble in chloroform; is colored orange-red by nitric and pale-violet by sulphuric acid, the latter color changing to dark-brown on heating.

13. Meconidine, $C_{21}H_{23}NO_4$, is amorphous, colorless or yellowish, tasteless, easily soluble in alcohol, ether, benzene, chloroform, and acetone. It yields very bitter unstable salts, and is dissolved by sulphuric acid with an olive-green, and by nitric acid with an orange-red, color.

14. Laudanine, $C_{20}H_{25}NO_4$, crystallizes in hexagonal prisms, melts at 166° (331° F.), is sparingly soluble in ether and cold alcohol, soluble in benzene, chloroform, and alkalies; in ferric chloride with an emerald-green, in nitric acid with an orange-red, and in sulphuric acid containing iron with a rose-red, color, the latter changing to violet on heating. The hydriodate is sparingly soluble in cold water; the hydrochlorate is nearly insoluble in solution of sodium chloride.

15. Codamine, $C_{20}H_{25}NO_4$, crystallizes from ether in large six-sided colorless prisms; is easily soluble in chloroform, benzene, ether, alcohol, and boiling water; forms amorphous bitter salts, and dissolves in nitric acid with a dark-green, and in sulphuric acid containing iron with a blue, color, changing to green and dark-violet on warming.

16. Deuteropine, $C_{20}H_{21}NO_5$, homologous with cryptopine, requires further investigation.

17. Laudanosine, $C_{21}H_{27}NO_4$, is soluble in alcohol, chloroform, ether, and warm benzol; the crystals fuse at 89° C. (192.2° F.). It neutralizes acids, and yields with hydriodic acid a sparingly soluble salt. Pure sulphuric acid colors rose-red, in presence of ferric salt brown-red, on warming green and deep violet.

18. Protopine, $C_{20}H_{19}NO_5$, resembles cryptopine, and is with difficulty soluble in ether, alcohol, and benzene, more readily soluble in chloroform. The solutions of its salts do not gelatinize and have a bitter taste. The solutions in sulphuric acid turn yellow, red, and purple; in presence of ferric salt they are deep-violet.

19. Hydrocotarnine, $C_{12}H_{15}NO_3$, crystallizes in large colorless prisms, fuses at 55° C. (131° F.); volatilizes, partly unchanged, at 100° C. (212° F.); is easily soluble in benzene

ether, and alcohol, and forms readily soluble salts. It is formed from narcotine, besides meconin, by the action of nascent hydrogen.

From many of the above alkaloids derivatives have been obtained which are highly interesting in a scientific point of view, and which prove that at least between some of them there exists evidently a close relation. It is not unlikely that some of those enumerated above are the decomposition-products of others. This may most likely be affirmed to be true of Wittstein's *metamorphine* (1860), which was obtained in preparing morphine by Mohr's process (page 1050), but has not been observed since. It liberated iodine from iodic acid, was colored red by nitric acid, but was not affected by ferric chloride. Hinterberger's *opiane* was proved by Hesse to be impure narcotine.

The *proportion* in which the alkaloidal constituents of opium are present in the drug is, without doubt, largely influenced by the climate, the nature of the soil, and the treatment to which the milk-juice is exposed in obtaining the opium. Most of the pharmacopœias require dried opium to contain not less than 10 per cent. of morphine; good Smyrna opium frequently contains between 12 and 15 per cent. of it, but cakes taken from the same case are apt to vary considerably. Egyptian opium usually contains a smaller amount of morphine, varying from 6 to 12 per cent. Persian opium varies to a still greater extent, but much of that found in commerce is equal to the ordinary qualities of Turkey opium. East Indian opium, as a rule, is weak in morphine. It is sometimes as low as 2.5 per cent., more frequently perhaps between 3.5 and 5 per cent., but occasionally as high as 8 or 9 per cent. Most of the opium made in Europe has been of good and even of excellent quality. French opium yielded 14.4 to 22.8 (Guibourt), German opium 16.5 to 20, and from white poppy 6.8 per cent. (Biltz) of morphine. Opium made in Algiers from red poppy yielded 10.4 to 17.8 per cent., and from white poppy 1.5 to 8.5 per cent. of morphine. Several morphiometric assays of opium grown in the United States have been recorded; the lowest percentage of morphine, 4, was observed by Grahame; Procter obtained from other samples 7.4 and 9.15, Flint 9.34, and Wayne 10.2 per cent.

The other alkaloids have been observed in the following proportions:

Narcotine, 1.3 to 10.9 per cent.
Pseudomorphine, 0.02 per cent.
Narceine, 0.02 to 0.1 (0.7) per cent.
Rhœadine, minute.
Lanthopine, 0.005 per cent.
Codamine, 0.003 per cent.
Codeine, 0.2 to 0.4 per cent.
Thebaine, 0.15 (to 1.0) per cent.
Papaverine, 1.0 per cent.
Cryptopine, minute.
Laudanine, 0.005 per cent.

Meconic Acid (Acidum meconicum, *Br.*), $C_7H_4O_7$, discovered by Sertürner, is obtained by precipitating the concentrated infusion of opium with calcium chloride, and treating the calcium meconate repeatedly with warm diluted hydrochloric acid. It crystallizes in micaceous scales or rhombic prisms containing $3H_2O$, dissolves in 4 parts of boiling water, and is also soluble in alcohol. Opium yields 3 to 4 per cent. of it. It is a tribasic acid, and imparts to ferric salts a deep-red color, which does not disappear on the addition of dilute hydrochloric acid (difference from formic and acetic acids) or by the chlorides of gold or of mercury (difference from sulphocyanates). When boiled with water, or more rapidly when boiled with dilute hydrochloric acid, meconic acid is decomposed into carbon dioxide and crystallizable *comenic acid*, $C_6H_4O_5$, which on being heated yields a sublimate of *pyrocomenic acid*, $C_5H_4O_3$. The two derivative acids likewise redden ferric salts, the last less deeply than the former.

T. and H. Smith (1862) exhibited *thebolactic acid* as one of the constituents of opium. This acid has the composition and physical properties of lactic acid, and, according to Buchanan (1870), is identical with the latter. It is present to the extent of about 1¼ per cent., and is probably the decomposition-product of another constituent of poppy-juice. The same may also be said of the free acetic and traces of butyric acid announced by David Brown in 1876.

Meconin is obtained from narcotine (see above), exists also in opium, and forms colorless shining prisms, which are inodorous, bitter, soluble in alcohol, ether, and slightly soluble in water. It was discovered by Dublanc (1832), and is also known as *opianyl*. It melts in water at 77° C., and in the air at 110° C. (230° F.), and when evaporated with slightly diluted sulphuric acid gives a green color.

Meconoiosin, $C_5H_{10}O_2$, was obtained by T. and H. Smith (1878) from the mother-liquors left on the isolation of meconin, from which it separates in an impure state as brown leaf-like crystalline masses. When pure it is colorless, is freely soluble in alcohol,

ether, and hot water, fuses at 88° C. (190.4° F.), and on evaporation with dilute sulphuric acid yields a red color, changing to purple.

Morphiometry.—In view of the variable quality of opium and of its liability to adulteration, the determination of the amount of morphine in it is frequently necessary, and must not be neglected if uniformity of strength of the pharmaceutical opium preparations is desired. The U. S. Pharmacopœia gives the following directions:

"Opium, in any condition to be valued, 10 Gm.; Ammonia-water, 3.5 Cc.; Alcohol, Ether, Water, each, a sufficient quantity. Introduce the opium (which, if fresh, should be in very small pieces, and if dry in very fine powder), into a bottle having a capacity of about 300 Cc.; add 100 Cc. of water, cork it well, and agitate frequently during twelve hours. Then pour the whole as evenly as possible upon a wetted filter having a diameter of 12 Cm., and when the liquid has drained off wash the residue with water, carefully dropped upon the edges of the filter and the contents, until 150 Cc. of filtrate are obtained. Then carefully transfer the moist opium back to the bottle by means of a spatula, add 50 Cc. of water, agitate thoroughly and repeatedly during fifteen minutes, and return the whole to the filter. When the liquid has drained off wash the residue, as before, until the second filtrate measures 150 Cc., and finally collect about 20 Cc. more of a third filtrate. Evaporate in a tared capsule, first, the second filtrate to a small volume; then add the first filtrate, rinsing the vessel with the third filtrate, and continue the evaporation until the residue weighs 14 Gm. Rotate the concentrated solution about in the capsule until the rings of extract are redissolved, pour the liquid into a tared Erlenmeyer flask having a capacity of about 100 Cc., and rinse the capsule with a few drops of water at a time until the entire solution weighs 20 Gm. Then add 10 Gm. (or 12.2 Cc.) of alcohol, shake well, add 25 Cc. of ether, and shake again. Now add the ammonia-water from a graduated pipette or burette, stopper the flask with a sound cork, shake it thoroughly during ten minutes, and then set it aside, in a moderately cool place, for at least six hours or over night. Remove the stopper carefully, and, should any crystals adhere to it brush them into the flask. Place in a small funnel two rapidly-acting filters of a diameter of 7 Cm., plainly folded, one within the other (the triple fold of the inner filter being laid against the single side of the outer filter), wet them well with water, and decant the ethereal solution as completely as possible upon the inner filter. Add 10 Cc. of ether to the contents of the flask, rotate it, and again decant the ethereal layer upon the inner filter. Repeat this operation with another portion of 10 Cc. of ether. Then pour into the filter the liquid in the flask, in portions, in such a way as to transfer the greater portion of the crystals to the filter, and, when this has passed through, transfer the remaining crystals to the filter by washing the flask with several portions of water, using not more than about 10 Cc. in all. Allow the double filter to drain, then apply water to the crystals, drop by drop, until they are practically free from mother-water, and afterward wash them, drop by drop from a pipette, with alcohol previously saturated with powdered morphine. When this has passed through, displace the remaining alcohol by ether, using about 10 Cc., or more if necessary. Allow the filter to dry in a moderately warm place, at a temperature not exceeding 60° C. (140° F.), until its weight remains constant; then carefully transfer the crystals to a tared watch-glass and weigh them. The weight found, multiplied by 10, represents the percentage of crystallized morphine obtained from the opium."—*U. S.*

"Take of powdered opium, dried at 212° F. (100° C.), 100 grains; Lime, freshly slaked, 60 grains; Chloride of Ammonium, 40 grains; Rectified Spirit, Ether, Distilled Water, of each, a sufficiency. Triturate together the opium, lime, and 400 grain-measures of distilled water in a mortar until a uniform mixture results; then add 1000 grain-measures of distilled water and stir occasionally during half an hour. Filter the mixture through a plaited filter about three inches in diameter into a wide-mouthed bottle or stoppered flask (having the capacity of about 6 fluidounces and marked at exactly 1040 grain-measures) until the filtrate reaches this mark. To the filtered liquid (representing 100 grains of opium) add 110 grain-measures of rectified spirit and 500 grain-measures of ether, and shake the mixture; then add the chloride of ammonium, shake well and frequently during half an hour, and set it aside for twelve hours. Counterbalance two small filters; place one within the other in a small funnel, and decant the ethereal layer as completely as practicable upon the inner filter. Add 200 grain-measures of ether to the contents of the bottle and rotate it; again decant the ethereal layer upon the filter, and afterward wash the latter with 100 grain-measures of ether added slowly and in portions. Now let the filter dry in the air, and pour upon it the liquid in the bottle in portions, in such a way as to transfer the greater portion of the crystals to the filter. When the fluid has

passed through the filter, wash the bottle and transfer the remaining crystals to the filter, with several small portions of distilled water, using not much more than 200 grain-measures in all, and distributing the portions evenly over the filter. Allow the filter to drain, and dry it, first by pressing between sheets of bibulous paper, and afterward at a temperature between 131° and 140°. (55° and 60° C.), and, finally, at 194° to 212° F., (96° to 100° C.). Weigh the crystals in the inner filter, counterbalancing by the outer filter. The crystals should weigh 10 grains, or not less than 9½ and not more than 10½ grains, corresponding to about 10 per cent. of morphine in the powdered opium."—Br.

Mayer (1863) recommended a similar method, but substituted baryta for lime, and instead of weighing the morphine, estimated it by his test solution.

Prollius (1877) devised a process which is also recommended by Flückiger (*Pharmacographia*, 2d ed. p. 63): A tincture is made from 10 Gm. of opium and sufficient alcohol spec. grav. 0.950 to obtain 100 Gm. of filtrate; add to this 50 Gm. of ether and 2 Gm. of ammonia-water spec. gr. 0.960; collect the crystals of morphine after a day or two, and dry them at 100° C. (212° F.).

The following is a modification of this process: 6 Gm. of opium, in moderately fine powder, are softened with 6 Gm. of water, the mixture diluted, transferred to a tared flask, and sufficient water added to make 54 Gm. After one hour the mixture is transferred to a filter 10 Cm. in diameter. To 42 Gm. of the filtrate 2 Gm. of a mixture of 17 Gm. of ammonia water and 83 Gm. of water are added and thoroughly mixed, without shaking too severely, and then immediately transferred to a filter 10 Cm. in diameter. 36 Gm. of this filtrate are shaken in an accurately tared flask with 10 Gm. of ether and 4 Gm. of the above diluted ammonia-water, continuing the agitation until the liquid becomes clear. After six hours the ethereal layer is poured as well as possible on a filter 8 Cm. in diameter. Add to the liquid remaining in the flask 10 Gm. of ether, rotate and transfer the ethereal layer to the filter and lastly also the aqueous solution. The flask and filter are then washed twice with 5 Gm. of water, which is saturated with ether. After completely draining the flask and the filter, both are dried at 100° C. The crystals collected on the filter are then transferred to the flask, and the heating continued until the weight is constant. The morphine obtained should weigh not less than 0.4 Gm. The morphine thus obtained should be soluble in 100 parts of lime-water with a yellowish color when remaining in contact for several hours. The gradual addition of chlorine-water should cause a brown-red, and ferric chloride a blue or green color.—*P. G.*

Numerous other processes and modifications have been recommended. The principal difficulties encountered in most of them are (1) the large quantity of water required for extracting the morphine, frequently rendering the concentration of the solution necessary, which should always be accomplished at a moderate heat; and (2) the impurities which are always precipitated with the morphine, and which consist of coloring matter with or without narcotine; the latter may be removed by ether, but in decolorizing the precipitate, either by alcohol or with the aid of animal charcoal, there ensues inevitable loss.

Pharmaceutical Preparations.—Opium deodoratum, Deodorized opium. Powdered opium, containing 13 to 15 per cent. of morphine, 100 Gm.; stronger ether 1400 Cc.; sugar of milk, in fine powder, a sufficient quantity, to make 100 parts. Macerate the powdered opium with 700 Cc. of stronger ether in a well-closed flask for twenty-four hours, agitating from time to time. Pour off the clear ethereal solution, and repeat the maceration with 2 other portions of the ether, each of 350 Cc., first for twelve hours, and the last time for 2 hours. Collect the residue in a weighed dish, dry it, first by a very gentle heat, and finally at a temperature not above 85° C. (185° F.), and mix it thoroughly, by trituration, with enough sugar of milk to make the product weigh 100 Gm. —*U. S.* Instead of taking 100 parts of powdered opium, containing 13 to 15 per cent. of morphine, a proportionately smaller quantity of powdered opium of any higher percentage of morphine may be taken. The average quantity, in parts by weight, for the above formula is ascertained by dividing 1400 by the percentage of morphine in the powdered opium selected.

Aqua opii, Opium-water. From a mixture of 1 part of bruised opium and 10 parts of water distil 5 parts. It is colorless and has a slight narcotic odor.

Action and Uses.—In doses varying from ¼ grain to 1 grain, opium produces usually a soothing and luxurious calm of mind and body, followed in the course of forty or fifty minutes by a disposition to sleep, or, if sleep does not take place, the body and mind enjoy a sense of repose from external impressions, while the mind is filled with dreamy and generally pleasant ideas. The pulse at first is quickened, but gradually

becomes slower, the mouth grows dry, and the skin moist. Excited consciousness is followed by sleep, which is natural in its phenomena, and from which one awakes refreshed. Larger doses, as from 1 to 3 grains, occasion turgor and redness of the face, heat and fulness of the head, flashes of light before the eyes, and contraction of the pupils. The mind is excited, even to delirium; the pulse is full, tense, and frequent; the skin is hot and dry, and often there is vomiting. Depression follows, with a slow and sometimes irregular pulse; dulness oppresses all the functions of relation, and the mind is torpid; the muscles lose their co-ordinating action, and the gait is sluggish and staggering. Deep sleep, or rather coma, succeeds; the breathing is stertorous and slow, and therefore the exhalation of carbon dioxide is diminished; the skin pale and damp, and the hands and feet cold. The return to consciousness is attended with depression of mind and body, headache, thirst, nausea, and constipation. In narcotism by opium, when an excessive dose has been taken, no stage of excitement occurs; giddiness is speedily followed by insensibility and immobility, the respiration is slow and stertorous, and then scarcely perceptible; deglutition is suspended; the pupils are extremely contracted; the face is pale and cadaverous; the muscles of the limbs are relaxed. Vomiting sometimes occurs, but more usually in fatal cases coma continues until death, which is sometimes preceded by convulsions. In some cases the urine is albuminous (*Zeitsch. f. klin. Med.*, xiv. 506). After death from opium-poisoning the convolutions of the brain are flattened, the vessels of the cerebro-spinal axis are gorged with black blood, and the capillaries of the brain on section give out minute drops of the same fluid. A serous liquid is usually found in the ventricles and beneath the cerebral surface of the arachnoid. The lungs, heart, liver, and spleen are in most cases distended with dark and fluid blood. It is worthy of notice that some persons who have recovered from the immediate effects of a poisonous dose of opium have afterward died of congestion or consolidation of the lung, doubtless induced by the narcotic effects of the poison (Shapleigh). Death has also taken place by syncope after apparent recovery (Townsend, *Boston Med. and Surg. Jour.*, Sept., 1885, p. 297).

The action of opium, like that of all agents which especially influence the nervous system, is greatly modified by numerous causes besides its mere dose. Thus it acts with extreme energy in the very young, because their nervous systems are highly susceptible. Infants have been narcotized by the milk of mothers under the influence of opiates. Ordinary doses are unsafe in the old, because, their eliminating functions being feeble, the medicine remains in their blood. For the former reason, probably, females are, as a rule, more readily affected than males by opium. All nervous, susceptible persons feel its influence speedily, and often in an abnormal manner, being unduly excited by ordinary doses. On the other hand, as in the case of alcohol, there are persons who can take with impunity doses of opium which to others would be distressing or even fatal. There are those, also, in whom the habit of using opiates has created a relative insensibility to the action of medicinal doses. In other cases extreme pain, like that of tetanus or biliary and nephritic colic, may neutralize the narcotic operation of the largest medicinal doses.

In a work like the present a detailed account of the morbid effects produced by the habitual use of opium would be out of place. They have been briefly summarized under MORPHINA, and need not be repeated here. An elaborate discussion of the subject is contained in a work of one of the present authors (*Therapeutics and Materia Medica*, 4th ed., i. 823), where the opium habit (in which this drug or some one or other of its preparations is taken internally, hypodermically, or by smoking) is illustrated by many examples, and its influence on health and life considered. To the cases there cited, and which prove that the slavery of this habit may be strangely prolonged, may here be added one of more recent publication. It is that of a former officer in the English army, who at the alleged age of one hundred and eleven was still living in New York. "He had been an opium habituate for seventy years," and at one time his daily consumption of the drug was 90 grains (Mattison, *New York Med. Record*, xii. 239). His extreme longevity makes any detail of its morbid effects superfluous. Indeed, the chief disorders it produced consisted of obstinate constipation when the dose of opium was very large, and diarrhœa when it was suspended or greatly diminished. (Respecting the opium habit, the following are a few of the articles that may be consulted: Mattison, *Phila. Jour. of Phar.*, Apr. 1879, p. 209, and *N. Y. Med. Record*, xxiii. 621; Kane, *Med. Record*, Nov. 1881, p. 511; Francis, *Lond. Med. Times and Gaz.*, Jan. 1882, pp. 87, 116; Myers, *Ibid.*, June 1882, p. 672; Moore, *Edinb. Med. Jour.*, xxviii. 958; *Amer. Jour. Med. Sci.*, Oct. 1884, p. 510; *Jour. Amer. Med. Assoc.*, xi. 419. That the misery and danger of opium-smoking are much less than attend on alcoholic intemperance, compare *Boston Med. and Surg. Jour.*, Oct. 1888, p. 416, and *Med. Record*, xxxvi. 288).

The several constituents of opium which have been isolated by chemical analysis manifest various modes of action, which differ more or less widely from those of opium itself. While *morphine*, as we have shown elsewhere, very nearly represents the crude drug, and codeine, meconine, papaverine, cryptopine, and narceine share with it a certain soporific virtue, the remaining elements, narcotine, thebaine, etc., are almost if not entirely destitute of this quality. The following statements represent the ambiguous condition of existing knowledge on these subjects:

Narcotine was first introduced as an anti-periodic, and, although freely given, was not suspected of possessing narcotic properties. Experiments upon animals prove it to be eminently a tetanizing agent, and productive at the same time of great depression; yet some observers report its possession of a slight narcotic power. According to others, this power is distinctly manifested in man by doses of from Gm. 0.60–2 (10 to 20 or 30 grains), yet it is certain that it has been administered as a tonic and anti-periodic in Gm. 2 (30-grain) doses without producing any narcotic effects. The conclusion almost necessarily is, that the alkaloid was not pure in the former case, but contaminated with morphine. *Papaverine* is, on the one hand, alleged to be hypnotic, and even the "prime hypnotic element of opium," an arterial and nervous sedative; and, on the other, it is by turns pronounced inert, tetanizing, relaxing, and a heightener of reflex action. Physiological experimenters have demonstrated that *thebaine* is eminently a convulsifying agent, the "most potent of all the poisonous constituents of opium." In man it is anodyne and soporific in the hypodermic dose of Gm. 0.10 (1½ grains), and is nearly equivalent to ¼ grain of a salt of morphine, while it does not occasion headache and nausea. *Cryptopine* appears to be closely analogous in its action to thebaine, tetanizing some of the lower animals, convulsing others. In man it acts like morphine, but without the unpleasant consequences due to the latter alkaloid. It is stated to be about one-fourth as strong as morphine. *Meconine*, when administered even in large doses hypodermically to large animals, and by the mouth to man, appears to be quite inert; but hypodermically, in doses of from Gm. 0.03–0.10 (½ grain to 1½ grains), it produces in man a moderately hypnotic effect. The action of *codeine*, which is now official, is discussed elsewhere. *Narceine* was once proclaimed to possess all the virtues, without any of the defects, of morphine, and as being operative in an equal dose. The usual contraindications of physiological experiment and therapeutical observation have only left the fact to survive that it is soporific for cold-blooded animals, and for man a feeble though pure hypnotic in the dose of 5 grains and upward, but, being at the same time rare and costly, it is practically useless as a medicine. In fact, the existence of a separate body described as narceine is no longer accepted (Dujardin-Beaumetz, *Bull. de Thér.*, cxvii. 339). The peculiar action of *apomorphine* has been fully described elsewhere (p. 236); it may suffice in this place to say that it is an emetic and general depressant. According to Ott, *chlorocodide* is a tetanizing agent; *apocodeine* produces vomiting, coma, and death; *cotarnine* is soporific, and paralyzes the motor nerves; *hydrocotarnine* is narcotic and convulsivant; *laudanosine* and *laudanine* are tetanic agents. In 1878, Bardet undertook a course of experiments to determine, if possible, the relative value of the principal constituents of opium, and reached the following conclusions: Codeine in small doses is null, in large doses a fruitless and distressing agent; narceine has either no real existence or is totally inert as a narcotic; and morphine "is the sole useful and narcotic alkaloid of opium" (*Bull. de Thérap.*, c. 78).

In 1883, Von Schroeder pursued this investigation much more thoroughly and minutely (*Archiv. f. exp. Pathol. etc.*, xvii. 96). Space is wanting to detail his results, but they proved, as Bardet's had done, that morphine is the only true narcotic element of opium, and that codeine, papaverine, narcotine, and thebaine are mainly tetanizing agents and but slightly narcotic. Narceine he held to be wholly inoperative. Thus the most recent results as substantially agree as the early ones were at variance with one another.

The different modes of action of opium, according to its dose, upon the two great vivifying elements of the animal economy, its stimulant and sedative operations, upon the nervous and circulatory systems, and its directly anæsthetic influence in all doses, render it the most useful of all medicines, as well as the most multifarious in its applications. It relieves pain, allays agitation, delirium, and spasm, restrains tissue-change, secretion, and hæmorrhage, and both directly and indirectly supports the powers of the system. By the possession of these manifold virtues it becomes the most fitting associate of numerous other medicines, the operation of which it moderates, exalts, or directs.

Fevers.—It is an old precept, which all judicious experience has confirmed, that opium ought not to be prescribed at the onset nor at the climax of a continued fever, but during

the augment to appease its violence, and during the decline to support the strength and calm the nervous symptoms which denote exhaustion. In *typhus* its greatest usefulness is not when the strongest tendency to stupor exists, but when muttering delirium, jactitation, tremor, and spasm denote exhausted nervous power; but even then it must be used in such doses only as revive, and not in such as tend to oppress, the brain. In the rarer cases of this disease presenting violent delirium, a furious aspect, suffusion of the eyes, constant raving and muttering, and perfect sleeplessness, moderate doses of a liquid preparation of opium, associated with tartar emetic, according to a former practice, or with veratrum viride or digitalis, or one of the so-called antipyretics, as more recently employed, will often render the patient tranquil and induce refreshing sleep. These remarks are equally applicable to all forms of disease when the *typhoid state*, characterized by the above phenomena, is present, and especially to *typhoid fever*, and to *small-pox* as it occurs in adults. In the latter disease it has been associated with the subcutaneous injection of ether. But opiates in the diseases of children, and especially in their eruptive fevers, are seldom useful, and often involve serious risk. Another object of employing opium in the exanthematous fevers is to hasten the development of the eruption when it is tardy and imperfect. Under such circumstances the medicine should be given in small and repeated doses, and associated with external heat and rubefacients and internal diffusible stimulants. Before the introduction of cinchona, opium was generally used to abort the paroxysms of *periodical fevers*, which it did by creating a vascular excitement opposed to the formation of the chill, and inducing artificially a diaphoresis which also prevented that stage of the attack. In the same manner it is often now associated with quinine, whose specific operation it favors. Another mode of using opium in intermittent fever is to administer it in so large a dose as to hold the nervous system in a state of immobility, and so prevent the formation of the paroxysm.

Inflammation is less directly under the control of opium than idiopathic fever, yet its judicious employment, by lessening pain, tends to prevent an aggravation of the disorder and to allow the natural recuperative powers their full operation. In chronic inflammations, also, attended with constitutional irritation and hectic fever, opium exerts a salutary restraining influence. After severe operations it tends to prevent the irritative fever which the shock of pain and loss of blood, and the consequent reaction, are apt to excite. As a rule, the dose required is large and sedative. In *hæmorrhage*, even of the active sort, opium is sometimes of service by diminishing the agitation upon which its continuance depends, and especially by allaying the excitability of the nervous system of the heart; but its greater utility is in cases of passive hæmorrhage accompanied by a similar excitability. Possibly, also, it may directly contract the capillaries. The use of opium in *gangrene*, advocated by Pott, and Hoffmann, Eberle, and Travers, has been eulogized by Mr. Pollock (*Brit. Med. Jour.*, April, 1884, p. 799), who advocates it "in almost every condition approaching to gangrene or partaking of it," including senile gangrene, gangrenous ulcers, simple and syphilitic phagedæna, and gangrene of the mouth, but excluding "traumatic spreading gangrene."

All forms of *pain* are palliated by opiates, but the more independent pain is of material lesions, as in pure *neuralgia*, the more efficient are these remedies, unless, perhaps, when the narcotic operation suspends the action of the physical cause of pain. All forms of *spasmodic pain*, of the bowels, bladder, uterus, gall, and urinary ducts, etc., are lessened by suspending the spasm in which the pain arises. Pain due to movements of the affected part is directly palliated by opium, and indirectly by promoting rest. In nearly all painful disorders the dose of opium must be proportioned to the degree of pain. The tolerance of large doses of the drug during severe pain, and also in prolonged spasmodic attacks like tetanus, is a remarkable fact. Opium is seldom appropriate for pain within the head; it may dangerously mask this symptom in other cases where pain is the chief indication of the disease. Of the latter, strangulated *hernia* is an example. After the operation for this accident the bowels should be restrained by full doses of opium. In case of peritonitis the use of opiates becomes all the more urgent. (See below.)

Sleeplessness is relieved by the direct action of opium, and also indirectly, in so far as opium removes the cause that prevents sleep, whether it be pain, mental excitement, or exhaustion, etc.; but very often it fails of its effect, although given in large doses, in such excessive excitement as occurs in *mania a potu*, acute *insanity*, *meningeal inflammation* in some of its forms, etc. Moreover, if long continued, its utility as a hypnotic is more than counterbalanced by the danger of forming the opium habit, by the derangement of digestion, secretion, etc. which it induces, particularly as its original effects can only be maintained by largely increased doses of the drug. A study of the opium treat-

ment of melancholia, mania, and dementia has not furnished favorable results (Ziehen, *Therap. Monatsheft.*, iii. 61; 115). In *puerperal insanity* it is more beneficial than in other forms of mental disorder, particularly when morphine is used hypodermically. The treatment of *delirium tremens* by large doses of opium, which at one time prevailed, was most unfavorable in its results; and if the drug is used at all in this disorder, its doses should be small and repeated, so as to produce a primary stimulant and not a narcotic operation. We have observed with intense regret a tendency to revive the practice of administering large doses of opiates in this disease. In one case 5 grains of morphine were given subcutaneously in 2 doses, and in another no less than 8 grains within four hours (*Med. Times and Gaz.*, March 11 and 18, 1876). The mortality of delirium tremens under the opium treatment, as formally practised, was enormous, and is remembered by the present writer as one of the most painful features of his hospital life. Since that time, with an expectant and rational treatment, he has rarely had occasion to witness a death from this disease. In *epidemic cerebro-spinal meningitis* opium is probably the most efficient of all the remedies that have been employed. But its utility is most conspicuous in those cases of the disease in which spasm (*i. e.* spinal irritation) predominates over septic phenomena, and when it is administered steadily from the commencement of the attack. *Sunstroke* marked by nervous symptoms, such as convulsions, twitchings, delirium, and general excitement, is greatly benefited by the hypodermic injection of morphine. Opium may be used as a palliative in *epilepsy*, *hysteria*, *eclampsia*, and *spasm of the glottis;* and although it is contraindicated in obstruction of the kidneys, as in Bright's disease, it is nevertheless of great value in *uræmic convulsions*, especially in the form of hypodermic injections.

In obstinate cases of *chorea* the sustained use of opium has sometimes been followed by a great reduction of the spasmodic movements, and even by cure. Hardly any remedy has effected as much good in *traumatic tetanus* as opium, even when given by the mouth, although a large portion of the drug is wasted by this mode of administration. The liquid preparations are preferable, and superior to these again is the hypodermic injection of morphine. Neither method should exclude the due employment at the same time of other remedies, and especially of counter-irritation of the spine and the use of alcohol. In this disease larger doses of opiates are required than in any other. In the somewhat analogous affection produced by *strychnine-poisoning* subcutaneous injections of morphine have proved curative. The use of opiates in *neuralgia* is most efficient when the salts of morphine are injected hypodermically, as is elsewhere at greater length described. (See MORPHINA.) This statement applies to internal as well as external neuralgia.

In diseases of the respiratory organs *pain* and *cough* are the symptoms which especially call for the use of opiate preparations, which relieve the former directly as well as diminish the violent movements accompanying the latter symptom. So far as the pain caused by coughing depends upon pleural inflammation or upon the action of muscles affected with rheumatism, opium affords certain relief, while it palliates also the painful sensations accompanying acute bronchitis. But as coughing is largely a conservative act, tending to prevent the accumulation of secretions in the bronchia, opium must not be employed in such doses as tend to prevent this salutary operation; hence it must be cautiously used, if at all, when the bronchia are filled with their secretions. In the forming stage of *pulmonary catarrh* or *bronchitis*, when the air-tubes are dry and irritable and coughing painful, opium, especially with ipecacuanha, as in Dover's powder, will sometimes mitigate, or even terminate, the attack by promoting the pulmonary and cutaneous secretions. Opium has been used in the form of morphine, hypodermically, with reported advantage in arresting the development of *autumnal catarrh*. Narceine has been credited with the cure of *whooping cough*, but upon insufficient grounds. In *pneumonia* and *pleurisy* opium should be restricted to moderating cough and pain; and the same may be said of chronic *phthisis*. In the latter, if habitually used, it is very apt to impair digestion and hasten the patient's decline, but is nevertheless almost indispensable when the cough is harassing. It may sometimes be given in an atomized solution more profitably than when otherwise administered. In *asthma* hypodermic injections of morphine are efficient palliatives. In our lectures on the Practice of Medicine we were in the habit of recommending opiates in *spasmodic croup* (*An Epitome of Medicine*, etc., 1883, p. 82). More recently a similar treatment has been advocated by Dr. Arthur V. Meigs (*Med. News*, 1889, liv. 311). In the various affections of the heart, of which *angina pectoris* is a more or less frequent symptom, opium, but still more morphine, is an invaluable palliative, and that without too closely regarding the special lesion upon which the pain and the

disordered action of the heart depend. Of heart lesions which accompany such attacks those of the mitral valve are the most frequent. For the relief by opium of all symptoms depending upon a positive or relative debility of the heart the medicine must be given so as to stimulate; that is to say, in small and repeated doses.

Among diseases of the digestive organs the symptoms most appropriately treated by opium are *vomiting*, *pain*, and *diarrhœa*. All forms of vomiting are more or less under its control, as that of *sea-sickness*, of *pregnancy*, of *reflex irritation* generally, and of diseases affecting the stomach itself. In the last opium is often given in the form of an old or hard pill, but the hypodermic injection of morphine is usually more efficient. *Simple ulcer* of the stomach as a cause of vomiting is sometimes treated with opium and its preparations, but they are unnecessary when the diet is properly regulated and bismuth or lime-water is employed. In pure *gastralgia* these medicines are often extremely valuable as palliatives, but other means are required to cure the disease through the removal of its cause. When used, they should be administered 10 or 15 minutes before meals, and also when a paroxysm is imminent.

Of the use of opiates in *diarrhœa*, it may be remarked that the less this symptom depends upon material lesions or upon irritating crude ingesta, the more efficient are opium and its preparations as remedies. Indeed, they only hasten somewhat the natural cure by moderating the peristaltic action and diminishing the secretions of the intestine. Otherwise, they act as aids to absorbents and astringents, such as chalk, tannin, etc. In *dysentery* opium is of less value for its curative properties than as a palliative of the tormina and tenesmus which belong to the active forms of this disease; but even these symptoms are more successfully relieved by the evacuant method, either alone or in alternation with the administration of opium by the mouth and by the rectum in enemata or suppositories. When once the violence of the disease is subdued, moderate doses of opium greatly hasten its termination. In the chronic form of dysentery the main reliance must be upon diet, especially upon a milk diet, but opium with astringents is the best medicinal remedy. In *lientery* opium, with or without astringents, is almost indispensable. It is by far the best remedy in *cholera morbus*. No evacuant medicines need be first administered. A grain of opium should be given every half hour in severe cases, the patient refraining from the use of liquids as much as possible. Enemata of laudanum should also be employed, or the treatment may be confided to the hypodermic use of morphine. Care should be taken not to exceed the needful quantity of the drug administered, on account of the depression which is apt to follow the use of large doses. In *epidemic cholera*, depending as it does upon a specific cause, opium cannot be as confidently relied upon; indeed, the records of its use in this disease are extremely discouraging. But in the forming stage, or that of premonitory diarrhœa when that stage exists, opium with chalk and vegetable astringents is invaluable. The tender age and great susceptibility to the influence of opium of the ordinary subjects of *cholera infantum* render opium an unsafe remedy for that affection, notwithstanding the apparently clear indications for its use in the nature of the disease. If used at all, it should be in the form of Dover's powder alone or along with gray powder or calomel.

The symptom *colic*, as a form of pain, is of course amenable to a treatment by opiates, but it is a symptom connected with very numerous and dissimilar conditions. In the ordinary form, due to flatulent dyspepsia of the bowel, opium with diffusible or carminative stimulants affords prompt relief. In *painter's colic*, which is attended with intestinal contraction and spasm, opium is the best remedy, especially in alternation with purgatives. *Biliary* and *nephritic colic* are most efficiently treated by opium; and when pain arises from any of the various acute forms of intestinal displacement (*invagination*, *hernia*), the moderate but sustained use of opiates is infinitely preferable to the too common method of attempting to force an evacuation by means of purgatives. (Compare Curshmann, *Therap. Monatshefte*, iii. 201). In all of these cases the hypodermic use of morphine is preferable to opium internally. (Compare Post, *New York Med. Record*, xxi. 431.) Of the several forms of *peritonitis*, those only whith are due to traumatic causes, such as external violence and perforation or irritation of the peritoneum by diseases of the organs which it covers, are favorably influenced by opium; but in these it is indispensable, for by its means alone can that repose of the abdominal organs be secured which is necessary to control the degree and extent of the inflammation. In *puerperal peritonitis*, although it has been employed in heroic doses and emphatically praised, it has not been generally recognized as appropriate.

Among diseases of the genito-urinary organs opium is an efficient palliative in *nephritic colic*, already referred to, and in all the spasmodic affections of the *ureters*,

bladder, and *urethra*, such as arise during calculous disorders and inflammation of these several parts. Thus it is a usual remedy for *chordee*, although generally associated with camphor. In all of these cases it is best administered by the rectum. It should never be used in *Bright's disease*. Opium is superior to any other single medicine in diminishing the quantity and the saccharine quality of the urine in *diabetes* when administered in full and progressively increasing doses until a partial tolerance of the drug is induced. At the same time it lessens the thirst and hunger, renders the skin softer, and the mind less despondent. Its most efficient coadjutors are exercise and appropriate food. (See case, *Boston Med. and Surg. Jour.*, Sept. 1881, p. 277.) It is an efficient palliative of the *grinding pains* which precede actual labor, and for those uterine contractions which so often lead to *abortion* or premature labor. Hypodermic morphine injections are more efficient than opium in such cases. The same means are frequently employed in *dysmenorrhœa*. In these various affections, and in all others within the pelvis for which opium is appropriate, suppositories containing this drug or its derivatives, and enemata with laudanum, are especially indicated. In constitutional *syphilis* opium has been erroneously represented as a means of cure. It only allays constitutional irritability and procures rest from nocturnal pains. In the primary forms of the disease it is useful as a dressing for irritable sores.

Muscular rheumatism may generally be relieved by opium, used so as to produce free diaphoresis, and especially in the form of Dover's powder. It is much more efficient in the forming stage of the attack than later. In *articular rheumatism* it has sometimes been used as an exclusive treatment, but with very unfavorable results, in that it augments the frequency and the gravity of cardiac complications. It is, however, valuable as an anodyne and soporific, thereby husbanding the patient's strength while the disease is removed by eliminative medicines. In the same manner it is useful in *gout*, and particularly its liquid preparations. When this disease becomes *retrocedent*, and especially when it attacks the stomach, opiates associated with diffusible stimulants are the most reliable remedies. Wine of opium or laudanum should then be administered in doses of from Gm. 2–3 (40 to 60 drops) every hour by the mouth or rectum, or morphine may be employed hypodermically.

The use of opium in poisoning by Belladonna, Atropina, Strychnina, Stramonium, and Physostigma will be found described under those several titles.

As a *local remedy* opium has already been noticed in connection with various painful affections; the uses of morphine in this respect are even more numerous. But the liquid preparations of opium in liniments, epithems, poultices, etc. as topical anodynes are more habitually employed. A watery solution is used as a dressing for irritable *ulcers;* the wine of opium is an admirable anodyne and stimulant in granular *conjunctivitis* and *ulcers of the cornea;* in *earache* laudanum and sweet oil are applied on cotton to the auditory canal; in *toothache* a small piece of opium may be introduced into the hollow of a carious tooth, or, still better, a solution of morphine in chloroform, saturating a plug of cotton, may be similarly applied, or in rheumatic toothache the gums may be bathed with laudanum. In *paronychia* and numerous other forms of painful local inflammation the anodyne operation of opium and its preparations lessens the inflammation by assuaging the pain.

The rational and habitual method of treating *poisoning by opium* consists in emptying the stomach of whatever portion it still contains of the poison, and in keeping the nervous system stimulated and the respiratory apparatus active, and so preventing or diminishing narcotism until the poison is eliminated from the system. For the first purpose emetics are indicated; *e. g.* large draughts of warm salt and water, mustard-water, or water containing ipecacuanha, sulphate of zinc, or sulphate of copper. Tartar emetic should never be prescribed, unless other evacuants fail. It has been successfully employed by the rectum and also by the veins. Vomiting should be favored by tickling the fauces. If these means are not promptly and completely efficient, the stomach-pump should be resorted to. When solid opium has been taken—which, however, is rarely the case—the stomach-pump is of secondary importance. To counteract narcotism, stimulants of the general nervous system and of the respiratory apparatus are employed, both internally and externally. One of the best, as well as the most accessible, is a strong infusion of coffee, given without sugar or cream, but with a small proportion of brandy or whiskey. A strong infusion of green tea is nearly as efficient. The mydriatics (belladonna and stramonium) and also nitrite of amyl have been employed as direct antidotes. Their value is estimated in the articles devoted to those medicines. A single illustration of the efficacy of atropine may be mentioned here: A man had taken

2½ ounces of laudanum, none of which was rejected or removed, and no remedies were applied until two hours had elapsed. Then ¼ grain of atropine was given hypodermically in four hours and in six doses. The man recovered (Bryant, *Med. Record*, xviii. 648). Fluid extract of gelsemium has been employed hypodermically with advantage. Its sedative action should be watched. Of external means for stimulating the nervous system, one of the best is to cause the patient to walk, as long as he is able, supported between two assistants, while his attention is kept aroused by conversation or by flagellating the back with a whip of fine cords or a bundle of birch-twigs. Unless the impression made is sharp it is almost useless. Hence the electrical brush answers remarkably well for this purpose. Cold, or alternate heat and cold, affusion, made to the upper part of the body, produce a powerful impression and excite the respiratory act. The partial restoration of consciousness by these means is sometimes accompanied by a renewal of the susceptibility of the stomach, and the emetics it may contain excite vomiting. Ammonia may be held to the nostrils occasionally, and mustard applied over the epigastrium and heart; but the irritation produced by these agents makes it necessary to watch their action. Artificial respiration, although inferior to the other means described, has occasionally been used with success. In infants the natural resiliency of the ribs renders this agency especially useful.

The cure of the *opium-habit* consists either in gradually diminishing the quantity of the drug consumed, and the substitution for it of aromatic and stimulant tonics, such as ginger, black pepper, columbo, quassia, etc., or in the abrupt cessation of the practice. Both methods count a few successful cases, but the latter, while the more efficient, is the more arduous, and, where there is marked general or cardiac debility, is not safe. In such cases the preparations of coca are appropriate. In certain inveterate cases it is claimed that a cure has been effected by prescribing 40 minims of dilute phosphoric acid and 80 minims of tincture of lupulin an hour before meals in a wine-glassful of water. At night sleep may be promoted by tincture of cannabis and Hoffmann's anodyne. The exhausted digestive function should be allowed to revive under simple food, such as milk and rich broths, in small quantities at a time. Exercise and bathing should be insisted upon, and zinc, quinine, and iron may be cautiously administered. The various secret nostrums sold for the cure of the opium habit nearly all contain opiates.

The average *dose* of opium for an adult is Gm. 0.06 (gr. j). This is usually an objectionable form of its administration when the medicine must be repeated. In that case a liquid preparation should always be preferred. When a gradual operation is intended an old opium pill is the best, since its slow solution prolongs its action and extends its local influence over a larger surface. It is also much less apt than freshly-made opium pills to occasion nausea. The after-effects of opium are supposed to be mitigated by bromide of potassium in a full dose administered along with the opiate. This apparent operation is rather due to the fact that with a full dose of the bromide a smaller one of opium is necessary. Owing to the extreme susceptibility of children to opium, it should rarely be prescribed for them in the solid form. Suppositories of opium for the rectum and vagina are very useful in local disorders of the pelvic organs, and the rectal forms may also be used when for any reason the drug cannot be administered by the mouth. But they are less prompt in action than enemata of liquid opiates.

Denarcotized opium (opium deodoratum) is supposed to be free from narcotine, and, according to some, from thebaine also, and therefore that it is less apt than opium to excite those distressing nervous symptoms which the whole drug sometimes occasions. Its *dose* is the same as that of opium.

Opium-smoking has been recommended by Thudicum as one of the most effectual remedies for commencing *coryza*, *hay fever*, *bronchitis*, obstinate *coughs*, various *neuralgia*, and *hyperæsthesiæ* generally. The watery extract is alone suitable for the purpose. (For the mode of using opium in this manner see Kerr, *Med. News*, xliii. 402).

Eschscholtzia Californica was stated in 1887, by Stanislas Martin, to contain opium (*Bull. de Thérap.*, cxii. 375). The statement was renewed later by Bardet and Adrian (*Gaz. hebdom.*, Nov. 23, 1888), and the experiments of Ter-Zakariant led him to conclude that the alcoholic and watery extracts of the plant had the same virtues as morphine, but in a much less degree. He administered from 40 to 150 grains of it a day (*Bull. de Thérap.*, cxvi. 21).

OPOPANAX, *Fr. Cod.*—Opopanax.

Opoponaso, Sp.

A gum-resin obtained from Opopanax Chironium, *Koch*, s. Pastinaca Opopanax, *Linné*. *Nat. Ord.*—Umbelliferæ, Orthospermæ.

Origin.—The opopanax-plant is a perennial herb, with a long, thick, and fleshy root, a tall stem, large pinnately decompound leaves, yellow flowers, and dorsally flattened fruit containing many oil-tubes. It is indigenous to Southern Europe. On wounding the root or lower part of the stem a yellowish milk-juice exudes, which after hardening constitutes opopanax.

Description.—The best quality of opopanax is in irregular angular or subglobular pieces from the size of a pea to that of a walnut, red-brown or yellowish-brown, friable, breaking with a flat somewhat waxy fracture, and frequently with vegetable fragments adhering. It has a strong, unpleasant odor, a balsamic bitter taste, yields with water a yellowish emulsion, and when heated softens and exhales a rather alliaceous odor. An inferior quality comes in larger irregular masses, which contain many impurities and are of a less bitter taste.

Composition.—According to Pelletier, opopanax contains 42 per cent. resin, 33.4 per cent. gum, besides volatile oil, a little wax, starch, etc.

Allied Gum-Resins.—Sagapenum, obtained from a Persian species of Ferula, is met with in yellowish-brown somewhat translucent small tears, and is frequently agglutinated to larger pieces, of a bitter acrid taste and a faint alliaceous odor, which becomes prominent on heating. Cake sagapenum is soft, adhesive, brown, nearly free from tears, mixed with foreign matters. A mixture of galbanum and asafetida is sometimes sold in place of sagapenum. Pelletier and Brandes found in sagapenum 50 to 54 per cent. of resin, 32 per cent. gum, with small quantities of volatile oil, bassorin, etc.

Gummiresina hederæ, *Ivy gum*, is in the Levant and Southern Europe obtained from the common ivy, Hedera Helix, *Linné* (nat. ord. Araliaceæ). It is in irregular yellowish or reddish-brown pieces, translucent on the edges, with a garnet-red color, of a slightly bitter and somewhat acrid taste, and when heated of an agreeable balsamic odor. Pelletier found in a sample nearly 70 per cent. of wood-fibre.

Action and Uses.—Opopanax ("the all-healing juice") is one of the numerous gum resins, including galbanum and ammoniac, which were most esteemed by the ancients. Galen speaks of it and of the root-bark of the plant as stimulating and cleansing when applied to ulcers, and of the seeds as diuretic. Dioscorides describes its internal uses in fever and ague, pleurisy, cough, dysury, and amenorrhœa, and its topical applications in sprains, headache, gout, toothache, and carbuncle. Arabian writers advise it in nervous exhaustion, for promoting the expulsion of the dead fœtus, for paralysis, and for inflammation of the eyes. In modern times it has been used, like ammoniac, for *chronic bronchitis* with profuse secretion, and externally in stimulating plasters, but it is now very seldom employed. The *dose* may be stated at Gm. 1.30–2 (gr. xx–xxx).

Sagapenum was anciently used for the purposes to which asafetida and galbanum were also applied—*i. e.* to the cure of chronic bronchitis and other chronic catarrhs, menstrual disorders, hysteria, etc. The gum of *Hedera helix* was held to be acrid and astringent, stimulant and emmenagogue, and was employed topically for the relief of local pains and the moderation of profluvia, the healing of ulcers, etc. The berries have been used as emeto-cathartics, and the leaves as stimulant and irritant applications. Griffith states that some species of *Silphium* afford a fragrant bitter gum which is stimulant and aromatic; and Porcher refers to *S. laciniatum*, s. gummiferum, as having been used for asthma in horses, and to *S. perfoliatum* as tonic, diaphoretic, etc. In France a species of Silphium has been credited with the cure of phthisis, but doubtless the disease which it benefited was chronic bronchitis.

ORIGANUM.—Origanum.

Origan vulgaire, Fr. Cod.; *Dosten*, *Wilder Majoran* (*Meiran*), G.; *Oregano*, Sp.

Origanum vulgare, *Linné*. Bentley and Trimen, *Med. Plants*, 204.

Nat. Ord.—Labiatæ, Satureieæ.

Origin and Description.—Origanum, or *wild marjoram*, is a perennial herb growing in dry soil throughout a large portion of Asia, Europe, and Northern Africa. It has been introduced into the United States, where in some places it is now quite common. The stem is quadrangular, often purplish, branched above. The leaves are opposite, petiolate, roundish ovate, obtuse, entire, or slightly toothed, hairy on the veins beneath, and pellucid punctate. The flowers are terminal on the branches, forming a corymbose panicle, have a purple, ovate bell-shaped and five-toothed calyx, a purplish somewhat two-lipped corolla, and four didynamous exserted stamens. The herb has a strong aromatic, marjoram-like odor and a warm aromatic and bitterish taste.

Constituents.—The herb contains volatile oil, a little tannin, bitter principle, etc.

Oleum origani.—Oil of origanum, *E.*; Essence d'origan, *Fr.*; Dostenöl, *G.*—Rayband obtained only 0.024 to 0.03 per cent. from the fresh plant, and Redtel 2 per cent. from the recently-dried herb. Red oil of thyme (see Oleum Thymi) is often sold in its place. It is pale-yellow and limpid, becoming thicker and brown-yellow on exposure, has a strong aromatic odor, and a warm, pungent, and slightly bitter taste. Its specific gravity varies between 0.87 and 0.91. It yields a turbid solution with 12 parts of alcohol specific gravity 0.85, fulminates when brought into contact with powdered iodine, acquires with sulphuric acid a dark blood-red color, and a deep-brown one with potassium dichromate and sulphuric acid (Zeller). The oil consists of a liquid and a solid portion, which have not been fully investigated. Kane (1838) ascribed to it the composition $(C_{10}H_{16})_5O$. According to Jahns (1881), it is left-rotating, and contains 0.1 per cent. of phenols.

Allied Plants.—Origanum majorana, *Linné*, s. Majorana hortensis, *Mœnch*: Herba majoranæ.—Sweet marjoram, *E.*; Marjolaine, *Fr.* Cod; Meiran, *G.*; almoraduz, mejorana, *Sp.*—It is an annual herb, frequently cultivated for culinary purposes, and is indigenous to Western Asia and Southeastern Europe. The leaves are spatulate or oval, very obtuse, entire, gray-green, soft-hairy, and pellucid punctate. The flowers are aggregated in small heads and have a small whitish corolla. The plant is agreeably and pungently aromatic.

The volatile oil (*Oleum majoranæ*) is thin, yellowish, of the specific gravity 0.89, boils above 163° C., is readily soluble in alcohol, has the aromatic odor of the herb, and, according to Beilstein and E. Wiegand (1882), contains a terpene boiling at 178° C. (352.4° F.) and forming a liquid compound with HCl; the fraction boiling between 200° and 220° C. (392° and 428° F.) has the composition $C_{15}H_{26}O$, and is not affected by metallic sodium.

An ointment of marjoram, *Unguentum majoranæ*, is occasionally employed; it is prepared by softening 2 parts of the cut herb with 1 part of alcohol, then digesting with 10 parts of lard until the alcohol has evaporated, straining and cooling.

Orig. creticum, *Linné*, indigenous to Southern Europe, has hairy ovate or nearly cordate and somewhat five-nerved, pungently aromatic leaves, and whitish flowers. In Europe the volatile oil is distilled from it, and is used like allied oils. The volatile oil of Orig. hirtum, *Link*, which is often sold in place of it, consists, according to Jahns (1879), of 50 to 60 per cent. of *carvacrol* and of several terpenes, besides a volatile acid and a small quantity of a phenol which becomes violet-colored with ferric chloride.

Orig. Dictamnus, *Linné*, is found in the Levant, has wolly-tomentose, obtusely quadrangular branches, roundish ovate tomentose leaves, partly purple-colored bracts, and a dark-purplish corolla. It is pungently aromatic.

Lippia origanoides, *Kunth* (*nat. ord.* Verbenaceæ) is the origano of Mexico.

Action and Uses.—*Wild marjoram* has been applied in fomentations and poultices for the relief of local pains in the same manner as numerous other plants containing an aromatic volatile oil. *Sweet marjoram* is chiefly used as a condiment in cooking, to diminish, by its excitant qualities, the indigestibility of pork, goose, and other fatty food. It is sometimes employed in warm infusion to promote the eruption in exanthematous fevers, allay *colic*, *dysmenorrhœal pains*, etc., and the fresh bruised herb is applied as a cataplasm to assuage local pains. The infusion may be made with Gm. 30 to Gm. 500 (℥j in Oj) of water. Oil of origanum is applied locally as an anæsthetic to relieve the pain of *carious teeth*, *neuralgia*, etc. It forms an efficient ingredient of liniments for *muscular rheumatism*, *contusions*, etc. It may be prescribed internally in doses of Gm. 0.30–0.60 (gtt. v–x).

OS.—Bone.

Os, Fr.; *Knochen*, G.; *Hueso*, Sp.

Description.—Bones form the skeleton of the vertebrate animals, and consist of a dense organic tissue which is filled with a calcareous deposit. They are white, externally smooth, insoluble in water, partly soluble in acids, leaving a gelatinous mass behind, and when heated are partly decomposed, an empyreumatic animal odor being given off and a porous charcoal left. (See Carbo Animalis, p. 405.) On continuing the heat in contact with air, the organic matter is entirely consumed and a white earthy residue remains.

Composition.—The organic portion of bones, which is left undissolved on treatment with hydrochloric acid, has been called *ossein*, and on continued boiling with water is converted into gelatin (see page 767). The inorganic portion varies in different bones of the same individual, in the bones of different species, and in different layers of the same bone; it is smaller in the inner layers, amounting sometimes to 40 per cent., and in the outer layers it may reach 67 per cent. The ash contains calcium phosphate (usually about 75 per cent. of the bones) and carbonate (about 5 to 10 per cent.), magnesium phosphate (1.1 to 2.7 per cent.), calcium fluoride (less than 1 per cent.), and traces of silica, iron,

manganese, and probably also sodium chloride. Eby (1874) considers the principal inorganic constituents of bones to be united to a chemical compound having the formula $3Ca_3(PO_4)_2\,CaCO_3$, probably united with water and mixed with calcium carbonate. *Ivory*, including the fossil kind, has the composition $6Ca_3(PO_4)_2\,Ca(OH)_2\,CaCO_3.4H_2O$. When old bones free from organic matter are dried at 200° C. (392° F.), the residue on being moistened with water becomes warm and increases to its original weight again. Above 250° C. (482° F.) more water and carbon dioxide are given off.

When ground bones are treated with about 50 per cent. of their weight of sulphuric acid a mixture is obtained which is largely used as a manure under the name of *superphosphate of lime*, containing, besides the organic matter of the bones, about 50 per cent. of calcium sulphate, 22 or 23 per cent. of acid calcium phosphate, and small quantities of magnesium compounds. On exposing such a mixture in thin layers to a current of crude illuminating gas the latter is deprived of ammonia, which combines with the superphosphate to the extent of about 10 per cent., forming ammonium phosphate and sulphate. The product of this *dry ammonia process* for gas purification is considered to be more valuable as a fertilizer than the superphosphate of lime.

Pharmceutical Uses.—Os ustum, *Br.* Bone-ash is the inorganic residue left on burning bones to whiteness, and consists principally of calcium phosphate, with about 10 per cent. of calcium carbonate and a little calcium fluoride and magnesium phosphate. It is used in the manufacture of glacial phosphoric acid and in preparing Calc. phosphas and Sod. phosphas, *U. S.*, *Br.*

OXALIS.—Wood-Sorrel.

Alléluia, *Surelle*, *Pain de coucou*, Fr.; *Sauerklee*, *Hasenklee*, G.; *Acederilla*, *Socoyol*, Sp.

Nat. Ord.—Geraniaceæ, Oxalideæ.

Description.—The following species indigenous to North America and Europe have been used:

O. Acetosella, *Linné*. The thin, thread-like rhizome, near the ascending apex, is furnished with crowded reddish fleshy scales and fine brown radicles. The leaves are radical petiolate, and have three triangular-obcordate entire leaflets 12 Mm. (½ inch) long. The scapes are longer than the petioles, and bear a single white, red-veined flower with ten alternately short stamens. The capsule is five-angled and five-celled, each cell containing two seeds.

O. corniculata, *Linné*, is an annual herb, producing subterranean shoots which survive the winter. The leaves are petiolate, with three obcordate leaflets, and the flowers yellow, forming a small umbel on peduncles longer than the petioles. The variety *stricta* is common in North America.

Allied Plants.—Several species, mostly acaulescent and bulbous, and bearing white, purple, or yellow flowers, are seen in cultivation. All are inodorous or nearly so, and have a pleasant acidulous taste.

Rumex Acetosa, *Linné* (*nat. ord.* Polygonaceæ); Sorrel, *E.*; Oseille commune, *Fr. Cod.*; Sauerampfer, *G.*; Acedera, *Sp.*—The stems of the sorrel dock is about 50 cm. (20 inches) high; the leaves are broadly lanceolate, with arrow-shaped or halberdform basal lobes; the acidulous taste is due to potassium oxalate. The *field* or *sheep sorrel* (R. Acetosella, *Linné*) resembles the preceding, but is only about one-fourth its size. It is a common weed, while the former is sparingly naturalized in North America.

Constituents.—Besides the principles common to most herbs, these plants contain acid potassium oxalate.

Action and Uses.—Wood-sorrel and yellow wood-sorrel depend for their medicinal virtues upon the potassium oxalate they contain. They have been long considered antiscorbutic, diuretic, and sedative in febrile conditions. In the last case an infusion of the plant forms an agreeable acidulous drink. Sorrel may be eaten as a salad mixed with lettuce, water-cress, etc. In *scurvy*, *purpura*, and some cases of vernal *intermittent fever* it is reported to have been curative. In Europe it is commonly eaten as a dressing for insipid meats, such as veal and sweetbread, and it is stated that its habitual use in this way has led to the formation of urinary calculi of oxalate of lime. It is related that a boy who had eaten a quantity of raw sorrel-leaves, quenched his thirst with water which was soapy: he was seized with giddiness and died unconscious. This result was attributed to the combination of the oxalic acid of the sorrel with the alkali of the soap (*Med. Press*, June 23, 1886). Externally, the bruised leaves are sometimes applied to cleanse and stimulate foul *ulcers*. Eltinge reports a case of *epithelioma* of the lip cured by the appli-

cation of the inspissated juice of Oxalis acetosella. It occasioned intense pain, lasting for half an hour (*Philad. Med. Times*, xii. 159). Such instances have led to the suggestion of its use as a remedy for cancer.

OXYGENIUM.—Oxygen.

Oxygène, Fr.; *Oxygen, Sauerstoff*, G.

Symbol O. Atomicity bivalent. Atomic weight 15.96.

Oxygen was discovered by Scheele (1772) and Priestley (1774). It constitutes about one-fifth of the volume of atmospheric air, the remainder being nitrogen, with a small proportion of carbon dioxide. Eight-ninths of the weight of water and one-half the weight of many minerals consist of oxygen, and it is estimated that at least one-third the weight of the solid crust of the earth is made up of this element, which is the most abundant of all.

Preparation.—Oxygen may be obtained by exposing manganese dioxide, mercuric oxide, or some other metallic oxide to a strong heat, but it is most conveniently prepared by heating a mixture of 4 or 5 parts of potassium chlorate with 1 part of manganese dioxide. At a low red heat the chlorate is completely decomposed into oxygen and potassium chloride, which remains mixed with the manganese; the latter, not being altered, may be recovered by dissolving the potassium chloride in water; $KClO_3$ yields $KCl + O_3$. Care should be taken that black antimony sulphide be not used in place of manganese dioxide, and that the mixture be free from organic compounds, since a violent explosion would take place on the application of heat.

Properties.—Oxygen is a colorless and inodorous gas having the density 1.1056 as compared with air; 1 liter of it at 0° C. (32° F.) and a barometric pressure of 0.76 meter weighs 1.43 Gm. L. Cailletet and R. Pictet (December, 1877) succeeded in reducing it to the liquid state, when it has the density 1.0. It is slightly soluble in water and alcohol, and combines with all other elements, perhaps with the sole exception of fluorine. These compounds are called *oxides*, and the act of combination *oxidation*, and when attended with heat and light it is termed *combustion*.

By the action of electricity upon oxygen, or by the slow oxidation of phosphorus in moist air, and under various other circumstances, oxygen is converted into *ozone*, which is a gas as usually obtained colorless, but, according to Hautefeuille and Chappuis (1880), of a deep-blue color if sufficiently concentrated, and under a pressure of 125 atmospheres forms indigo-blue drops, which after the removal of pressure evaporate slowly. It has a peculiar odor, somewhat resembling that of chlorine, is a powerful oxidizing agent, bleaches indigo solution, and liberates iodine from potassium iodide; paper dipped in thin starch-paste containing potassium iodide is turned blue by ozonized air, and is a delicate test for the presence of ozone. This body has not been obtained free from oxygen; it is regarded simply as a modification of oxygen, its formula being O_2O, indicating that 3 vols. have been condensed into 2; its spec. gravity is one-half greater than that of oxygen. It is nearly insoluble in water.

Action and Uses.—Assuming that oxygen could be introduced through the lungs as readily as food is carried into the system through the stomach, it was inferred that by its means all the organic operations of the economy could be aroused to an increased activity. Experimenters graphically described the enlivening influence of this increased supply of "vital air" upon the sensations and the organic functions, and were apt at explaining how it not only must, but actually did, cure some of the gravest of diseases. But it was pointed out by Dr. A. H. Smith, and then by Dr. B. W. Richardson, that no more than a certain proportion of oxygen, such as exists in the atmosphere, can be absorbed by the lungs. Their results were subsequently (1875) confirmed by Buchheim, who concluded that "henceforth we must abandon the notion that the course of diseases can be modified by increasing the amount of oxygen in the blood." It should be remembered that Richardson and others have shown (*Lancet*, Nov. 1878, p. 749) that oxygen inhaled in large quantities is so far from being a stimulant that it relaxes and debilitates the system, and, in fact, induces narcotism. The vivifying action of oxygen has also been questioned by Brown-Séquard (*Annuaire de Thérap.*, 1889, p. 36), who has shown that the phenomena of asphyxia are by no means exclusively due to the privation of oxygen, that carbonic acid can be largely introduced into the blood without serious results, and that the addition of oxygen to this gas renders it more poisonous. Hayem holds that the inhalation of from 50 to 100 quarts a day of oxygen, more or less diluted with atmospheric air, stimulates the appetite, raises the temperature slightly, quickens the pulse,

and increases the weight, that it temporarily augments "the hæmatoblasts and the red corpuscles," and the proportion of hæmoglobin in the latter, but that it restores neither their normal size nor form (*Archives gén.*, June, 1881, p. 745). It may be added that Dr. J. H. Kellogg (*Therap. Gaz.*, xi. 589), on injecting oxygen into the rectum of a guinea-pig, found that the dark venous blood of the intestines almost immediately assumed a bright-red hue. Similar observations were also made by Dr. H. Wyman.

A critical examination of the reports of *pulmonary consumption* treated by oxygen proves that no ground exists for the belief that the disease is either curable or much benefited by this gas, although it has been claimed (Ransome) that the treatment arrested the fever and night-sweats, reduced the expectoration, and increased the flesh and appetite; the same may be said of *diabetes*, in which it transiently diminishes the diuresis and the proportion of sugar; and of *albuminuria*, in which it similarly reduces the albumen. In asthma, chronic *bronchitis*, and other affections of the respiratory organs, including *pneumonia*, attended with symptoms of *asphyxia* the inhalation of oxygen has certainly appeared to prolong, and even to save, life. According to Dr. Blodgett (*Boston Med. and Surg. Journ.*, Nov., 1890, pp. 481, 493) the inhalation must be copious and prolonged. This has been demonstrated in asphyxia from emphysema with bronchitis, in laryngitis of various forms, in compression of the lungs by the gravid uterus, in *opiate narcotism*, in poisoning by *charcoal fumes* or by *illuminating* or *privy gas*, by *chloroform*, and in similar conditions. A case is recorded in which it seems to have saved the life of a child poisoned by a very large dose of carbolic acid (*Bull. de Thérap.*, cv. 417). Its most striking benefits are observed when the gas is inhaled by *dyspeptic chlorotic* patients. It revives the appetite, quickens the digestion, and arrests vomiting if present, and consequently increases the excretion of urea. But this improvement is not permanent unless iron is used as supplementary to the oxygen (*Bull. de Thér.*, xcviii. 427). The same remark applies to *hysterical* and *hystero-epileptic* cases. In puerperal *eclampsia* oxygen seems to have been useless, but in *hydrophobia* to have mitigated the severity of the symptoms (Kastyleff, *Med. News*, xlviii. 38). Most of the above conclusions have been confirmed by Dr. W. G. Thompson (*Med. Record*, xxxvi. 1, 26); and Creswell (*Practitioner*, xli. 241, 321), who used oxygen by inhalation and oxygen-water in the treatment of *scarlatina* and its renal complications, believed that "hopeless cases were revived by the gas and existence was by it occasionally prolonged;" and he thought that it served a useful purpose in a case of *uræmic coma* and in several cases of pulmonary complications. Dr. Kellogg has stated that in the case of a person who was passing large quantities of *lithic acid* the excess was corrected by oxygen enemata. Drs. DaCosta and Hershey have reported that in the treatment of *leukæmia* and grave *anæmias* oxygen inhalations may "prolong life and produce results not otherwise to be obtained" (*Amer. Jour. Med. Sci.*, xcviii. 482). In traumatic *tetanus* the inhalation of oxygen is said to have caused profuse diaphoresis and muscular relaxation (Richardson). In some cases of *vomiting* during pregnancy this treatment has arrested the symptom when all other measures had failed. (For a detailed account of oxygen as a medicine see STILLÉ, *Therapeutics*, etc., 4th ed., i. 703.) If possible, the oxygen should be inhaled from a reservoir or bag containing it through a tube with a suitable stopcock and valves, in the same manner as nitrous-oxide gas, or from a metallic bottle of compressed oxygen. Water charged with oxygen in the same manner as it commonly is with carbonic-acid gas is more convenient, and probably as efficient in many cases, as the inhaled oxygen; and the peroxide of hydrogen similarly administered or applied has been credited with remarkable vivifying effects.

OXYMEL, *Br.*—OXYMEL.

Oxymel simplex, Mel acetatum.—Oxymel (Oxymellite) simple, Acétomel, Fr.; *Sauerhonig*, G.

Preparation.—Take of Clarified Honey 40 ounces; Acetic Acid and Distilled Water, each 5 fluidounces. Liquefy the honey by heat, and mix with it the acetic acid and water.—*Br.*

The French Codex orders 1 part of white wine vinegar to be mixed with 4 parts of virgin honey, and the mixture to be concentrated and clarified with paper pulp. The German Pharmacopœia of 1872 directed the mixing of 40 parts of clarified honey with 1 part of acetic acid spec. grav. 1.040; this is certainly the simplest process.

Action and Uses.—This is an official form of the popular mixture of honey and vinegar, which is generally used as a gargle in *sore throat*. It may be prescribed as an excipient for various expectorant medicines, and particularly for squill and ipecacuanha in the form of syrup.

OXYMEL SCILLÆ, *Br., F. Cod., P. G.*—Oxymel of Squill.

Oxymel scilliticum.—Oxymel scillitique, Fr.; *Meerzwiebelhonig*, G.

Preparation.—Take of Vinegar of Squill 1 pint; Clarified Honey 2 pounds. Mix and evaporate by a water-bath until the product when cold shall have the specific gravity 1.32.—*Br.* The P. G. directs that 1 part of vinegar of squill and 2 parts of honey shall be mixed and evaporated to 2 parts. Vinegar of squill 1 part, honey 4 parts; clarify with paper pulp and evaporate to the density of 1.26.—*F. Cod.*

Action and Uses.—Oxymel of squill has the medicinal virtues of syrup of squill, neither more nor less. Honey is superior to syrup as a local application to the throat, but there is no known difference between the two in their action upon the air-passages. Like the syrup of squill, the oxymel may be prescribed in *catarrhal affections* of the respiratory mucous membrane, and in young children as an emetic in *spasmodic croup*. It has been employed, and in large doses frequently repeated, in the treatment of whooping cough (Netter; Monti). The *dose*, as an expectorant, is for adults Gm. 4 (fʒj); for infants, from Gm. 0.30–1.30 (gtt. v–xx). As an emetic for children Gm. 4 (fʒj) may be given at short intervals.

PÆONIA.—Peony.

Pivoine officinale, Fr.; *Gichtrose, Pfingstrose*, G.; *Peonia*, Sp.

Pæonia officinalis, *Linné*.

Nat. Ord.—Ranunculaceæ. Pæonieæ.

Description.—Peony is a perennial herb from Southern Europe, which is frequently cultivated for ornament. It has an oblique many-headed root-stock 15–23 Cm. (6 or 9 inches) in length, with numerous at first fibrous *roots*, which afterward enlarge and become fusiform, dark-brown, internally white and mealy, resembling elongated tubers, about 5–8 Cm. (2 or 3 inches) long, and 12 Mm. (½ inch) thick. In commerce these are generally peeled, are whitish or purplish, and have near the circumference narrow yellow wood-wedges. The branched stem is about 60 Cm. (2 feet) high, smooth, with large, twice or thrice pinnately dissected and cleft green smooth leaves, and large terminal flowers, having five sepals, five to eight petals, numerous stamens, and two to five ovaries. The *petals* are obovate, entire or crenate, 38 Mm. (1½ inches) long, dark-red, purple or rose-red, after drying inodorous, and have a sweetish astringent taste. The *seeds* are nearly globular, 3–4 Mm. (⅛ to ⅙ inch), in diameter, black, glossy, and smooth, inodorous, and contain a yellowish oily albumen and a small embryo. The tuberous roots, petals, and seeds have been used.

Constituents.—Wiggers obtained from the fresh root a distillate having the odor of bitter almonds and acquiring a blood-red color by ferric chloride; separated by means of ether, the volatile oil had a pale-yellow color. The analysis of the fresh root by Morin proved the presence of starch, sugar, fat, malates, oxalates, and phosphates, a little tannin, etc. The root of Pæonia peregrina, *Miller*, yielded to Dragendorff and Mandelin (1879) 4.1 to 5.4 per cent. of ash, some sugar, starch, gummy matter, and small quantities of tannin, resin, fat, etc., while the seeds contain 23.6 per cent. of fixed oil, various coloring matters, etc., and a crystalline body which in the ripe seeds appears to be changed to an indifferent and an acid resin. The Japanese Botan-root, Pæonia Moutan, *Simson*, according to Jagi (1878), contains a crystalline substance closely related to caprinic acid; it melts at 45° C. (113° F.), sublimes at a higher temperature, and is easily soluble in ether and alcohol.

Action and Uses.—That the plant is not inert is abundantly proved; its very odor has caused syncope; in one case an infusion of it brought on an attack of convulsions, and in another it produced headache, ringing in the ears, confusion of sight, violent colic, and vomiting. And although some have reported favorably of it in *epilepsy*, *chorea*, and *whooping cough*, the evidence in favor of its efficacy is very slender indeed. The powdered root may be prescribed in *doses* of Gm. 1–4 (gr. xv–lx), or an infusion may be made with Gm. 16–32 in Gm. 500 (ℨss–ℨj in water Oj).

PANCREATINUM, *U. S.*—Pancreatin.

A mixture of the enzymes naturally existing in the pancreas of warm-blooded animals, usually obtained from the fresh pancreas of the hog (Sus scrofa, *Linné*; class, Mammalia; order, Pachydermata).—*U. S.*

Origin.—The *pancreas* is a gland which is deeply seated in the abdomen and secretes the *pancreatic juice*, containing the proteid *pancreatin*, to which it owes the property of peptonizing albuminoids, of emulsifying and decomposing fats into glycerin and acid, and of converting starch into sugar. The pancreatic juice is a colorless, clear, somewhat viscid liquid, of an alkaline reaction, without odor and of an insipid somewhat saline taste; it contains, besides the ferment, nearly 1 per cent. of mineral salts, a trace of fat and of organic matters soluble in water.

Preparation.—Pancreatin may be obtained as follows: Fresh pancreas of the hog, freed as much as possible from fat and adhering membranes, is reduced to a fine paste by means of a suitable mincing-machine; it is next mixed with half its weight of cold water, and kneaded thoroughly and frequently during one hour, after which the mass is transferred to a strainer and forcibly expressed; the liquid is filtered as quickly as possible through flannel, and to the filtrate is added an equal volume of alcohol. The precipitate is collected, drained, and freed by pressure from as much of the adherent liquid as possible; it is then spread on shallow trays, dried by exposure to warm air at a temperature not exceeding 40° C. (104° F.), and reduced to powder. When large quantities of pancreas are operated upon, it is advisable to use water saturated with chloroform, which will retard decomposition for a long time.—*Nat'l Form.*

In some instances the finely-mixed pancreas is macerated with highly dilute hydrochloric acid, the fat being removed from the powdered mass by means of purified benzin. The temperature for drying pancreatin should never exceed 43.3° C. (110° F.).

Composition.—Like other proteids, pancreatin consists of C, H, N, O, and a little S. (see VITELLUS), and belongs to the soluble ferments, designated by Kuehne as *enzymes*. There are supposed to be no less than four of these unorganized ferments present in the pancreatic juice—namely, *trypsin*, for the digestion of albuminoids; *amylopsin*, for carbohydrates; *steapsin*, for fats; and a rennet ferment which coagulates milk. Trypsin has been isolated in a comparatively pure state; it differs from pepsin in several important particulars, acting best in an alkaline medium, and, although active in a neutral or even faintly acid solution, it is completely destroyed in acid liquids even as weak as gastric juice; it converts albumoses very rapidly into hemi- and anti-peptones, whereas the action of pepsin in this respect is very slow. Unlike pepsin, trypsin will digest mucin, but not the fibres of ordinary connective tissue until these have first been converted into gelatin. Amylopsin very closely resembles diastase and ptyalin both in action and properties, but its action in converting starch into maltose and dextro-glucose is much more energetic than that of ptyalin. Steapsin or fat-digesting ferment appears to exert a special action in the emulsification of fats, and more particularly in the presence of the alkali salts of the biliary acids, thus preparing them for better absorption; it is said also to possess the power of decomposing small amounts of neutral fat into glycerin and fatty acids. The milk-curdling ferment is probably indentical with that found in the stomach.

Properties and Tests.—Pancreatin usually appears in form of a yellowish, yellowish-white, or grayish-white powder, or in the form of transparent, brittle, yellowish scales, which are odorless or have a faint; peculiar, not unpleasant odor, and a somewhat meat-like taste. It is slowly and almost completely soluble in water, but insoluble in alcohol.

Pancreatin digests albuminoids, and converts starch into sugar, in presence of alkalies; prolonged contact with acids renders it inert. It is hygroscopic, and when exposed to the air for some time loses its value; hence it should be preserved in well-stoppered bottles. Dilution with sugar of milk seems to retard deterioration, and saccharated pancreatin has been found to retain its peptonizing value far better than the pure article. The aqueous solution of pancreatin is a clear, pale-yellowish liquid, which is precipitated by heat, by alcohol, and by hydrochloric acid, but not by a saturated solution of sodium chloride.

"If there be added to 100 Cc. of tepid water contained in a flask, 0.28 Gm. of pancreatin and 1.5 Gm. of sodium bicarbonate, and afterward 400 Cc. of fresh cow's milk previously heated to 38° C. (100.4° F.), and if this mixture be maintained at the same temperature for thirty minutes, the milk should be so completely peptonized that if a small portion of it be transferred to a test-tube and mixed with some nitric acid, no coagulation should occur. Peptonized milk, prepared in the manner just described, or even when the process is allowed to go on to the development of a very distinct bitter flavor, should not have an odor of rancidity."—*U. S.*

Although the proteolytic value of commercial pancreatin is probably the most important (as shown by the pharmacopœial test), yet its action on carbohydrates should likewise be observed: we have examined some samples that peptonized milk very readily, and yet had little or no effect on starch paste, and *vice versa*. For testing pancreatin a 5 per cent.

starch mucilage is better suited than a stronger preparation, and the length of time required for the complete conversion of starch into sugar should be noted; usually good pancreatin is supposed to convert six or eight times its weight of starch in a few minutes, the test being conducted at a temperature of 43.3°–46.1° C. (110°–115° F.). The fact that pancreatin liquefies starch paste is not sufficient, as this may be due to the simple change of the starch into dextrin: the liquid should be tested every few minutes by adding a drop or two to some very dilute iodine-water; as soon as the purplish or pinkish color fails to appear, the conversion into sugar is complete. The less time required for this change the better is the quality of the pancreatin.

Action and Uses.—Pancreatic juice has an alkaline reaction, converts starch into sugar, and decomposes fat into fatty acids and glycerin. It also forms with albumen an alkaline solution. The latter action, which is ascribed to pancreatin, and forms the ground of its utility in disease, is said not to be interfered with by the presence of the acid secretions of the stomach. During the first years of life, when the food consists chiefly of milk and farinacea, a state of *dyspepsia* frequently arises which often leads to marasmus, and which is not traceable to any organic lesions of the stomach or auxiliary viscera. In this it is claimed that pancreatic emulsion speedily restores the digestive function to its normal condition, and, through improved nutrition, renews the health. "Defresne has recommended pancreatin in *phthisical* cases where the patient is unable to digest or assimilate cod-liver oil; in cases of *jaundice* in which fat is badly digested; in cases of *dyspepsia* in which the patient experiences abdominal pains, vomiting, diarrhœa, and flatulence several hours after meals; and, speaking generally, in those cases of disturbances of digestion in which fats and starches are badly assimilated and where pepsin is found to be useless" (*Practitioner*, xx. 454). Hence it is reported to be serviceable in such diseases as are more or less maintained by the imperfect digestion of albuminous food, including *rachitis*, *scrofula*, *diabetes*, and *fatty diarrhœa*, *anæmia*, *chlorosis*, *leukæmia*, *pernicious anæmia*, and the early stage of *tuberculosis*. It has also been profitably employed during *convalescence* from acute wasting diseases (Loebisch). In all of these cases it may be administered by the mouth. It was, however, originally introduced into medicine by Leube in 1874 as an efficient means of nourishing by the rectum when the stomach could not retain or digest food, as in *gastric atony* produced by protracted illness; *gastric irritability* caused by disease of the stomach itself or by disorders of its nervous system leading to the rejection of food; cases also of *stricture of the œsophagus* or compression of it by tumors; and finally, cases of *gastric hæmorrhage* in which the introduction of food into the stomach might be attended with danger. Other forms of nutritive enemata fail of their purpose, both because they are, or soon become, mechanically irritating, and because they are not of such a nature as to be absorbed, or to subserve the purposes of nutrition even were their absorption practicable. The first of these objections does not apply to pancreatic emulsions, probably because their reaction, like that of the rectum, is alkaline.

Leube's directions for preparing the enemata are as follows: Take a piece of lean beef and scrape or grate it until it is reduced to a fine pulp. For one injection from Gm. 150–300 (℥v–x) of it should be mixed with an equal quantity of finely-hashed pancreas and thoroughly pounded in a mortar or crushed in a bowl with a spoon, with the gradual addition of about Gm. 150 (℥v) of lukewarm water until the mixture is of the consistence of pap. If it is desired to administer fat, it may be added in the proportion of about one-sixth of the meat. To inject this mixture a syringe with a much larger nozzle than usual is required. If the enema is judiciously introduced, the whole of it will be retained, and, according to Leube, will penetrate even to the transverse colon. He refers to cases in which, after from twelve to thirty-six hours, the stool was feculent, without any trace of the emulsion. He advises that, as the pancreas readily becomes stale in warm weather, it should be preserved by mixing its pulp thoroughly with glycerin.

A number of cases have been published in which pancreatic enemata were either the means of saving life permanently, or in which, owing to the incurable nature of the disease, they prolonged life far beyond the term when it must otherwise have terminated. To the latter category necessarily belong all cases of organic stricture of the digestive canal; to the former, cases of simple ulcer of the stomach and nervous vomiting.

The preparation of the pancreas for administration by the mouth differs from that just described. According to Engesser, the pancreas of the hog, sheep, or ox should be used, that of the hog being preferable. After being finely minced it is forced through a hair sieve. The semi-liquid product may then be directly mixed with the food, or may, after

the addition of a little salt, be preserved in a cool place in a properly-covered jar. For immediate use the watery infusion of pancreas may be employed, although it is less efficient than the gland substance. It is also less repulsive in appearance than the emulsion, and its taste is not unlike the cold prepared extract of beef. Pancreatic pulp may be given in bolus, in wafers, or mixed with the food, and in the dose of about a dessertspoonful at each meal. Care must be taken not to mix it with hot food (113° F. = 45° C.). Various expedients have been suggested for concealing the unpleasant taste and smell of the emulsion, and for securing its thorough and equable mixture with the food, but they must generally be left to the ingenuity of the physician or patient. It need only be added that the food should not be taken very hot, especially in the form of soup, nor very highly seasoned, nor with much or strong wine. On the whole, it must be admitted that pancreatic emulsions given by the mouth are less valuable than was anticipated, probably because their active constituents are neutralized by the acid contents of the stomach, to a greater degree than was supposed.

Trypsine has been used with apparent success in dissolving *diphtheritic* false membrane. A solution of 30 grains in an ounce of water, with the addition of 10 grains of sodium bicarbonate, was employed to spray the affected parts (Chapin, *Med. Rec.*, xxvii., 257).

PAPAVERIS CAPSULÆ, *Br.*—Poppy-Capsules.

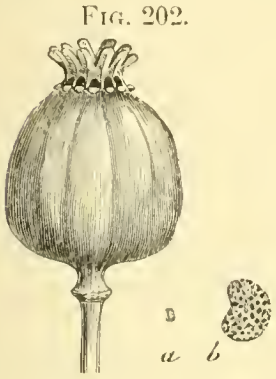
Fructus s. Capita papaveris immaturi, P. G.; *Papaver*, U. S. 1870.—*Pavot blanc, Têtes de pavot*, Fr. Cod.; *Mohnkapseln, Mohnköpfe*, G.; *Adormidera*, Sp.

The nearly-ripe capsules of Papaver somniferum, *Linné*. Bentley and Trimen, *Med. Plants*, 18.

Nat. Ord.—Papaveraceæ.

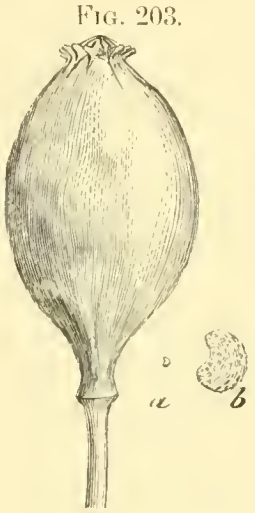
Origin.—The poppy is an annual herb, and is most likely indigenous to Western Asia and South-eastern Europe, where it is found wild in fields and waste places. It is

Fig. 202.



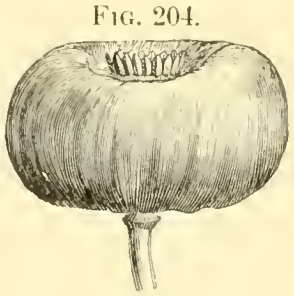
Black.

Fig. 203.



White.

Fig. 204.



Depressed.

Poppy-capsules and seeds: *a*, natural size: *b*, magnified.

frequently cultivated in gardens for ornament, and very extensively in several countries for the production of opium (See Opium). The stem is 0.9–1.5 M. (3 to 5 feet) high; the leaves are alternate, oval-oblong sessile, and the upper ones clasping, irregularly dentate, frequently cleft or nearly pinnatifid, rather thick, smooth, and glaucous. The flowers terminate the branches, have two oval blunt caducous sepals, and four broad roundish petals varying in color from white to violet and dark-purple, with a darker spot near the base. The stamens are numerous, and inserted beneath the subglobular ovary, which is crowned by the peltate radiating stigma. The wild form, Papaver setigerum, *De Candolle*, has acute teeth, prolonged into a stiff bristle. The white flowering variety, Pap. officinale, *Gmelin*, has white seeds, and its capsules are alone recognized by pharmacopœias.

Description.—Poppy-capsules vary in shape and size according to the variety of the plant from which they have been obtained. The black poppy usually has rather small capsules, which are globular-ovate, about 1½ inches (37 Mm.) in diameter, broadest near the base, and dehiscent by small apertures forming underneath the stigma. The capsules of the white poppy are mostly larger, indehiscent, and occasionally depressed and much

broader than high, but usually oblong, or in some varieties much elongated and narrowed toward the base. The sessile and peltate stigma is formed of from eight to twenty rays, and a similar number of longitudinal striæ, marking the sutures, are observed upon the immature capsule, which is smooth, and underneath the larger laticiferous vessels. The capsule is one-celled, but internally is furnished with placentas equal in number to the lobes of the stigma and projecting into the interior, forming incomplete partitions. In the fresh state it has a narcotic odor; after drying it is nearly inodorous; its taste is bitter.

Semen papaveris, *P. G.*—Poppy-seed, Maw-seed, *E.;* Semences (Grains) de pavot, *Fr.;* Mohnsamen, Magsamen, *G.*—The seeds are very numerous, quite small, about 1.2 Mm. ($\frac{1}{20}$ inch) long, reniform in shape, white, blackish, or bluish, finely netted-veined, and contain an oily albumen enclosing a curved embryo. They are inodorous, and have a bland oily and scarcely bitterish taste. Only white poppy-seeds are medicinally employed.

Constituents.—1. The Capsules. Winckler (1837), Merck, and others have demonstrated the presence of *morphine* in ripe poppy-capsules; the former chemist obtained as much as 2 per cent. of this alkaloid, and likewise *narcotine* and *narceine*. Groves (1854) found also another alkaloid, which was probably *codeine*. A. Buchner obtained an alkaloid which differed from morphine, and other chemists were unable to find the latter. Deschamps (1864) isolated an alkaloid, and silky needles of a nitrogenous body called *papaverin*, which is said to have an acid reaction; the alkaloid *papaverosine* forms colorless, nearly tasteless prisms, is soluble in alcohol, ether, chloroform, and benzene, has a slight alkaline reaction, and with sulphuric acid assumes a violet color, which on warming becomes red, and with nitric acid orange-red. Hesse (1866) obtained *rhœadine* from ripe poppy-capsules. Besides meconic acid, which could not be detected by several chemists, citric and tartaric acids were found by Deschamps. The capsules contain considerable mucilage. The waxy coating of the epidermis is scraped off in the preparation of opium, and forms a constituent of the latter. Examined by Hesse (1870), it yielded a colorless compound insoluble in chloroform, crystallizing in prisms, and melting above 100° C. (212° F.); the portion soluble in boiling chloroform consists of *ceryleerotate*, $C_{27}H_{55}.C_{27}H_{53}O_2$, which crystallizes in silky scales, melts at 82.5° C. (180.5° F.), and congeals in crystals at 80° C. (176° F.); and of *cerylpalmitate*, $C_{27}H_{55}.C_{16}H_{31}O_2$, which forms crystalline warts melting at 76° C. (168.8° F.)

2. The Seeds. Saec (1849) obtained from white poppy-seeds nearly 55 per cent. of fixed oil, 23 pectin, and 12.6 per cent. protein compounds. Accarie (1833) announced that he isolated 30 grains of morphine from 6 pounds of white seeds. The fixed oil (Oleum papaveris, *P. G.*—Poppy-seed oil, *E.;* Huile de pavots, Huile d'œillette, *Fr.;* Mohnöl, *G.*) is pale-yellow, bland, limpid, of the density 0.92, congeals near —18° C. (0° F.), and on exposure becomes thick and hard. It is soluble in 25 parts of alcohol, freely soluble in ether, and yields when saponified 9.5 per cent. of glycerin.

Uses.—Formerly decoctions of poppy-heads were much used internally, but such is no longer the case since preparations of opium of definite strength have become multiplied. Even for external use such decoctions have been almost entirely supplanted by liquid opiates and plasters containing opium. The official retention of papaver seems unnecessary, unless for pharmaceutical purposes.

PARAFFINUM.—Paraffin.

Paraffinum durum and Par. molle, Br.; *Paraffinum liquidum and Par. solidum*, P. G.; *Ceresinum.—Paraffine*, Fr.; *Paraffin*, G.

Origin.—The paraffins are produced under various circumstances from fats and other organic compounds, but are chiefly obtained among the products resulting from the destructive distillation of many organic substances, especially cannel and boghead coal, and from bituminous shale. They are a natural constituent in varying proportions of the different kinds of petroleum, and solid paraffins are found native in Austria, Great Britain, the United States (Utah), and some other countries, constituting the minerals known as *earth-wax*, *fossil (mineral) wax*, *ozokerite*.

Properties.—Paraffinum durum, Br., is a colorless semi-transparent, crystalline, inodorous, and tasteless mass, slightly greasy to the touch. Its specific gravity is 0.820 to 0.940. It melts at 43.3°–62.80° C. (110°–145° F.), and burns with a bright flame, leaving no residue.

Paraffinum solidum, P. G., is a white, hard, opaque, micro-crystalline mass, free from odor, but not entirely tasteless, having the specific gravity 0.920–0.940 and melting

at 74°–80° C. (165.2°–176° F.). It boils above 360° C. (680° F.), but not without decomposition. At ordinary temperatures it is not affected by caustic alkalies nor by concentrated sulphuric and nitric acids. When boiled with alcohol the latter should not acquire an acid reaction. If 3 Gm. of solid paraffin be heated together with 3 Cc. of sulphuric acid in a water-bath for ten minutes, the paraffin should undergo no change and the acid become only slightly brownish.

Paraffin is insoluble in water, alkalies, and cold alcohols, but dissolves in volatile and fixed oils, ether, chloroform, benzene, and carbon disulphide; the solubility is, however, influenced by the composition. The melting-point of commercial paraffin varies much. Obtained from the residuum of petroleum distillation, it is usually about 43° C. (109.4° F.), or somewhat higher; from peat, about 47° C. (116.6° F.); from ozokerite, about 60° C. (140° F.); from *Rangoon tar* of Burmah, about 62° C. (143.6° F.); and the mineral wax of Moldavia, known as *zietrisikite*, melts between 85° and 90° C. (185°–194° F.), and is insoluble in ether.

Composition and Characters.—The general formula of the paraffins is the same as that of the lighter coal oils, C_nH_{2n+2}, but in their physical properties they differ from the latter in being at the ordinary temperature either solid, and frequently crystalline, or of a butyraceous consistence or liquid. Those which are liquid at the ordinary temperature are known in commerce as *paraffin oils*, while the name *paraffin* is retained for the solid products. They can be separated from one another only with great difficulty, but it is known that the different members of this homologous series increase in density, viscidity, and in boiling-point, and the solid paraffins also in melting-point and hardness, as the molecular weight increases. The paraffins, obtained in as pure a state as possible, show the following differences:

Nonane (Nonylhydride),	C_9H_{20},	boils near	138° C.	= 280.4° F.,	spec. grav.	.741
Decane (Decatylhydride),	$C_{10}H_{22}$,	"	160	= 320	"	.757
Endecane (Undecylhydride),	$C_{11}H_{24}$,	"	180	= 356	"	.766
Dodecane (Lanrylhydride),	$C_{12}H_{26}$,	"	200	= 392	"	.778
Tridecane (Cocinylhydride),	$C_{13}H_{28}$,	"	220	= 428	"	.796
Tetradecane (Myristylhydride),	$C_{14}H_{30}$,	"	240	= 464	"	.809
Pentadecane (Benylhydride),	$C_{15}H_{32}$,	"	260	= 500	"	.825

Galletly (1871) ascertained for paraffins—

Fusing at 32.0°	39.0°	40.5°	53.3°	58.0°	59.0°	80.0° C.,
the spec. grav. .8236	.8480	.8520	.9100	.9243	.9248	.9400

The solubility of paraffins in benzene decreases as the melting-point rises, the last one of the table being nearly insoluble therein.

Paraffins are not easily acted on by chemicals. By continued boiling with nitric acid the higher paraffins yield nitro-compounds and various acids. Boiling hydrochloric acid or contact with chlorine gas, ammonia, or potassa has no effect upon paraffin, but the lowest members of the series, which are gaseous at the ordinary temperature, yield substitution-products with chlorine.

In distilling paraffin, the heat to which the vapors are exposed influences the melting-point, and consequently the composition; at a red heat *naphthalene* is produced, and when paraffin is heated for some time in a sealed tube it is split into an olefin and a paraffin of a lower boiling-point.

Olefins are present among the products of dry distillation of organic substances, in rock oils, mineral tars, etc. They have the formula C_nH_{2n}, and the so-called paraffin oils usually consist principally of olefins, particularly of *heptilene*, C_7H_{14}, which boils at 96° C. (205° F.). The olefins are readily polymerized by the action of sulphuric acid, zinc chloride, and other chemicals, and unite with the halogens, their hydro-acids, and with hypochlorous acid; by nascent hydrogen they are converted into paraffins.

J. L. Lemberger and A. W. Miller ascertained (1875) that crude paraffin oils may be deprived of their odor by filtering them through granulated animal charcoal. *Cosmoline*, *vaseline*, and other copyrighted preparations are paraffins containing olefins of the consistence of ointments. (See PETROLATUM.) The liquid paraffins are extensively employed for lubricating purposes, and are known in commerce as *lubricating oils* and *neutral oils*.

Action and Uses.—A case of death in a boy from swallowing paraffin oil is reported (*Med. Times and Gaz.*, Nov. 1878, p. 631), but the symptoms are not detailed. A child two years old drank some of the oil, and fell into a state of collapse with drowsiness. There was neither vomiting nor diarrhœa. On the morrow the child was well (*Lancet*, 1880, vol. ii. p. 730). Soft paraffin and paraffin oils are much used in a pure state and in oint-

ments as a dressing for *chilblains*, *burns*, *excoriations*, *bruises*, *indolent ulcers*, and in some diseases of the skin, especially *eczema*, *psoriasis*, and *scabies*. Borated vaseline has been applied in *erysipelas*, and the pure preparation given as a protective to the bowel in diarrhœa (Randolph). As a substitute for various fatty substances, oils, lard, glycerin, and glycerite of starch which are more or less irritating in cutaneous affections, Kaposi prefers petroleum or vaseline jelly, as being unirritating and having no tendency to become rancid, and employs an ointment composed of equal parts of lead plaster and vaseline, thoroughly incorporated by the aid of heat and scented with oil of bergamot. In exceptional cases vaseline ointments have produced boils or an eczematous eruption of the skin, probably because they were not pure. Galezowski recommends vaseline as the best excipient for yellow oxide of mercury, nitrate of silver, etc. in the treatment of *scrofulous affections of the eye*, chiefly *keratitis* and *conjunctivitis*. The lead plaster spoken of above is *Unguentum diachylon Hebræ*, and consists of simple litharge ointment melted with an equal quantity of olive or linseed oil. Solid paraffin, when mixed with glycerin or linseed oil, has been used with advantage in the same diseases (Purdon). Dubois is of the opinion that vaseline scented with otto of roses, when applied to the vagina during parturition, facilitates labor by relaxing the tissues; that it may be used with advantage to protect the hands of the obstetrician in vaginal explorations; and that it answers better than oil or soap to remove the smegma from the new-born child. It is said that vaseline used as an excipient for carbolic acid impairs or destroys the antiseptic qualities of the latter. But when the mixture is applied to a moist tissue the acid is dissolved out by the water of the part and exerts its special action. Mixed with an equal weight of honey and 10 grains of borax or of chlorate of potassium to the ounce, it is a useful application in *thrush*. Vaseline mixed with Gm. 0.60 to Gm. 32 (gr. x to the ounce), quickly removes *ascarides of the rectum;* it is beneficial in the *ophthalmia* of the newborn child; cures the *coryza* of suckling children when applied with a brush to the interior of the nostrils; and effects a rapid healing of *intertrigo*.

Pure liquid paraffin, or vaseline oil, "dissolves in nearly all proportions ether, chloroform, essential oils, benzine, sulphide of carbon, iodine, bromine, phosphorus, eucalyptol, thymol, myrtol, terpinol, iodoform, paraldehyde, and four times its volume of sulphuretted hydrogen. It forms a convenient vehicle for their administration hypodermically, since it is entirely unirritating and very diffusive, so that the taste of some of the articles injected is almost immediately perceived in the mouth. It can be made to dissolve many alkaloids—*e. g.* morphine and cocaïne—and to suspend other substances, which it does not dissolve—calomel, for instance. Dujardin-Beaumetz states that the hypodermic injection of a cubic centimetre of equal parts of eucalyptol and vaseline oil, injected twice a day, controls excessive *bronchial secretion* and its attendant cough; that in similar proportions myrtol palliates *neuralgia;* that a cubic centimetre of the iodic solution is equivalent to 15 grains of potassium iodide; and that the same quantity of the saturated solution of sulphuretted hydrogen in vaseline is readily tolerated (*Bull. de Thérap.*, cxii. 97). Formulæ for hypodermic injection have been proposed by Meunier (*ibid.* pp. 21; 81; 174).

PARALDEHYDUM, *U. S., Br. Add., P. G.*—Paraldehyde.

Paraldehyd, G.

Formula $C_6H_{12}O_3$. Mol. weight, 131.7.

A polymeric form of ethylic aldehyde. It should be kept in well-stoppered, dark amber-colored bottles, in a cool place.—*U. S.*

Preparation.—If ordinary (ethylic) aldehyde be treated at normal temperature with small quantities of hydrochloric acid, carbonyl chloride, ($CO\ Cl_2$), sulphur dioxide, or zinc chloride, the temperature of the liquid rises and almost complete conversion into paraldehyde takes place. For the trade it is usually manufactured by conducting gaseous hydrochloric acid into aldehyde at ordinary temperature; the conversion into paraldehyde is known to be complete when the liquor is no longer soluble in an equal volume of water. The crude product is cooled to below 0° C. (32° F.), and the crystalline mass thus obtained is carefully distilled, the process of freezing and distilling being repeated until the whole product finally volatilizes at 124°-C. (255.2° F.).

Properties and Tests.—A colorless, transparent liquid, having a strong, characteristic, but not unpleasant or pungent odor, and a burning and cooling taste. Soluble in 8.5 parts of water at 15° C. (59° F.), and in 16.5 parts of boiling water; miscible in all proportions with alcohol, ether, and fixed or volatile oils. When cooled to near 0° C.

(32° F.), paraldehyde solidifies to a crystalline mass, which becomes liquid again at 10.5° C. (51° F.). It boils at 123°–125° C. (253.4°–257° F.) giving off inflammable vapors. Paraldehyde is neutral, or has a slightly acid reaction. When distilled with a small portion of sulphuric acid, paraldehyde is converted into ordinary aldehyde, boiling at about 21° C. (70° F.). On warming some silver ammonium nitrate test-solution saturated with paraldehyde in a test-tube, a silver mirror will form on standing. On heating some paraldehyde on a water-bath, it should completely volatilize, without leaving any disagreeable odor (absence of aldehyde derived from fusel oil). 1 Cc. of paraldehyde should form with 10 Cc. of water a clear solution, free from oily drops (absence of amylic alcohol, etc.), and this solution, when acidulated with nitric acid, should not be affected by silver nitrate test-solution (absence of hydrochloric acid), or barium chloride test-solution (absence of sulphuric acid). A mixture of 8 Cc. of paraldehyde and 8 Cc. of alcohol with 1 drop of phenolphtalein test-solution should acquire a pink color upon the addition of 0.5 Cc. of normal potassium hydroxide test-solution (limit of free acid).—*U. S.*

The P. G. and Br. Add. give the specific gravity at 0.998; the latter requires that no coloration shall take place within two hours if paraldehyde be mixed with a solution of potassa or soda (intended to detect the presence of aldeyde). "A mixture of 1 Cc. each of paraldehyde and alcohol should not, after addition of 1 drop of normal alkali solution, show an acid reaction (limit of acid)."—*P. G.*

Allied Compounds.—Metaldehyde, $C_{12}H_{24}O_6$, is obtained by the action of polymerizing agents on common aldehyde at a temperature of 0° C. (32° F.) It is a white crystalline body, insoluble in water, but freely soluble in alcohol and ether. When heated to 112°–115° C. (233.6°–239°F), it sublimes without melting, but is partially decomposed. It is claimed to possess hypnotic properties (Helbing). *Sulphaldehyde* is formed by the action of hydrogen sulphide on aldehyde. It is said to be an oily liquid of a repulsive odor, solidifying at —8° C. (17.6° F.), and melting again at —2° C. (28.4° F.). Little attention has been bestowed upon it.

Aldehyde, Acetic or ethylic aldehyde, Acetaldehyde. $CH_3CHO = C_2H_4O$, mol. weight, 43.90. This body was noticed, but not isolated, by Scheele (1774), who supposed it to be ether. Liebig (1835) isolated it and determined its relation to alcohol. Aldehyde is formed by the oxidation of alcohol and many of its derivatives; it is found among the products of the dry distillation of wood and sugar and on distilling various protein compounds with manganese dioxide and sulphuric acid. The formation of polymeric modifications of aldehyde was first observed by Liebig. Pure aldehyde is prepared by distilling either of the two following mixtures: 4 parts each of 80 per cent. alcohol and water and 6 parts each of manganese dioxide and sulphuric acid (Liebig), or 3 parts of alcohol, 4 parts of sulphuric acid, mixed and slowly added to 3 parts of potassium dichromate and 12 parts of water contained in a glass retort (Rogers). In both cases the impure distillate is rectified at a temperature of 50° C. (122° F.), and the vapors conducted into anhydrous ether, which is afterward charged with gaseous ammonia, when *aldehydeammonia*, $C_2H_4ONH_3$, crystallizes. The crystals are washed with ether, decomposed by dilute sulphuric acid, and the distillate rectified over calcium chloride. As thus obtained it is a colorless, very mobile liquid, of neutral reaction, and very inflammable; it has a peculiar, rather suffocating, odor, and boils at 21° C. (69.8° F.). It is miscible in all proportions with water, alcohol, and ether, and yields with alcoholic potassa solution a yellow resin (aldehyde resin), and exposed to the air is converted into acetic acid. Aldehyde separates from ammoniacal silver nitrate solution a metallic mirror, the reaction becoming more delicate in the presence of caustic soda.

Pharmaceutical Uses.—Elixir of paraldehyde may be prepared as follows: Dissolve 3 fluidounces of paraldehyde in 10 fluidounces of alcohol, add 4 ounces of orange-flower water, 10 fluidounces of simple syrup, caramel 5 minims, and sufficient distilled water to make 32 fluidounces (Wearn).

Action and Uses.—The experiments of Cervello (*Jour. Amer. Med. Assoc.*, v. 11), of Gordon (*Brit. Med. Jour.*, March 1889, p. 515), and of others furnish substantially the same results. In doses of 15 to 45 grains its soporific effects are speedily developed, but less so in perfectly healthy persons than when wakefulness exists. They are not preceded by excitement. The sleep is natural and tranquil, and the awakening is not attended with headache or weariness. The heart, pulse, temperature, and respiration are somewhat reduced during the sleep, and as in natural sleep the blood-pressure within the brain diminishes. It does not impair the appetite. It is eliminated chiefly by the lungs, and gives to the breath a smell like that exhaled by a confirmed alcoholic drunkard. The urine has a similar odor. Given to guinea-pigs in poisonous doses, it produces complete insensibility, with lowered temperature and respiration, until death. The heart's beat survives respiration. Among the unfavorable actions of this preparation may be enumerated irritation of the mucous membranes (throat, rectum), impaired digestion, scarlatinoid eruptions and desquamation of the cuticle, irritation of the eyes, and ulceration of the nails (Kiernan, *Therap. Gaz.*, x. 719). Its hypodermic use is painful and irri-

tating. Capelli and Brugia (*ibid.*, xi. 336) found it to lessen the rate and tension of the pulse, and suggest its danger in cases with feeble heart. Rolleston has reported (*Practitioner*, xli. 339) a case of advanced emphysema with dilatation of the heart and a dusky complexion, in which a drachm of the medicine occasioned collapse, with rapid and feeble pulse and respiration. The case is recorded of a lady who daily consumed an ounce or more of the medicine, was unable to sleep without it, and if deprived of it became sleepless, wretched, full of pains, and without appetite (*Med. Record*, xxxv. 391). This and similar cases may perhaps be explained by the results of experiment, such as those of Bókai (*Centralb. f. Ther.*, v. 44), which showed that its prolonged use might produce fatty degeneration of the heart and liver, and of Fröhner (*Edinb. Med. Jour.*, xxxiii. 675), who found that in dogs it produced disorganization of the red corpuscles of the blood. On the whole, its action is closely analogous to that of chloral, but it is less apt to cause depression or collapse. Its analgesic action is also less marked. It is hypnotic rather than anodyne; hence pain counteracts its operation.

It appears to be best adapted to relieve what may be called idiopathic *insomnia* as it is met with in many nervous states, including various forms of *mental strain*, *insanity*, *melancholia*, and *delirium tremens*. In acute mania and agitated melancholia it seems to have proved useful. Dr. Harris, of the Pennsylvania State Hospital for the Insane at Norristown, employed it in 152 cases of insanity, including 38 of an acute type, and found it efficient as a hypnotic and free from all objection on the score of danger (*Philad. Med. Times*, xv. 602). In delirium tremens it is also very appropriate if not given in extravagant doses, and especially when duly associated with alcohol. Among those who have corroborated these statements by the results of their observation may be named Sympson (*Practitioner*, xliii. 13), Savage (*ibid.*, xxxviii. 35), Goodhart (*Brit. Med. Jour.*, Jan. 19, 1889), Stewart (*ibid.*, Apr. 1889, p. 848), Finucane (*Lancet*, July 1889, p. 15), Hay (*Amer. Jour. Med. Sci.*, July 1889, p. 34), Jastrowitz (*Therap. Gaz.*, xiii. 646), Williams (*Boston Med. and Surg. Jour.*, Jan. 1887, p. 89), and Keniston (*ibid.*, June 1888, p. 575). Dr. Clouston, physician to the Edinburgh Asylum for the Insane (*Amer. Jour. Med. Sci.*, xcvii. 353), declares paraldehyde to be a hypnotic "free from risks near or remote," leaving behind it none of the unpleasant effects of other soporifics, and suited to all forms of insanity, simple or complicated, in the young or old. He never saw it "affect the heart's action in any way except to strengthen it," and yet he prescribed unusually large doses, such as three or four drachms. As it does not successfully overcome sleeplessness due to pain, so, too, it is of little use when this symptom depends upon fever, dyspnœa, heart disease, etc. Yet it has been successful in allaying *itching* of the skin in some cases of jaundice, and thereby promoting sleep. It is said to have relieved *vomiting* in sick headache, in pregnancy, irritable ovary, etc. (*Therap. Gaz.*, xii. 539).

Paraldehyde has been proposed as an antidote to strychnine-poisoning, but it does not appear to have been tested clinically. It has also been employed in the treatment of the morphine habit.

The *dose* of paraldehyde varies from Gm. 0.30–4 (5 to 60 gr.). It may be prescribed in sweetened water, with brandy or whisky, and flavored with an aromatic or a bitter tincture to mask its offensive taste. It has also been used in suppositories containing Gm. 1 (15 gr.) each, with or without the addition of opium.

Aldehyde has been tried on man, but its property of arresting respiration when inhaled, and its irritant action upon the lungs and the stomach, have caused it to be avoided as an anæsthetic. It has, however, been applied to the nasal passages in chronic *catarrh* and *ozæna*. For this purpose a solution of Gm. 0.3–0.5 in Gm. 500 has been employed (say ♏v–x in Oj of hot water).

Metaldehyde is said to be used in the same manner and for the same purposes as aldehyde.

PAREIRA, *U. S.*—Pareira.

Pareiræ radix, Br.—*Pareira brava*, E., Fr., G., Sp.; *Butua*, Fr., Sp.; *Grieswurzel*, G.

The root of Chondodendrom tomentosum, *Ruiz et Pavon*, s. Coeculus Chondodendron, *De Candolle*, s. Cissampelos Abutua, *Vellozo*, s. Botryopsis platyphylla, *Miers*. Bentley and Trimen, *Med. Plants*, 11.

Nat. Ord.—Menispermaceæ.

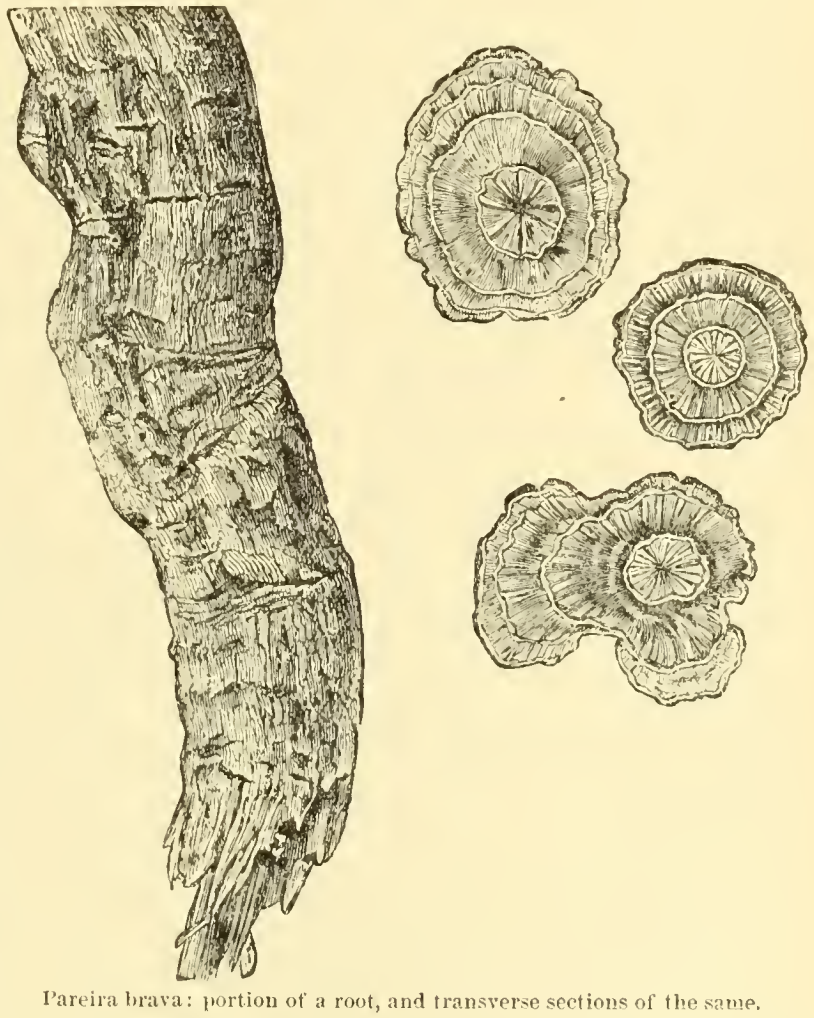
Origin.—Pareira brava was formerly referred to Cissampelos Pareira, *Linné*, s. Ciss. microcarpa, *De Candolle* (Bentley and Trimen, *Med. Plants*, 15), which is a woody climber indigenous to the West Indies and Central America, and probably to other tropical coun-

tries. It is medicinally employed there, but is not exported. The root as well as the stem rarely reaches 25 Mm. (one inch) in diameter, and is often not thicker than a goose-quill; both show no concentric rings in transverse section, the wood consisting of about twenty porous wedges, separated by narrower medullary rays and covered by a gray-brown suberous bark.

The true origin of pareira brava was established by Hanbury (1873), and is the species mentioned above, which, according to Peckolt, is known in Brazil as *abutua*. This is a tall woody climber of Brazil and Peru, having large cordate or ovate-cordate, somewhat five-nerved leaves, very small unisexual flowers and purplish-black ovoid one-seeded drupaceous fruits, which form thick bunches resembling grapes in appearance.

Description.—Pareira brava comes to us in pieces 7–15 Cm. (3 to 6 inches) long, or even longer, and from about 2–10 Cm. (1 to 4 inches) in diameter, more or less tortuous, dark-brownish gray externally, and marked with transverse ridges and fissures and with irregular longitudinal furrows. Internally it is of a pale-brown color, when cut exhibits a somewhat waxy lustre, and on breaking shows a fibrous fracture. On transverse section are seen, under a thin bark, two or more concentric zones separated by wavy circles of a waxy tissue of parenchyma, resembling that of the medullary rays; in each zone are found a varying number of harder porous wood-wedges. Each one of the different zones is mostly nearly uniform in width, so that the axis is nearly in the centre of the root. Pareira brava is nearly inodorous and has a bitter taste.

FIG. 205.



Pareira brava: portion of a root, and transverse sections of the same.

Admixtures and Substitutions.—The *stem* of chondodendron is sometimes found mixed with the commercial root, which it closely resembles. It is distinguished by being rather more woody, but more particularly by the distinct central pith.

Several drugs derived from menispermaceous plants have been sold in place of pareira brava; these consisted of roots, or more frequently of sections of the stem. The one which was most commonly met with some years ago consisted of woody, more or less flattened pieces, with a thin brown-gray bark, often covered with patches of lichens, and upon transverse section showed numerous woody zones in more or less eccentric layers, so that the axis was removed to one side. This variety of *false pareira brava* is not readily cut with the knife, does not present a waxy appearance of the internal tissue, and, though possessed of a bitter taste, is much less so than the root of chondodendron. A second variety of false pareira was usually in thinner pieces, of a brown color, very woody and nearly concentrically arranged in the interior, and almost tasteless.

A *yellow pareira brava* has also been met with in commerce, and was imported from Brazil. It consists of the flat, often twisted stems, which Bentley and Trimen presume to be obtained from Abuta amara, *Aublet*. This kind is easily recognized by the eccentric arrangement of its woody zones and by its bright-yellow color internally. C. Morrison (1878) isolated from it an alkaloid which closely resembles berberine, but appears to be distinct from it, since with iodine it gave a reddish-brown crystalline precipitate instead of green spangles.

Hanbury mentions also a *white pareira brava*, derived from Abuta rufescens, *Aublet*, which has numerous concentric layers traversed by very distinct dark medullary rays, the interradial spaces being white and rich in starch. It is known in Brazil as *butua* (Martius, Peckolt), and is not an article of commerce.

Constituents.—Wiggers (1838) obtained an alkaloid from pareira brava which was named *pelosine* or *cissampeline*, and was found by Flückiger to be identical with beberine, paricine, and buxine (see pp. 325 and 1077), and to exist also in the stem and root of Cissampelos Pareira, *Linné*, to the extent of about ½ per cent. Pareira brava contains it in the same proportion. The pure alkaloid is amorphous, nearly insoluble in water, somewhat soluble in ether and carbon disulphide, but freely soluble in chloroform and acetone, also in alcohol and benzene; its nitrate is sparingly soluble, and its acetate is precipitated by sodium phosphate, by the group reagents for alkaloids, and by potassium iodide, ferrocyanide, ferricyanide and chromate; the precipitate with phosphomolybdic acid dissolves in ammonia with a blue color. Feneuille (1821) examined pareira brava, and obtained a yellow bitter principle soluble in alcohol and ether, a soft resin soluble in alcohol, and brown extractive soluble in alcohol and water.

Infusum pareiræ, *U. S.* 1870.—Infusion of pareira brava, *E.*; Tisane de pareira, *Fr.*; Pareira-Infusion, *G.*—Pareira brava, bruised, a troyounce; boiling water, a pint; macerate for two hours in a covered vessel, and strain.

Action and Uses.—Pareira appears to be analogous in its virtues to uva ursi and chimaphila, since they are chiefly manifested in diseases of the mucous membrane of the urinary organs, and especially in those attended with muco-purulent deposits in the urine. In chronic *pyelitis* and *cystitis* it may be advantageously administered in the form of infusion, decoction, or the official fluid extract. The solid extract is less efficient. The former official infusion was made with an ounce of pareira to a pint of boiling water. The *dose* is represented by Gm. 2–4 (gr. xxx–lx) of the root.

PARIETARIA.—Parietaria, Pellitory.

Wall pellitory, E.; *Pariétaire*, Fr. Cod.; *Perce-muraille*, Fr.; *Glaskraut*, G.; *Parietaria*, Sp.

Nat. Ord.—Urticaceæ, Urticeæ.

Description.—The following perennial European species has been used:

Par. officinalis, *Linné*. The stem is diffusely branched, reddish, rough-hairy; the leaves are petiolate, alternate, short-hairy, elliptic, entire, and acute; the polygamous flowers are in cymose axillary clusters with an involucre of short bracts, which are united at the base. The plant is perennial, and grows on walls and along roadsides. A variety with a nearly simple stem is Par. erecta, *Koch*.

Par. pennsylvanica, *Muhlenberg*, indigenous to the United States, probably possesses similar properties. It is an annual, has thin oblong-lanceolate, rather obtuse and opaquely-dotted leaves, and an involucre which is longer than the flowers. It grows on shaded rocky banks.

These plants are inodorous, and have a mucilaginous, saline, and slightly bitter taste.

Constituents.—No complete analysis of these plants has been made. Among the saline constituents of the European species potassium nitrate is named.

Pharmaceutical Uses.—The *infusion* and *syrup of parietaria* are used in France. *Tisane de pariétaire* is made from 1 part of the leaves and 100 parts of boiling water. *Sirop de pariétaire* is prepared by dissolving 19 parts of sugar in 10 parts of the expressed and clarified juice of the herb.

Action and Uses.—Anciently, common wall pellitory was held to be astringent, cleansing, and cooling, and hence was applied in the first stage of *abscesses* and other local inflammations, including *burns*, erysipelas, inflamed hæmorrhoids, gouty joints, and scaly eruptions. Its expressed juice was used as a *gargle*, and in modern times was taken internally, in the dose of Gm. 32–64 (f℥j–ij) as a diuretic and *lithotriptic*.

PARTHENIUM.—Feverfew, Featherfew.

Matricaire, Fr. Cod.; *Mutterkraut*, G.; *Matricaria*, *Yerba de Santa Maria*, Sp.

The flowering herb of Pyrethrum (Matricaria, *Linné*, Chrysanthemum, *Persoon*, Tanacetum, *C. H. Schultz*) Parthenium, *Smith*.

Nat. Ord.—Compositæ, Senecionideæ.

Origin.—Feverfew is a perennial herb growing in waste places in Europe and cultivated in gardens, where it is often seen with double flowers.

Description.—The stem is about 60 Cm. (2 feet) high, furrowed, and has alternate, petiolate, ovate, twice pinnately-cleft leaves with obovate or oblong mostly toothed lobes, the teeth terminating with a white point. The flower-heads are in small cymes at the end of the branches, have an involucre composed of linear scales in two rows, a naked hemispherical receptacle, white ligulate obovate and three-toothed ray-florets, and tubular yellow disk-florets. The herb (*herba matricariæ*) has a peculiar odor resembling that of chamomile, but less agreeable, and a bitter, somewhat acrid taste.

Constituents.—The bitter principle of feverfew has not been isolated; the tannin is of that variety which produces dark-green precipitates with iron salts. The volatile oil contains, according to Dessaignes and Chatard (1848), a stearopten which has the composition of camphor, $C_{10}H_{16}O$, fuses at 170° C. (338° F.), and turns polarized light to the left; also another oxygenated but liquid portion, and probably a hydrocarbon.

Allied Plants.—Parthenium integrifolium, *Linné*, a North American perennial growing in dry soil in the Southern and Western States, has oblong or ovate leaves, of which the lower ones are sometimes lobed, and the upper ones merely crenately toothed, and small corymbose flower-heads, with a conical chaffy receptacle, five inconspicuous white pistillate ray-florets, and sterile disk-florets. It has a bitter taste.

Parth. Hysterophorus, *Linné*, indigenous to the West Indies, Florida, and Louisiana, resembles the preceding, but has bipinnatifid leaves and numerous small flower-heads. It is employed like feverfew.

Silphium laciniatum, *Linné*, is indigenous to the Western and Southwestern United States, and attains a height of 1.5–3 M. (5 to 10 feet). The root is 60–90 Cm. (2 to 3 feet) long, and contains a circle of resin-ducts in the bark and one near the centre. The flowers have a cup-shaped involucre composed of imbricated ovate pointed and squarrous scales, and contain numerous yellow tubular sterile disk-florets and many pistillate yellow ray-florets, with compressed, broadly winged, and notched akenes. On the open prairies the lower leaves point north and south, hence the names *compass-plant* and *polar-plant*. The leaves are rough and bristly, ovate in outline, pinnately divided, the segments lanceolate, toothed or lobed. All parts of the plant are rich in resin, hence the name *rosin-weed*. The exudation of the stem and leaves forms translucent or transparent tears resembling mastic in appearance, having an agreeable terebinthinate odor and taste, and readily becoming plastic when masticated. It is only partly soluble in the different simple solvents, and, according to L. I. Morris (1881), contains nearly 20 per cent. of volatile oil consisting of a hydrocarbon, and 37 per cent. of acid resin, which, on being fused with potassa, does not yield protocatechuic acid; the other constituents are wax, a little sugar, ½ per cent. of inorganic salts, and a whitish tasteless powder insoluble in alcohol, but soluble in chloroform and carbon disulphide.

Silphium terebinthinaceum, *Linné*, Prairie burdock. It has a smooth stem and smaller flower-heads than the preceding, with smooth and obtuse involucral scales. The leaves are thick, rough, cordately ovate, and toothed or pinnatifid. The plant likewise yields a resinous exudation.

Action and Uses.—The medicinal properties of *Matricaria parthenium* may be referred to the bitter principle associated with the essential oil which it contains. It has been much used in the treatment of flatulent or atonic *dyspepsia*, in *amenorrhœa*, *dysmenorrhœa*, and simple *intermittent fever*, as well as in conditions of *nervous debility* with hysterical symptoms, and as an *anthelmintic*.

The expressed juice has been administered, and also a decoction and infusion of the herb. The last is sometimes applied, like chamomile, in fomentations, to allay the pain of local inflammations (*toothache*, *abscesses*, *rheumatism*) and to promote suppuration.

The flowering-tops of *Parthenium integrifolium* are extremely bitter. Many years ago an infusion made from them was reported to be remarkably efficacious in curing *intermittent fever*. As no further testimony has been published in confirmation of this statement, it may fairly be assumed to have been exaggerated, and that the alleged cures were only such as occasionally follow the use of various vegetable bitters. *Parthenine*, an extract, erroneously called an alkaloid, and derived from *P. histerophorus*, is said, in the dose of Gm. 0.20 (gr. iij), to quicken, and of Gm. i (gr. xv) to slow, the pulse, and in some cases to occasion more or less giddiness or sinking, and to have relieved *neuralgia* of the fifth nerve when given in doses of from two to several grams an hour (*Bull. et Mém. de la Soc. de Thérap.*, 1886, p. 40). The species of *Silphium* above mentioned are more allied by their medicinal virtues to the gum-resins than to the aromatic bitters. They are noticed under Opopanax.

PASSIFLORA.—Passion-Flower.

Grandille, Fr.; *Passionsblume*, G.; *Granadita*, Sp.

Nat. Ord.—Passifloraceæ.

Origin and Description.—This genus is chiefly confined to tropical America, and

consists of climbing shrubs or herbs with alternate undivided or palmately lobed stipulate leaves and perfect flowers. The calyx has five sepals, united below to a short cup-shaped tube, which is fringed in the throat with two or three rows of filaments. The five petals are inserted on the throat of the calyx; the five stamens are united with their filaments, forming a tube from which the long-stalked ovary projects, bearing three somewhat club-shaped styles; the fruit is often edible, berry-like, one-celled, and contains numerous seeds, which are invested with a pulpy covering. Two indigenous species have been employed to a limited extent.

P. lutea, *Linné*, has obtusely three-lobed leaves with the lobes entire, and greenish-yellow flowers; and P. incarnata, *Linné*, with three-lobed serrated leaves, and large whitish flowers having a flesh-colored crown. The berry of the latter is orange-yellow, oval, of the size of a hen's egg, and is known as *May-pops*.

Allied Plants.—The following are indigenous to tropical America:

P. CŒRULEA, *Linné*, has five-lobed leaves, greenish flowers with blue fringes, and orange-colored berries.

P. LYRÆFOLIA, *Tussac*. The ovate leaves are divided at the end into three unequal lobes; the flowers are red and the berries cherry-like.

P. RUBRA, *Linné*, has two-lobed leaves, whitish and pale-red flowers and scarlet-red berries.

P. MALIFORMIS, *Linné*. Its white, blue-fringed flowers produce a fruit resembling an apple in size, shape, and color.

P. QUADRANGULARIS, *Linné*, has quadrangular and winged branches and yellowish berries of the size and shape of goose-eggs.

P. FŒTIDA, *Cavanilles*, with three-lobed leaves, and whitish flowers having a purple crown, is characterized by its strong disagreeable odor.

The fruits of the allied Paropsis edulis, *Petit-Thouars*, Tacsonia tripartita, *Jussieu*, T. molissima, *Kunth*, and others, are edible.

The constituents of these plants are unknown.

Action and Uses.—Several species of Passiflora are endowed with active qualities. P. quadrangularis, a West India plant, was long ago (1824) stated to cause in animals, spasms, paralysis, and a cataleptic condition, and its root was said to be emetic. In Jamaica, P. rubra was regarded as narcotic; P. fœtida, as "pectoral, anti-spasmodic, and emmenagogue;" P. laurifolia, as anthelmintic; and P. lyræfolia, as diuretic. According to Phares, P. lutea and incarnata, the passion-flower indigenous to our Southern States, was used by him "with extraordinary success in all cases of *tetanus neonatorum*," in all sorts of *neuralgic affections*," and in the form of an extract of the root as "an application to *chancres*, irritable *piles*, *erysipelas*, and recent *burns*." An extract prepared by evaporating to dryness the expressed juice of the leaves gathered in May was given in the form of powder, and in the dose of from 1 to 4 teaspoonfuls. For external use an inspissated decoction of the whole plant was used.

PEPO, *U. S.*—PUMPKIN-SEED.

Semen Peponis.—Semences de potirons, Fr.; *Kürbissamen*, G.; *Semillas de calaboza*, Sp.

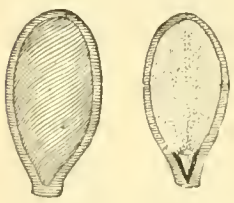
The seed of Cucurbita Pepo, *Linné*.

Nat. Ord.—Cucurbitaceæ.

Origin.—The plant is probably indigenous to tropical Asia and America, and is often cultivated. It has a rough hollow stem, large five-lobed, serrate leaves, five-branched tendrils, yellow bell-shaped monœcious flowers, and usually large globular or oblong fruits.

Description.—The seeds are about 20 Mm. ($\frac{3}{4}$ inch) long, flat, broadly ovate, somewhat oblique at the pointed end, white or pale-yellowish, nearly smooth or finely granular on the surface, near the edge and parallel with it marked with a shallow groove, and frequently covered with fragments of a white membranous tissue. The embryo consists of two flat cotyledons of the shape of the seed, and of a short conical radicle. It is inodorous and has a bland oily taste.

FIG. 206.



Pumpkin-seed: entire, and longitudinally divided.

The seeds of Cuc. melopepo, *Linné*, the *squash*, are very similar, rather more obtuse, and less plainly margined. (See also p. 559.)

Constituents.—Dorner and Wolkowich (1870) obtained from pumpkin-seeds 44.5 per cent. of slowly-drying fixed oil, 32.75 starch, and traces of volatile oil, resin, and sugar. They also announced the discovery of an alkaloid, *cucurbitine;* this, however could not be found by Kopylow (1876), who was also unable to establish the

presence of a glucoside. He proved the seeds to contain free fatty acids, and the bland oil to consist of the glycerides of palmitic, myristic, and oleic acids. Heckel (1875) attributes the tænifuge properties to a resin contained in the tegmen (perisperm?) of the seed, but Vigier (1876) found the embryo to possess the activity. Dr. L. Wolff (1882) extracted the fixed oil by petroleum benzin, and treated the seeds afterward with alcohol, ether, or chloroform, obtaining a greenish-brown soft resin of an acrid bitter taste. Cadenberg (1881) obtained from the seed of Cucurbita maxima, *Duchesne*, by pressure, 20 to 25 per cent. of bland yellow fixed oil, an aromatic principle, emulsin, gum, sugar, and an acid soluble in alcohol and water. When triturated with water the seeds yield a white and bland emulsion; the emulsionizing principle is probably a protein compound.

Pharmaceutical Preparation.—Extractum peponis fluidum.—Fluid extract of pumpkin-seed, *E.*—It was recommended by Dr. Wolff (1882) to be prepared with alcohol, like other fluid extracts.

Action and Uses.—Pumpkin-seeds are among the most efficient remedies for *tape-worm*. Originally referred to as a vermifuge in the last century, it is only within a comparatively few years that their efficiency has been established by numerous and trustworthy witnesses, notwithstanding their neglect by most writers on helminthology. It was stated in 1878 that the people in Northern Italy are in the habit of using them to expel tæniæ (Bröking). The remedy has the advantage of being free from any unpleasant taste or harsh mode of action. According to Heckel, the tænifuge virtues reside in the perisperm. Bérenger-Féraud, who made comparative trials of numerous vermifuges, has declared pumpkin-seed to be one of the least reliable for expelling unarmed tæniæ (*Bull. de Thérap.*, xcix. 57; ciii. 104). In a later clinical study he states that C. pepo has no tænifuge power, and that C. maxima possesses it only in an inferior degree, and is at the same time apt to occasion disgust, nausea and vomiting (*ibid*, cxvii, 101). The offensive qualities may have been due to the "rum or Chartreuse" mixed with the medicine. The fixed oil of the seeds, extracted by ether, has been used successfully in the dose of Gm. 16 (℥ss.) repeated in two hours, and followed in two hours more by a dose of castor oil. For administration, Gm. 64.–128 (℥ii–iv.) of fresh pumpkin-seeds should be beaten into a paste with finely-powdered sugar and diluted with water or milk. The night before using the emulsion, and early the following morning also it has been recommended to administer a large saline purgative for the purpose of washing away the mucus and other intestinal contents that protect the tænia. The emulsion, to the amount of a pint, should be taken in three doses at intervals of about two hours, beginning at ten oclock, the patient remaining very still in bed to prevent vomiting (Squibb, *Ephemeris*, i. 172). Three or four hours later 1 or 2 tablespoonfuls of castor oil should be administered. Before taking the medicine he should fast for twenty-four hours. A fluid extract has also been used. The same treatment has been recommended for *lumbricoid* worms.

PEPSINUM, *U. S.*, *P. G.*—Pepsin.

Pepsin, Br.; *Pepsina*, Fr. Cod.; *Pepsine*, Fr.; *Pepsin*, G.

A proteolytic ferment or enzyme obtained from the glandular layer of fresh stomachs from healthy pigs, and capable of digesting not less than three thousand times its own weight of freshly coagulated and disintegrated egg albumen, when tested by the process given below. If it be desired to use a diluent for reducing pepsin of a higher digestive power to that required by the Pharmacopœia, sugar of milk should be employed for that purpose.—*U. S.*

A preparation of the mucous lining of the fresh and healthy stomach of the pig, sheep, or calf.—*Br.*

History.—Pepsin was discovered in 1836 by Schwann, after Eberle had furnished proof that digestion of food in the stomach is due neither to the mechanical action of the mucous membranes nor to the solvent action of acids, but is dependent upon some unorganized ferment present in the gastric juice: this ferment was determined by Schwann and named pepsin, from the Greek word πέψις (digestion). Pepsin is a secretory product of certain glands imbedded in the tissue of the inner coating of the stomach, but has also been found in muscular tissue, urine, brain, and the mucous membrane of the intestines. True or active pepsin probably does not exist at all times in the gastric juice, but is formed by the action of hydrochloric acid and chlorides from a mother substance known as "pepsinogen" as the digestive functions of the stomach may require; in support of this theory we find that glycerin will abstract increased quantities of pepsin from the mucous membrane of the stomach after this has been treated with 0.2 per cent. hydrochloric acid

or 1.0 per cent. sodium chloride solution. The use of pepsin in medicine is mainly due to the efforts of Dr. Corvisart, court physician to the Emperor Napoleon III., but the quality of the commercial article has been vastly improved since that time: to the perseverance and energy of American pharmacists are due the improvements in the mode of manufacturing pepsin and the wonderful increase in digestive power of the commercial article.

Preparation.—The stomach of one of these animals recently killed having been cut open and laid on a board with the inner surface upward, any adhering portions of food, dirt, or other impurity are to be removed and the exposed surface slightly washed with cold water; the cleansed mucous membrane is then to be scraped with a blunt knife or other suitable instrument, and the viscid pulp thus obtained is to be immediately spread over the surface of glass or glazed earthenware and quickly dried at a temperature not exceeding 100° F. The dried residue is to be reduced to powder and preserved in a stoppered bottle.—*Br.*

This process is the same as that suggested by Dr. Lionel Beal, the product consisting merely of the carefully dried mucous membrane of the stomach. The U. S. and German Pharmacopœias give no process for the manufacture of pepsin, recognizing any preparation that comes up to the official requirements. The French Codex follows the plan of M. Boudault which directs that the mucous membrane of sheep stomachs shall be macerated for two hours at 15° C. (59° F.), the strained liquid to be precipitated with lead acetate, the precipitate washed, then diffused in water, and decomposed by hydrogen sulphide; the liquid is rapidly filtered, and evaporated below 45° C. (113° F.) in very shallow vessels to a brownish-yellow firm mass. Boudault added starch to the evaporated liquid before it had reached dryness, and at times also added lactic acid; Hottot recommended the precipitation of the pepsin by sodium sulphate and its drying so as to form pale-brown scales. Lamatch's German pepsin is obtained by triturating the mucous membrane of the stomach with clean dry sand, filtering the liquid obtained, and drying this in thin layers at a temperature of 50° C. (104° F.). In this country two kinds of pepsin are manufactured, known respectively as precipitated pepsin and soluble or scale pepsin; the former is made by the method recommended by E. Scheffer in 1872, and consists in precipitating an acid infusion of clean mucous membrane of hog stomach (prepared cold) by a saturated solution of sodium chloride, redissolving the precipitate in acid water, reprecipitating with salt in order to purify the pepsin, and finally drying at or below 40° C. (104° F.). (See *Amer. Jour. Phar.* 1872.) The process for the manufacture of the so-called scale or peptone pepsins insures an increased yield of product and higher digestive power, but not always the same degree of purity: it consists in subjecting the well-cleaned mucous membranes of animal stomachs, after being thoroughly minced by machinery, to a process of self-digestion in water acidified by hydrochloric acid at a temperature of 38°–45° C. (100.4°–113° F.), until the whole mass is converted into a uniform transparent glairy fluid. This is allowed to cool and deposit over night after an addition of chloroform or sulphurous acid solution, which prevents putrefaction and in nowise interferes with the activity of the pepsin; the liquid is carefully strained, concentrated in a vacuum apparatus to a syrupy consistence, and spread upon plates of glass, where it is allowed to scale in suitable dust-free rooms. Pepsin thus prepared always contains mucus, peptones, and syntonin, while that prepared by the Scheffer method is contaminated with salt and some inert albuminous matter. In 1891 a process was patented in this country and in England combining the advantages of the two preceding processes. The essential features are as follows: the well-cleansed and minced mucous membranes are brought to solution by digesting with acidulated water, the solution being clarified after addition of sulphurous acid; the clear liquid is separated from the deposit, and then precipitated by saturating at a higher temperature with sodium sulphate, whereby the pepsin is deposited, while the peptone remains in solution. The precipitated pepsin is dissolved in weak hydrochloric acid and subjected to dialysis, which removes the sodium sulphate and remaining peptones, after which the residual solution is concentrated at a low temperature and dried on plates of glass. The sodium sulphate is not lost in the process, but obtained from the peptone solution by recrystallization.

Selldén (1873) observed that the mucous membrane is not deprived of pepsin by maceration in acidulated water, but that by digestion at 37° C. (98.6° F.) about double the amount of pepsin is obtained; the mother-liquor from the precipitated pepsin, after having been deprived of salt by dialysis, possesses only very slight digestive properties. That pepsin exists partly in the stomach in an insoluble form has also been demonstrated by Béchamp and by Gautier (1882); the insoluble granules, termed *microzimes*, gradually dissolve in water on digestion.

Properties.—The different pharmacopœias ascribe the following properties to pepsin:

"A fine, white, or yellowish-white, amorphous powder, or thin, pale yellow or yellowish, transparent or translucent grains or scales, free from any offensive odor, and having a mildly acidulous or slightly saline taste, usually followed by a suggestion of bitterness. It slowly abstracts moisture when exposed to the air. Soluble, or for the most part soluble, in about 100 parts of water, with more or less opalescence; more soluble in water acidulated with hydrochloric acid; insoluble in alcohol, ether, or chloroform. On heating a solution of pepsin in acidulated water to 100° C. (212° F.) it becomes milky, or yields a light, flocculent precipitate, and loses all proteolytic power. In a dry state it can endure this temperature without injury. Pepsin usually has a slightly acid reaction. It may be neutral, but should never be alkaline."—*U. S.*

"A light yellowish-brown powder, having a faint but not disagreeable odor and a slightly saline taste, without any indication of putrescence. Very little soluble in water or spirit."—*Br.*

"A fine, almost white, slightly hygroscopic powder, having a peculiar bread-like odor and a sweetish, afterward bitter taste. 1 part forms with 100 parts of water a faintly opalescent solution of very slightly acid reaction."—*P. G.*

The greater the proportion of peptone present in pepsin the more rapidly does it absorb moisture from the air, and the greater the absence of mucus the less unpleasant will be the odor and the more perfectly clear will be the solution of pepsin in water, especially if the water be acidulated with acetic acid. Except in minute quantities sodium chloride impairs the activity of pepsin; the same is true of alcohol. An aqueous solution of pepsin will decompose in a short time; after addition of hydrochloric acid it remains clear, but gradually loses its effects on albumen. Glycerin, on the other hand, preserves its virtues. Tannin and the alkali carbonates and bicarbonates inhibit the proteolytic action of pepsin.

Tests.—Pepsin exposed on a watch-glass to the air, even in damp weather, should not become sticky in the course of a few hours, showing the absence of an undue amount of peptone. It should form with distilled water an almost clear solution, which is not rendered turbid by the addition of acetic acid, showing the absence of mucus. (Pepsin made by Scheffer's process never yields a clear solution with water, owing to the presence of syntonin or acid albumen.) It should be free from any disagreeable or ammoniacal odor, due to the presence of putrescible matter. A drop of tincture of iodine added to a solution of pepsin should not develop a blue or purplish-red color, showing the absence of starch and dextrin.

The valuation of pepsin is directed by the different pharmacopœias as follows:

"Prepare, first, the following three solutions: *A*. To 294 Cc. of water add 6 Cc. of diluted hydrochloric acid. *B*. In 100 Cc. of solution *A* dissolve 0.067 Gm. of the pepsin to be tested. *C*. To 95 Cc. of solution *A*, brought to a temperature of 40° C. (104° F.), add 5 Cc. of solution *B*. The resulting 100 Cc. of liquid will contain 2 Cc. of diluted hydrochloric acid, 0.00335 Gm. of the pepsin to be tested, and 98 Cc. of water. Immerse and keep a fresh hen's egg during fifteen minutes in boiling water; then remove it and place it into cold water. When it is cold separate the white, coagulated albumen, and rub it through a clean sieve having 30 meshes to the linear inch. Reject the first portion passing through the sieve. Weigh off 10 Gm. of the second, cleaner portion, place it into a flask of the capacity of about 200 Cc., then add one-half of solution *C*, and shake well so as to distribute the coherent albumen evenly throughout the liquid. Then add the second half of solution *C*, and shake again, guarding against loss. Place the flask in a water-bath, or thermostat, kept at a temperature of 38° or 40° C. (100.4° to 104° F.), for six hours, shaking it gently every fifteen minutes. At the expiration of this time the albumen should have disappeared, leaving at most only a few, thin, insoluble flakes. (Trustworthy results, particularly in comparative trials, are obtained only, if the temperature is strictly maintained between the prescribed limits, and if the contents of the flasks are agitated uniformly, and in equal intervals of time.) The relative proteolytic power of pepsin stronger or weaker than that described above may be determined by ascertaining through repeated trials, how much of solution *B* made up to 100 Cc., with solution *A*, will be required exactly to dissolve 10 Gm. of coagulated and disintegrated albumen under the conditions given above."—*U. S.*

"2 grains of pepsin with an ounce of distilled water, to which 5 minims of hydrochloric acid have been added, form a mixture in which at least 100 grains of hard-boiled white of egg, passed through a No. 36 sieve, will dissolve on their being well mixed,

digested, and well stirred together for thirty minutes at a temperature of 54.4° C. (130° F.)."—*Br.*

"10 Gm. of hard-boiled egg-albumen, passed through a No. 25 sieve, added to 100 Cc. of water and 10 drops of hydrochloric acid, should be dissolved by 0.1 Gm. of pepsin when digested for one hour at 45° C. (113° F.), with frequent agitation."—*P. G.*

Although the U. S. Pharmacopœia requires of pepsin a digestive power of only 1 to 3000, higher grades are in daily use by physicians, such as 1 to 4000, 1 to 5000, and 1 to 6000. In addition, manufacturers of pepsin are prepared to furnish still purer products, capable of dissolving eight, ten, fifteen, and even twenty thousand times their weight of hard-boiled egg-albumen.

Composition.—Absolutely pure pepsin is unknown; it probably contains the same elements present in other protein compounds. Syntonin has a similar composition, but is insoluble in water and neutral saline solutions; its presence in pepsin made by Scheffer's process was shown by Selldén (1873).

Allied Substances and Products.—Gastric Juice. As taken from the stomach and filtered from the undigested food, this forms a clear, transparent, limpid liquid of a pale-yellow or brownish color, of a slight peculiar odor, and of a somewhat saline and acidulous taste. It is but slightly heavier than water, and has a strongly acid reaction, which has been attributed to free lactic and hydrochloric acids, to acid phosphates, and to acid hippurates. The gastric juice retains its digestive power for a long time, even after it has become mouldy. Lehmann obtained from it between 0.1 and 0.132 per cent. of free hydrochloric, and between 0.32 and 0.585 per cent. of lactic, acid. The latter was observed by Richet (1878) to be identical with *sarcolactic acid* of horseflesh. The total percentage of all solids contained in gastric juice is between 1 and 1.5 per cent., but varies in different animals, and is invariably increased by admixture with saliva. The chlorides amount to nearly $\frac{1}{2}$ per cent., among them small quantities of ammonium and calcium chlorides. Phosphates of calcium, magnesium, and iron amount to $\frac{1}{5}$ or $\frac{1}{4}$ per cent., but alkali sulphates and phosphates cannot ordinarily be detected.

Papain, Papayotin, is obtained from the milk-juice of the *melon tree* or *papaw*, Carica Papaya, *Linné*, s. Papaya vulgaris, *De Candolle;* nat. ord. Papayaceæ. The tree is indigenous to tropical America, but now is cultivated and wild in most tropical countries. The trunk is mostly undivided, 20 to 25 feet (6 to 7.5 M.) high, has a crown of long-petioled, large, palmately-lobed leaves, and bears as fruit fleshy berries which under cultivation attain a length of 12 inches (30 Cm.) and a thickness of 6 inches (15 Cm.). Peckolt (1879) found the fruit to contain albuminoids, resin, sugar, fat, tartrates, citrates, malates, etc.; the milk-juice of the unripe fruit, dissolved in water, yields with alcohol *papayotin* as a snow-white, inodorous, and nearly tasteless powder, which is very soluble in water and glycerin, but insoluble in other solvents. Wurtz and Bouchut (1879) named it *papaïn*. Wittmack (1878) showed that the filtered milk-juice is not coagulated by heat. The residue from dialysis, precipitated by alcohol, gave to Wurtz (1880) a product containing only 1 to 3 per cent. of ash, and having a composition closely resembling that of albuminoids. The aqueous solution foams when agitated, and is not precipitated by acetic or orthophosphoric acid, but nitric or hydrochloric acid yields a precipitate soluble in excess of acid. Precipitates are also obtained with tannin, picric acid, platinic chloride, corrosive sublimate (on boiling), copper sulphate (violet), and Millon's reagent (yellowish-white, on heating brick-red).

Bouchut (1880) found the milk-juice of the *fig tree* to contain a similar digestive ferment.

Peptone. This is the product of the digestion of albuminoid substances. Peptones are readily soluble in water, and this solution is not disturbed by boiling nor by the addition of acids or alkalies. Neutral solutions of peptone are precipitated by alcohol, tannin, and by various salts. Acid solutions yield precipitates with potassio-mercuric iodide, bromine-water, and other group reagents for alkaloids, but these precipitates are soluble in excess of peptone (Tanret, 1881). Brieger (1883) extracted from some peptones by boiling alcohol an amorphous poisonous alkaloid resembling the ptomaïnes in behavior. Peptone is colored yellow by nitric acid, and gives with Millon's reagent, on warming, a red precipitate, and with Fehling's solution violet-red color.

Peptone is readily assimilated by the intestinal mucous membrane. Poehl (1882) states that peptones may be again converted into albuminoids by the influence of alcohol, various alkali salts, and other agents having much affinity for water. *Peptonized meat* has been recommended as a nutritive medicine. The liquid resulting from the artificial digestion of lean meat is strained, neutralized with sodium bicarbonate, and the filtrate evaporated until it has the density 1.208, when it is stated to contain 50 per cent. of peptone (Petit, 1881), and may be preserved by the addition of glycerin and combined with ferric chloride, mercuric chloride, and other salts. By desiccating its concentrated solution upon oiled plates peptone may be obtained in scales resembling gelatin, which are hygroscopic, but not deliquescent on exposure.

Pharmaceutical Preparations.—Pepsinum saccharatum, *U. S.;* Saccharated pepsin.—Take of Pepsin 10 Gm.; Sugar of Milk, recently dried, and in No. 30 powder, 90 Gm. Triturate the pepsin with the sugar of milk to a fine uniform powder, and keep the product in well-stoppered bottles. Saccharated pepsin, when tested by the process given under Pepsin, with the modification that 0.67 Gm. of it are to be taken in pre-

paring solution *B*, should digest three hundred times its own weight of freshly coagulated and disintegrated albumen.

Glyceritum pepsini, *N. F.;* Glycerite of pepsin, Glycerole of pepsin.—Dissolve 640 grains of pepsin in a mixture of 80 minims of hydrochloric acid and 7 fluidounces of water; add 120 grains of purified talcum and filter, adding sufficient water through the filter to make 8 fluidounces. Finally, add to the filtrate 8 fluidounces of glycerin and mix well.

Liquor pepsini aromaticus, *N. F.;* Aromatic solution of pepsin, Aromatic liquid pepsin.—Mix 128 grains of pepsin with 8 fluidounces of water and 75 minims of hydrochloric acid; shake until dissolved; then add 120 grains of purified talcum and 2 drops of oil of cinnamon, 2 drops of oil of pimento, and 4 drops of oil of cloves, previously dissolved in 4 fluidrachms of alcohol; mix thoroughly, filter clear, and pass enough water through the filter to make the filtrate measure 12 fluidounces. Finally, add 4 fluidounces of glycerin and mix well.

Vinum pepsini, *N. F., P. G.*; Wine of pepsin, *E.*; Pepsinwein, *G.*—Mix 30 minims of hydrochloric acid, 360 minims of glycerin, and 1 fluidounce of water; add 128 grains of pepsin; agitate thoroughly until dissolved, then add enough white wine to make 16 fluidounces; mix intimately with 120 grains of purified talcum and filter.—*N. F.* Mix 20 parts of pepsin with 20 parts each of glycerin and water and 3 parts of hydrochloric acid; set the mixture aside for eight days, with frequent agitation; then filter and add 92 parts of syrup, 2 parts of tincture of orange-peel, and 839 parts of sherry wine or as much as may be necessary to bring the total weight up to 1000 parts.—*P. G.*

Action and Uses.—The effects of swallowing 5 drachms of pure pepsin are said to have been burning pain in the stomach, nausea, colic, and diarrhœa, but no vomiting (*Med. Record*, xxviii. 346). On the admission of pepsin into medical practice it soon acquired a brilliant reputation as a remedy for numberless dyspeptic ailments indirectly engendered by the wear and tear of civilized life, as well as for those directly produced by certain affections of the structural elements of the stomach itself. The introduction into this organ from without of a substance necessary to the solution of the food, but which it was incompetent to furnish by its own power, was a happy thought of the rational therapeutist, and which has been repeated less rationally in the case of pancreatin. The practical results of its application were apparently, and at first, as flattering as possible; but confidence in the remedy began to decline when it became certain that nearly all of the numerous preparations of pepsin were absolutely inert intrinsically, or had become so from the changes induced by time or by the various substances associated with the pepsin they originally contained. It is unnecessary to describe in detail the various *dyspeptic disorders* which might be profitably treated by a really active preparation of pepsin: it will suffice to say that, besides those already referred to, there is the common gastric derangement of infants and of children during the period of dentition, induced usually by the pain and irritation of this process, which being duly corrected, the patients are enabled to bear with comparatively slight disorder of function the continued action of the disturbing cause. Other causes besides teething may occasion the same condition, such as unwholesome air and food. Under the use of pepsin sometimes the vomiting and diarrhœa cease, the abdominal distension subsides, and the increased flesh and improved complexion testify to the more complete assimilation of the food. In numerous cases occurring during convalescence from exhausting acute diseases, and in the course of chronic affections, more or less of the same effect may be hoped for from the administration of pepsin in a really active condition. Still, we believe that general clinical experience will support the deduction of Dana from his experiments, "that *good* pepsin has a *real* though not a *great* medicinal value" (*Amer. Jour. of Med. Sci.*, Oct. 1882, p. 347). It is at best only a transient substitute for the gastric juices; its continued use enfeebles the digestion. It seems probable that pepsin prepares albuminous compounds for absorption, for Catillon fed a dog by the rectum with eggs prepared with pepsin, and the animal retained its weight and temperature during the two months that the experiment continued. As soon as the pepsin was omitted it began to lose flesh and heat (*Bull. de Thérap.*, c. 233). There is much doubt entertained by competent authorities whether pepsin is really the active agent in cases where it seems to do good, and not the hydrochloric acid with which it is generally administered. It is claimed that pepsin is a valuable remedy in dyspeptic forms of *diabetes*. It is unnecessary to do more than mention that pepsin has been applied locally to dissolve diphtheritic membrane, and also coagulated blood retained in the urinary bladder.

Perfectly fresh pepsin may be prescribed in *doses* of about Gm. 0.60 (gr. x) imme-

diately before or after each meal in water acidulated with muriatic acid. It may also be mixed with arrowroot and given in a little sweetened water. Liebreich has found that to preserve the ferment of pepsin in the liquid state glycerin is the only reliable agent.

Carica papaya fruit and the tree producing it were described as long ago as 1665 by Rochefort (*Hist. nat. des Antilles*, etc., 2ème éd., p. 66). His statement is that it strengthens the stomach and promotes digestion. In the *History of Barbadoes*, by the Rev. Griffith Hughes, pp. 181, 182 (London, 1750), the author, speaking of two varieties of papaw, says: "Both these fruits, especially the round sort, are likewise when near ripe boiled and eaten with any kind of flesh meat, and esteemed wholesome if they are cleansed of the milky corrosive juice they contain and eaten but seldom. This juice is of so penetrating a nature that if this unripe fruit when unpeeled is boiled with the toughest old salt meat, it will soon make it soft and tender, and if hogs are for any considerable time fed with it, especially raw, it is said it will wear off all the mucous slimy matter which covers the inside of the guts, and would in time, if not prevented by a change of food, entirely lacerate them. I know of no physical virtue in any part of this tree, unless that the milky juice of the popo is sometimes made use of to cure ringworms and such cutaneous eruptions." Rossbach, who has furnished the amplest account of the matter (*Zeitsch. f. klin. Med.*, vi. 527), cites from Holder that when swine are fed upon the fruit, their flesh becomes too soft for salting; from Karsten, that in the higher regions of Quito, where water boils below 212° F., papaw-juice is used to supplement the action of hot water by softening the meat; and from Schacht, that flesh enveloped in papaw-leaves for a few hours becomes tender. Roy found that the juice dissolved raw meat and also coagulated albumen more powerfully than the gastric juice. Wittmack saw fresh beef disintegrated and dissolved by a weak solution of the juice at a temperature lower than the boiling-point of water. Under like conditions pepsin, unless acidulated, exhibited no solvent power at all. Rapid cooking arrested the action of the juice upon animal tissues. The minutest portion of it coagulated milk. Wurtz and Bouchut (*Compte rendu des Séances de l'Acad. des Sci.*, 1879, p. 425) found that papaine, the nitrogenous substance precipitated by alcohol from papaw-juice, dissolves from one thousand to two thousand times its weight of fibrin, and differs from pepsin in doing so not only in a faintly acid solution, but even in a neutral or slightly alkaline liquid. The presence or absence of bacteria did not affect the solvent power of the preparation, and when cold it seemed as active as when warm. The addition of muriatic, carbolic, or salicylic acid lessened the solvent power of papayotin. "Papoid," says Finkler, "is an albuminous body which under certain conditions can convert albumen into peptone. It is more energetic than pepsin in this respect, especially in alkaline or neutral solutions, while pepsin acts only in acid ones." Ruttan has made a similar statement (*Therap. Gaz.*, xi. 517; *Med. News*, lii. 27). The experiments of Rossbach show that in man and animals this constituent does not act upon normal living organs, but that when injected subcutaneously it occasions more or less softening of the connective tissue. When thrown into the blood-vessels, it instantly disorganizes the blood and consequently arrests the heart. The flesh of animals killed in this manner rapidly undergoes putrefaction.

In regard to the medicinal uses of papaw products, Kohts and Asch in 1882 (*Zeitsch. f. Klin. Med.* v. 558) stated that a 5 per cent. solution of papayotin softens and completely dissolves *diphtheritic* false membranes in the nose, pharynx, or trachea, provided that the preparation be genuine and the solution thoroughly applied at least every half hour. The infiltrated form of diphtheria is, however, not amenable to this treatment. In the Medical Society of Berlin discussion did not bring about an agreement as to the value of the application (*Deutsche Med. Wochensch.* 1883, p. 327). It seems that only well-tested and concentrated solutions applied every few minutes can be relied upon to dissolve the exudation. Among later reports attesting its efficacy may be mentioned those of Croner (*Med. News*, xliii. 24), Jacobi (*Therap. Gaz.*, x. 145), Bruce (*Med. Record*, xxxiv. 448); Bauduy (*Jour. Amer. Med. Assoc.*, ix. 705), and Ruttan (*Med. News*, lii. 521), who states that it deodorizes as well as dissolves the exudation. The softening power of this agent has been applied to remove the crusts of *eczema*. Morris painted the crusts twice a day with a solution of 12 grs. of papaine and 5 grs. of borax in 2 drachms of distilled water (*British Med. Jour.*, May 20, 1882). Fenwick, and also Schwimmer, found that in *syphilitic ulcers* of the tongue and throat much good was done by applying to them a paste made with papaine, glycerin, water, and potassium carbonate, by using lozenges containing papaine gr. ⅛, cocaine, gr. ⅛, potassium bicarbonate gr. ¼. Johnston (*Edinb. Med. Jour.*, Jan. 1890) employed a 5 per cent. solution of papaine to

cleanse the auditory canal of obstructing indurated secretions. Injections of papayotin have been made in *cancerous* tumors of the skin and superficial glands, but the action is said to be painful and slow. Morris applied it to remove "tubercles of irritation from the hands of a mortuary porter," and Cox to heal *sinuses*. As long ago as 1802, Sprengel described the virtues of papaw-juice in destroying *tæniæ* and *lumbricoid worms*. Castor oil was administered to expel the dead parasites. It has been used in the same forms of *dyspepsia* as pepsine—*i. e.* in gastric atony, muscular or glandular, with acid regurgitation and flatulence. Herschell has described a gastric catarrh, or biliousness, as amenable to this medicine, but the enumerated symptons are merely those of constipation from intestinal atony. In Australia a liquid extract of Carica papaya, a tincture, and a gelatinous extract have been used both internally and topically to stimulate the *mammary secretion*. It is also said to be an *abortifacient* (*Therap. Gaz.*, xi. 318).

Ingluvin is obtained from the gizzard of the domestic fowl, and is supposed to promote digestion in the same manner as pepsin. From ancient times it has been employed in China for that purpose, and has long been a popular medicine in the Western World. But Dr. Edes and Dr. Ellis both failed to discover that it displayed any such action upon albumen as pepsin exerts (*Boston Med. and Surg. Jour.*, April, 1883, p. 381). In 1877 the attention of physicians was called to it by Dr. Shelley (*Phila. Med. and Surg. Reporter*, June, 1877) as a remedy for *nausea* and *dyspepsia* associated with debility (Kennedy, *Phila. Med. Times*, x. 104). In doses of 8 to 15 grains before meals it has suspended the *vomiting* of pregnancy (*Med. Record*, xii. 664; *Practitioner*, xxvi. 43; *Med. News*, liv. 187). Dr. Dobbs advises that it be given very early in the morning in the dose of 10 grains, at eight or nine o'clock 15 grains more, and that an hour later a light breakfast be taken, and that this administration be continued for several days, while the dose is increased to Gm. 1.30 (gr. xx.) (*Brit. Med. Jour.*, 1881, i. 86). Sawyer recommends that in atonic dyspepsia it be given in doses of Gm. 0.60 (gr. x.) thrice daily, in powder sprinkled on bread, immediately *after* meals (*Practitioner*, xxvi. 43).

PERSICA.—Peach.

Pêcher, Fr. Cod.; *Pfirsich*, G.; *Melocoton*, *Durazno*, Sp.

Persica vulgaris, *De Candolle*, Amygdalus Persica, *Linné*.
Nat. Ord.—Rosaceæ, Amygdaleæ.

Description.—The peach tree is indigenous to South-western Asia, and is at present extensively cultivated in most temperate countries. It is of medium size, and has a nearly smooth brown bark and spreading branches. The *leaves* are alternate, short petiolate, lanceolate, pointed, closely serrate, green, and smooth on both sides. The *flowers* appear in April, are axillary, have a bell-shaped and five-cleft calyx, five ovate, reddish petals, about twenty-five stamens, and a single ovary developing into a sub-globular drupe, with a hard and firm putamen and containing a seed resembling the almond. The leaves, flowers, and seeds when bruised exhale a bitter-almond odor and have a bitter taste.

Constituents.—The young branches, leaves, flowers, and seeds, after maceration in water and distillation, yield a volatile oil which is chemically identical with oil of bitter almond. Geiseler (1840) proved the presence of about 3 per cent. of crystallizable amygdalin in the seeds. The fixed oil of the latter is bland, and resembles expressed oil of almond.

Action and Uses.—The bark, the leaves, the kernels, and even the flowers, are endowed with active properties, which they owe in part to hydrocyanic acid. The flowers are chiefly laxative, and the leaves are not destitute of this quality. Indeed, they have been used as a substitute for manna, and especially for their *vermifuge* effect; they have also been reputed to cure *intermittent fevers* and to allay the pain of *nephritic colic*, as well as to promote the discharge of calculi by causing diuresis. Bruised and applied to the abdomen, they are said to relieve colic produced by indigestion. They are also reported to have cured *whooping cough*. They have been applied to arrest slight *hæmorrhages*. Peach-kernels have frequently produced poisonous effects. A child three years old who had eaten a quantity of them became insensible, with slow, deep, sobbing respiration, slight twitching of the mouth, icy-cold extremities, lividity of the finger-nails, and dilated pupils. It was restored by an emetic (Keating). In other cases active vomiting and purging, with convulsions, have been observed. The possibility of these effects having resulted from the indigestibility of the kernels should not be overlooked. The leaves, and also the flowers, may be prescribed in an infusion, and a syrup prepared from them or from the bark has also been used.

PETROLATUM, *U. S.*—Petrolatum.

The U. S. Pharmacopœia recognizes three varieties of petrolatum, which are officially designated as Petrolatum Liquidum, P. Molle, and P. Spissum; they are all mixtures of hydrocarbons, chiefly of the marsh-gas series, and are obtained by distilling off the lighter and more volatile portions from petroleum until the residue has reached the desired consistence or has attained the desired melting point, and then purifying it by filtration through a long column of well-dried granular bone-black, the temperature being kept at from 40°–50° C. (104°–122° F.), or even higher, so as to keep the product in a melted condition while percolating through the charcoal. The first portion of the percolate is colorless or nearly so; the subsequent portions are more colored. The bone-black retains nearly its own weight of the soft paraffin. The crude paraffin which settles in the storage-tanks of coal oil is first deprived of the lighter hydrocarbons by distillation, and is afterward filtered as above. Crude paraffins are also extensively purified by treatment with sulphuric acid and subsequent washing with water and caustic soda solution before filtration through bone-black.

Petrolatum liquidum, *U. S.*; Paraffinum liquidum, *P. G.*; Liquid petrolatum, *E.*; Flüssiges Paraffin, *G.*

"A colorless, or more or less yellowish, oily, transparent liquid, without odor or taste, or giving off, at most, only a faint odor of petroleum when heated. Specific gravity, about 0.875 to 0.945 at 15° C. (59° F.). Insoluble in water; scarcely soluble in cold or hot alcohol or in cold absolute alcohol; but soluble in boiling absolute alcohol, and readily soluble in ether, chloroform, carbon disulphide, oil of turpentine, benzin, benzene, and fixed or volatile oils. When heated on platinum, liquid petrolatum is completely volatilized, without emitting any acrid vapors. The alcoholic solution of liquid petrolatum is neutral to litmus-paper. If 5 Gm. of liquid petrolatum be digested, for half an hour, with 5 Gm. of sodium hydroxide and 25 Cc. of water, the aqueous layer separated and supersaturated with sulphuric acid, no oily substance should separate (absence of fixed oils or fats of animal or vegetable origin, or of resin). If 2 volumes of concentrated sulphuric acid be added to 1 volume of liquid petrolatum, melted in a test-tube placed in hot water, and the contents occasionally agitated during fifteen minutes, the acid should not acquire a deeper tint than brown, nor lose its transparency (limit of readily carbonized organic impurities)."—*U. S.*

The Germ. Pharm. demands a colorless, clear, non-fluorescent, odorless and tasteless, oil-like liquid, having at least the specific gravity 0.880, and not boiling below 360° C. (680° F.).

Petrolatum molle, *U. S.*; Paraffinum molle, *Br.*; Unguentum paraffinum, *P. G.*; Paraffinum unguinosum, Adeps petrolei.—Soft petrolatum, Soft petroleum ointment, Paraffin jelly, Soft paraffin, *E.*; Paraffinsalbe, Paraffin-butter, *G.*

When petrolatum is prescribed or ordered without further specification, soft petrolatum (petrolatum molle) is to be dispensed.—*U. S.*

"A fat-like mass, of about the consistence of ointment, varying from white to yellowish or yellow, more or less fluorescent when yellow, especially after being melted, transparent in thin layers, completely amorphous, and without odor or taste, or giving off, at most, only a faint odor of petroleum when heated. If a portion of soft petrolatum be liquefied and brought to a temperature of 60° C. (140° F.), it will have a specific gravity of about 0.820 to 0.840. The melting-point of soft petrolatum ranges from about 40° to 45° C. (104° to 113° F.). In other respects soft petrolatum has the characteristics and should respond to the tests given under Liquid Petrolatum."—*U. S.* (See Petrolatum Liquidum.)

Soft paraffin, *Br.*, melts at 35°–40° C. (95°–105° F.), and has at the melting-point the specific gravity 0.840–0.870.

Unguentum paraffini, *P. G.*—Melt together solid paraffin 1 part and liquid paraffin 4 parts. This is somewhat crystalline, and on exposure becomes harder from the slow evaporation of the liquid portion. It is not a suitable substitute for petrolatum.

Petrolatum spissum, *U. S.*—Hard petrolatum.

"A fat-like mass, of about the consistence of cerate, varying from white to yellowish or yellow, more or less fluorescent when yellow, especially after being melted, transparent in thin layers, completely amorphous, and without odor or taste, or giving off, at most, only a faint odor of petroleum when heated. If a portion of hard petrolatum be liquefied, and brought to a temperature of 60° C. (142° F.), it will have a specific gravity of about 0.820 to 0.850. The melting-point of hard petrolatum ranges from about 45°

to 51° C. (113° to 125° F.). In other respects hard petrolatum has the characteristics and should respond to the tests given under Liquid Petrolatum."—*U. S.* (See Petrolatum Liquidum.)

Action and Uses.—This preparation is intended to be used as a substitute for lard in making many ointments, and for oil as a protecting and lubricating substance. It is absolutely unirritating, and has the advantage of not becoming rancid by keeping. As Randolph has shown, it is valueless as a food-stuff.

Ichthyol.—The eulogies of this preparation published by Baumann and Schrotten, Unna, v. Hebra, and other German dermatologists led to its general employment in *diseases of the skin*. They attributed its virtues mainly to the sulphur in its composition (Lorenz, *Therap. Gaz.*, xi. 693). It was used not only in every form of skin disease proper, including lichen, prurigo, urticaria, herpes zoster, etc., intertrigo, erysipelas, variola, but also for wounds, ulcers, burns, frostbite, and rheumatic joints, and was even given internally for the relief of laryngeal, pharyngeal, and gastro-intestinal disorders, and extravagant estimates of its virtues were proclaimed (*Centralb. f. Ther.*, iv. 411). It was even credited with removing a lipoma as large as a pigeon's egg (*Therap. Gaz.*, x. 755) when applied as an ammonium-ichthyo-sulphate of 50 per cent. strength. Like other unctuous substances, it was found a palliative of tonsillitis when applied with friction to the sides of the neck. Freund claimed for it a special power of resolving chronic indurations of the pelvic organs when topically or internally administered (*Am. Jour. Med. Sci.*, June, 1890, p. 617). As an internal medicine v. Nussbaum proclaimed its virtues in asthmatic complaints, digestive derangements, and pelvic neuralgia resulting from congestion, as well as "neuralgia of the bones, joints, and muscles" (*Bull. de Thérap.*, cxiv. 378). Hoffman and Lange lengthen the list of its virtues by its power over fermentative dyspepsia, comparable to that of carbolic acid (*Therap. Monatsh.*, iii. 218). On the other hand, not a few whose testimony is quite as credible, express an opposite opinion (*Boston. Med. and Surg. Jour.*, Oct. 1888, p. 384). The more general use of the preparation has greatly reduced the ground of its remedial claims. Many patients found its smell and taste intolerable, and others could not endure a stronger application of it than a 10 per cent. ointment. Dermatologists, in particular, agreed that its curative action was less real than had been alleged. (Compare Elliott, *Med. Record*, xxxi. 321; Stelwagen, *Jour. Cutan. and Vener. Dis.*, Nov. 1886.) The strength of ichthyol ointments varies from 5 to 50 per cent. Internally it has been given in capsules containing 10 per cent. of ichthyol in solution with ether, alcohol, glycerin, or water, and to the extent of Gm. 0.20–0.67 (gr. iij–x) three times a day. It may also be inhaled from a 25 per cent. watery solution (Mays, *Med. News*, liii. 175). (See also pp. 860, 861.)

Thiol, like ichthyol, is a product of chemical synthesis and has identical virtues, but is less offensive. It has been applied in a vaseline ointment 1 : 8, and also given internally in 2-grain pills three times a day (Schwimmer, *Therap. Monatsh.*, iv. 179).

PETROLEUM.—Petroleum.

Oleum petræ.—Rock oil, Coal oil, E.; *Pétrole, Huile minéral*, Fr.; *Steinöl, Bergöl*, G.; *Petroleo*, Sp.

Origin.—Petroleum is met with in several parts of North America, on the west coast of the Caspian Sea, and to a limited extent in most European countries. It oozes from the ground, frequently mixed with water, but is obtained in largest quantities from wells sunk in the ground. Its formation in the soil has been the subject of much speculation. Most frequently it is assumed to be produced by the distillation of fossil carbonized vegetable or animal matter under high pressure; but theories of its inorganic origin, elevated temperature, and considerable pressure being amongst the physical agencies, have also been maintained. Thus Byasson (1876) refers it to salt water charged with lime salts coming in contact with metals or their sulphurets; Mendelejeff (1887) to water and metallic carbides; and Ross (1891) to limestone ($CaCO_3$), hydrogen sulphide, and hydrogen peroxide, the gases being of volcanic origin.

Properties.—As naturally obtained, petroleum varies in consistence from thin limpidity to the thickness of molasses or tar, and in color from pale-yellow to blackish-brown, usually showing a distinct fluorescence. Its specific gravity is generally between 0.8 and 0.9, but some varieties slightly exceed water in density. The heavier and dark-colored kinds yield, on rectification, light and limpid oils, and leave a residue consisting of *paraffin* and solid *bitumen*, a variety of which is found native as *asphaltum*. The latter is black, glossy, and brittle, while the bituminous residues from coal-oil distillation

are less glossy and scarcely brittle at the ordinary temperature. The solid as well as the liquid fractions of petroleum are inflammable and burn with a bright sooty flame; the vapors of the more volatile kinds, mixed with atmospheric air, are highly explosive.

Barbadoes tar and *Seneca oil* are two varieties of petroleum which were formerly employed; they are viscid and dark-colored, the last named lighter, thinner, and of a less disagreeable odor than the former.

Constituents.—Petroleum consists of a large number of hydrocarbons, belonging to two homologous series—namely, that of *marsh gas*, of the general formula C_nH_{2n+2} (see PARAFFINUM), and of *olefiant gas* (olefin or ethylene series), having the formula C_nH_{2n}. On treating petroleum with strong sulphuric acid the olefins, coloring matter, and some other constituents are removed, and the hydrocarbons of the paraffin series left. The hydrocarbons of both series exist also in isomeric modifications which differ from the normal compounds in volatility and some other properties. Those containing C_4 and less are gases at the ordinary temperatures; the relation of the others is shown by the following table (see also PARAFFINUM):

		Normal.	Iso.			Normal.	Iso.
Pentane, C_5H_{12},	boils at	38° C.	30° C.	Pentene, C_5H_{10},	boils at	37° C.	35° C.
Hexane, C_6H_{14},	"	70° C.	62° C.	Hexene, C_6H_{12},	"	70° C.	65° C.
Heptane, C_7H_{16},	"	98° C.	90° C.	Heptene, C_7H_{14},	"	100° C.	——
Octane, C_8H_{18},	"	124° C.	118° C.	Octene, C_8H_{16},	"	125° C.	——

These compounds are to some extent separated by fractional distillation. The portion boiling below 50° C. (122° F.), being collected by itself, constitutes *naphtha* or *gasolene*, and consists almost exclusively of pentane and pentene; but if the vapors are well refrigerated the product contains also *butane*, C_4H_{10}, boiling at 1° C. (33.8° F.), and constitutes *rhigolene*, which requires to be kept in strong and well-corked bottles and in a cool place, since it evaporates rapidly at the common temperature. The naphtha freed from the low-boiling hydrocarbons is commercially known as *benzin* or *petroleum benzin* (see page 333); its specific gravity is about .67. The portion boiling at a higher temperature is separately collected and furnishes *kerosene*, *photogene*, or *coal oil*, which is largely employed for illuminating purposes; its safety for that use depends upon the absence of the low-boiling hydrocarbons. At a still higher temperature paraffin oils, paraffin jelly, and paraffin wax (see PARAFFINUM) pass over, and the residue left in the still at a temperature of about 300° C. (572° F.) constitutes the ordinary *asphaltum* or *bitumen*. Heptane was ascertained by Thorpe (1879) to be a constituent of the volatile oil of Pinus Sabiana (see page 1158).

OLEUM PETRÆ ITALICUM, s. Petroleum crudum. Yellowish or reddish, limpid, iridescent, of a peculiar bituminous odor, soluble in fixed and volatile oils, in ether and absolute alcohol, with difficulty soluble in alcohol; specific gravity 0.75 to 0.85. This is sometimes employed in Europe.

Action and Uses.—Taken internally in excessive doses, petroleum has caused thirst, burning in the throat and stomach, oppression, giddiness, palpitation, faintness, and headache, but only exceptionally a tendency to stupor, or even sleep. In one case frightful tonic and clonic convulsions occurred; in another the pulse fell from 82 to 48, the pupils were contracted, the skin hot, the respiration hurried, and the voice weak. It is remarkable that it does not produce vomiting, nor, usually, diarrhœa. In one case 5 ounces (*Med. News*, xlvii. 658), and in another about a pint (*Med. Record*, xxviii. 348), was taken with suicidal intention. Both persons recovered. In only one case is death said to have resulted from it, with symptoms of gastro-enteritis, on the twentieth day after the oil was taken. The urine has a peculiar aromatic odor, and a large proportion of the oil may be recovered from it. Sometimes it is albuminous. The vapor of the oil produces a state resembling alcoholic intoxication, but the pupils are contracted, the eyes are staring, and cyanosis sometimes occurs. The workers in refining petroleum are subject to erythematous and vesicular eruptions, due, probably, to the sulphuric acid employed (*Med. News*, lii. 554; liii. 150, 152). Wielczyk states, regarding the petroleum miners in the Carpathians, that when they remain long exposed to its vapors they suffer from noises in the ears, luminous spectra, throbbing of the arteries, syncope, stupor, and hallucinations. They are, however, exceptionally free from phthisis, bronchitis, and diseases of the skin (*Bull. de Thérap.*, cxi. 374).

The oil has been highly esteemed for the cure of *tapeworm* and other verminous affections, and for overcoming *retention of urine* caused by atony of the bladder, and also credited with singular virtues as an embrocation in *paralysis*, *contraction*, and *stiffness* of

the *joints*, atonic *rheumatism*, and *tumors*, *burns*, *chilblains*, etc. The popular use of it as a remedy for *itch* has been imitated by physicians, and many cures by its means have been reported. It is said to be one of the promptest of the remedies for this affection, but it is also stated by eminent authorities not only to fail in a majority of cases, but in some to be a painful application, and to produce sleeplessness, intoxication, and eczematous eruptions of the skin. It has been found curative in *prurigo*. Kaposi recommends as the best remedy for *pediculi* the following liniment, well rubbed into the skin: Petrolei venalis, Gm. 100; Ol. olivæ., Gm. 50; Balsam Peruvian, Gm. 10—for one or two days, and then washed out with soap and water. Dr. Frayer used petroleum in the treatment of *wounds*, and regarded it as possessing "some, if not all, of the advantages assigned to carbolic acid for this purpose." The ancient use of this substance for the cure of chronic *bronchitis* has been revived with such advantage as attends the administration of various terebinthinate and balsamic medicines (*Practitioner*, xxiv. 375). For this purpose the crude oil is greatly to be preferred to the refined, and wherever petroleum is manufactured it is considered a sovereign remedy not only for bronchitis, but for all other mucous profluvia, as well as for internal lesions of every sort (Blache, *Bull. de Thér.*, xcv. 489; Campardon, *ibid.*, xcvii. 463). It has been applied with alleged success to the removal of *diphtheritic* false membranes (*Bull. et Mém. Soc. thérap.*, Juin, 1882, p. 135; *Phila. Med. News*, xli. 509), and suggested as a remedy for *favus* (*Boston Med. and Surg. Jour.*, Nov. 1882, p. 453).

Petroleum may be given internally in doses of Gm. 0.30–0.60 (gtt. v–x) in the same way as oil of turpentine. For the cure of tapeworm larger doses, such as Gm. 2 (ʒss), may be used. In liniments its odor may be partially masked by that of some agreeable essential oil. It is sometimes united with cosmoline, which renders it easy of application in all of the external diseases mentioned above. Its operation and advantages are nearly identical with those of paraffin and vaseline. Petroleum may be administered in capsules, but as this method allows the pure oil to irritate the stomach, it is preferably given in an emulsion made with white of egg, sugar, and tragacanth, so as to form a semiliquid mixture.

Oleum deelinæ, a product of petroleum made by the "Dee Oil Company" (Eng.), is recommended by Roberts and others as an application after the acute stage of *eczema*, and in *pityriasis capitis* after the parts have been cleansed by a warm bran or oatmeal bath (*Practitioner*, xxxiv, 401; xxxix. 287; *Edinb. Med. Jour.*, xxxi. 922). It should be diluted with a neutral oil.

Rhigolene, or Amyl hydride. Used with an ordinary hand spray-producer, furnished with metal tubes, it readily produces a temperature of 15° below zero F. It is therefore more reliable than ether for this purpose, although if its application be too long continued, it may cause frostbite, and even mortification. Richardson recommends a mixture of equal volumes of anhydrous ether and rhigolene. It was used in a great variety of cases in which local anæsthesia was required to render certain surgical operations painless, but it does not seem to have commended itself to general adoption, on account probably of its explosiveness when in contact with flame.

Dr. B. W. Richardson recommends for *burns* a solution of 1 drachm of spermaceti and 1 drachm of camphor in 2 fluidounces of rhigolene. The anæsthetic action of the rhigolene is succeeded by the protective action of a film of camphorated spermaceti. The mixture should be applied on cotton. A solution of iodine in amyl hydride applied to *wounds*, *ulcers*, etc. acts in a similar manner. Such a solution (gr. v to fʒj) may be used in spray for inhalation; and by shaking a strong solution of ammonia with rhigolene and then decanting the water, an antiseptic solution for inhalation is obtained. Dr. Stabler has extended this method to the use of olive and almond oil in rhigolene (2 : 6), and has found that various other medicinal substances may be similarly used—*e. g.* copaiba, cubeb oil, iodol, iodoform, oil of turpentine, thymol, etc. Cocaine dissolved in alcohol and mixed with castor oil and rhigolene makes a perfect solution (*Med. News*, l. 429).

PETROSELINUM.—Parsley.

Persil, Fr.; *Petersilie*, G.; *Peregil*, Sp.

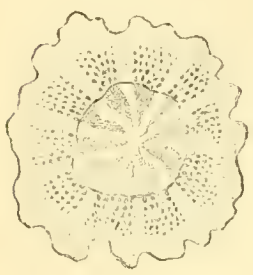
The root of Petroselinum sativum, *Hoffmann*, s. Apium Petroselinum, *Linné*.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—Parsley is indigenous to Southern Europe, and is much cultivated for culinary purposes. It is a biennial, has bi- or tri-pinnate smooth and shining leaves, with ovate wedge-shaped three-cleft toothed or crisp leaflets.

Description.—Radix petroselini. The root is 15–20 Cm. (6 or 8 inches) long, 12–25 Mm. ($\frac{1}{2}$ to 1 inch) thick, when dry pale brown-yellow externally, annulate above, longitudinally wrinkled below, and marked with transverse corky ridges; it breaks with a short and mealy fracture, upon which is seen a thick white and in the inner layer radially striate bark, a fine dark-colored cambium-line, and a yellow, soft meditullium with irregular medullary rays. The bark and medullary rays contain scattered brown resin-cells. The root is faintly aromatic and has a sweetish taste.

Fig. 207.



Parsley-root: transverse section, magnified 3 diameters.

Fructus petroselini. The fruit is 1.5–2 Mm. ($\frac{1}{16}$ to $\frac{1}{12}$ inch) long, ovate, laterally flattened, greenish-brown, each mericarp with five light brown-gray filiform ribs and six oil-tubes, and has a strong aromatic odor and a warm taste.

Constituents.—The root contains starch, mucilage, sugar, volatile oil, and *apiin*, $C_{24}H_{28}O_{13}$. The latter is best obtained from the fresh herb by boiling with water, expressing while hot, and purifying the green gelatinous precipitate which forms on standing by dissolving it in hot water. It was discovered by Braconnot (1843), and is a white, inodorous, and tasteless powder, perhaps a glucoside, soluble in boiling water and alcohol, separating on cooling jelly-like; the hot aqueous solution acquires a blood-red color on the addition of ferrous sulphate.

The fruit was examined by C. Rump (1836), and found to contain 1.4 per cent. of volatile oil and 22 per cent. of fixed oil, besides mucilage and other common principles. *Oil of parsley* is colorless or yellowish, has the specific gravity 1.01 to 1.14, dissolves in $2\frac{1}{2}$ parts of 80 per cent. alcohol, commences to boil near 170° C. (338° F.), and consists of a hydrocarbon, $C_{10}H_{16}$, and a stearopten, $C_{12}H_{14}O_4$. This *parsley camphor* crystallizes in silky needles or prisms which fuse at 30° C. (86° F.) and are partly sublimable; it is readily soluble in strong alcohol, ether, and fixed and volatile oils, and has a faint odor of parsley and a camphoraceous, pungent taste.

Joret and Homolle (1855) separated from parsley-fruit *apiol*, by exhausting with alcohol, treating the tincture with animal charcoal, distilling off three-fourths of the alcohol, dissolving in ether, evaporating the ethereal solution, macerating the residue with levigated litharge, and filtering through charcoal. A simpler process was recommended by L. Wolff (1877). The fruit is exhausted with petroleum benzin, the solvent evaporated, and the residue treated with strong alcohol, on the evaporation of which apiol is left. It is a colorless oil of spec. grav. 1.07, becomes turbid without congealing at −12° C. (10.4° F.), has an acid reaction, the odor of parsley, and a pungent taste, forms a kind of emulsion with alkalies, and is easily soluble in alcohol, ether, chloroform, and in glacial acetic acid.

Allied Plant.—Apium graveolens, *Linné.*—Celery, *E.*; Ache Cèleri, *Fr.*; Sellerie, Eppich, *G.*; Apio silvestro, *Sp.*—A biennial plant indigenous to Europe, where it grows wild in ditches and meadows. It has a spindle-shaped whitish root, which, like the dark-green glossy pinnate or ternate lobed and coarsely serrate leaves, has a disagreeable odor, an acrid bitter taste, and is regarded as poisonous. Under cultivation the root becomes short, thick, tuberous, juicy, and of an agreeable flavor, and with the blanched stalks is much used as a salad. The fruit (Fructus apii, *celery-seed*) is about 1–1.5 Mm. ($\frac{1}{25}$ to $\frac{1}{16}$ inch) long, roundish-ovate, laterally flattened, brown, with lighter-colored ribs, and smooth; the mericarps are usually separate, somewhat curved, flat on the face, and contain about twelve thin oil-tubes; odor and taste are agreeably aromatic. All parts of the cultivated plant contain volatile oil, sugar, mucilage, and fat; the root and leaves also mannit.

Action and Uses.—In modern as in ancient times parsley has been used as a carminative, disentient, and diuretic. The root is said to be more actively diuretic than the rest of the plant; its fruit resembles in its action those of fennel, anise, etc., and its peculiar oil, apiol, acts in part after the manner of essential oils.

Freshly-bruised parsley-leaves are a popular remedy for the "weed," or the engorgement of the mammæ at the commencement of lactation, and for threatening abscess of these and other external *glands*. In like manner they are employed to dry up the milk. A decoction of parsley-root is useful in relieving *strangury* from cantharides and turpentine, and the painful micturition attending attacks of *gravel*. An infusion of the dried leaves and the juice have been used to cure *gonorrhœa*, and also *periodical fevers* and *neuralgia*; but the seeds are said to be superior to either in the treatment of intermittent fever when given in the form of a recently-prepared and strong decoction. Its repulsive smell and taste render it a very ineligible remedy, and it is now supplanted by apiol, to

which identical therapeutic powers are ascribed. The value of this agent as an antiperiodic is no better established than that of the almost innumerable medicines which are reported to cure periodical affections. The case is different in regard to *amenorrhœa*, *scanty menstruation*, and *dysmenorrhœa*, in which its efficacy is demonstrated whenever these affections appear to be owing to a want of activity and power in the ovarian nisus; in a word, in all those cases for which direct emmenagogues are considered appropriate. It must not be forgotten, however, that the state in question is often subordinate to or associated with a general atony of the system, which requires for its cure tonics, hæmatics, and hygienic agents. Apiol has been used successfully in cases of *fetid menstruation* (*Boston Med. and Surg. Jour.*, Nov. 1880, p. 482).

Powdered parsley-seeds may be given in doses of Gm. 0.60–1.00 (gr. x–xv). The root should be employed in the recent state, and generally in strong infusion. Apiol may be administered two or three times a day in doses of Gm. 0.30 (gtt. v–vj) enclosed in gelatin capsules. In the uterine disorders above referred to the use of the medicine should be commenced four or five days before the menstrual period.

Celery-juice and the infusion of the herb or roots have been long employed for the same purposes as parsley, as well as for chronic *bronchitis* and *intermittent fever*. The same preparations, or the bruised leaves and stalks, have been applied as stimulant and anodyne cataplasms to *contusions*, *glandular swellings*, etc.

PHALARIS.—Canary-seed.

Episte, Fr., Sp.; *Kanariensamen*, G.

The fruit of Phalaris canariensis, *Linné*.

Nat. Ord.—Graminaceæ.

Origin.—This annual grass is indigenous to the basin of the Mediterranean, and is cultivated for its fruit, which is much used as food for canaries and other birds.

Description.—The fruit is about 4 Mm. (⅛ inch) long, ovate or elliptic, flattened, enclosed by glossy, yellowish-gray paleæ, after the removal of which the fruit is smooth and brownish and internally white. It is inodorous and has a slightly bitter taste.

Constituents.—Like other graminaceous fruits, canary-seed contains starch, gluten, a little sugar, and fat; Dubuc ascertained also the presence in it of notable quantities of calcium chloride and of a brown bitter coloring matter.

Action and Uses.—Canary-seed is to be ranked with other amylaceous seeds as nutritious and emollient. It is familiar as a food for birds, and has been used by man for the same purpose, alone or mixed with wheat or rye flour. In medicine poultices have sometimes been made of it.

PHELLANDRIUM.—Phellandrium.

Fructus phellandrii, P. G.—*Five-leaved water-hemlock*, E.; *Phellandrie aquatique*, Fr. Cod.; *Fenouil d'eau*, Fr.; *Wasserfenchel*, G.

The fruit of Œnanthe Phellandrium, *Lamarck*, s. Phellandrium aquaticum, *Linné*.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—This biennial plant grows in swampy places and on river-banks in Europe and Northern Asia. It has pale-green pinnately dissected leaves, with ovate lobed or pinnately cleft leaflets, the submersed ones narrow and thread-like. The flowers are white, in compound umbels, with short linear involucral leaves.

Description.—The fruit is 3–5 Mm. (⅛ to ⅕ inch) long, ovate-oblong in shape, scarcely compressed, and narrowed above. The three dorsal ribs are broad and obtuse, the two lateral ones larger, the four grooves narrow, each with a single oil-tube, and two additional oil-tubes on the face of each mericarp. It is of a brown, and when collected in an unripe state of a blackish-brown, color, and has an unpleasant odor, recalling that of caraway, and a bitterish somewhat acrid taste.

Constituents.—Berthold (1818) obtained 1.5 per cent. of volatile oil, 7.8 of fat and wax, 4.9 of resin, and other unimportant principles. Smaller quantities, 0.5 to 0.8 per cent., of volatile oil were obtained by others. According to Pesci (1883), the greater portion of the volatile oil consists of *phellandrene*, which is a levogyrate terpene boiling at 171° C. (340° F.) and polymerized by heat. Frickhinger (1839) describes the volatile oil as being brownish-yellow, limpid, of spec. grav. 0.86, of neutral reaction, fulminating with iodine, and possessing the odor and taste of the fruit. Distilled with potassa, the alkaline distillate contained ammonia, but no other alkaloid; 186 ounces of the recently-dried

fruit yielded over 12 drachms of ammonium sulphate. The supposed alkaloid obtained by C. Fronefield (1860) was probably identical with Devay and Guillermond's (1852) *phellandrin*, which appears to be merely volatile oil; it is volatile, liquid, neutral, and soluble in alcohol, ether, and fixed oils.

Action and Uses.—Five-leaved water-hemlock has been compared in its action to conium, for it is said that some animals upon eating the fresh herb lose their muscular power, and that this effect is not produced by the dried herb. The essential oil prepared from it injected into a dog's veins in the dose of 10 grains caused dyspnœa, trembling, and anxiety for several hours. The fruit appears to be stimulant, diaphoretic, diuretic, and expectorant, and without a direct or exclusive action upon the nervous system. Although recommended sometimes as a remedy for dropsy, whooping cough, intermittent fever, etc., it is chiefly in chronic *bronchitis* that the virtues of the medicine are displayed. At a time when this affection was considered a form of consumption, phellandrium was reputed to be a remedy for the latter disease; but it is now certain that it could be useful in tubercular phthisis in so far only as it might diminish the bronchial secretion, as it does in simple bronchitis. It shares this virtue with numerous plants whose activity is due to their essential oil, but neither it nor they can be compared in efficiency with the terebinthinate and balsamic preparations. The *dose* of the powdered fruit is Gm. 2–4 (gr. xxx–lx). An infusion made with Gm. 16 in Gm. 250 (bruised fruit ℥ss in Oss of hot water) may be given in doses of 1 or 2 tablespoonfuls several times a day.

PHENACETINUM, *Br. Add., P. G.*—Phenacetin.

Para-acetphenetidin, Para-oxyethylacetanilid.—Phenacétine, Fr.; *Phenacetin*, G.
Formula $C_6H_4.OC_2H_5.NHC_2H_3O$. Mol. weight 178.63.

Phenacetin was first produced in 1887 by Kast and Hinsberg. Chemically, it may be looked upon as para-phenetidin, in which a hydrogen atom has been displaced by acetyl, C_2H_3O, or as acetanilid, in which a hydrogen atom has been displaced by the oxyethyl group, OC_2H_5.

Preparation.—When somewhat diluted nitric acid is allowed to act on melted phenol, C_6H_5OH, ortho- and para-nitrophenol are formed, $C_6H_4OHNO_2$, which are separated by distillation in a current of steam; the para-nitrophenol not volatilizing is purified by crystallization from hot concentrated hydrochloric acid, and is converted into sodium para-nitrophenol, $C_6H_4ONaNO_2$, by treatment with sodium hydroxide. The latter compound is converted into para-nitrophenetol, $C_6H_4OC_2H_5NO_2$, by the action of ethyl iodide or chloride, and this by nascent hydrogen into para-amidophenetol or para-phenetidin, $C_6H_4OC_2H_5NH_2$. By prolonged boiling with glacial acetic acid para-phenetidin is converted into para-acetphenetidin or phenacetin.

Properties.—Phenacetin occurs as colorless, inodorous, glistening, scaly crystals or as a white crystalline powder; it is almost tasteless, and very sparingly soluble in cold water (1400 parts P. G.), more freely soluble in boiling water (70 parts P. G.), and soluble in 16 parts of cold alcohol (Br. Add., P. G.) and 2 parts of boiling alcohol (P. G.); it also forms a colorless solution with sulphuric acid. Phenacetin melts at 135° C. (275° F.), and completely volatilizes when heated on platinum-foil. 1 grain (0.1 Gm. P. G.), boiled with 20 minims (1 Cc. P. G.) of hydrochloric acid for about half a minute (one minute, *P. G.*), yields a liquid which, diluted with ten times its volume of water, cooled, and filtered, assumes a deep-red (ruby-red, *P. G.*) coloration on the addition of chromic acid (3 drops of a 3 per cent. solution, *P. G.*).

Tests.—A cold saturated aqueous solution should not become turbid on the addition of bromine-water (absence of acetanilid). "A mixture of 5 grains of phenacetin with 2 fluidrachms of solution of potash, boiled, should yield no unpleasant odor when again boiled after the addition of 5 drops of chloroform" (*Br. Add.*). Since prolonged heating of phenacetin with caustic alkali solutions causes decomposition into acetic acid and para-amidophenetol, the last-mentioned test is unreliable, as the odor of phenyl isonitrile will be observed.

Derivative and Allied Compounds.—Iodophenine. If to a mixture of hydrochloric acid and a cold saturated aqueous solution of phenacetin be added a solution of iodine in potassium iodide and water, a fine crystalline precipitate of chocolate-brown color will be obtained, which is a compound of phenacetin and iodine, containing about 50 per cent. of the latter substance. If glacial acetic acid be used as the solvent for phenacetin in place of water and the solution warmed, iodophenine will be obtained in crystals of steel-blue color resembling potassium permanganate. It is insoluble in water, soluble with difficulty in benzene and chloroform, but more readily in

alcohol, glacial acetic acid, and boiling hydrochloric acid. It has a feeble iodine-like odor, a burning taste, and colors the skin yellow. Iodophenine melts at 130° C. (266° F.) with decomposition.

Methacetin, Para-acetanisidin, Para-oxymethylacetanilid, $C_6H_4OCH_3NHC_2H_3O$. This, the most formidable rival of phenacetin, differs from the latter, as the formula shows, in the substitution of a methyl group in place of an ethyl group. The process for its manufacture is identical with that for phenacetin, except that methyl iodide or chloride is used in place of the respective ethyl compound. It occurs in lustrous scaly crystals, colorless, odorless, and melting at 127° C. (260.6° F.). Methacetin is soluble in 350 parts of water at 15° C. (59° F.), and in 12 parts at 100° C. (212° F.); it is abundantly taken up by alcohol, acetone, chloroform, glycerin, and fixed oils. It may be distinguished from phenacetin by melting to an oily liquid if heated with water in insufficient quantity for solution, phenacetin being unaffected by this treatment; the liquid solidifies again on cooling. It has been recommended as an antipyretic and analgesic in much smaller doses than phenacetin.

Hydracetin, Acetylphenylhydrazine, $C_6H_5HN—NHC_2H_3O$. This antipyretic may be prepared by heating together phenylhydrazine and acetic anhydride, dissolving the product in boiling water, and crystallizing, or by prolonged action of glacial acetic acid on phenylhydrazine, distilling off the excess of acid, and crystallizing. It occurs in lustrous, colorless hexagonal prisms, odorless and practically tasteless, melting at 128.5° C. (263.3° F.); it is soluble in 50 parts of water at 15° C. (59° F.) and in 8–10 parts at 100° C. (212° F.). Hydracetin may be distinguished from phenacetin and methacetin by forming a colorless solution with sulphuric acid, which turns blood-red on addition of a drop of nitric acid. If added to silver or gold solutions, it precipitates the metals in the reguline state. Like phenylhydrazine, it is poisonous, exerting a solvent action on blood-corpuscles, and is cumulative in its effects. The dose internally is 0.01–0.06 Gm. ($\frac{1}{6}$–1 grain), not exceeding 0.125 Gm. (2 grains) daily. Externally a 10 per cent. ointment has been used against psoriasis in place of chrysarobin. Impure hydracetin appeared in 1888 under the fancy name of *pyrodin*.

Phenylhydrazine, $C_6H_5.NH.NH_2$, from which hydracetin, as also antipyrine and other substances, are prepared, is obtained by the reducing action of nascent hydrogen on diazobenzene, $C_6H_5N.N.OH$, which latter compound is formed by the action of nitrous acid, HNO_2, on aniline, $C_6H_5NH_2$. It is a colorless oily liquid, which boils at 233°–234° C. (451.4°–453.2° F.) and solidifies at a low temperature in tablets, melting at 23° C. (73.40° F.).

Phenocoll hydrochloride. Glycocollparaphenetidin hydrochloride, $C_6H_4.OC_2H_5.NH.COCH_2.NH_2.HCl$. This is one of the latest additions to the already large class of antipyretics, and is the result of efforts to produce a soluble phenacetin derivative retaining the valuable properties of the latter substance. The name of phenocoll is a contraction of phenetidin (para-amidophenetol) and glycocoll (amido-acetic acid), the two bodies which by interaction produce the new substance. It is usually prepared by acting on paraphenetidin with monochloracetylchloride, and then converting the newly-formed oxyethyl-monochloracetanilid into phenocoll by means of ammonia; the base is freed from combination by sodium hydroxide and purified by recrystallization from hot water; it readily neutralizes acids to form salts. Phenocoll hydrochloride occurs in the form of a white micro-crystalline powder, soluble at 15° C (59° F.) in 20 parts of water; it crystallizes from hot water in cubes, from hot alcohol in needles. Its solutions are neutral, from which the pure base is precipitated by ammonia, the fixed alkalies, and their carbonates in the form of white matted needles with one molecule of water of crystallization. The anhydrous base melts at 100.5° C. (212.9° F.), but the compound with water at 95° C. (203° F.). It is difficultly soluble in cold water, but readily in hot water and alcohol. Physiologically, the compound appears to possess advantages over other synthetical antipyretics in not having injurious effects upon the blood-corpuscles even when brought in direct contact with them. It is given in doses of 0.52 Gm. (8 grains) three times a day in powder or solution. Other salts of phenocoll have been prepared, the carbonate, salicylate, and acetate, the latter being soluble in 4 parts of water, and therefore well adapted for hypodermic use.

Action and Uses.—This is one of the many artificial compounds that reduce the pulse and temperature to the verge of death, with accompaniment of chilliness, sweating, cyanosis, etc. (See case by Hallopeter, *Med. News*, lv. 335). The remarkable power of phenacetin to control pain was probably suggested by its close analogy, in other respects, to antipyrine. It allays the pain in chronic muscular *rheumatism*, *sciatica*, and *gastralgia*. Yet it palliates, and sometimes removes, the acute pains of *articular rheumatism*, of *pleurisy*, of *dysmenorrhœa*, and of *migraine*, and also lessens the irritability of the larynx due to congestion in *laryngitis* and *whooping cough*. By allaying pain it tends to promote sleep, and in local inflammation and congestions to diminish swelling. It is said to have controlled *diabetes* and *polyuria* (Misrachi and Rifat, *Bull. de Thérap.*, cxiv. 48). These observations agree with Rumpf's conclusions, that the analgesic virtue of the medicine is greatest when the cause of pain is not permanent and organic. It relieves the pain of *acute neuritis*, but fails to palliate that of chronic *myelitis*, *arthritis*, *cystitis*, *metritis*, etc. (*Berlin. klin. Wochensch.*, No. 23, 1888). The advantage claimed for it over other antipyretics is that it is tasteless, rarely excites vomiting, diuresis, or diarrhœa, ringing in the ears, or cutaneous eruptions. According to Masius (*Lancet*, Mar. 1889,

p. 497), its antithermic action is prompter, but briefer, than that of antipyrine, while its tendency to cause rigors is greater. Being tasteless, phenacetin may be administered to children, as to adults, in powdered sugar or in wafers. Lactic acid promotes its solution. As an antithermic the dose is about Gm. 0.30 (gr. v.) every two or three hours; as an analgesic, single doses of Gm. 0.75–2 (gr. x.–xxx, must be given, beginning with smaller ones (max. dose, Gm. 1; max. daily quantity, Gm. 5, *Ph. G.*). For children the average dose is about 5 grains.

Methacetin reduces the pulse-rate and temperature in fever, and sometimes produces profuse sweating, collapse, and cyanosis, especially in persons already enfeebled. It has been employed in *typhoid fever* and *articular rheumatism*—in the latter, with some apparent advantage. In *neuralgia* its use has not been encouraging. The daily dose has varied from Gm. 0.50–1 (gr. vij–xv.)

Hydracetin, alleged by Guttmann (*Therap. Monatsh.*, iii. 330) to be the active constituent of pyrodin, is poisonous to rabbits, affecting all the excretory organs and tingeing the urine with disorganized blood-corpuscles. In daily portions of Gm. 0.1–0.15 (gr. iss–ij) and in divided doses it lowered the temperature by one to three degrees C., and in acute articular *rheumatism* appeased the pain, without otherwise affecting the course of the disease. Its continued internal use for seven days has produced symptoms of poisoning, and Ostricher (*ibid.*, p. 383) found that in a 10 per cent. lanolin ointment, used in *psoriasis*, the local effects were good, but its continued application caused weariness and heaviness of the limbs, pallor of the skin and visible mucous membranes, and in one case jaundice. Paschkis (1890) states that the alarming consequences of its absorption caused it to be laid aside (*Centralb. f. Ther.*, viii. 58. Compare Basch, *Ther. Gaz.*, xiv. 576.)

Phenedin is reported to be antipyretic and analgesic, but is rarely employed. Its dose is said to be Gm. 0.60 (gr. xij) a day in a single dose or in divided doses.

Phenocoll, like its congeners, reduces temperature and allays pain, especially of the *neuralgic* and *rheumatic* types, and hence is indirectly hypnotic. It is also diaphoretic, and imparts to the urine a dark color. The claims made for it as a remedy for intermittent fever have not been confirmed. The hydrochlorate is given in doses of Gm. 0.30–1 (gr. v–xv), but much larger ones have been used without injury.

PHORMIUM.—Phormium.

New Zealand flax (*hemp*), E.; *Lin* (*Chanvre*) *de la Nouvelle-Zélande*, Fr.; *Flachslilie*, *Neuseeländischer Flachs*, G.

The root and leaf-bases of Phormium tenax, *Forster*.

Nat. Ord.—Liliaceæ, Lilieæ.

Origin and Description.—The plant is indigenous to New Zealand and the Chatham Islands, has been introduced into Australia, the Azores, and other countries, and in temperate climates is cultivated as an ornamental hot-house plant. It has a fleshy rhizome, beset with nearly simple roots, and sending forth from its end a tuft of leathery, linear-lanceolate leaves, which are from 1.5–2.4 M. (5 to 8 feet) long and 7–10 Cm. (3 to 4 inches) broad. The leaves, sufficiently matured, are cut off above their base, the remaining portion attached to the rhizome, and, with the rootlets, constituting the drug. The straight fibres of the leaves, separated from the other tissue, are brought into commerce as New Zealand flax; they are cream-colored, of a silky lustre, tough, but rougher than hemp, and are mainly used for cordage. The flowering stalk attains a height of about 4.5 M. (15 feet).

Constituents.—The drug has not been subjected to analysis.

Uses.—New Zealand flax was made use of in a strong decoction by Mr. Monckton (*Therapeutic Gaz.*, ix. 320) as a dressing for all manner of lesions of continuity, including *lacerations and amputations*. As it readily deteriorated by fermentation, he added to each quart of the decoction about an ounce of equal parts of carbolic acid and glycerin. With this he washed the part and maintained cotton wool or lint soaked in it constantly, and declared that the discharges were altogether insignificant. Without further knowledge of the constitution and qualities of Phormium tenax, it would be unjust to suggest that its value is perhaps overestimated; but unless the results of its use without the adjunction of carbolic acid were furnished, we can scarcely refuse to the latter agent a large part in the success of the compound.

PHOSPHORUS, *U. S., Br., P. G.*—Phosphorus.

Phosphore, Fr.; *Phosphor*, G.

Symbol P. Atomicity trivalent and quinquivalent. Atomic weight 30.96.

Phosphorus should be carefully kept under water in a secure and moderately cool place, protected from light.—*U. S.*

Origin and Preparation.—Phosphorus exists, mostly as phosphates, in many minerals and in all plants and animals; the bones of the higher animals contain much phosphorus as tricalcium phosphate ($Ca_3(PO_4)_2$). Phosphorus was discovered by Brandt (1669) of Hamburg among the products of the dry distillation of urine, and about 1769 Gahn and Scheele detected the presence of phosphoric acid in bones, and the latter succeeded in isolating it in 1771. Phosphorus is made by treating calcined bones with sulphuric acid, decanting from the calcium sulphate, evaporating the solution of acid calcium phosphate, after mixing it with powdered charcoal and sand to complete dryness, gently igniting and distilling the residue, composed of calcium metaphosphate, charcoal, and sand, in a stoneware retort. The different steps in the manufacture of phosphorus may also be explained by the following chemical equations: 1st, $Ca_3(PO_4)_2 + 2H_2SO_4 = CaH_4(PO_4)_2 + 2CaSO_4$; 2d, $CaH_4(PO_4)_2 = Ca(PO_3)_2 + 2H_2O$; 3d, $2Ca(PO_3)_2 + 2SiO_2 + 10C_2 = P_4 + 2CaSiO_3 + 10CO$. In case the organic matter of bones is to be utilized in the manufacture of glue, the bones are treated with hydrochloric acid and the liquid treated as stated. The retort is connected with a wide bent tube which dips into water; a number of retorts are placed in each furnace, and after the distillation is completed the melted phosphorus is strained under water and run into tubes of suitable size, where it congeals. Phosphorus is manufactured in the United States, but much of it is still imported.

Properties.—Phosphorus is seen in commerce in the form of cylindrical sticks, which are nearly colorless or pale-yellow, transparent or translucent, of a waxy lustre, and about as hard as beeswax, and flexible at ordinary but brittle at low temperatures. It is inodorous and tasteless, but in contact with air it has an alliaceous odor and taste, and emits white vapors, which are luminous in the dark (phosphorescence). It is very easily inflammable in the air, burning with a brilliant white flame and giving off dense white vapors of phosphoric anhydride, and must be preserved and cut under water, in which it is insoluble. Its specific gravity is 1.830 at 15° C. (59° F.), U. S., 1.77 at 15.6° C. (60° F.), Br., and when fused at 44° C. is 1.743, but after purification with alcoholic potassa was found by Böttger to be 2.089 at 17° C. (62.6° F.). It melts at 44° C. (111.2° F.), U. S., P. G., at 43.3° C. (110° F.), Br., and may be cooled to 40° C. (104° F.) before it congeals again —under certain circumstances even to 4° C. (39.2° F.), as observed by Bellani (1813). Grotthuss (1810) obtained phosphorus in an oily condition after boiling it with alcoholic solution of potassa, and Kalhofert (1850) by slowly evaporating a solution of phosphorus in carbon disulphide from under water. Houston and Thompson (1874) made similar observations with phosphorus treated with hot potassa solution, and regard this oil as a modification of ordinary phosphorus. The boiling-point of phosphorus is 288° C. (550° F.), according to Dalton; 290°. C. (554° F.), Hager. Mitscherlich found it at 260° C. (500° F.); but it volatilizes slowly with the vapors of boiling water; the density of its vapor is 4.3. According to Joubert, phosphorus is not luminous in pure oxygen below 14° C. (57° F.) unless the pressure be diminished or the oxygen is mixed with an indifferent gas; the luminosity is prevented in the presence of hydrogen sulphide, of vapors of alcohol, ether, and other compounds. Phosphorus is soluble in alcohol, ether, fixed and volatile oils; it dissolves "in 350 parts of absolute alcohol at 15° C. (59° F.), in 240 parts of boiling absolute alcohol, in 80 parts of absolute ether, in about 50 parts of any fatty oil."—*U. S.* It is more freely soluble in sulphur chloride, chloroform, benzene, and abundantly so in carbon disulphide, the latter solution being extremely inflammable. Phosphorus crystallizes after fusion when slowly cooled, and from its solutions in volatile oils and carbon disulphide. It unites directly with oxygen, sulphur, chlorine, iodine, bromine, and with many metals, and precipitates some of the latter from their solutions. When kept in water and exposed to light and air it is superficially corroded, and becomes white and opaque (Baudrimont, 1865), while phosphorous acid is found in the water; the change does not take place in water which is free from air, nor does phosphorus lose its transparency when kept in the dark. This is due to the presence of a black body which is rather more volatile than ordinary phosphorus. Commercial phosphorus frequently contains a little arsenic, from which it cannot be freed by distillation.

Amorphous or Red Phosphorus.—This was discovered by Schrötter (1848) by heating ordinary or vitreous phosphorus for a long time to 250°–260° C. (482°–500° F.) in an atmosphere in which it cannot burn. It is an amorphous dark-red mass or powder, becomes nearly black on being boiled with potassa solution, is insoluble in simple solvents, remains unaltered in dry air, and enters into chemical combinations less readily than the ordinary variety. According to Hittorf (1865), it has the specific gravity 2.19, is infusible, volatilizes slowly above 260° C. (500° F.), and, according to Lemoine (1867), is best converted into ordinary or vitreous phosphorus by heating to near 450° C. (842° F.) in an atmosphere of nitrogen. At the temperature stated Hittorf observed it to be converted into another modification, which forms black laminæ of a metallic lustre, is less volatile even than amorphous phosphorus, but, like the latter, is gradually converted by heat into ordinary vitreous phosphorus.

Black Phosphorus.—As far back as 1800 it was reported that phosphorus when treated with ammonia gas would deposit a brownish-black powder; the same phenomenon was observed later on by Thenard, Vogel, Wild, and in 1865 by Blondlot. Prof. Flückiger, who carefully examined the subject in 1892, has come to the conclusion that the so-called black modification of phosphorus is nothing but arsenic in metallic form; by treating ordinary phosphorus repeatedly with ammonia-water of 0.920 sp. grav. until all phosphorus has been removed, mainly in form of phosphine, a black residue in powder form eventually remains, which is permanent in the air and was proven to be arsenic (*Arch. d. Phar.*, 1892).

Tests.—The impurities likely to be present in phosphorus are derived from the sulphuric acid used in its preparation, and are mainly arsenic and sulphur; a small proportion of the latter renders phosphorus hard and rather brittle at ordinary temperatures. "If 3 Gm. of phosphorus contained in a flask be digested at a gentle heat with a mixture of 15 Cc. of nitric acid and 15 Cc. of distilled water until it is completely dissolved, the solution evaporated until no more nitrous vapors are given off, then diluted with distilled water to the measure of about 30 Cc., hydrogen sulphide passed through 20 Cc. of the liquid while being heated for half an hour at about 70° C. (158° F.), and afterward until the liquid has become cold, not more than a trifling quantity of a lemon-yellow precipitate should appear after the lapse of twenty-four hours (limit of arsenic). On adding barium chloride test-solution to the remainder of the liquid, not more than a slight opalescence should be produced (limit of sulphur)."—*U. S.*

Compounds of Phosphorus.—Hypophosphorous Acid, H_3PO_2 (molecular weight 65.88), is formed by boiling phosphorus with milk of lime (see page 68) and under other circumstances. In its purest state it forms a thick uncrystallizable liquid:

Phosphorous Acid, H_3PO_3 (molecular weight 81.84), is formed on the slow oxidation of phosphorus in moist air, and forms a crystalline deliquescent mass. If phosphorus is slowly burned with a very limited supply of dry air, *phosphorous oxide* or anhydride, P_2O_3, is formed as a voluminous flocculent powder, which liquefies in the air by the absorption of moisture, and is gradually oxidized to phosphoric acid, or, heated in a close vessel, is decomposed into phosphoric acid and hydrogen phosphide.

Phosphoric oxide, P_2O_5 (molecular weight 141.72), and phosphoric acid are described on page 82.

Phosphorous acid and phosphites are rarely, if ever, employed in medicine. The phosphates and hypophosphites, which are sometimes used, are described under their appropriate heads. Of other chemical compounds only zinc phosphide has been employed.

Action and Uses.—The first employment of phosphorus in medicine is ascribed by some to Kinkel in 1721, and by others to Mentz in 1751. After them it was advocated from time to time during the last and the early part of the present century, and the most extravagant statements were published of its life-giving powers; but the numerous, and generally unforeseen, accidents that sometimes followed its administration caused it to be abandoned as a medicine, and to retain its interest for physicians chiefly through its operation as a poison. Within the last few years it has once more risen into notice—in a great measure, we must believe, through the influence of those chemico-physiological doctrines which still prevail, and the predominant part which the nervous system holds in the medical theories of the day, and possibly also because an increased number of nervous diseases is chargeable to the augmented luxury and wear and tear of modern life.

The following are the principal phenomena of acute phosphorus-poisoning: The first is usually a burning pain in the stomach and vomiting of matters which are more or less luminous in the dark. The heat extends to the whole abdomen, which may be tender

under pressure; the stools are loose, dark, bloody, and sometimes phosphorescent, and are voided with pain. The pulse and temperature are generally raised at first, but subsequently fall below the normal standard. Usually, there is general nervous excitement, sometimes headache, giddiness, fainting, sleeplessness, delirium, spasms, convulsions, followed by collapse, coma, coldness of the extremities, strabismus, and dilatation of the pupils. In other instances death is owing to exhaustion, the mind remaining clear. Meanwhile, from the second to the fourth day there is pain in the liver, with dark jaundice, and blood is passed by stool and in the urine, and may exhale from the gums or appear in ecchymoses of the skin. The urine is albuminous. After death the interior of the body is everywhere phosphorescent in the dark; the stomach is seldom widely inflamed, but chiefly in the pyloric extremity, where there may also be some ulceration, and the organ is apt to contain a bloody liquid. Sanguineous effusions are also found in other organs. The blood is dark and thick, but, according to most authorities, not easily disintegrated, and it contains an undue proportion of tissue-waste in the form of uric acid, creatine, etc. The liver is of a light-yellow color, and it, as well as the heart, capillary vessels, and kidneys, shows more or less distinct signs of fatty degeneration. The symptoms of chronic phosphorus-poisoning—as they occur, for instance, among lucifer-match makers—are briefly these: Bronchial irritation and dyspepsia; a straw-colored or grayish tint of the skin; extreme sensitiveness to cold; formication; stiffness and numbness of the limbs; softening, abscess, and ulceration of the gums; loss, and sometimes decay, of the teeth, with caries and necrosis of the jaw-bones. Usually there is hectic fever, and if the patient continue to work in phosphorus until its effects are fully developed, he is worn out by them or dies of consumption of the lungs. Phosphorus-necrosis of the jaws has been illustrated by Dr. J. Ewing Mears (*Phila. Med. Times*, xvi. 264). In a case of poisoning with lucifer matches phosphorus was found in the body three months after death (*Virchow's Archiv*, lxxxiii. 501). (For several later cases of phosphorus-poisoning see Huber, *Zeitsch. f. klin. Med.*, xiv. 479; *Therap. Monatsh.*, Mar. 1889, p. 126; Grose, *Lancet*, Nov., 1889, p. 902.)

Phosphorus has been employed chiefly in the treatment of diseases of the nervous system. It is useless, if not mischievous, in *epilepsy*. In *paralysis* following cerebral hæmorrhage or embolism, or their frequent consequence, softening, improvement may be attributed to phosphorus in the first case alone. But its value becomes more than doubtful when the tendency to spontaneous cure after this accident is borne in mind. Possibly its stimulant influence may quicken the operations of repair, but not without the risk of increasing the mischief. The same statement is essentially true of *spinal* paralysis; but as this affection is not, like the other, always associated with a substantial lesion, the cases of paraplegia benefited by phosphorus are numerous enough to deserve a certain consideration. The same statement is applicable to *locomotor ataxia*. The persistent but moderate and interrupted use of phosphorus has unquestionably in a few instances temporarily improved the power of locomotion in this disease, but it has not, any more than other remedies, effected a cure. In regard to this class of diseases it may well be said: "Phosphorus is a rapid stimulant, but it acts by causing waste, and not by increasing power; it impoverishes, and does not enrich. It momentarily galvanizes, as it were, the torpid functions, but is incapable of renewing a dilapidated constitution, or even a nervous system exhausted by chronic disease" (Gubler). Although in former years phosphorus was alleged to have cured *neuralgia*, it is only of late that it has been asserted to operate "with a rapidity, a certainty, and a permanency unequalled by the action of any other medicine in this or any other disorder" (Thompson). It is said to exhibit its virtues most conspicuously—indeed to be "apparently specific"—in neuralgia attended with extreme debility produced by hæmorrhage, lactation, etc. when the pain follows on exposure to cold, and especially when it affects the fifth nerve. Doses less than Gm. 0.005 (gr. $\frac{1}{12}$) of phosphorus every four hours are said to be inefficient, and it is added that if relief does not ensue in twenty-four hours, it is useless to persevere in this treatment. It is singular that if the medicine possesses such remarkable powers, they should not have been recognized and described by other observers. But notwithstanding the extreme frequency and intractability of this disease, phosphorus is not usually employed by physicians who have had the largest experience in its treatment. In certain cases of neuralgia of the heart, or simple *angina pectoris*, it is alleged to have entirely suspended the attacks. It has been used with probable advantage in chronic *psoriasis*, *lepra*, *lupus*, etc., but can seldom be necessary unless after the failure of more usual remedies. It was also credited with the cure of *pernicious anæmia* and splenic *leucocythæmia*, but a more extended and critical inquiry proved it to be useless.

There is some reason to believe that this medicine may be serviceable in functional asthenic *amaurosis*, but in no other form of that defect of vision. In *melancholia*, and even in *dementia*, it is alleged to be useful; and still more so in that state of *nervous exhaustion* and depression which follows excessive mental or even physical fatigue. In the latter case there is a rational as well as an empirical ground for supposing that it may occasionally do good. In regard to the reputed *aphrodisiac* action of phosphorus authorities differ; for while one of its most moderate expositors (Lemaire) declares that if any power belongs to the drug it is certainly this, the most extravagant of its eulogists (Thompson) concludes that phosphorus is not an aphrodisiac, unless given in a larger dose than it is safe to employ for remedial purposes. In poisonous doses it certainly exerts this power upon man and animals, but only as a transient influence which is soon succeeded by general insensibility.

Kassowitz claimed (*Zeitsch. f. klin. Med.*, vii. 36, 193) to have found in phosphorus a more efficient remedy for *rachitis* than any that has been hitherto employed, and yet he administered it in the minute dose of $\frac{1}{2}$ Mgm. (gr. $\frac{1}{128}$) a day. A wider experience of its use has proved it to be of little value in this disease (Comby, *Archives gén.*, 1888, i. 627; Schabanowa, *Therapeut. Monatsh.*, iii. 423).

In *poisoning* by phosphorus it has been usual to administer lime-water, magnesia, or charcoal, with the intention of producing its chemical combination with the two first-mentioned substances, and its mechanical mixture with the last. It should be borne in mind, however, that phosphorus does not act primarily as a corrosive poison, like several acids, and that its local gastric lesions are quite disproportioned to those which are due to its absorption. It may also be remarked that, under ordinary circumstances, the contents of the stomach do not favor the combustion of phosphorus. Oil of turpentine has been proved by numerous experiments and by some clinical observations to be capable of arresting the poisonous phenomena (*Guy's Hosp. Rep.*, xli. 13). It should be administered in doses of from 15 to 30 drops every half hour for several hours, and meanwhile all albuminous and oily substances should be withheld. An agent the very opposite in its chemical properties to this hydrocarbon has been recommended by Percy, who claims that oxygenated water by the stomach and the inhalation of oxygen gas are the true antidotes to phosphorus, by converting it into hypophosphorous and phosphoric acids, which are comparatively innocuous. This conclusion is supported by experiments on animals. Still more recently potassium chlorate has appeared to have an antidotal and curative effect (*Amer. Jour. of Med. Sci.*, Oct. 1882, p. 575).

The dose of phosphorus is variously stated as between Gm. 0.002–0.016 (gr. $\frac{1}{30}$–$\frac{1}{4}$). Those who have most advocated its use recommend that a first dose of Gm. 0.003 (gr. $\frac{1}{128}$) should be repeated every four hours until six doses are taken. If then no improvement has occurred, the dose should be increased to Gm. 0.005 (gr. $\frac{1}{12}$), and repeated in the same manner as before. Of the authorities in this matter some recommend that the medicine should be given before and some after meals. Phosphorus was originally administered in ether or alcohol, and more recently dissolved in almond oil, olive oil, cod-liver oil, glycerin, chloroform, etc., or mixed with cocoa butter, wax, soap, spermaceti, and formed into pills coated with gelatin; or, finally, in capsules containing phosphorized oil (1 : 100). Each capsule should contain 1 Mgm. (gr. $\frac{1}{65}$) of phosphorus. The following formula has been recommended: ℞. Phosphori gr. ij; Carbon. bisulphid. q. s.; solve; Saponis, Guaiaci resinæ, āā gr. xxxv; Glycerinæ gtt. xij; Pulv. rad. glycyrrhiz. gr. xij.—M. Ft. mass. Divide into pills of the required strength and coat with gelatin or varnish.

PHYSOSTIGMA, *U. S.*—Physostigma.

Physostigmatis semen, Br.; *Faba calabarica.*—*Calabar bean*, *Ordeal bean*, E.; *Fève de Calabar*, Fr.; *Kalabarbohne*, G.; *Haba de Calabar*, Sp.

The seed of Physostigma venenosum, *Balfour*. Bentley and Trimen, *Med. Plants*, 80. *Nat. Ord.*—Leguminosæ, Papilionaceæ.

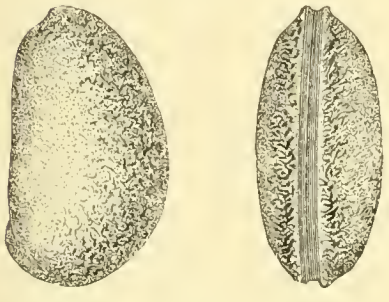
Origin.—This plant is a woody climber growing near the mouths of the Niger and of Old Calabar River in Western Africa, and attaining a length of 12 or 15 M. (40 or 50 feet). It somewhat resembles the scarlet runner or Spanish bean of our gardens. The purple flowers are in pendulous racemes, originating from tubercular knots to the number of two or three. The curved style bears at its apex a triangular fleshy reflexed appendage. The pale-brown, reticulately-veined legumes contain two or three seeds. The plant was described by Balfour in 1861, and has been introduced into India and Brazil.

Description.—The seeds are 25–30 Mm. (1 to $1\frac{1}{4}$ inches) long, 15–20 Mm. ($\frac{3}{5}$ to $\frac{3}{4}$ inch) broad, and 10–15 Mm. ($\frac{2}{5}$ to $\frac{3}{5}$ inch) thick, oblong, and more or less reniform in shape. A well-marked black furrow, the hilum, with a ridged border, extends along the convex edge from one extremity of the seed to the other, and contains in the centre the thread-like raphe. The seed has a brittle, somewhat polished, granular testa of a chocolate-brown color, two white cotyledons adhering to the testa and concave upon the inner surface, thus enclosing a rather large cavity; along the hilum each cotyledon is marked with a long shallow black groove. The short radicle is situated at one end, and its position is externally indicated by the small depressed micropyle. Calabar beans are inodorous, but on the evaporation of the tincture an odor resembling that of cantharides is given off. Their taste is nearly like that of the ordinary bean. On being moistened with potassa solution the cotyledons become pale-yellow.

The seed of another species was observed by Holmes (1879) among the commercial drug. The plant was described by Oliver as Mucuna cylindrosperma, *Welwitsch*, but should evidently be called Physostigma cylindrosperma. The seeds are about 44 Mm. ($1\frac{3}{4}$ inches) long, nearly cylindrical, of a dark reddish-brown color, and have a shorter hilum, not extending quite to the end where the micropyle is visible. The cotyledons acquire with alkalies a deep-yellow color.

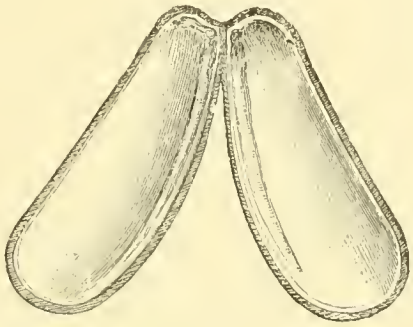
Constituents.—The poisonous principle of Calabar bean is the alkaloid *physostigmine*, which was isolated by Jobst and Hesse (1864), and by the latter (1867) ascertained to have the composition $C_{15}H_{21}N_3O_2$. Vée (1865) proposed to call the alkaloid *eserine*. It is obtained by mixing powdered Calabar bean with 1 per cent. of tartaric acid, exhausting with alcohol, evaporating the solvent, treating the residue with water,

Fig. 208.



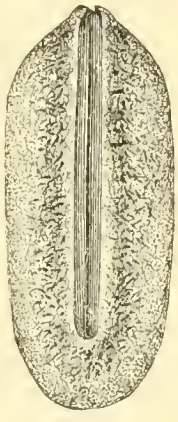
Calabar Bean: view from the side and edge, showing length of hilum.

Fig. 209.



Calabar Bean, split, showing cotyledons.

Fig. 210.



Phys. cylindrosperma seed.

agitating the filtrate with ether as long as the latter becomes colored, then supersaturating with potassium or sodium bicarbonate, and again agitating with ether; on evaporating the ether physostigmine is left behind in a colorless, amorphous condition. The crystals obtained by Vée were isolated by Hesse (1877) and found to be *physosterin*, an indifferent body resembling cholesterin, and crystallizing from ether, chloroform, and petroleum benzin in silky needles, and from hot alcohol in scales. Physostigmine becomes soft at 40° C. (104° F.), and is liquid at 45° C. (113° F.); it is readily soluble in alcohol, ether, benzene, carbon disulphide, and chloroform, less freely so in water, and neutralizes acids completely; it even precipitates ferric hydroxide from a solution of ferric chloride. The pure alkaloid and its salts are tasteless; their solutions yield with Mayer's reagent a white precipitate which is readily soluble in ether and alcohol and crystallizes from the latter in prisms. Physostigmine is colored red by chlorinated lime, and becomes colorless again by more of the reagent. Nitric acid dissolves the alkaloid with a yellow color, sulphuric acid with yellow, turning olive-green. On adding excess of ammonia to the solution of a salt and heating the mixture upon a water-bath, the liquid turns successively red, orange-red, yellow, green, and blue. Alkalies color solutions of physostigmine red, producing the *rubreserine* of Duquesnel, and if now agitated with ether the ethereal solution will become blue or red on the addition of dilute sulphuric acid, the color depending on the degree of decomposition undergone by the alkaloid. The formation of rubreserine can be seen even in a dilution of 1 to 64,000 if the reaction is obtained on a white porcelain dish (Eber, 1888). Rubreserine crystallizes from its solution in chloroform, and, according to Harnack and Witkowski (1880), is insoluble in pure ether; its red color

disappears in presence of sulphurous acid, but reappears on the evaporation of the latter. PHYSOSTIGMINA is official in Br. P.

Harnack and Witkowski (1876) succeeded in isolating a second alkaloid, *calabarine*, which produces tetanic effects in cold-blooded animals. It is obtained from the liquid from which physostigmine has been separated by precipitating it with lead subacetate and ammonia, evaporating the filtrate, treating the residue with alcohol, precipitating with phosphotungstic acid, and decomposing with baryta. This alkaloid is soluble in alcohol and water, insoluble in ether, and its mercuric double iodide is insoluble in water and alcohol. Subsequently (1880) the same authors ascertained that calabarine is formed in solutions of physostigmine; for instance, under the long-continued influence of hydriodic acid.

According to Teich (1867), Calabar bean contains 48 per cent. of starch, 3.65 of nitrogen, indicating about 23 per cent. of proteids, and 3 per cent. of ash, chiefly phosphate of potassium. Mucilage and a small quantity of fat are likewise present. The alkaloids appear to exist mainly in the cotyledons, but the testa likewise possesses medicinal activity.

Adulterations of Calabar bean have not been observed by us. The seeds of a Mucuna (cylindrosperma?) and of the oil palm have been mentioned, but bear no resemblance to the official article.

Action and Uses.—(For an account of this substance as an "ordeal bean" see STILLÉ, *Therapeutics, etc.*, 4th ed., ii. 320.) In excessive but not fatal doses physostigma causes pallor of the skin, giddiness, weakness and faintness, indistinctness of vision, contraction of the pupils, nausea or vomiting, an accumulation of liquid in the mouth, a feeble but rapid and tumultuous action of the heart, and a total inability to perform voluntary muscular acts. The muscles twitch, but there is a complete absence of pain in them and elsewhere. The contraction of the sphincters caused by it has induced retention of urine. In a few fatal cases of poisoning by this substance the following characteristic effects have been observed: Extreme muscular relaxation and debility, salivation, urgent nausea and vomiting; a slow, feeble, and almost insensible pulse, with coldness of the extremities and of the skin, which is covered with a cholera-like sweat. Some colic may be felt at first, but generally no pain is experienced, although a distressing oppression of the chest is complained of. The pupils are not usually contracted. There is much vomiting and purging, the respiration is rattling, and the face livid. Consciousness remains until death, which occurs without a struggle. It is probable that the whole chain of toxical phenomena occasioned by this substance is more readily explained by its immediate action upon the muscles or upon the nervous branches supplying them than by its operation upon the spinal axis. This conclusion is supported by the results of its direct application to the eye. It then produces a marked contraction of the pupil, which may last in a high degree for twelve to fourteen hours, and less conspicuously for several days. But the effect is confined to one eye if the application is limited to one; and if it be made also to the corresponding eyelids, they become paralyzed, but no general symptoms are exhibited. It seems probable that pupillary contraction by this substance is due to its dilating the blood-vessels of the iris, just as dilatation of the pupil by atropine is caused by its power of contracting the same blood-vessels. It is true that Falck states as the inevitable inference from experiments that physostigmine (eserine) acts as a stimulant upon the sphincter muscle of the iris (*Antagonismus der Gifte*, 1879). It is also true that neither of these antagonistic explanations affects the fact that eserine contracts the pupil.

Physostigma is frequently employed to contract the pupil; for example: "In *mydriasis* dependent upon the over-action of belladonna or as a symptom of amaurosis; in *iritis* and inflammation of the neighboring structures, where the prevention of adhesions may be more successfully secured by an alternation of contraction and dilatation than by dilatation alone; in injuries of the eyeball with displacement of the iris, etc." It favors the healing of *corneal ulcers*, such as so frequently occur in strumous children and are accompanied with extreme photophobia that maintains a constant irritation of the eye; and when perforation of the cornea occurs it also prevents *prolapse of the iris*. Even when this accident takes place eserine is the best agent for extricating the hernia of the iris. Sometimes the alternate action of atropine and eserine is better than that of either alone. It has been recommended in some cases of dislocated lens. In *photophobia* depending upon asthenia, and therefore on irritability of the nerves of the eye, eserine is very useful, and may render the employment of shades, dark rooms, etc. superfluous. It is equally so in *paralysis of accommodation* of the *iris*, such as follows diphtheria and other debilitating disorders. In the opinion of ophthalmologists eserine is a valuable pal-

liative of *glaucoma*. It combats "the particular displacement of the iris which is often the cause of the tension" (Priestley Smith), but is not in any sense a substitute for the operation of iridectomy. The operation of *iridectomy* is facilitated by the tension and increase of surface which the iris, under the use of this medicine, presents. *Night-blindness* has been successfully treated by instillations of a solution of eserine, which is supposed to act by augmenting the vascularity of the retina. When the sight is impaired by paralytic dilatation of the iris this medicine is a useful palliative of the defect. Of all the medicines which have cured *tetanus*, physostigma certainly holds the first place. In 1874 an analysis of published cases showed that out of sixty-three cases of traumatic tetanus treated by this medicine thirty-three recovered. Since then this unusual proportion of cures of a disease which was before nearly always fatal has been considerably increased. When the treatment has failed, as has often happened, the failure has been mainly attributable to an inefficient use of the remedy, but sometimes also to its employment having been too long delayed. The more recent experience of its use in tetanus fully confirms the judgment here expressed (Minor, *Med. News*, Dec. 29, 1888). The minimum dose of extract of physostigma which should first be administered is Gm. 0.02 (gr. $\frac{1}{3}$). It should be repeated every quarter of an hour until its specific operation is developed and the spasms are completely overcome. This effect should be steadily maintained, and then reproduced as often as spasms recur. It is usually necessary to increase the dose in order to maintain the original impression. Several German physicians have used this agent to overcome passive dilatation of the intestine, especially in cases of *fecal accumulation*. Subbotin used for this purpose the following: R. Ext. physostigmat., Gm. 0.10 (gr. $\frac{1}{3}$); Glycerin, Gm. 20.0 (ʒv). *Dose*, 10 drops. An objection to this medicine is, that its action is likely to continue longer than necessary, and also that it leaves the bowel more confined than at first. Eschle found eserine efficient in combating various *diarrhœal* affections (*Boston Med. and Surg. Jour.*, July, 1883, p. 41), which it may be presumed to do by contracting the blood-vessels of the intestine. Hiller has suggested that in epidemic *cholera* this spastic action of the drug might be utilized to prevent the colliquative discharges, or rather the profuse secretion that produces them. But the method seems too mechanical. Moreover, it could only have a chance of acting in the early stage of the attack. DaCosta and also Murrell have used physostigma to counteract colliquative *sweats* in the dose of $\frac{1}{10}$ gr. of the extract, and eserine in the dose of $\frac{1}{60}$ gr. In a tetanoid disease known as *tonic convulsion* the medicine has also been successfully employed. Its efficacy in *strychnine-poisoning* is not so well established, and in *chorea* it so generally fails that its use is hardly warrantable unless in very prolonged and obstinate cases. (Compare Riess, *Centralbl. f. Ther.*, v. 377.)

The physiological antagonism between physostigma and belladonna has been illustrated by the neutralization of the poisonous effects of the latter by the former medicine. But as fatal *poisoning by belladonna* is exceedingly rare, the practical value of the antidote is very small. That poisoning by physostigma is neutralized by the hypodermic injection of atropine has been abundantly demonstrated by experiments upon man. The antagonism is not so evident in similar experiments upon rabbits.

Physostigma has been found useful internally as a palliative of *gastralgia*, and topically its tincture is distinctly anodyne in *neuralgia* and *muscular rheumatism* and in cases of painful malignant *tumors*.

As antidotes to the *poisonous effects of physostigma*, atropine should be used hypodermically, while coffee and alcoholic and other diffusible stimulants are internally administered. If the patient is unable to swallow, artificial respiration should be maintained, mechanically as well as by means of induced electricity, and the use of atropine persisted in. The hypodermic dose of the latter should not be less than Gm. 0.002 ($\frac{1}{30}$ grain).

The commencing dose of the powdered bean is about 1 grain; of the official extract, about Gm. 0.006 ($\frac{1}{10}$ grain); of the officinal tincture, about 10 minims. For external use a solution of 1 part of the alcoholic extract in 5 parts of glycerin has been employed. In affections of the eye this solution is applied on little disks of gelatin or of paper that have been soaked in it. Eserine may be applied to the eye in its original state or as a hydrochlorate in a solution containing 1 part to 1000. Internally, it may be given in the dose of from Gm. 0.001–0.005 (gr. $\frac{1}{65}$ to $\frac{1}{12}$).

Doundaké (said to be a shrub of the Rubiaceæ family, and found on the western coast of Africa) and its organic base *doundakine*, given to frogs hypodermically, produce either a paralytic or a cataleptic condition, and kill by suspending the respiration without affecting the heart (*Med. News*, xliii. 265). The bark has a very bitter taste, and is employed by the natives as a febrifuge. (See page 430.)

In 1880, Tanret described the effects of cedrine and valdivine, the active principles of the fruits of *Simaba cedron* and *Picrolemma valdivia*, products of Colombia, S. A. *Valdivine* has been found by Dujardin-Beaumetz and Restrepo to be a mortal poison to rabbits and dogs. It is peculiar in the slowness with which its symptoms are developed even when used in fatal doses. In dogs it causes violent and persistent vomiting, and in rabbits a deep torpor, which continues until death and is not attended with convulsions. In man doses of Gm. 0.004 ($\frac{1}{16}$ grain) occasion vomiting at the end of half an hour. It was found useless in counteracting the effects of poisonous *serpent-bites*, but in *hydrophobia* it prevented the convulsions that usually precede death. It does not seem to influence the course of intermittent fever. *Cedrine* is much less poisonous than valvidine. It has "unquestionable *antiperiodic* virtues, although they are feebler and slower than those of quinine" (*Bull. de Thérap.*, c. 328).

PHYSOSTIGMINÆ SALICYLAS, *U. S.*—Physostigmine Salicylate.

Physostigminum (Eserinum) salicylicum, P. G.—*Eserine salicylate*, E.; *Salicylate d'ésérine*, Fr.; *Physostigmin-Salicylat*, G.

Formula $C_{15}H_{21}N_3O_2C_7H_6O_3$. Molecular weight 412.17.

The salicylate of an alkaloid obtained from Physostigma. It should be kept in small, dark amber-colored, well-stoppered vials.—*U. S.*

Preparation.—Dissolve 2 parts of physostigmine and 1 part of pure salicylic acid in 35 parts of boiling distilled water; strain if necessary, and set aside to crystallize (Hager).

Properties.—The salt forms colorless glossy needles or prismatic crystals, which in the dry state remain unaltered for a long time, even on exposure to light, but ultimately turn reddish, which change is hastened by the presence of ammoniacal vapors; its aqueous and alcoholic solutions, however, become reddish in the course of several hours after exposure to diffused daylight, though the change occurs less rapidly than with other salts of physostigmine. The salicylate is usually slightly acid, and dissolves at 15° C. (59° F.) in 12 parts of alcohol and in 130 (Hager) or 150 (*U. S.*, *P. G.*) parts of water, and at the boiling temperature in about 30 parts of water, and in much less alcohol. The salt fuses at 179° C. (354.2° F.), and on ignition is consumed without leaving any residue. The aqueous solution of the salt acquires a violet color on the addition of a little ferric chloride, and if sufficiently concentrated produces with sulphuric acid a white precipitate of salicylic acid. The alkaloid is recognized by decomposing the aqueous solution with sodium bicarbonate and agitating with ether; the amorphous residue left on evaporating the ethereal solution should show the reactions described under Physostigma.

Tests.—The salts should have the properties described above. The solution in strong sulphuric acid is at first colorless, but becomes yellow. If a minute portion of the salt be added to a few Cc. of ammonia-water in a small capsule, the liquid will acquire a yellowish-red color. On evaporating the liquid on a water-bath, a blue residue will be left, which yields, with alcohol, a blue solution, becoming violet-red upon supersaturation with acetic acid, and exhibiting a strong reddish fluorescence.

Other Salt.—Physostigminæ hydrobromas, Physostigmine hydrobromate. It is crystalline, more stable than the sulphate, but inferior in this respect to the salicylate.

Action and Uses.—The salicylate is said to be less liable to decomposition than the other salts of physostigmine. It has been employed in *diarrhœa* and in *dysentery*. If it is intended especially for hypodermic use, its difficult solubility in water and its changes under the action of light render it of doubtful value in a permanent solution. It is probably better adapted for solution in alcohol and water for instillation into the eye. It may be given hypodermically in *doses* of Gm. 0.001–0.005 (gr. $\frac{1}{65}$–$\frac{1}{12}$). But Lewin states Gm. 0.001 as the maximum dose.

PHYSOSTIGMINÆ SULPHAS, *U. S.*—Physostigmine Sulphate.

Physostigminum (Eserinum) sulphuricum.—Eserine sulphate, E.; *Sulphate d'ésérine*, Fr.; *Physostigminsulfat*, G.

Formula $(C_{15}H_{21}N_3O_2)_2H_2SO_4$. Molecular weight 646.82.

The sulphate of an alkaloid obtained from Physostigma. It should be kept in small dark amber-colored and well-stoppered vials.—*U. S.*

Properties.—The sulphate forms a neutral white or yellowish-white, micro-crystalline powder, which is inodorous and possesses a bitter taste. It is very soluble in water,

deliquescent when exposed to moist air, and turns reddish on exposure to air and light. It is readily soluble in alcohol at 15° C. (59° F.), and more so in alcohol and water at the boiling temperature. At 105° C. (221° F.) the salt fuses, and on ignition it leaves no residue.

On adding a small portion of the salt to colorless sulphuric acid, the latter should not assume a tint deeper than yellow. If a minute portion of the salt be added to a few Cc. of ammonia-water in a small capsule, the liquid will acquire a yellowish-red color. On evaporating this liquid on a water-bath, a blue or bluish-gray residue will be left, which yields, with alcohol, a blue solution, becoming violet-red upon supersaturation with acetic acid, and exhibiting a strong reddish fluorescence. The aqueous solution of the salt yields, with barium chloride test-solution, a white precipitate insoluble in hydrochloric acid.

Action and Uses.—The action, uses, and dose of physostigmine sulphate may be regarded as the same as those of the salicylate; and this also may be said of the hydrochlorate and the tartrate.

PHYTOLACCA.—Phytolacca, Poke.

Agouman, Morelle à grappes, Fr.; *Kermesbeere*, G.; *Mazorquilla, Namoll, Jaboncra*, Sp.

Phytolacca decandra, *Linné.*

Nat. Ord.—Phytolaccaceæ.

1. Phytolaccæ Radix, U. S., Phytolacca-root.—Poke-root, *E.*; Racine de phytolaque, *Fr.*; Kermesbeerenwurzel, *G.* The root.

2. Phytolaccæ Fructus, U. S., Phytolacca-fruit.—Phytolaceæ bacca. *U. S.*, 1880.—Pokeberry, *E.*; Raisin d'Amérique, *Fr.*; Amerikanische Kermesbeere, *G.* The fruit.

Origin.—Poke or garget is a perennial herb indigenous to North America and naturalized in the West Indies and Southern Europe. It grows in waste places, and has a smooth stem, alternate petiolate, ovate-oblong acute leaves, and white decandrous flowers in elongated racemes, which are usually opposite the leaves. The young shoots collected in early spring are sometimes eaten as a substitute for asparagus. It commences to flower in June, and ripens its fruits in August, when the root and berries should be collected. The young shoots of Phyt. octandra, *Linné*, indigenous to Central and South America, and Phyt. acinoso, *Roxburgh*, a native of Northern India, are likewise eaten.

Description.—1. The Root. In the fresh state the root is large, conical, branched and fleshy. In commerce it is seen in transverse or longitudinal slices from 2–10 Cm. (1 to 4 inches) in diameter, longitudinally wrinkled, yellowish brown-gray externally, hard, and breaking with a fibrous fracture. It is of a dingy-white color internally, and exhibits upon transverse section a number of circles composed of wood-tissue radiately divided by numerous medullary rays and concentrically approximate, being separated from one another by shrunken parenchyma, which in the fresh state is fleshy and of about the width of the wood-circles. The root is inodorous; its taste is at first sweetish, afterward somewhat acrid.

Fig. 211.

Poke-root; transverse section.

2. The Fruit is a flattened globular compound berry, about 8 Mm. ($\frac{1}{3}$ inch) in diameter, and composed of ten carpels, which are concentrically arranged around a short axis, are laterally confluent, and contain each one lenticular black and shining seed, with the embryo curved around a mealy albumen. The fruit is of a dark-purple color, has a thin pericarp, and contains a purplish-red juice which is inodorous and has a sweet and slightly acrid taste. When the berries are dried on their common peduncles they have a slight resemblance to raisins.

Constituents.—The root was analyzed by E. Donnelly (1843) and W. F. Pape (1881), who found starch, tannin, resin, and other common constituents of plants, but did not succeed in isolating the active principle. Pape's observation renders the presence of an alkaloid probable; he obtained 1.07 per cent. of ash, two-thirds of which was soluble in water. Terreil (1881) obtained amorphous *phytolaccic acid*, which is soluble in water and alcohol, reduces silver salts, and yields with earths and alkalies soluble salts, from which boiling hydrochloric acid separates the acid as a jelly. Reichel's analysis (1836) of the root of Phytolacca (Pircunia, *Betéso*) drastica, *Pöppig*, yielded similar results; among the salts was found 6.6 per cent. of calcium malate. The alkaloid, *phytolaccine*, was obtained by Preston (1884) in the form of white crystals. These are quite soluble in alcohol, moderately so in water, nearly insoluble in ether and chloroform. It gave

precipitates with tannin, phosphomolybdic acid, potassium iodohydrargyrate, and auric chloride. The fruit was examined by Braconnot (1804); its coloring matter is bleached by sunlight and turned yellow by alkalies. W. Cramer (1881) showed the presence of sugar, gum, and malic acid, and found the fresh fruit to contain 70 per cent. of moisture and the dried fruit to yield 5 per cent. of ash, of which 62 per cent. was soluble in water. E. Claassen (1879) obtained from the seed *phytolaccin*, which is soluble in alcohol, ether, and chloroform, slightly so in benzin, and insoluble in water; it crystallizes in colorless needles, is tasteless, and dissolves in sulphuric acid with a brown-yellow, and in warm nitric acid with a yellow, color. The fruit of most other species of Phytolacca contains a similar coloring matter. According to Landerer (1836), the juice is employed in Turkey for coloring sweetmeats.

Action and Uses.—The most probable evidence in favor of the medicinal powers of this plant relate to its use in *rheumatism* and in *diseases of the skin*. In the former, and especially in *syphilitic* rheumatism, it has been employed as a tincture either of the root or of the berries and as a decoction of the former, and is reputed to have displayed anodyne and sudorific powers. The decoction, the tincture, the juice of the leaves, etc. have been used extensively and with reputed advantage, both internally and locally, in the treatment of sanious *ulcers*, *scabies*, *tinea capitis*, *sycosis*, and *favus*, and of the *mange* in dogs. An ointment made with the roots or leaves (℥ij to lb j of lard) has been applied in the same affections. All of these preparations have been much employed in the treatment of *hæmorrhoids*, and the infusion and decoction both internally and by injection. The decoction has been administered with alleged benefit in *scrofula*, as well as used locally in treating the ulcers peculiar to that disease. It has been alleged, when taken internally and applied locally, to prevent and also relieve *mammary inflammation* after delivery, and also to cure "irritation of the ovaries with uterine complications," but the latter statement is too vague for acceptance.

In the action and medicinal uses of phytolacca it is difficult to avoid observing a certain analogy between it and dulcamara on the one hand and white hellebore on the other. The *dose* of the powdered root as an emetic is Gm. 0.60–2 (gr. x–xxx). Of a saturated tincture about Gm. 4 (a fluidrachm) may be given two or three times a day. An ointment may be made by mixing with an ounce of lard the extract produced by evaporating an ounce of the tincture.

PICROTOXINUM, *U. S.*—Picrotoxin.

Picrotoxine, Fr.; *Pikrotoxin*, G.

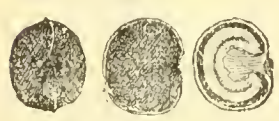
Formula $C_{30}H_{34}O_{13}$. Molecular weight 600.58.

A neutral principle prepared from the seeds of Anamirta paniculata, *Colebrooke*, s. Anam. (Menispermum, *Linné*) Cocculus, *Wight et Arnott*, s. Cocc. suberosus, *De Candolle*. Bentley and Trimen, *Med. Plants*, 14.

Nat. Ord.—Menispermaceæ.

Origin.—Anam. paniculata is a tall climbing shrub, with broad heart-shaped leaves and long drooping racemes of small greenish diœcious flowers, indigenous to India and some of the East Indian islands. The fruit is known as

Fig. 212.



Cocculus indicus: fruit and longitudinal section.

Cocculus indicus, s. Fructus cocculi.—Fishberries, *E.*; Coque du Levant, *Fr.*; Kokkelskörner, Fischkörner, *G.*—It is globular, kidney-shaped, about 6 Mm. (¼ inch) in diameter and 10 Mm. (⅖ inch) in length, blackish-brown and wrinkled. The base and apex of the fruit are close together on one side of the fruit, separated from each other by a shallow sinus and connected by an obscure ridge running around the convex side. The endocarp or shell is whitish, thin, and on the narrow concave side folded inward, forming a double projection into the interior of the fruit, and causing the embryo to assume a semilunar shape upon longitudinal section. The fruit is inodorous and almost tasteless, with the exception of the shrivelled oily embryo, which is disagreeably bitter. Cocculus differs in the characters described from all other fruits usually met with in drug-stores. According to Schmidt and Rolmer (1883), the fruit contains 23.6 per cent. of fat, over one-third of which is free stearic acid. Pelletier and Couërbe (1833) isolated from the integuments of the fruit the crystalline and tasteless alkaloid *menispermine*, $C_{18}H_{24}N_2O_2$, and *paramenispermine*, which has the same composition, but differs from the former in being insoluble in ether, sublimable, and in failing to neutralize acids. These bodies are associated with the amorphous brown *hypopicrotoxic acid*, which is insoluble in ether and water. The

poisonous principle picrotoxin is contained in the kernel, and was first isolated by Boullay in 1819.

Preparation.—Bruised cocculus indicus is exhausted by boiling alcohol sp. gr. 0.85; the tincture is concentrated by distillation to about one-third the weight of the fruit; after cooling, the fat is removed and the residue boiled with one-half its weight of water; the decoction is filtered while hot, the filtrate slightly acidulated and crystallized; the crystals require to be purified from hot alcohol. The portion insoluble in water contains menispermine, paramenispermine, and hypopicrotoxic acid.

Properties and Tests.—Picrotoxin is in "colorless, flexible, shining, prismatic crystals, permanent in the air, odorless, having a very bitter taste and a neutral reaction; soluble in 240 parts of water and in 9 parts of alcohol at 15° C. (59° F.), in 25 parts of boiling water, and in 3 parts of boiling alcohol; also soluble in acids and in solutions of the alkalies. "When heated to 200° C. (392° F.), picrotoxin melts, forming a yellow liquid. Upon ignition it is consumed, leaving no residue. Concentrated sulphuric acid dissolves picrotoxin with a golden-yellow color, very gradually changing to reddish-brown, and showing a brown fluorescence. On mixing about 0.2 Gm. of powdered sodium nitrate with 3 or 4 drops of sulphuric acid in a small, flat-bottomed capsule, sprinkling a minute quantity of picrotoxin over it, and then adding, from a pipette, concentrated solution (1 in 4) of sodium hydroxide, drop by drop, until it is in excess, the particles of picrotoxin will acquire a brick-red to deep-red color, which fades after some hours. On diluting 2 Cc. of alkaline cupric tartrate solution with 10 Cc. of water, and adding a small portion of picrotoxin, red cuprous oxide will be separated within half an hour at the ordinary temperature, and much more rapidly upon the application of heat. The aqueous solution of picrotoxin should remain unaffected by mercuric or platinic chloride test-solution, tannic acid test-solution, mercuric potassium iodide test-solution, or other reagents for alkaloids (absence of alkaloids)."—*U. S.*

The reaction with sulphuric acid and a trace of potassium dichromate was described by H. Koehler (1867) as giving a violet-blue color, changing to violet-brown, brown-green, and finally apple-green; excess of dichromate causes a red-brown, then dark-brown, color (W. Schmidt, 1862). The yellow color produced by sulphuric acid disappears on the addition of nitric acid. Picrotoxin dissolves in strong nitric acid to a colorless liquid, which becomes mahogany-brown with a little potassium dichromate. Heated with Fehling's solution, picrotoxin yields a precipitate of cuprous oxide (Ludwig), but is not a glucoside. Warm alkaline solutions occasion also a reduction of silver and gold salts. The reaction with potassium nitrate, sulphuric acid, and soda was suggested as a characteristic one by J. W. Langley (1862).

Diluted acids do not increase the solubility of picrotoxin in water (Pelletier, Koehler), but caustic alkalies render it much more soluble; hence Pelletier and Conëbre regarded it as *picrotoxic acid;* the alkaline solutions are, however, precipitated by carbonic and other acids. Picrotoxin is soluble in strong acetic acid, also in amylic alcohol, benzene, chloroform, ether, and in fixed oils (Koehler).

The above formula is that of Paterno and Oglialora (1877). By fractional crystallization from benzene Barth and Kretschy (1880) separated picrotoxin into three bodies. One, for which the name picrotoxin was retained, melts at 201° C. (394° F.), answers in the main to the above description, and has the composition $C_{15}H_{16}O_6 + H_2O$. The second, *picrotin*, $C_{25}H_{30}O_{12}$, has similar properties, but melts at 250° C. (482° F.), is less freely soluble in benzene, and is not poisonous. The third compound, *anamirtin*, $C_{19}H_{24}O_{10}$, remains in the mother-liquor on recrystallizing picrotoxin from water; it is but slightly bitter, is not poisonous, and its alkaline solutions do not reduce metallic salts.

Action and Uses.—Its chief effects in excessive doses appear to be slight giddiness and lightness of the head and partial loss of power in the lower limbs. In one case the symptoms of active poisoning by cocculus have been described as including gastro-intestinal irritation, congestion of the brain, strabismus, sweating, exhaustion, and death. The absence of any spasmodic phenomena throws doubt upon the alleged nature of the attack (Stillé, *Therapeutics*, 4th ed., ii. 353). A case is reported by Sosinsky in which several ounces of whiskey impregnated with cocculus were taken by a male adult. Within an hour he became unconscious, and was seized with epileptiform convulsions. The pupils were contracted and the respiration was slow, and there was also profuse sweating, with diarrhœa. Death occurred in three hours, "and was apparently due to failure of respiration and exhaustion" (*Med. News*, xliii. 485). The observations of Haynes record the above symptoms essentially, with the addition of a cyanotic discoloration of the skin; and he points out that the convulsions much more closely resemble those of epilepsy

than those due to strychnine, especially in their clonic character and the unconsciousness that attends them (*Phila. Med. Times*, xiv. 748).

The resemblance between the actions of picrotoxin and of strychnine led to the use of the former in *paralysis* of the extremities and of the sphincters of the bladder and rectum, but the degree of its success does not appear to have been very great. Its virtues in curing *epilepsy* have been confidently set forth by Planat, who recognizes, as the sole exceptions to its curative power in this affection, inveterate cases, whether idiopathic or symptomatic. This physician reports no less than sixteen cases of the disease cured by a saturated tincture of cocculus, of which the primary dose was 2 drops twice a day, and on each subsequent day every dose was increased by 1 drop until 30 drops a day were given. It was then gradually reduced until the original dose was reached, when the medicine was suspended for a fortnight, after which it was renewed and intermitted alternately during six months. If the results above related could be relied upon, then cocculus would be a remedy for epilepsy of far higher curative power than any one before used in the disease. This is far from being the case, for the observations of Gowers and Ramskill render it probable that picrotoxin aggravates the paroxysms in epileptic patients (*Times and Gaz.*, Apr. 1880, p. 448). Planat attributes to the medicine a striking curative power in infantile *eclampsia*, in chronic *spasm of the limbs*, and in *chorea*. A case of labio-glosso-pharyngeal *paralysis* is stated to have been greatly benefited by the hypodermic injection of 1 Mgm. (gr. $\frac{1}{64}$) doses of picrotoxin (Gubler). Much more positive are the effects of picrotoxin in controlling *night-sweats*, as illustrated by Murrell (*Practitioner*, xxiii. 241; xxv. 93). He made use of a solution of 1 part in 240, as follows: Picrotoxin 8 gr.; Glacial acetic acid f ʒiv; Distilled water, to f ʒiv. Mix and filter. Of this solution 4 minims contain $\frac{1}{60}$ gr. of picrotoxin, which is the average dose. From 1 to 4 teaspoonfuls of the solution seldom failed to diminish, and then arrest, the sweating, without leaving the skin dry. It did not disagree with the stomach. Other clinicians have found this dose too small, and prescribed from Gm. 0.001–0.003 ($\frac{1}{60}$ to $\frac{1}{20}$ gr.). Picrotoxin may also be given in pills, each containing one-sixteenth of a grain. On theoretical grounds it has been proposed as an *antidote to morphine*, by Bókai (*Lancet*, March, 1889, p. 497). Cocculus indicus is employed in decoction or in ointment to destroy *lice*, and in the latter form to cure *ringworm of the scalp*. The skin should in this disease be thoroughly cleansed with soap and water before applying the ointment. *Porrigo* has been cured by an ointment made with Gm. 0.60 (gr. x) of picrotoxin to an ounce of lard. Cocculus indicus is said to prevent the secondary fermentation of liquors, and for this purpose it is sometimes added to malt liquors at the risk of poisoning those who drink them. The average hypodermic dose of picrotoxin is 1 Mgm. or $\frac{1}{64}$ of a troy grain.

PILOCARPINÆ HYDROCHLORAS, *U. S.*—Pilocarpine Hydrochlorate.

Pilocarpinum hydrochloricum, P. G.; *Hydrochlorate de pilocarpine*, Fr.; *Pilocarpinhydrochlorid*, G.

Formula $C_{11}H_{16}N_2O_2HCl$. Molecular weight 243.98.

The hydrochlorate of an alkaloid obtained from Pilocarpus. It should be kept in small, well-stoppered vials.—*U. S.*

Preparation.—Diluted hydrochloric acid is neutralized with pilocarpine, and the solution concentrated and set aside over sulphuric acid to crystallize.

Properties.—This salt forms long colorless needles or is obtained in small white needle-shaped or scaly crystals. It is inodorous, and has a slightly bitter taste and a neutral or slightly acid reaction to test-paper. It is deliquescent on exposure, and dissolves, according to Schuchardt (1881), in 1½ parts of water at 15° and at 100° C. (59° and 212° F.) in 7 parts of alcohol at 15° C. (59° F.), and in about ⅖ part of boiling alcohol. According to Poehl, it is insoluble or nearly so in ether, chloroform, benzene, and carbon disulphide, but, according to Gerrard (1876), chloroform dissolves the salt. This melts at 197° C. (386.6° F.), and at a higher heat is decomposed without leaving any fixed residue. The aqueous solution remains clear for many weeks, and yields with silver nitrate a white curdy precipitate insoluble in nitric acid, but soluble in ammonia. Only concentrated solutions are precipitated by sodium hydroxide (whitish cloudiness) or by platinic chloride (yellowish, crystalline), but diluted aqueous solutions are precipitated by mercuric chloride (white, soluble in hydrochloric acid), iodine (brown-red, crystallizable), phosphomolybdic acid (yellow, curdy), and other group reagents for alka-

loids. Pure sulphuric acid dissolves the salt nearly colorless, with evolution of hydrochloric-acid vapors; in the presence of a little potassium dichromate the solution is at first dark green, but soon changes to a lasting bright-green color (Poehl, 1879). Fuming nitric acid dissolves the salt with a pale greenish color (*U. S., P. G.*).

Composition.—The formula given above is that of Harnack and Meyer, but Kingzett maintains that the correct formula of the salt is $C_{23}H_{34}N_4O_4(HCl)_2$.

Allied Salt.—Pilocarpinæ nitras, *Br.* $C_{11}H_{16}N_2O_2HNO_3$. White crystalline powder or needles, soluble in 8 or 9 parts of water or freely soluble in hot alcohol.

Dose.—Hydrochlorate of pilocarpine may be administered by the mouth in doses of Gm. 0.03–0.05 (gr. ½–¾), and hypodermically Gm. 0.02 (gr. ⅓) may be given. (See Pilocarpus).

PILOCARPUS, *U. S.*—Pilocarpus, Jaborandi.

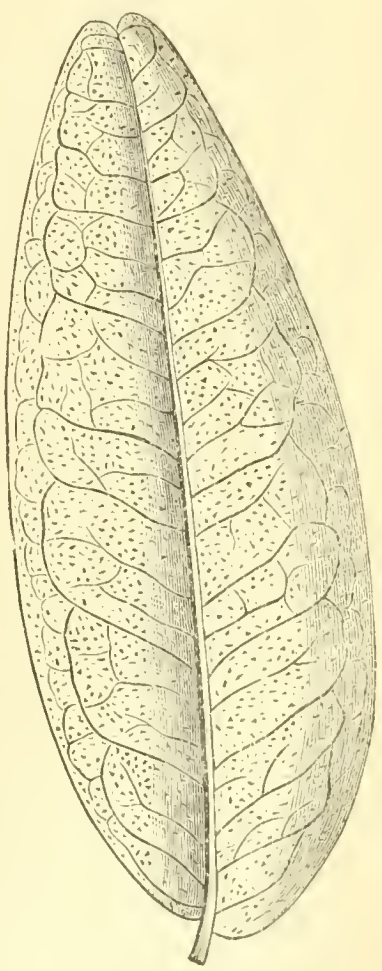
Jaborandi, Br., F. Cod.; *Folia jaborandi*, P. G.

The leaflets of Pilocarpus Selloanus. *Engler* (Rio Janeiro jaborandi) and of Pilocarpus Jaborandi, *Holmes* (Pernambuco jaborandi). Bentley and Trimen, *Med. Plants*, 48.

Nat. Ord.—Rutaceæ, Xanthoxyleæ.

Origin.—Jaborandi is a kind of generic name used in South America for several plants possessing diaphoretic properties. The Pilocarpus jaborandi is a shrub growing in Brazil in the neighborhood of Pernambuco, perhaps also in the southern provinces of that empire. E. M. Holmes (1875) determined the origin of jaborandi. There appear to be several more or less distinct forms of Pilocarpus in Brazil, which are regarded as distinct species by some botanists, while others regard them as mere varieties. Of these may be mentioned—Pil. Selloanus, *Engler*, Pil. heterophyllus, *A. Gray*, and Pil. pauciflorus, *St. Hilaire*. From the anatomical structure of the leaves constituting the drug Poehl (1879) regards it to be obtained from an undescribed species, Pil. officinalis, *Poehl*.

Fig. 213.



Pilocarpus pennatifolius, *Lemaire*: leaflet, natural size.

Description.—The leaves are imparipinnate, and are composed of four to ten short-stalked leaflets with an unequal base, and a terminal one which has a longer stalk and is more tapering and nearly equal at base. The leaflets are about 10 to 15 Cm. (4–6 inches) long and 4 to 6 Cm. (1½–2½ inches) broad, oval or ovate-oblong, entire and slightly revolute at the margin, rather rounded below and obtuse and usually emarginate above. They are of a coriaceous texture, green and shining above, and on the under side paler and smooth or somewhat hairy, and with a prominent midrib; the veins branch from the midrib at nearly right angles, and anastomose near the margin, forming on each side one or two distinct wavy lines. The entire blade is marked with numerous pellucid glands. The leaves are nearly inodorous, but where bruised exhale a slight aromatic odor; the taste is herbaceous, afterward aromatic, warm, and somewhat bitter.

Constituents.—Byasson (1875) obtained from jaborandi-leaves a volatile oil, and a volatile alkaloid which he named *jaborandine*. But both Gerrard and Hardy (1875) showed that the alkaloid is not volatile, and named it *pilocarpine*. It is obtained from the aqueous solution of the alcoholic extract by adding an alkali, agitating with chloroform, and extracting it from the latter by agitation with water acidulated by hydrochloric acid. It is best purified by crystallizing the nitrate from boiling alcohol, which, according to Schuchardt, dissolves 2.5 per cent. of the salt, while at 15° C. (59° F.) only .77 per cent. remains in solution. The alkaloid is uncrystallizable, but A. W. Gerrard (1875) crystallized from alcohol a number of its salts, of which the sulphate and acetate are very deliquescent; the latter is also soluble in ether, chloroform, and benzene, in which the nitrate and phosphate are insoluble, while the chlorhydrate and bromhydrate

dissolve besides in water and alcohol, also in chloroform. Kingzett (1876) gives to the alkaloid the formula $C_{23}H_{34}N_4O_4$, and states that on distillation with caustic potassa it yields trimethylamine, and that jaborandi contains only one alkaloid. These observations have been corroborated by Gerrard (1880). But Harnack and Meyer (1880) give to pilocarpine the formula $C_{11}H_{16}N_2O_2$. Chastaing (1881) found the same composition, and states that on treating the alkaloid with a large excess of fuming nitric acid, *jaborandine nitrate*, $C_{10}H_{12}N_2O_3.HNO_3$, is obtained, together with traces of another alkaloid, probably jaborine. Poehl (1879) agrees with Kingzett's formula; he also found but one alkaloid, but on distilling this with caustic soda obtained *coniine*. The latter alkaloid was also obtained by Harnack and Meyer, but only from impure pilocarpine, and they believe it to be a decomposition-product of a second alkaloid, *jaborine*, which could not be prepared in the pure state, and is probably produced by the alteration of pilocarpine; it is yellow, amorphous, more soluble in ether and less in water than pilocarpine, and resembles atropine in its action. Merck (1885) obtained two more alkaloids, which he named *jaboridine* and *pilocarpidine*; these he considers simply as oxidation-products of jaborine and pilocarpine respectively. Jaboridine is syrupy, and its nitrate forms prisms; pilocarpidine differs from pilocarpine principally in that its aqueous solution is precipitated by gold chloride.

Hardy (1876) obtained from the leaves 0.56 per cent. volatile oil, consisting of *pilocarpine*, $C_{10}H_{16}$ (sp. gr. 0.85; boiling-point 178° C.), and two hydrocarbons of higher boiling-points.

Other Jaborandis.—Peckolt (1875) enumerated the following Brazilian drugs which are known in some of the provinces as jaborandi, and belong either to the natural order of Piperaceæ or to that of Rutaceæ (Xanthoxylaceæ):

1, Serronia (Piper, *Vellozo*, Ottonia, *Kunth*), Jaborandi, *Guillemin*; 2, Piper reticulatum, *Linné*; 3, P. nodulosum, *Link*; 4, Artanthe Mollicoma, *Miquel*; 5, Aubletia trifolia, *Richard*; Monnier a trifolia, *Linné*; and 6, Xanthoxylum elegans, *Engler*. Herpestes gratioloides, *Kunth* (nat. ord. Scrophulariaceæ), is also stated to yield a jaborandi; and to these must probably be added Piper citrifolium, *Lamarck*, and perhaps other species. (See paper by Dr. F. V. Greene in *Phila. Med. Times*, 1877, p. 537.)

Piper Jaborandi, *Vellozo*, is, according to Peckolt, the true jaborandi of Brazil, and, according to Parodi (1875), the true *yaguarundi* of Paraguay. The latter isolated from it a volatile oil of an acrid and biting taste and a crystalline alkaloid, *jaborandine*, $C_{10}H_{12}N_2O_3$, which is slightly soluble in ether and has but a weak affinity for acids.

Infusum jaborandi, *Br.*—Jaborandi ½ ounce, boiling water 10 fluidounces; infuse for half an hour and strain.

Tinctura jaborandi, *Br.*, *F. Cod.*—Jaborandi 5 ounces, proof spirit 20 fluidounces (*Br.*). Jaborandi 100 Gm.; alcohol (sp. gr. 0.912) 500 Gm. (*F. Cod.*).

Substitutions.—The leaves of one or more species of Piper have occasionally been in the market and sold as jaborandi; they are thin or subcoriaceous, ovate, acuminate, and so finely glandular that on being held up to the light and examined with the naked eye they do not appear to be pellucid punctate.

We have seen the leaves of Laurus nobilis, *Linné*, offered as jaborandi; they are easily distinguished by the characters described on page 931.

Action and Uses.—When a jaborandi-leaf is chewed it causes an acrid sensation in the fauces, and the powder by prolonged contact with the skin irritates it. In doses of from Gm. 2–6 (gr. xxx–xc) infused in boiling water, the water and grounds being swallowed together, it produces within ten or fifteen minutes its characteristic effects. Very similar, if not identical, effects are produced by the hypodermic injection of muriate of pilocarpine in the dose of Gm. 0.01–0.02 (gr. $\frac{1}{6}$–$\frac{1}{3}$). Pilocarpine acts more promptly than jaborandi, especially when used hypodermically. In the dose just indicated it produces, in the course of two or three minutes, a sense of vertigo or faintness, a flushing of the face and breast, and in from three to six minutes drops of sweat appear upon the forehead and moisture is felt in the axillæ and groins, and then upon the trunk and limbs. In a case of glaucoma the patient by mistake received a hypodermic injection of 6 grains instead of $\frac{3}{4}$ gr. of pilocarpine. Hardly had the needle been withdrawn before the saliva began to dribble from the patient's mouth (*Med. Record*, xx. 599). The amount and duration of the sweating are increased by the patient's remaining covered in bed, and also depend in part upon individual peculiarities. The secretion of tears and of nasal and bronchial mucus is commonly augmented. These abundant losses of liquid necessarily reduce the patient's weight, often to the extent of from 2 to 6 pounds, and occasionally as much as 8 pounds. Pilocarpine sometimes also increases the bronchial secretion, or causes diarrhœa, or produces swelling of the submaxillary glands. During the

sweating the temperature is apt to fall about 1° F., the pulse grows fuller and tenser, and its rate is at the same time increased, sometimes by as much as 40 or 50 beats a minute. The face becomes flushed at first, but grows pale when the perspiration is most profuse. These phenomena are attributed to the action of the medicine upon the heart and arteries, whereby the walls of the latter are dilated and their capacity increased. Meanwhile, at the time when the sweat breaks out the patient feels his mouth begin to water, and the flow of saliva is so rapid, and often so copious, that he is unable to speak. During the hour and a half, on an average, that the secretion lasts it may amount to 1 or 2 pints. The saliva is usually ropy. When the extract of jaborandi or pilocarpine dissolved in glycerin is introduced into the eye, it in most cases contracts the pupil, but when taken internally it produces this effect much less uniformly, if at all. Instead of diminishing the secretion of milk, as might reasonably be expected from its causing such profuse discharges elsewhere, it appears to be a true galactagogue. It is said to exhibit this virtue even when directly applied to the mammæ (*Practitioner*, xvii. 443). It is stated that the milk secreted under its influence produces a sudorific action upon the infant that consumes it. It is alleged that such milk is also deficient in solids, and therefore innutritious; on the other hand, it is certain that infants have been nourished and have thriven upon milk so obtained (*Jour. Amer. Med. Assoc.*, iv. 238; *Therap. Gaz.*, x. 194). Children are but little affected by doses which would produce the full operation of the medicine in adults.

There can be no doubt that these medicines, especially pilocarpine hydrochlorate, sometimes occasion distressing and even alarming symptoms, such as nausea, vomiting, salivation, diarrhœa, tenesmus, contracted pupils, collapse, tremor, extreme weakness, indistinct vision, slow and sighing respiration, rapid pulse, palpitation of the heart, and vertigo, for all which the appropriate remedy is a hypodermic injection of atropine; the inhalation of nitrite of amyl has also been used for the same purpose.

Jaborandi resembles atropine in quickening the pulse and flushing the face, and in acting more powerfully upon adults than upon children; but it is antagonistic to atropine in its action upon the salivary, sudoral, and mammary secretions, upon the pupils also, and the minute arteries. Moreover, the tendency of belladonna to excite delirium contrasts with that of jaborandi to cause prostration and drowsiness, and the sweats and salivation produced by the latter are checked by the hypodermic injection of atropine. The dryness of the mouth and skin which this alkaloid or belladonna occasions is relieved by the administration of jaborandi or pilocarpine. The mammary secretion is diminished by the one and increased by the other. In this connection it may be mentioned that in experiments upon frogs the dilatation of the heart produced by the one agent has been overcome by the operation of the other. Nevertheless, it has happened in cases of poisoning by belladonna or its alkaloid that no mitigation of the symptoms followed the administration of jaborandi or of pilocarpine.

The utility of jaborandi and pilocarpine in medicine is chiefly shown by their power of lessening the amount of liquid in the system. Hence they are often of service in removing effusions due to cardiac or renal obstruction, and even to inflammation. The last effect has been illustrated in some cases of chronic as well as acute *pleurisy*, probably, however, with serous rather than purulent effusion. The relief afforded by the medicines is sometimes wonderfully prompt, especially if the patient refuses to yield to his thirst and abstains, as far as possible, from using liquids. In children it is more apt to be afforded by profuse salivation than by sweating. In *hydrothorax* the benefit is even more speedy and complete, although its duration must depend upon the cardiac or renal disease during which the effusion occurred. When *dropsy* arises in connection with desquamative *tubular nephritis* (especially scarlatinous), or even with *interstitial nephritis*, the medicine is very efficient, in the former disease often leading to a cure, and in the latter to a prolongation of life. But it can be of no service unless its sialagogue or its diaphoretic action is fully developed. A danger, however, which perhaps attends this treatment of acute renal dropsy is that the discharge of water by the skin diminishes the excretion of the kidneys, and if carried too far may cause them to become obstructed and uræmic symptoms to arise. In regard to the dropsy of pregnancy and the usually associated *puerperal albuminuria* and *convulsions* the efficacy of the medicine does not yet appear to be determined. In certain cases its administration has been followed by its physiological effects and the dissipation of threatening symptoms; but some physicians (Bidder: Fordyce Barker) regard its utility as more than doubtful, and the latter states that after puerperal convulsions its depressing influence, which is continuous and exhausting, prevents sleep and the repose of the nervous system, and thus renders it in these cases a

dangerous remedy. This judgment has been strengthened by the results of an investigation by Dr. John Phillips, who felt constrained to "warn others against its use, especially when coma was pronounced" (*Lancet*, Oct. 13, 1888. Compare *Med. News*, xlvii. 382; *Therap. Gaz.*, x. 473; *Braithwaite's Retrospect*, xciv. 300). In *dropsy* caused by *disease of the heart* it is a temporary palliative which may appropriately be used from time to time during a treatment by digitalis, etc. Indeed, it simply serves as a substitute for the ancient practice of purging or sweating by heat, etc., and may be used alternately with them. Its action in lessening the contractile power of the heart and arteries, and retaining them in diastole, should be borne in mind, since it tends to favor the accumulation of blood in them and to obstruct rather than relieve the circulation and respiration. In all cases in which the rhythm of the heart is disordered by valvular or muscular degeneration this medicine should be cautiously used, lest during the prostration it cause the action of the heart to be suspended. Used in certain cases of pulmonary *emphysema*, it has embarrassed respiration and threatened to produce asphyxia. But when dropsy of whatever form (hydrothorax, ascites, anasarca) due to Bright's disease is associated, not with obstructive lesions of the heart, but with hypertrophy of the left ventricle, the relief obtained from jaborandi is immediate and striking. Yet the rule must not be too absolutely followed. In cases of obstructive diseases of the heart from valvular or muscular degeneration, with emphysema, and even disease of the arteries, the action of pilocarpine may sometimes be so adjusted as to afford relief without embarrassing the circulation. It has been used to cure or prevent the full development of *bronchitis*, *laryngitis*, and *coryza*, dry *bronchitis*, etc., Riess (*Centralb. f. Therap.*, v. 303). In a case of *œdema of the larynx* the hypodermic use of pilocarpine seems to have saved life (*Bull. et Mém. Soc. de Thérap.*, 1881, p. 146). The utility of pilocarpine in all forms of dropsy is precisely like that which has long been derived from hot-air and steam-baths and other powerful diaphoretics, but is greater, inasmuch as it excites profuse salivation as well as sweating. It must be borne in mind also that some clinical observers have found it injurious by causing distressing nausea and vomiting, and so exhausting the strength that its repeated use was not tolerated.

In 1880 and for several subsequent years marvellous success was announced from the use of pilocarpine in *diphtheria*, on the ground apparently of the salivation induced by it causing the separation of the false membranes (*Bull. de Thérap.*, cv. 237; *Med. News*, l. 321). As usual, the "rational" anticipation resulted in disappointment, and it was found that the medicine added to the disease a new element of weakness, and therefore of danger. A caution has been given to beware of the possible uræmic symptoms that may follow the diminished urination, but as urea is eliminated by the saliva and sweat, the advice is perhaps not very important. In primary and sthenic laryngeal *croup* the utility of the medicine is probably greater.

Pilocarpine is alleged to bring on *labor* in pregnancy at term, and to hasten and facilitate it when once begun. Its influence in these respects is not, however, determined. According to Galezowski, pilocarpine equals eserine in its power of *contracting the pupil*, and has the advantage of not irritating the conjunctiva. He prefers a solution of 20 Cgm. of the nitrate in 10 Gm. of cherry-laurel water, or of 10 Cgm. of the sulphate in 6 Gm. of the same solvent. Dr. H. W. Williams has confirmed this judgment, adding that it produces less supraorbital pain than the eserine sulphate, and less spasm of the accommodative power. It is used chiefly in cases of corneal lesions in which it is desirable to withdraw the iris from the danger of prolapsing or of adhering to the cornea. In cases of detachment of the retina its use is said to have been followed by opacity of the lens. It was observed by Schmitz that the administration of muriate of pilocarpine hypodermically caused a growth of downy hair on the scalp of two men affected with *alopecia*. A like effect has been reported by André (*Bull. de Thérap.*, ci. 139), and others relating to diseases of the scalp by Pick (*Phila. Med. Times*, x. 451). A case is reported of a "change of color of the hair from light blond to nearly jet black in a patient while under treatment by pilocarpine" (Prentiss, *Phila. Med. Times*, xi. 609; *Therap. Gaz.*, xiii. 238). *Urticaria* is said to have disappeared under its use, *eczema* to have been cured by the local action of the fluid extract, and the hypodermic injection of $\frac{1}{10}$ gr. of pilocarpine is reported to have allayed the *itching* of jaundice. The full sudorific effect of the medicine has been employed to reduce the excitement and delirium occasioned by alcohol in vigorous subjects (Isham). It appears to have some influence in lessening the *salivation* of pregnancy and in reducing the swelling in acute *glossitis*.

Jaborandi has been employed to diminish the discharge of urine in watery and also in saccharine *diabetes*, but it only changes the outlet of the liquid without reducing the

loss. The morbid conditions producing *polyuria* are so various that the excessive flow of urine cannot in all cases be under the control of the same agent. In the present case it is doubtful whether the simple functional (?) affection, or the excessive urination that attends the first stage of interstitial Bright's disease, or chronic poisoning by lead, is most benefited by the vicarious discharge of liquid under the influence of pilocarpine. Upon "scientific principles" jaborandi should be a specific for acute *articular rheumatism*, but clinically it is so far from curing the disease that it does not even modify its symptoms or its course. In syphilitic rheumatism its sudorific action is said to have removed the nocturnal pains, and it has been efficacious in *muscular rheumatism* and *sciatica*. In scaly *skin diseases* it is useless. In *prurigo* it is a palliative. Some published cases render it probable that the sudorific power of pilocarpine may take the place of the sweating by means of the "decoction of the woods" which was once considered essential to the cure of constitutional *syphilis* (*Practitioner*, xxvi. 55; *St. Bart's Hosp. Reports*, xvi. 280). In *mumps* it is reported to have been curative both of the parotid swelling and of the metastatic engorgement of the testicles. In the dose of $\frac{1}{12}$ to $\frac{1}{6}$ grain pilocarpine has been found to palliate the colliquative *sweats of phthisis* by West, Horne, and others (*St. Bart's Reports*, xx. 125; *Lancet*, Sept. 6, 1884, p. 408). This effect has been questioned, but on insufficient grounds, by Ablestoff (*Lancet*, July 3, 1886). Pilocarpine obeys the general law that medicines which act on the nervous system produce opposite effects in small and large doses. In a case of unilateral *sweating* the hypodermic injection of pilocarpine is reported to have cured the affection after having at first increased it. A case of persistent *hiccough* from disease of the brain, and which had resisted various other remedies, yielded at once to the hypodermic injection of Gm. 0.03 ($\frac{1}{2}$ grain) of pilocarpine. Two very obstinate cases of more recent date have been reported, one of which was cured by an infusion of jaborandi (*Bull. de Thérap.*, cviii. 84), and the other by the hypodermic injection of muriate of pilocarpine (*Therap. Gaz.*, ix. 572). The latter preparation has cured *rheumatic tetanus* (*Centralbl. f. Ther.*, iv. 171), and palliated *locomotor ataxia* (*Lancet*, Nov., 1882). Politzer and others have found that repeated hypodermic injections of small doses of pilocarpine relieve *deafness* from chronic affections of the internal ear, due either to simple or to syphilitic inflammation (*Amer Jour. Med. Sci.*, April, 1885, p. 588); and Rosegarten, that they are useful "in cases of chronic dry *catarrh* of the middle ear, complicated with affections of the labyrinth" (*ibid.*, April, 1887, p. 565). In all such cases the treatment, which must be prolonged, seems to act by softening and rendering more pliable the tissues of the organ of hearing. This medicine seems to have caused improvement in *myxœdema* (*St. Bart's Rep.*, xx. 128). It has been alleged that pilocarpine has cut short the development of *yellow fever* (*Med. Record*, xxxii. 484), and that an infusion of the leaves has acted as an antidote to the poison of a *viper* (*Med. News*, li. 718). It is alleged to be curative of *whooping cough*. A case of reputed *hydrophobia* treated by means of pilocarpine is said to have recovered, but the Academy of Medicine of Paris did not regard the case as being accurately designated (*Bull. de Thérap.* ciii. 39). In several cases pilocarpine has served as an antidote to the poisonous effects of *daturine*, *atropine*, *stramonium*, and *belladonna*. Its effects appear to be prompt and decided (*Phila. Med. Times*, x. 415; *ibid.*, xi. 637; *Med. Record*, xx. 41; *Edinb. Med. Jour.*, xxviii. 1048; *N. Orleans Med. and Surg. Jour.*, Oct. 1885; *Brit. Med. and Surg. Jour.*, Sept. 1885; *ibid.*, Jan. 1887; *Lancet*, July, 1890, p. 175; *Therap. Gaz.*, xvi. 330, 549). Hypodermic injections of nitrate of pilocarpine are said to have cured *fetid sweating* (*Bull. de Thérap.*, c. 135).

Jaborandi may be administered in an infusion made with Gm. 6 of the medicine in Gm. 128 (90 grains in 4 fluidounces) of water, and taken in three or four equal portions at intervals of ten minutes. To avoid nausea it may be given by enema. A concentrated tincture containing the virtues of Gm. 2 in Gm. 4 (gr. xxx in f℥j) of the preparation, and a fluid extract made with 50 per cent. alcohol, Gm. 4 (a fluidrachm) of which represents Gm. 4 (60 grains) of jaborandi, have both been employed. Pilocarpine or its nitrate may be prescribed by the mouth in doses of from Gm. 0.03–0.05 ($\frac{1}{2}$ to $\frac{3}{4}$ grain), and hypodermically Gm. 0.02 ($\frac{1}{4}$ grain) may be given. It is less apt to occasion retching and vomiting when the stomach does not contain food. Squire recommends pilocarpine hydrochlorate in solution as the best form to use—1 grain to 15 minims of water for hypodermic injections, 1 grain to 4 ounces of water for internal use, $\frac{1}{3}$ of a grain being the largest, and $\frac{1}{15}$ of a grain the smallest, dose needed.

PILULÆ.—Pills.

Pilules, Fr.; *Pillen*, G.

Pills are a very convenient mode of administering medicines, the chief advantage lying in the small bulk to which the medicine is reduced and in the almost complete disguise of bitter and nauseous remedies by reason of their being swallowed without previous mastication. Pills are admirably adapted for the administration of heavy metallic substances not readily suspended in liquids, and also in cases where the action of the medicine is to be slow, or even retarded until it reaches the lower bowels. The usual shape given to pills is that of a sphere or globe, although an ovoid shape is also sometimes resorted to, and in a few cases even the lenticular shape is preferred. Their weight ranges from less than 0.06 Gm. to 0.3 Gm. (1 gr. to 5 gr.) for vegetable substances, or about 0.5 or 0.6 Gm. (8 or 10 grains) for heavy mineral compounds; if a pill exceeds this weight, it is called a *bolus*. Boluses are occasionally made weighing 1.3 or 2.0 Gm. (20 or 30 grains) each, and are often of a softer consistence than pills. Very small pills coated with sugar are called *granules*.

Preparation.—The most important step in the preparation of pills is the formation of a proper mass, which should consist of a firm, consistent paste, sufficiently plastic to admit of being moulded without adhering to the moulds, and sufficiently firm to prevent the pills from losing their original shape. Plasticity is that peculiar condition where adhesiveness and firmness are properly balanced: the former of these properties is due to a partial softness, which enables the particles of the mass to adhere to each other, thus imparting tenacity to the whole. Some substances possess this adhesiveness in themselves, but require the addition of a liquid—water or alcohol—in order to develop it, as, for instance, gums and resinous drugs. Other substances possess no inherent adhesive properties, and in such cases it becomes necessary to impart tenacity to them by the addition of some liquid or solid material, called the excipient; such substances are camphor, calomel, bismuth salts, some saline vegetable powders, reduced iron, and the like. Firmness in a pill mass is as essential as adhesiveness, and, while the latter is brought about by a state of partial solution or fluidity, so, inversely, the insolubility of some particles is necessary for the required firmness. The addition of excipients must be made judiciously, so that the constituents of the mass be not modified in their action nor the bulk be unnecessarily increased; and after each addition the mass should be well kneaded, which, itself having a softening influence on the mass by reason of the heat generated, enables the operator to judge of the true condition of the mixture. Whenever possible all constituents of a pill mass should be reduced to very fine powder before the addition of any excipient, as only in this condition can the homogeneity of the mass be assured, as also the subsequent accurate division of doses. Small quantities of potent remedies, such as alkaloids, narcotic extracts, toxic chemicals, etc., are preferably triturated with a little sugar of milk before mixing them with the other ingredients, to facilitate uniform distribution.

For the proper incorporation of volatile oils in pill masses powdered soap is to be preferred, which completely emulsionizes the oil and prevents its separation during the subsequent manipulations; soap, however, should never be employed in pill masses containing heavy metallic salts, such as iron, lead, etc., as decomposition will take place and cause the mass to crumble: in such cases the addition of an absorbent powder is preferable. As an absorbent for large quantities of volatile oils or as an excipient for heavy metallic salts or troublesome combinations, such as capsicum, lead acetate, and extract of hyoscyamus, and the like, the powder suggested some years ago by Mr. Mattison will be found very serviceable: it consists of 1 part of powdered tragacanth and 7 parts of finely-powdered (No. 80) elm-bark; and the following quantities will be found sufficient for making a good pill mass with the aid of a little syrup: 3 grains of the powder for 60 grains of iron by hydrogen, or bismuth subnitrate, or calomel, or equal parts of camphor and extract of henbane, or equal parts of camphor and lead acetate; 6 grains of the powder for 60 grains of dried ferrous sulphate or scale salts of iron, or equal parts of camphor and capsicum, etc. As an absorbent for soft masses, or such as contain large amounts of extracts, powdered liquorice-root will be found a better drying agent than marshmallow-root or elm-bark, and less likely to increase the bulk, as it contains little or no mucilaginous matter. For creosote soap may be used if in combination with other drugs, but if prescribed alone, powdered liquorice-root or the mixture of tragacanth and elm-powder with syrup will be found to answer well: 2 or 3 grains of the powder should

be used for each drop of creosote. For tar, Peru balsam and similar substances, clay (kaolin or fuller's earth), will be found a good absorbent, the mass to be made with soap. For the salts of quinine, glycerin and acacia or tragacanth, or even glycerite of starch, will be found desirable excipients; for cinchonidine or its sulphate, however, honey with a little acacia will be found preferable to glycerin. Diluted alcohol and soap and water are the best excipients for gum-resins, such as asafetida or galbanum, and even for powders like aloes, as is shown in the Pharmacopœia. Although the use of wax has at times been recommended for pill masses containing volatile oils, balsams, etc., we think it should only be employed in extreme cases, as pills made with wax frequently fail to give up the active ingredients in the liquids of the stomach or bowels, owing to their higher melting-point. For pills of readily reducible substances, as potassium permanganate, silver nitrate, silver oxide, gold chloride, etc., all contact with organic matter should be avoided, and hence the best excipients would be white clay and water, which form a plastic mass, but require quick manipulation, as it soon becomes crumbly; a better excipient is a mixture of equal parts of kaolin, soft petrolatum, and paraffin, which forms a mass that readily gives up the active constituent, at the temperature of the body, in the presence of moisture. Potassium permanganate can be readily formed into a pill mass by triturating with one-half its weight of kaolin, and then adding one-sixth or one-fourth its weight of petrolatum.

Pills containing free iodine should invariably be made with the addition of starch, so as to combine with the iodine and prevent its irritating effect on the mouth and throat; the union is very feeble, and the iodine will be readily liberated by the warm liquids of the stomach.

When deliquescent substances are ordered in pill form or such as are slowly volatilized upon exposure to air, a mixture of potassium borotartrate with half its weight of water will prove a good excipient: about one-sixth of a grain of powdered tragacanth should be added for each pill, and the mass must be quickly formed and rolled out. 60 grains of chloral hydrate or 30 grains of potassium iodide require 2 drops of the excipient. Such pills, if they are to be kept on hand for some time, require a protective coating.

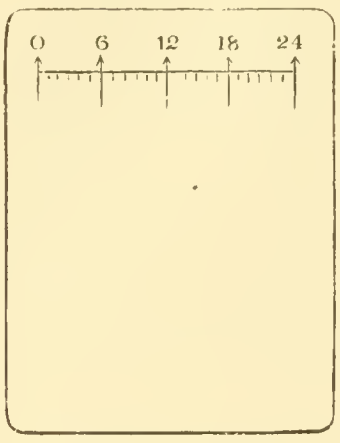
It is obvious, from the foregoing, that there cannot be an excipient which would be alike serviceable for all medicinal substances, or even for all drugs capable of being reduced to powder. The choice of the excipient is very frequently left to the pharmacist, and involves a knowledge not only of the constituents of the drugs, but also of the reactions which may take place between the different ingredients in the presence of moisture. *Mucilage of acacia* or of *tragacanth* serves a good purpose if the pills are to be used in a short time, but if kept on hand they become hard and dissolve very slowly. This may be prevented by replacing about one-half or more of the water with *glycerin*. The *glycerite of starch* (see p. 783) and various combinations of it with gum-arabic, tragacanth, and sugar have been used for the same purpose. Commercial syrupy *glucose*, *manna*, the official *pill masses*, most of the official *confections*, and more particularly those of rose, of hip, and of senna, will render powders adhesive, and if *extracts* are not inadmissible they will be found to yield good pill masses with a comparatively large amount of powder; a rather soft extract is capable of serving as an excipient for its own weight of vegetable powder and three or four times its weight of resins and insoluble salts, and with the addition of a little syrup or honey twice the weight indicated may be incorporated.

As a rule, it will be found desirable for the physician to order some adhesive material, like extracts, together with the other ingredients of pills, but the former should not be in excessive quantities, so as not to require the addition of inert absorbent powder. When no excipient is directed, the pharmacist should select one which is simple in composition, does not increase the bulk of the mass, and is not liable to become very hard. When resinous extracts and similar materials are ordered, an excipient is not often required, but the powders may be triturated together in a warm mortar and the plastic mass rolled out into pills while still warm. The compound cathartic pills furnish an example of this kind.

Pill masses should always be made in a mortar, except in the case of very simple combinations, for trituration by means of a pestle is essential to produce a uniform mixture of the ingredients, and it will be found that a mass can be formed in less time and with less excipient and labor in the mortar than on a pill-tile. After the mass has been properly prepared, it is transferred to a regular pill-machine or graduated glass or porcelain tile to be rolled out, by means of a flat piece of hard wood, into a cylinder of uniform thickness, which is then divided into the requisite number of pieces. These pieces are

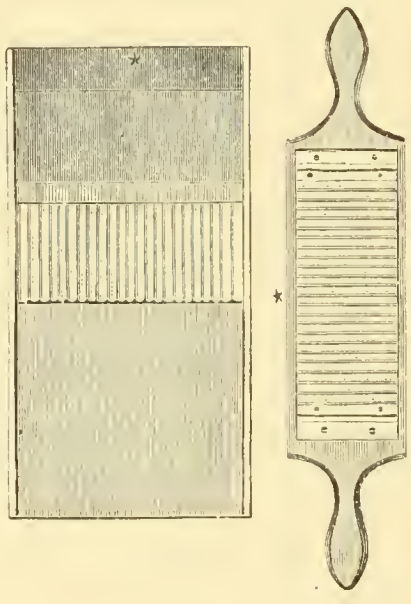
rounded either by continued rolling in the grooves of the pill-machine or by appropriate rolling between the fingers until they are nearly globular, when they are placed under the pill-finisher and completely rounded by rotary motion of the same, accompanied by some pressure. Various implements have been constructed for giving the pills a uniform

Fig. 214.



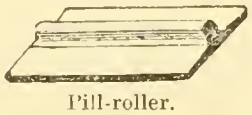
Pill-tile, graduated.

Fig. 215.



Pill-machine.

Fig. 216.



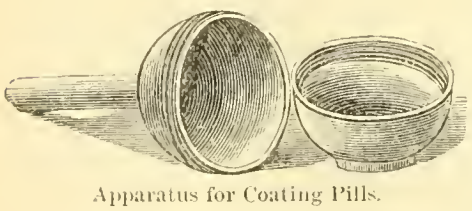
Pill-roller.

finish; they usually consist of a circular, smooth, rolling surface, with a projecting margin adjustable to pills of different size.

Pill-dusting.—The pill mass, being plastic and adhesive, is apt to adhere to the slab and the fingers while being rolled out and shaped into pills. This is prevented by the use of a fine powder, which should be strictly inert unless otherwise directed by the physician. Among the most suitable powders are lycopodium, liquorice-root, and starch; the former is particularly desirable on account of its fineness and uniformity, its slight adhesiveness, and its utter tastelessness. Powdered starch should be used with all white pill masses, Bermuda arrow-root being the best for the purpose. Only in exceptional cases is the addition of dusting powder to the pills in the box justifiable: the pills should receive a sufficient coating of the powder under the finisher, and if the mass has been properly made there is no danger of the pills adhering, and hence there is no occasion for putting an excess of powder in the box. Magnesia and magnesium carbonate should be used with due care on account of the possible chemical effect upon the ingredients of the pills. Powdered talc (soapstone) is likewise serviceable, and has the advantage of imparting a very thin opaque and tasteless coating to the pills without impairing their solubility in the stomach; it is particularly suited for pills of silver nitrate and the like. When asafetida or other substances of a nauseous odor are given in the form of pill, the odor may either be entirely covered or considerably modified by the use of powdered cinnamon, aromatic powder, ginger, or a similar powder.

Pill-coating.—If the pill mass be not too soft, the amount of powder adhering to the surface of the finished pill is quite small, though generally sufficient, if quickly swallowed, to cover the taste of bitter and nauseous ingredients. More perfect coverings may be obtained in various ways, an ordinary rather deep pill-box being used, or preferably an apparatus made of hard wood consisting of two hollow hemispheres, to one of which a short handle is attached. For *silvering* or *gilding* the pills are made firm, if possible rolled out and shaped without using any powder, and after a perfectly smooth surface has been obtained they are slightly dampened and introduced into the apparatus, together with the requisite quantity of gold- or silver-leaf; after a rapid rotary motion for a few seconds the pill will be found uniformly coated with the thin metal. Glycerin should not be used as an excipient or only in a very small quantity, as it lessens the brightness of this kind of coating.

Fig. 217.



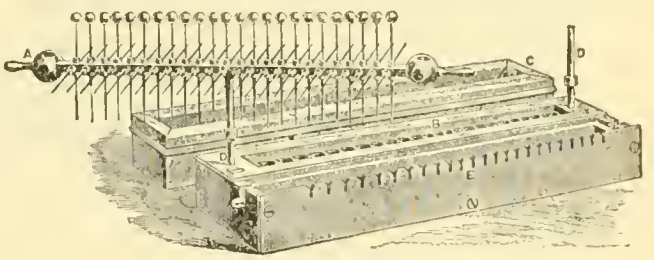
Apparatus for Coating Pills.

The same apparatus may likewise be employed for *sugar-coating* pills extemporaneously. To accomplish this, the pills receive first a thin coating of a thick mucilage, syrup of acacia or albumen, by rotating them upon a moistened slab or in a saucer, after which they are introduced into the apparatus with not too large a quantity of very finely-powdered sugar. The smoothness of the surface of the sugar depends altogether upon the mutual attrition of the pills, and consequently upon the absence of too large an excess of sugar and upon the rapidity of motion during the operation. A coating of *French chalk* may be applied in the same manner. Pills are now extensively coated with sugar on the large scale, hemispherical copper pans being used to which a somewhat eccentric rotary motion is given; these pans may be moderately heated either by steam or otherwise. To obtain a uniform and compact coating the powdered sugar is added gradually as required. In France sugar-coated pills are called *dragées*, and when of very small size *granules*.

Pills are occasionally coated with tolu or collodion: the former coating is directed officially for the pills of phosphorus and those of iodide of iron. Instead of using the pharmacopœial solution of tolu in ether, the following, suggested by Prof. Patch, will be found to give better results: 540 grains of balsam of tolu, 180 grains of mastiche, 2 fluidounces of alcohol; dissolve and filter. Coat the interior of two flat evaporating-dishes with a thin film of oil of sweet almond or petrolatum; place the pills in one of the dishes, and add a few drops of the solution; cover with the second dish, and rotate rapidly until the pills are coated, then put on a tray to dry.

For coating pills with gelatin a different manipulation from those described is required. A solution of pure gelatin in one-half or one-third its weight of water is made, and the solution kept at a temperature just high enough to keep it liquid. Fig. 218 represents a very useful machine for gelatin coating pills, and with a little practice very satisfactory results may be obtained. A number of pins are fastened to a bar, and so arranged that twenty-five pills can be taken up and dipped at one time; the solution of gelatin is kept fluid in a narrow vessel C resting in a water-bath, and the coated pills are easily removed by the comb attached to the tray E. The drying of the coating is effected by revolving the pin bars on the pivotal rod D. Of late years a continuous coating of gelatin has been successfully applied to pills by a process which is still kept a secret by manufacturers. Various serviceable apparatuses have been constructed to facilitate this operation. The coating of gelatin may be applied to pills while still plastic, but they should be sufficiently firm not to lose their shape while temporarily exposed to a somewhat elevated temperature.

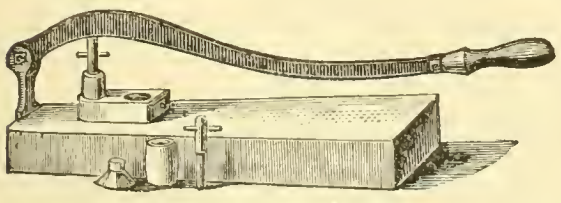
Fig. 218.



The "Franciscus" Pill-coater.

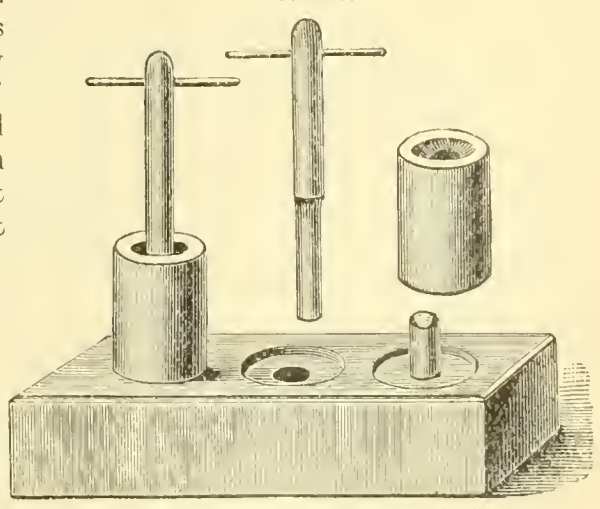
Compressed Pills.—These pills, which have lately come into use extensively, are usually lenticular in shape, and are made without any excipient, simply by subjecting the powdered material to pressure, the process being essentially that which was patented in England in 1843. Sometimes, however, it is found necessary in the case of extremely dry powders to add a very small quantity of cacao butter, petrolatum, sugar, or alcohol to facilitate compression and final expulsion from the mould. Figs. 219 and 220 represent two styles of apparatus for the convenient compression of pills at the dispensing counter: they are similarly constructed, the

Fig. 219.



The "Smedley" Pill-compressor.

Fig. 220.

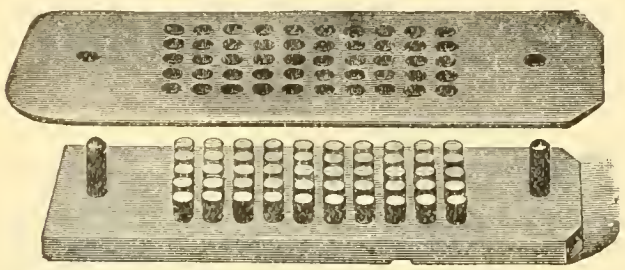


Apparatus for making Compressed Pills.

weighed powder being introduced into a movable cylinder resting over a metal base with concave surface; in the one case compression is effected by striking the plunger, which fits neatly into the cylinder, a quick blow with a wooden mallet; in the other case more uniform pressure is brought to bear by means of a long lever, which plan is decidedly better. Powders which are readily soluble in water without being deliquescent appear to be best adapted for this kind of pills.

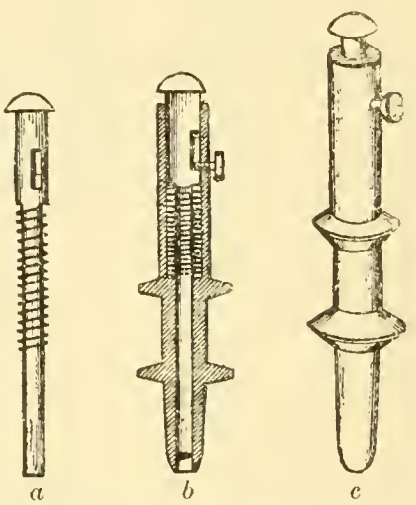
Tablet Triturates.—Closely allied to compressed pills are tablet triturates, which were first introduced in 1878 by Dr. Robert Fuller, and since then have rapidly increased in favor with physicians. Their use is particularly indicated for the administration of small doses of potent remedies, and, being free from adhesive excipients, the tablet is readily disintegrated in the stomach. Figs. 221 and 222 show two different styles of apparatus used in the manufacture of tablet triturates; they are made of hard rubber, although the perforated plate may be also of glass or metal. The method of using the moulds is easily learned and practice soon acquired. The basis of all tablet triturates is sugar of milk or a mixture of it with half its weight of cane-sugar; the active ingredient having been intimately mixed with the vehicle, a paste is made by the careful addition of alcohol. The paste is formed into tablets by pressing it into the perforations of the rubber or glass plate, and then removing the tablets from the holes by means of the pegs attached to another plate, and which fit exactly into the perforations of the first plate: the tablets are either allowed to dry on the pegs or are transferred to a finely-perforated tray and dried by exposure to warm air. When the combination mould is used, the paste is spread on a pill-tile and the tablet formed after the manner of cutting a lozenge by pressing the mould into the paste, so as to fill the open space completely, and then transferring to a tray by depressing the piston, which causes the tablet to be expelled. The weight of tablet triturates varies from ½ to 2 or 3 grains, and the proper division of doses is readily ensured by mixing the active ingredient and vehicle in such proportions that each ½, 1, 2, or 3 grains of the mixture shall contain the required quantity of active ingredient; thus 1 grain of calomel mixed with 19 grains of vehicle will make 20 one-grain tablets, each containing $\frac{1}{20}$ grain of calomel, or 10 two-grain tablets, containing $\frac{1}{10}$ grain of calomel, or 40 half-grain tablets, each containing $\frac{1}{40}$ grain of calomel, etc.

Fig. 221.



W. T. & Co.'s Hard Rubber Mould for Tablet Triturates.

Fig. 222.



a *b* *c*

Combination Mould for Tablet Triturates: *a*, Piston; *b*, Sectional View; *c*, Complete Mould.

Preservation.—Uncoated pills are best preserved in lycopodium or other powder, and in a vessel which does not prevent the exchange of air. Moist pills kept in well-closed vessels are apt to become mouldy.

It should be mentioned that the British Pharmacopœia directs only *pill masses*, leaving the final division to be specially ordered by the physician. The U. S. Pharmacopœia, on the other hand, besides recognizing three pill masses (see page 1020), directs *pills* of a certain weight; for convenience of dispensing, however, the mass of some of these is sometimes kept on hand undivided.

PILULÆ ALOES, *U. S.*—Pills of Aloes.

Pilula aloes Socotrinæ, Br.—*Pilules d'aloès et de savon*, Fr.; *Aloepillen*, G.

Preparations.—Purified Aloes, in fine powder, 13 Gm.; Soap, in fine powder, 13 Gm.; to make 100 pills. Beat them together with water, so as to form a mass, and divide it into 100 pills.—*U. S.* For 12 pills use aloes and soap, of each 1.56 Gm. (24 grains).

The formula of the French Codex is identical with this, except that Cape aloes is used, and that 100 pills contain 10 Gm. of each of the ingredients.

Take of Socotrine aloes, in powder, 2 ounces; hard soap, in powder, 1 ounce; volatile oil of nutmeg 1 fluidrachm; confection of roses 1 ounce. Beat all together until thoroughly mixed.—*Br.*

Pilula aloes Barbadensis, *Br.*, is made in precisely the same manner, except that Barbadoes aloes is substituted for Socotrine aloes, and oil of caraway for oil of nutmeg, both in the same proportion as in the preceding formula.

Pilulæ aloeticæ.—Pilules d'aloès, *F. Cod.* Cape aloes (10 Gm.) 154 grains; confection of rose 5 Gm. (77 grains); make 100 pills.

Uses.—The soap in this pill serves to divide the aloes and render it more soluble, whereby, it is thought, the tendency of the medicine to irritate the rectum is diminished. In the British pill the oil of caraway is intended to lessen the tendency of the medicine to gripe. Pills of aloes are convenient laxatives in habitual *constipation*, and may be taken at bedtime or after dinner. A single pill repeated daily forms the ordinary dose. It may be used as a purgative in the *dose* of five or more pills, but is less suited for this purpose than other aloetic preparations.

The *Pilula aloes Barbadensis*, Br., is nearly identical as a purgative with that of the United States Pharmacopœia, but the oil of caraway it contains gives it the advantage. *Dose*, from Gm. 0.30–0.60 (gr. v–x).

The *dose* of pills of aloes is from Gm. 0.30–0.60 (gr. v–x), or two or three pills.

PILULÆ ALOES ET ASAFŒTIDÆ, *U. S., Br.*—Pills of Aloes and Asafetida.

Pilules d'aloès et asefétide, Fr.; *Aloe- und Asafatida-Pillen*, G.

Preparation.—Purified Aloes, in fine powder, 9 Gm.; Asafetida 9 Gm.; Soap, in fine powder, 9 Gm.; to make 100 pills. Beat them together with water so as to form a mass, and divide it into 100 pills.—*U. S.* For 12 pills use aloes, asafetida, and soap, of each 1.08 Gm. (16 grains).

Take of Socotrine aloes, in powder, asafetida, hard soap in powder, confection of roses, each 1 ounce. Beat all together until thoroughly mixed.—*Br.*

Uses.—These pills may take the place of the simple aloetic pill in cases of constipation attended with flatulence, and especially in nervous or hysterical persons. *Dose*, from two to five pills.

PILULÆ ALOES ET FERRI, *U. S., Br.*—Pills of Aloes and Iron.

Pilulæ aloeticæ ferratæ, s. Pilulæ Italicæ nigræ, P. G., F. Cod.—*Pilules d'aloès et de fer*, Fr.; *Aloe- und Eisenpillen, Italienische Pillen*, G.

Preparation.—Purified Aloes, in fine powder, 7 Gm.; Dried Sulphate of Iron 7 Gm.; Aromatic Powder 7 Gm.; Confection of Rose a sufficient quantity to make 100 pills. Beat the powders together with confection of rose so as to form a mass, and divide it into 100 pills.—*U. S.* For 12 pills use aloes, exsiccated sulphate of iron, and aromatic powder, of each 0.84 Gm. (13 grains).

Take of sulphate of iron 1½ ounces; Barbadoes aloes, in powder, 2 ounces; compound powder of cinnamon 3 ounces; confection of roses 4 ounces. Reduce the sulphate of iron to powder, rub it with the aloes and compound powder of cinnamon, and, adding the confection, make the whole into a uniform mass.—*Br.*

Exsiccated sulphate of iron and powdered aloes equal parts; mix, form a mass with spirit of soap, and divide into pills, each weighing 0.10 Gm. Moisten the pills with tincture of aloes to make the surface black and glossy.—*P. G.*

Uses.—This is an old and efficient combination used in the treatment of *amenorrhœa* associated with anæmia and constipation. Like other analogous compounds, it should be used habitually in moderate doses, and in larger ones at the menstrual epochs. *Dose*, Gm. 0.30–0.60 (gr. v–x), or two or three pills.

PILULÆ ALOES ET MASTICHES, *U. S.*—Pills of Aloes and Mastic.

Lady Webster's dinner pills, E.; *Pilules d'aloès et de mastic*, Fr.; *Aloe- und Mastix-Pillen*, G.

Preparation.—Purified Aloes, in fine powder, 13 Gm.; Mastic, in fine powder, 4

Gm.; Red Rose, in fine powder, 3 Gm.; to make 100 pills. Beat them together with water so as to form a mass, and divide it into 100 pills.—*U. S.* For 12 pills use aloes 1.56 Gm. (24 grains), mastic 0.48 Gm. (7½ grains), and red rose 0.36 Gm. (5½ grains).

Uses.—The association of mastic with aloes in a purgative pill can hardly have any other effect than to retard the solution of the latter, and thereby cause it to act upon the large rather than upon the small intestine. These pills are used to quicken defecation, and are generally taken with or immediately before or after the principal meal. Hence they have been called *Pil. ante cibum*, *Pilules des gourmands*, etc. Under the latter title, however, pills are used containing extract of cinchona and absinth, as well as aloes. Each pill contains about 2 grains of aloes.

PILULÆ ALOES ET MYRRHÆ, *U. S., Br.*—Pills of Aloes and Myrrh.

Rufus's pills, E.; *Pilules d'aloès et myrrhe*, *Pilules de Rufus*, Fr.; *Rufus'sche Pillen*, G.

Preparation.—Purified Aloes, in fine powder, 13 Gm.; Myrrh, in fine powder, 6 Gm.; Aromatic Powder, 4 Gm.; Syrup a sufficient quantity; to make 100 pills. Beat them together so as to form a mass, and divide it into 100 pills.—*U. S.* For 12 pills use aloes 1.56 Gm. (24 grains), myrrh 0.72 Gm. (12 grains), and aromatic powder 0.48 Gm. (8 grains).

Triturate together Socotrine aloes 2 ounces, myrrh 1 ounce, dried saffron ½ ounce; then add treacle 1 ounce and sufficient glycerin, and beat them together into a uniform mass.—*Br.*

Uses.—The proportion of myrrh in this compound is too small to exert much influence, but, owing to its supposed action upon the uterine system, it is believed to increase the virtue of the aloes in the treatment of *amenorrhœa*, *uterine catarrh*, etc. The still smaller proportion of saffron (*Br.*) can scarcely add much to its virtues. As a purgative from three to six pills may be given, or Gm. 0.60–1.30 (gr. x–xx) of the mass in a bolus. As a laxative, taken at bedtime for a week or more, one or two pills will generally suffice, and will be found the most efficient mode of administration in the uterine disorders referred to.

PILULÆ ANTIMONII COMPOSITÆ, *U. S.*—Compound Pills of Antimony.

Pilula hydrargyri subchloridi composita, Br.; *Pil. calomelanos composita.—Compound pills of subchloride of mercury*, *Plummer's pills*, E.; *Pilules altérantes composées*, *P. antidartreuses*, *P. de Plummer*, Fr.; *Plummer'sche Pillen*, G.

Preparation.—Sulphurated Antimony 4 Gm.; Mild Mercurous Chloride 4 Gm.; Guaiac, in fine powder, 8 Gm.; Castor Oil a sufficient quantity; to make 100 pills. Mix the powders, beat them together with castor oil, added a few drops at a time, so as to form a mass, and divide it into 100 pills.—*U. S.* For 12 pills use sulphurated antimony and calomel, each 0.48 Gm. (7½ grains), guaiac resin 0.96 Gm. (15 grains).

Take of subchloride of mercury, sulphurated antimony, each 1 ounce; guaiacum resin, in powder, 2 ounces; castor oil 1 fluidounce or a sufficiency. Triturate the subchloride of mercury with the antimony, then add the guaiacum resin and castor oil, and beat the whole into a uniform mass.—*Br.*

Uses.—Plummer's pills—or compound calomel pills, as they might properly be called—probably owe their virtues to the mercury they contain, since various other mercurial preparations are equally efficacious in the diseases for the cure of which these pills are in greatest repute—viz. *chronic rheumatism* and *diseases of the skin*, so far as they are due to a syphilitic taint—and since the proportion of guaiac in them can have no efficiency. The *dose* is one or two pills twice a day.

PILULÆ ASAFŒTIDÆ, *U. S.*—Pills of Asafetida.

Pilule d'asefétide, Fr.; *Asafatida-Pillen*, G.

Preparation.—Asafetida 20 Gm.; Soap, in fine powder, 6 Gm.; to make 100 pills. Beat them together with water so as to form a mass, and divide it into 100 pills.—*U. S.* For 12 pills use asafetida 2.40 Gm. (36 grains) and soap 0.72 Gm. (12 grains).

Uses.—These pills, especially when sugar-coated, are convenient for the administration of asafetida, of which each one contains 3 grains. *Dose*, from one to three pills.

PILULA CAMBOGIÆ COMPOSITA, *Br.*—Compound Pill of Gamboge.

Preparation.—Take of Gamboge, in powder, Barbadoes Aloes, in powder, Compound Powder of Cinnamon, each 1 ounce; Hard Soap, in powder, 2 ounces; Syrup a sufficiency. Mix the powders together, add the syrup, and beat the whole into a uniform mass.

Uses.—As an efficient purgative in constipation and in congested states of the portal circulation this pill may be recommended. *Dose*, Gm. 0.30–0.60 (gr. v–x).

PILULÆ CATHARTICÆ COMPOSITÆ, *U. S.*—Compound Cathartic Pills.

Antibilious pills, E.; *Pilules cathartiques composées*, Fr.; *Abführpillen*, G.

Preparation.—Compound Extract of Colocynth 80 Gm.; Extract of Jalap 30 Gm.; Mild Mercurous Chloride 60 Gm.; Gamboge, in fine powder, 15 Gm.; to make 1000 pills. Mix the powders intimately; then gradually incorporate them with the extract of jalap and a sufficient quantity of water to form a mass, and divide it into 1000 pills.—*U. S.* For 12 pills use compound extract of colocynth 0.960 Gm. (15 grains); extract of jalap 0.360 Gm. (6 grains); calomel 0.720 Gm. (12 grains); gamboge 0.180 Gm. (3 grains).

In making this pill mass it is advisable to use a warm mortar and add very little water; while still warm it may be formed into pills which will better retain their shape than if made with more water at the ordinary temperature. The composition of these pills is almost exactly the same as in the previous Pharmacopœia, a lesser quantity of extract of jalap having been substituted for the abstract.

Action and Uses.—Whether or not the calomel acts upon the liver, as was once believed, there can be no question that in all cases requiring thorough purgation and in which the *gastric digestion* is *disordered*, the liver tumid and tender, the skin and the conjunctiva muddy, and the urine dark and sedimentary, these symptoms are promptly relieved by a purgative dose of compound cathartic pills. Hence, they are much used in malarial localities at seasons when periodical diseases prevail, and in other places for the relief of similar symptoms produced by the habit of eating excessively of animal food and using alcohol beyond the needs of the economy. There is much reason for believing that this pill operates upon the entire intestinal tract.

The *dose* as a laxative is about Gm. 0.20 (gr. iij), or one pill; as an active cathartic, about three pills. It is not adapted for habitual use, on account of its tendency to produce salivation, when often repeated.

PILULÆ CATHARTICÆ VEGETABILES, *U. S.*—Vegetable Cathartic Pills.

Pilules cathartiques végétables, Fr.; *Vegetabilische Abführpillen*, G.

Preparation.—Compound Extract of Colocynth 60 Gm.; Extract of Hyoscyamus 30 Gm.; Extract of Jalap 30 Gm.; Extract of Leptandra 15 Gm.; Resin of Podophyllum 15 Gm.; Oil of Peppermint 8 Cc.; Water, a sufficient quantity to make 1000 pills. Mix the compound extract of colocynth intimately with the resin of podophyllum and incorporate the oil of peppermint. Rub the extracts of hyoscyamus, jalap, and leptandra with enough water to render them plastic; then beat them together with the mixture first prepared, using a sufficient quantity of water, so as to form a mass to be divided into 1000 pills.—*U. S.*

For 12 pills use compound extract of colocynth 0.720 Gm. (12 grains); extract of hyoscyamus and extract of jalap, of each 0.360 Gm. (6 grains); extract of leptandra and resin of podophyllum, of each 0.180 Gm. (3 grains); oil of peppermint 3 drops.

Uses.—Neither the title nor the composition of this pill recommends it. The former is as applicable to several other compound pills, and the latter is such as might have been left to magistral prescription. The average dose may be stated at one pill, as a laxative.

PILULA COLOCYNTHIDIS COMPOSITA, *Br.*—Compound Pill of Colocynth.

Pilules de coloquinte composées, *Pil. cochés mineures*, Fr.; *Coloquinten-Pillen*, G.

Preparation.—Take of Powdered Colocynth-pulp 1 ounce; Barbadoes Aloes 2 ounces; Resin of Scammony 2 ounces; Potassium Sulphate ½ ounce; Oil of Cloves 2

fluidrachms; Distilled Water a sufficiency. Mix the powders, add the oil of cloves, and beat into a mass with the aid of the water.—*Br.*

The formula of the French Codex directs colocynth, Barbadoes aloes, and scammony, of each 10 Gm., honey 30 Gm., oil of cloves 0.05 Gm., to be divided into 200 pills, which are to be coated with silver.

Uses.—This pill is appropriate in the same cases as the compound pill of gamboge. *Dose*, Gm. 0.30–0.60 (gr. v–x), or two or three pills.

PILULA COLOCYNTHIDIS ET HYOSCYAMI, *Br.*—Pill of Colocynth and Hyoscyamus.

Preparation.—Take of Compound Pill of Colocynth 2 ounces; Extract of Hyoscyamus 1 ounce. Beat them into a uniform mass.—*Br.*

Uses.—The operation of the compound extract of colocynth in this pill is mitigated by its association with extract of hyoscyamus, but an officinal formula is hardly necessary for such a combination. It is better to add the narcotic extract to whatever purgative pill has a tendency to gripe in a magistral prescription. *Dose*, Gm. 0.30–0.60 (gr. v–x), or two or three pills.

PILULA CONII COMPOSITA, *Br.*—Compound Pill of Hemlock.

Preparation.—Take of Extract of Hemlock 2½ ounces; Ipecacuanha ½ ounce; Treacle a sufficiency. Mix the extract of hemlock and ipecacuanha, and add sufficient treacle to form a pill mass.

Uses.—This combination is intended to act as a sedative and expectorant, but the extract of conium contained in it can exert but little influence in either way. A pill of Dover's powder is more efficient. *Dose*, Gm. 0.30–0.60 (gr. v–x), or two or three pills.

PILULÆ FERRI CARBONATIS, *U. S.*—Pills of Ferrous Carbonate.

Pilula ferri, Br. Add.—*Pills of iron*, *Ferruginous pills*, *Chalybeate pills*, *Blaud's pills*, E.; *Pilules chalybés de Blaud*, Fr.; *Blaud'sche Pillen*, G.

Preparation.—Ferrous Sulphate in clear crystals, 16 Gm.; Potassium Carbonate 8 Gm.; Sugar 4 Gm.; Tragacanth, in fine powder, 1 Gm.; Althæa, in No. 60 powder, 1 Gm; Glycerin, Water, each, a sufficient quantity; to make 100 pills. Rub the potassium carbonate in a mortar, with a sufficient quantity (about 10 drops each) of glycerin and water, then add the ferrous sulphate and sugar, previously triturated together to a uniform powder, and beat the mass thoroughly until it assumes a greenish color. When the reaction appears to have terminated, incorporate the tragacanth and althæa, and, if necessary, add a little more water, so as to obtain a mass of pilular consistence. Divide this into 100 pills. These pills should be freshly prepared when wanted.—*U. S.*

For 12 pills use ferrous sulphate crystals 1.920 Gm. (30 grains); potassium carbonate 0.960 Gm. (15 grains); sugar 0.480 Gm. (7½ grains); tragacanth and althæa, of each 0.120 Gm. (2 grains); glycerin and water, of each 1 drop or a sufficient quantity.

Take of ferrous sulphate 60 grains; reduce to fine powder in a mortar, adding 12 grains of powdered sugar and 4 grains of powdered tragacanth, and mix intimately. Finely powder 36 grains of potassium carbonate in another mortar, and mix with it 2½ minims of glycerin. Transfer this to the mortar containing the ferrous sulphate, beat thoroughly until the mass becomes green, and add water, if necessary, sufficient to impart a pilular consistence. Divide into 5-grain pills.—*Br. Add.*

This is a new official pill, intended to present ferrous carbonate in a freshly prepared form; as frequently prescribed by physicians, equal weights of ferrous sulphate and potassium carbonate are ordered, being a decided excess of the latter, which renders the mass hygroscopic and more difficult to manage. 1 part of pure crystallized ferrous sulphate requires 0.497 + part of absolute potassium carbonate (equal to 0.523 + official 95 per cent. salt) for complete decomposition, yielding 0.417 + part of ferrous carbonate. Unless absolutely pure potassium carbonate is used, the decomposition in the official pills will not be complete, as 16 Gm. of ferrous sulphate require 8.368 Gm. of 95 per cent. potassium carbonate. Each pill is intended to contain about 0.0648 Gm. (1 grain) of ferrous carbonate.

Allied Preparation.—Pilula ferri carbonatis, *Br.*—Pill of carbonate of iron. Take of saccharated carbonate of iron, 1 ounce; confection of rose, ¼ ounce; beat them into a uniform mass.

Uses.—Under the name of Blaud's pills this preparation has long been used in France. They may be taken as representing in a pilular form the compound mixture of iron. *Dose*, one or more pills.

PILULÆ FERRI IODIDI, *U. S., Br.*—Pills of Ferrous Iodide.

Pilules d'iodure de fer, P. de Blancard, Fr.; *Eisenjodür-Pillen*, G.

Preparation.—Reduced Iron 4.0 Gm.; Iodine 5 Gm.; Glycyrrhiza, in No. 60 powder, 4.0 Gm.; Sugar, in fine powder, 4.0 Gm.; Extract of Glycyrrhiza, in fine powder, 1.0 Gm.; Acacia, in fine powder, 1.0 Gm.; Water, Balsam of Tolu, Ether, each a sufficient quantity, to make 100 pills. To the reduced iron, contained in a porcelain capsule, add about 6 Cc. of water, and gradually add the iodine, constantly triturating, until the mixture ceases to have a reddish tint. Then add the remaining powders, previously mixed, and evaporate the excess of moisture on the water-bath, constantly stirring, until the mass has acquired a pilular consistence. Lastly, divide it into 100 pills. Dissolve 10 Gm. of balsam of tolu in 15 Cc. of ether; shake the pills with a sufficient quantity of this solution until they are uniformly coated, and put them on a plate to dry, occasionally stirring them until the drying is completed. Keep the pills in a well-stoppered bottle. —*U. S.*

Take of fine iron wire 40 grains; iodine 80 grains; refined sugar, in powder, 70 grains; liquoriee root, in powder, 140 grains; distilled water 50 minims. Agitate the iron with the iodine and the water in a strong stoppered ounce phial until the froth becomes white. Pour the fluid upon the sugar in a mortar, triturate briskly, and gradually add the liquoriee.—*Br.*

To make 12 pills use redueed iron 0.480 Gm. (7½ grains); iodine 0.60 Gm. (9¼ grains); glycyrrhiza and sugar, of each 0.480 Gm. (7½ grains); extract of glycyrrhiza and acacia, of each 0.120 Gm. (2 grains).

Both pharmacopœias direct an excess of iron, but only in the U. S. formula is this exeess subsequently incorporated in the pill mass. If the redueed iron were perfectly pure, 1.104 Gm. would be sufficient to combine with 5 Gm. of iodine, yielding 6.104 Gm. of ferrous iodide.

Owing to the heat produced by the reaction the iodine should be eautiously added in small quantities, to avoid loss by vaporization. Due precaution being exercized, the quantity of water directed in this part of the proeess may even be reduced a little, as has been done by the British Pharmaeopœia, whereby subsequent evaporation may be avoided or materially lessened; if evaporation be neeessary, the ferrous iodide is sufficiently protected by the exeess of iron and by sugar, and without the presence of the other vegetable powders, which may be easily incorporated with the syrupy liquid. Owing to the gradual oxidation when exposed to the air, the pill mass should not be kept on hand, but should be at once made into pills. To proteet these against the influence of the air, they are directed to be coated with a thin layer of tolu balsam, or, according to the French Codex, with tolu balsam and mastic, used in ethereal solution. The latter authority—whose process, has, in the main, been adopted by the U. S. P., with several improvements—does not require an excess of iron to be incorporated with the pill mass, but directs the freshly-made pills to be rolled in finely-powdered iron, and afterward to be coated as stated, thus affording an additional protection to the surface of the pill.

If properly made and preserved, these pills will keep for years without acquiring the smell of iodine or tarnishing a strip of bright metal suspended in the vial. Should oxidation take place to the extent of liberating iodine, distilled water on being triturated with a few of the pills will yield a filtrate which, on the addition of gelatinized starch, will acquire a more or less distinct green tint, resulting from the brown-yellow color of the extractive matter and the blue color of iodide of starch.

Each pill contains very nearly 0.061 Gm. (1 grain), *U. S. P.*, or about 0.05 Gm. (¾ grain), *F. Cod.*, of ferrous iodide. 1 grain of the same compound is contained in 3½ grains of the pill mass, *Br.*

Uses.—These pills are reported to be useful in *anæmia* and in the *scrofulous* or *tuberculous* diathesis, but the opinion is founded rather on hypothetical notions than upon elinical experienee. In point of fact, glandular scrofula and pulmonary tubereulosis are neither identical nor closely allied, and while iodine and iron are both useful in the former, they are usually injurious in the latter, except when iron is demanded by the anæmie state of the system; but neither of them touches the root of the disease. *Dose*, Gm. 0.20–0.40 (gr. iij–viij).

PILULÆ GALBANI COMPOSITÆ, *U. S. 1880.*—Compound Pills of Galbanum.

Pilula asafœtida composita, Br.; *Compound pill of asafetida*, E.; *Pilules de galbanum composées*, Fr.; *Galbanum-Pillen*, G.

Preparation.—Galbanum 9.75 Gm.; Myrrh 9.75 Gm.; Asafetida 3.25 Gm.; Syrup a sufficient quantity; to make 100 pills. Beat them together so as to form a mass, and divide it into 100 pills.—*U. S.* For 12 pills use galbanum and myrrh, of each 1.17 Gm. (18 grains), asafetida 0.39 Gm. (6 grains).

Take of asafetida, galbanum, myrrh, each 2 ounces; treacle, by weight, 1 ounce. Heat all together by means of a water-bath, and stir the mass until it assumes a uniform consistence.—*Br.*

A similar pill was formerly official in France as *Pilules antihystériques.*

Uses.—The ingredients of this compound render it more or less stimulant to the mucous membrane, and especially appropriate in chronic *pulmonary catarrh* and *uterine leucorrhœa.* It is also used in functional nervous disorders, especially of an hysterical nature. *Dose*, Gm. 0.30–1.30 (gr. v–xx), or from two to four pills.

PILULA IPECACUANHÆ CUM SCILLA, *Br.*—Pill of Ipecacuanha and Squill.

Preparation.—Take of Compound Powder of Ipecacuanha 3 ounces; Squill, in powder, Ammoniacum, in powder, each 1 ounce; Treacle a sufficiency. Mix the powders, and beat into a mass with the treacle.—*Br.*

Uses.—The presumed effect of this pill is to mitigate *bronchitis* in its chronic, and especially its senile forms, by a combined sedative and stimulant action. There can be no question of its utility in many cases for which the balsams and terebinthinates are too stimulating. *Dose*, Gm. 0.30–0.60 (gr. v–x).

PILULÆ OPII, *U. S.*—Pills of Opium.

Pilules d'opium, Fr.; *Opiumpillen*, G.

Preparation.—Powdered Opium 6.50 Gm.; Soap, in fine powder, 2.0 Gm.; to make 100 pills. Beat them together with water, so as to form a mass, and divide it into 100 pills.—*U. S.* For 12 pills use powdered opium 0.78 Gm. (12 grains) and soap 0.240 Gm. (3 grains).

Uses.—Very often opium in substance is more suitable than any of its liquid preparations or than the salts of morphine. This is especially the case when it is desirable to limit the action of the medicine, as far as possible, to the *stomach* and *bowels* in painful affections of those viscera, and in cases of *vomiting* and *purging*, such as occur in *cholera morbus*, *ulcer of the stomach*, *gastralgia*, *typhoid fever*, etc. In most of these diseases the efficiency of the medicine is increased by its slow solution, and hence in them an old opium pill is greatly preferable to a freshly-made one. One pill may be given for a dose, and repeated if necessary.

PILULÆ PHOSPHORI, *U. S., Br.*—Phosphorus Pills.

Pilules au phosphore, *Pilules phosphorées*, Fr.; *Phosphorpillen*, G.

Preparation.—Phosphorus, 0.06 Gm.; Althæa, in No. 60 powder, 6.00 Gm.; Acacia, in fine powder, 6.00 Gm.; Chloroform, Glycerin, Water, Balsam of Tolu, Ether, each, a sufficient quantity; to make 100 pills. Dissolve the phosphorus, in a test-tube, in 5 Cc. of chloroform, with the aid of a very gentle heat, replacing from time to time any of the chloroform which may be lost by evaporation. Mix the althæa and acacia in a mortar, next add the solution of phosphorus, then immediately afterward a sufficient quantity (about 4 Cc.) of a mixture of 2 volumes of glycerin and 1 volume of water, and quickly form a mass, to be divided into 100 pills. Dissolve 10 Gm. of balsam of Tolu in 15 Cc. of ether, shake the pills with a sufficient quantity of this solution until they are uniformly coated, and put them on a plate to dry, occasionally rolling them about until the drying is completed. Keep the pills in a well-stoppered bottle.—*U. S.*

Take of phosphorus 3 grains; balsam of Tolu 120 grains; yellow wax 57 grains. Put the phosphorus and balsam of Tolu into a Wedgewood mortar about half full of hot water, and, when the phosphorus has melted and the balsam has become sufficiently soft, rub them together beneath the surface of the water until no particles of phosphorus are visible, the

temperature of the water being maintained at or near to 140° F.; add now the wax, and as it softens mix it thoroughly with the other ingredients. Allow the mass to cool without being exposed to the air, and keep it immersed in cold water in a bottle. When dispensed, incorporate 2 gr. of the mass with curd soap 1 gr.; if necessary, soften with spirit.—*Br.*

Phosphorus requires to be kept under water and to be weighed out under a liquid in which it is not oxidized, either water or chloroform. By melting a small quantity of phosphorus under warm water contained in a vial, and then agitating it well until the phosphorus has solidified, this is obtained in small granules, which are conveniently handled, and after having been rapidly dried with filtering-paper are at once dropped into the previously tared liquid until the desired quantity has been obtained.

Tolu as a vehicle for phosphorus in pills was proposed by A. C. Abraham (1874), who observed that it will retain 4 per cent. of the latter if combined with it in the melted condition. A. W. Gerrard (1873) had previously made a similar observation with regard to rosin, and this preparation became known at the time as *phosphoretted resin;* it is prepared by melting the resin in a wide-mouthed vial, adding the requisite quantity of phosphorus, and when it has melted agitating the stoppered vial until the phosphorus is dissolved. Like resin, it may be powdered, and, like the pill mass of the British Pharmacopœia, it should be kept under water to prevent oxidation. W. H. Walling (1875) found cacao butter very serviceable; 300 grains of it are melted in a vial, 25 grains of phosphorus are added, the vial is corked and well agitated until solution has been effected, and afterward with 200 grains of powdered soap until a uniform mixture is obtained. E. Lilly (1876) suggested fusing 6 parts of phosphorus under 260 parts of syrup, agitating well to effect its fine division, and incorporating with 340 parts of flour; formulas similar to this one are often followed in Europe. W. B. Addington (1875) proposed to dissolve the phosphorus in sufficient carbon disulphide, and to incorporate the solution in a mortar with a suitable extract, continuing the trituration until the solvent has evaporated; the extract may be replaced by soap, resin, or other suitable material. This process has been adopted by the U. S. Pharmacopœia, which, however, uses the far preferable chloroform as a solvent, which, aside from its odor, has the advantage of not being inflammable, while its vapor prevents the oxidation of the phosphorus. (See PHOSPHORUS.)

Uses.—This is one of the forms in which phosphorus may be prescribed internally *Dose*, Gm. 0.15–0.30 (gr. iij–vj), or one or two pills.

PILULA PLUMBI CUM OPIO, *Br.*—PILL OF LEAD AND OPIUM.

Preparation.—Take of Lead Acetate, in fine powder, 36 grains; Opium, in powder, 6 grains; Confection of Roses, 6 grains. Beat them into a uniform mass.—*Br.*

Uses.—2½ grains of acetate of lead and ⅛ grain of opium are contained in every 3 grains of this mass. The association of the two medicines is of great benefit in chronic *diarrhœa*, *dysentery*, and *bronchitis*, but as the proportion in which they ought to be employed should vary in almost every case, a fixed formula for their union appears superfluous. *Dose*, Gm. 0.20–0.30 (gr. iij–v).

PILULÆ RHEI, *U. S.*—PILLS OF RHUBARB.

Pilules de rhubarbe, Fr.; *Rhabarberpillen*, G.

Preparation.—Rhubarb, in fine powder, 20 Gm.; Soap in fine powder, 6 Gm.; to make 100 pills. Beat them together with water so as to form a mass, and divide it into 100 pills.—*U. S.* For 12 pills use rhubarb 2.40 Gm. (36 grains), soap 0.72 Gm. (12 grains).

Soap is an excellent excipient for rhubarb and many other powders.

Uses.—One of these pills, containing 3 grains of rhubarb, acts as a mild laxative, especially when taken after a meal or at bedtime, unless the constipation be decided. They are generally prescribed to relieve slowness of defecation rather than actual constipation. *Dose*, from one to three pills.

PILULÆ RHEI COMPOSITÆ, *U. S., Br.*—COMPOUND PILLS OF RHUBARB.

Compound rhubarb pills, E.; *Pilules de rhubarbe composées*, Fr.; *Rhabarber und Aloepillen*, G.

Preparation.—Rhubarb, in No. 60 powder, 13 Gm.; Purified Aloes, in fine pow-

der, 10 Gm.; Myrrh, in fine powder, 6 Gm.; Oil of Peppermint, 0.5 Cc.; to make 100 pills. Beat them together with water so as to form a mass, and divide it into 100 pills.—*U. S.* For 12 pills use rhubarb 1.56 Gm. (24 grains); aloes 1.20 Gm. (18 grains); myrrh 0.72 Gm. (12 grains); oil of peppermint about 2 drops.

Take of rhubarb-root, in powder, 3 ounces; Socotrine aloes, in powder, 2¼ ounces; myrrh, in powder, hard soap, in powder, each 1½ ounces; oil of peppermint 1½ fluidrachms; glycerin 1 ounce; treacle about 3 ounces. Mix the powders with the oil, then add the glycerin and sufficient treacle, and beat the whole into a uniform mass.—*Br.*

Uses.—Compound pills of rhubarb are among the best medicines for the relief of habitual *costiveness* depending upon atony of the large intestine and flatulent dyspepsia. In all cases of habitual constipation the milder should be preferred to the harsher purgatives, and the repetition at short intervals of a small dose is more efficient than a single large one. This rule applies particularly to all purgatives that act slowly, such as rhubarb and aloes. *Flatulence*, whether gastric or intestinal, is a serious hindrance to the proper movements of the muscular walls of the digestive canal, and tends to hinder the progress of the alimentary or fecal mass and increase its fermentation, with the production of gas or of the acrid and irritating products of its decomposition. Such results are more or less prevented by the stimulating operation of medicines of the class to which these pills belong. *Dose*, from one to four pills.

PILULA SAPONIS COMPOSITA, *Br.*—Compound Pill of Soap.

Pilula opii, Br. 1864.

Preparation.—Take of opium, in powder, ½ ounce; hard soap, in powder, 2 ounces; Glycerin a sufficiency. Mix the opium and soap, and beat into a mass with the glycerin. —*Br.*

Compound soap pill (*U. S. P.* 1870) was identical with this, but was prepared with water in the place of glycerin.

Uses.—This preparation contains 1 grain of opium in 5 of the mass. Its merit is supposed to consist in its ready solubility in the gastric juices and its being a convenient vehicle for prescribing opium under another name. *Dose*, Gm. 0.20–0.30 (gr. iij–v), or one or two pills.

PILULA SCAMMONII COMPOSITA, *Br.*—Compound Scammony Pill.

Pilules de scammonée composées, Fr.; *Scammoniumpillen*, G.

Preparation.—Take of Resin of Scammony, Resin of Jalap, Curd Soap, in powder, each 1 ounce; Strong Tincture of Ginger 1 fluidounce; Rectified Spirit 2 fluidounces. Add the spirit and tincture to the soap and resins, and dissolve with the aid of a gentle heat; then evaporate the spirit by the heat of a water-bath until the mass has acquired a suitable consistence for forming pills.—*Br.*

The process adopted furnishes a very good pill mass, in which the resins are uniformly divided through the agency of the soap, which also keeps them in suspension when the mass is macerated with water. A similar preparation which does not contain scammony, has been in use for a long time in continental Europe. (See Resina Jalapæ.)

Uses.—In this preparation the compound powder of scammony assumes a pilular form. It may be prescribed when drastic purgation is required in *dropsy*, *congestion of the brain* or *liver*, etc. *Dose*, from Gm. 0.30–1 (gr. v–xv).

PILULA SCILLÆ COMPOSITA, *Br.*—Compound Squill Pill.

Pilules de scille composées, Fr.; *Meerzwiebelpillen*, G.

Preparation.—Take of Squill, in powder, 1¼ ounces; Ginger, in powder, Ammoniac, in powder, Hard Soap, in powder, each 1 ounce; Treacle, by weight, 2 ounces or a sufficiency. Mix the powders, add the treacle, and beat into a uniform mass.—*Br.*

Compound pills of squill (*U. S. P.* 1870) contained each squill ½ grain, ginger 1 grain, ammoniac 1 grain, and soap 1½ grains.

Uses.—The stimulant action of these pills upon the bronchial mucous membrane makes them appropriate in the treatment of *chronic bronchitis* when it is attended with excessive secretion. The ginger in the compound probably renders it less hurtful to the stomach than it would be without that ingredient. *Dose*, two pills two or three times a day.

PIMENTA, *U. S., Br.*—Pimenta; Allspice.

Semen amomi, Piper jamaicense.—Pimento, E.; *Piment de la Jamaique, Toute-épice*, Fr.; *Nelkenpfeffer, Englisches Gewürz, Neugewürz*, G.; *Pimienta gorda, P. de Tabaso, Malagueeta*, Sp.

The nearly ripe fruit of Pimenta officinalis. *Lindley*, s. Eugenia Pimenta, *De Candolle*, s. Myrtus Pimenta, *Linné*, s. P. vulgaris, *Wight et Arnott*. Bentley and Trimen, *Med. Plants*, 111.

Nat. Ord.—Myrtaceæ.

Origin.—The allspice tree is indigenous to the West Indies, Central America, and the northern part of South America, and has been introduced into other tropical countries. It is slender, has opposite, entire, oblong or oval oblong, obtuse, and pellucid punctate leaves, and small white racemose flowers, the terminal ones being sessile and the lateral ones peduncled. The fruit is collected before it is ripe, but after it has attained its full size.

Fig. 223.

Pimenta officinalis, *Lindley*.

Description.—Allspice is nearly globular, 5 Mm. ($\frac{1}{5}$ inch) or less in diameter, and crowned above with the short four-parted calyx limb, or marked by its remnants, which surround a shallow depression containing a short style. The pericarp is of a reddish-brown or brown-gray color, and a granular appearance externally, lighter internally, woody, but thin and fragile, and contains numerous oil-cells. The berry has two cells, each with a single brown, plano-convex, roundish-reniform seed enclosing the spirally-curved, dark purplish-brown embryo. Allspice has an agreeable pungently aromatic odor and taste, with a flavor resembling that of cloves.

Constituents.—The most important constituent is the volatile oil (see Oleum Pimentæ), of which the fruit yields 3 to 4 per cent. Bonastre (1826) examined the fruit deprived of the seeds, and the latter separately, and obtained from them 10 to 5 per cent., respectively, of volatile oil; they also contain resin, tannin, fixed oil, sugar, mucilage, etc.

Action and Uses.—Pimento is an aromatic stimulant, and, like other agents of its class containing an essential oil, is used as a condiment to stimulate the digestive organs when they are suffering from exhaustion, and particularly from the debility caused by the prolonged heat of summer in tropical regions. In medical practice it is chiefly employed to relieve *flatulence*, to augment the effect of vegetable tonics, and to correct the tendency of purgatives to produce griping, or to cover the nauseous taste of certain medicines. It may be given in infusion, but the oil of pimento is more generally used. Like capsicum, pimento may be incorporated with Burgundy pitch or lead plaster to produce local stimulant, anodyne, and revulsive effects in *neuralgia* and *rheumatism*, or the extract itself may be spread upon cloth. Its application rapidly produces a sense of warmth in the part to which it is applied, followed by smarting and redness.

PIPER, *U. S.*—Black Pepper.

Piper nigrum, Br.; *Poivre noir*, Fr. Cod.; *Schwarzer Pfeffer*, G.; *Pimienta negra*, Sp.

The unripe berries of Piper nigrum, *Linné*. Bentley and Trimen, *Med. Plants*, 245.

Nat. Ord.—Piperaceæ.

Origin.—Black pepper is a climbing shrub indigenous to India, and at present cultivated in most of the East Indian and Philippine and some of the West Indian islands. It has smooth, alternate, petiolate, ovate, acute, and entire, five- or seven-nerved leaves, opposite to which elongated spikes of monœcious or diœcious flowers are produced, followed by sessile, berry-like fruits, which change from green to red, and finally yellow. The spikes are gathered as soon as some of the fruits begin to turn red; the next day the berries are rubbed off with the hands, and dried either near a fire or in the sun.

Description.—Black pepper is globular, about 4 Mm. ($\frac{1}{6}$ inch) in diameter, reticu-

lately wrinkled on the surface from the dried and contracted thin sarcocarp, blackish-brown or grayish-black externally, lighter colored internally, and encloses a single globular seed, which is whitish, mealy, and contains an undeveloped embryo in a central cavity. Pepper has a peculiar aromatic odor and a hot and pungent taste. Piper trioicum, *Roxburgh*, of India, yields a very similar fruit.

Constituents.—Black pepper was examined by Oersted (1819), who announced the discovery of *piperin*, and by Pelletier and Pontet (1820), who recognized the presence of volatile oil, acrid resin, starch, gum, etc. W. Johnstone (1889) isolated 0.56 per cent. (from long pepper 0.34 per cent., and from white pepper traces) of a volatile alkaloid, which is probably identical with piperidine. Willert (1817) ascribed the acrid taste to the soft resin, which conclusion was corroborated by Pelletier. According to Buchheim (1876), pepper contains an amorphous alkaloid, *chavicine*, which may be obtained from the ethereal solution of the alcoholic extract by agitating it with potassa solution to remove chlorophyll, resin, and fat acids, and evaporating; fat is removed by treatment with benzin, and piperin is left behind by repeated solution in a little ether. Thus obtained, chavicine is yellowish-brown, of the consistence of turpentine, has a strongly acrid taste, and when in alcoholic solution, boiled with potassa, is said to yield *piperidine* (see below) and amorphous *chavicic acid*. Lecanu obtained 1.17 per cent. of volatile oil from black and 1.04 per cent. from white pepper. *Oil of pepper* is colorless, lighter than water, commences to boil at 167.5° C. (333.5° F.), and was found by Dumas (1835) to be isomeric with oil of turpentine. It has the odor of pepper, but is destitute of its pungent taste, and yields with dry hydrochloric acid gas a liquid compound.

Fig. 224.

Piper nigrum, *Linné*.

The *pungent resin* is dark-green, soluble in alcohol, ether, and alkalies, and, in connection with other constituents of pepper, also in water. Pepper yields about 5 per cent. of ash.

Adulterations.—Ground pepper is frequently adulterated with various farinaceous substances, the press-cake of flaxseed, capsicum, and other materials. The adulterations are best detected by the microscope. With the view of determining the presence of adulterations in ground pepper, A. W. Blyth (1874) examined black pepper from five different localities, with the following results: Loss by the heat of a water-bath (moisture and volatile oil), 9.531 to 12.908, mean 10.95 per cent.; ash (for dried pepper), total, 4.189 to 5.770, mean 4.845 per cent., and soluble in water, 2.212 to 3.453, mean 2.84 per cent.; alcoholic extract, dried, 6.30 to 7.836, mean 6.922 per cent.; hot-water extract, 16.50 to 20.375, mean 18.177 per cent.

Other Peppers.—Piper Album, *White pepper*, consists of the fruit of black pepper, which is immersed in water and with the hands deprived of the epicarp and sarcocarp. It consists of the seed, which is composed of a large white mealy perisperm united at the apex with a small endosperm, in which the embryo is enclosed, the whole being enclosed in the reddish-brown testa, and this is covered with the white, soft, inner tissue of the fruit, in which about ten light lines are observable running from the base toward the apex. White pepper is rather larger and less pungent than black pepper, but contains the same constituents. A factitious white pepper is said to have been sometimes put into the market, made from black pepper by rubbing off the outer layers; it is easily recognized by its smaller size and large central cavity. White pepper yielded to Blyth 7.650 per cent. of alcoholic extract, but only 1.120 per cent. of ash, one-half of which was soluble in water.

Piper longum, *Long pepper* (Poivre long, *Fr. Cod.*, Pimiento larga, *Sp.*), consists of the spikes of Piper (Chavica, *Miquel*) officinarum, *De Candolle*, which is indigenous to Java. The nearly-allied Piper longum *Linné*, s. Chavica Roxburghii, *Miquel* (Bentley and Trimen, *Med. Plants*, 244), is likewise a shrub, but is found in India, Ceylon, and the Philippines. The spikes of the full-grown but still immature fruits are collected; they are 25–38 Mm. (1 to 1½ inches) long, nearly cylindrical, covered with the closely-packed, coalesced fruits, and agree with black pepper in odor, taste, and composition. In the amount of hygroscopic moisture and hot-water extract long pepper gives results agreeing with those mentioned above; but Blyth obtained 2.60 per cent. of alcoholic extract and 8.308 per cent. (4.472 soluble in water) of ash.

Piper (Macropiper, *Miquel*) methysticum, *Forster*. (See page 1025.)

Piper reticulatum, *Linné*, has a pungently aromatic root, which is employed in Brazil for its stimulating properties.

Piper (Chavica, *Miquel*) betle, *Linné*. (See page 1025.)

Piper (Chavica, *Miquel*) Siriboa, *Linné*, has leaves which are used like the preceding, and are of a similar appearance, but less distinctly heart-shaped.

Piper (Artanthe, *Miquel*) crocatum, *Ruiz et Pavon*. It is indigenous to Peru; the leaves and berries have a peppery taste; the ripe spikes are employed for dyeing yellow.

Piper anisatum, *Kunth*. It is found in the northern part of South America; the leaves and berries have an anise-like taste.

Action and Uses.—Black pepper is a powerful local and general stimulant, a quality which it owes to its concrete and volatile oils, and, when taken internally, it also probably exerts a special and more sustained influence upon the nervous system through its peculiar principle, piperin. Applied to the skin, powdered pepper occasions severe pain and redness; in the mouth and throat in large quantities it excites intense burning, and in the stomach a sense of diffusive warmth with some acceleration of the pulse. In very large doses it excites a burning heat throughout the abdomen, thirst and vomiting, sometimes fever, and occasionally convulsions. In some cases heat and tingling are felt in the palms of the hands and in the soles of the feet, followed by a sense of coolness in these parts. It augments the urine and irritates the bladder and urethra, and may produce a transient eruption of urticaria upon the skin.

Black pepper is, of all condiments except salt, the most extensively used to facilitate the digestion of soups and watery vegetables. Anciently, it was one of the most approved remedies for *intermittent fever*, and in modern times a large number of examples attest its efficacy, both in the form of the crude drug and as piperin. There can be no doubt that in many cases it has effected complete cures, but it is more generally employed in connection with quinine when the latter alone has failed, and often with advantage. Whether its efficiency is due to its own antiperiodic properties, or to its rendering the system more susceptible to the action of quinine, is undecided. Pepper is sometimes used in poultices to promote the resolution of enlarged *lymphatic glands;* in gargles to stimulate the *throat* and *gums* in flaccid conditions of these parts; and in plasters for the relief of *muscular rheumatism* and to assuage *headache*, *colic*, and other local pains. In powder it has been used to destroy *head lice*. Anciently, it was employed as a topical application to *hæmorrhoids*, and in recent times the confection of pepper has been given internally for a like purpose. In some cases of *fistula in ano*, of *gleet*, and of *leucorrhœa* it has been found very serviceable.

Powdered pepper may be given as a stomachic stimulant in *doses* of Gm. 0.30–1.30 (gr. v–xx), or as a condiment mixed with food. As an antiperiodic eight or ten peppercorns may be taken two or three times a day.

PIPERAZINUM.—Piperazine.

Piperazidine; Ethylene-imine; Diethylene-diamine; Dispermine.

Formula $(C_2H_4NH)_2 = C_4H_{10}N_2$. Molecular weight 85.9.

A synthetical compound, at one time supposed to be identical with spermine, but found to differ from the same both in chemical and physiological action.

Preparation.—When ammonia is allowed to act upon ethylene bromide or chloride, a mixture of salts of different bases is obtained, consisting of ethylene diamine, triethylene diamine, diethylene triamine, tetraethylene triamine, and diethylene diamine. In order to separate the last-named base the solution of the mixed salts is treated with an excess of sodium or potassium nitrite and heated to 60° or 70° C. (140°–158° F.), which causes dinitrosopiperazine to separate as a scaly crystalline mass; this is soluble with difficulty in cold, but readily soluble in hot, water and melts at 154° C. (309.2° F.). This compound, when treated with concentrated acids or reducing agents, yields ammonia and salts of piperazine, from which the pure base is obtained by distillation with alkalies.

Properties.—Piperazine occurs in colorless crystalline masses of faint but characteristic odor; it melts at 104°–107° C. (219.2°–224.6° F.), and boils at 145° C. (293° F.). From the air it greedily absorbs water and carbon dioxide, and liquefies in so doing. Crystallized from water, piperazine forms shiny glassy tablets. It is a strong base, very soluble in water and somewhat less so in alcohol; its solution rapidly changes red litmus-paper to blue. Aqueous chromic acid is without effect on piperazine, but potassium permangate oxidizes it even in the cold. An aqueous solution of piperazine is precipitated by mercuric chloride, cupric sulphate, tannin, picric acid, and Nessler's reagent. The

most important property of the base is its power of forming a readily soluble compound with uric acid, having twelve times the solvent power of lithium carbonate in this respect, the piperazine urate formed being soluble in 50 parts of water.

Action and Uses.—Piperazine is held to fulfil the conditions required for eliminating from the system an excess of *uric acid*, inasmuch as it is diuretic, forms with the acid a neutral salt which is soluble in 50 parts of water; does not undergo decomposition in the body; and is harmless. *Uric acid calculi* and *sand* dissolve in a solution of piperazine more quickly than in one of lithium or sodium. It will combine with seven times more uric acid than lithium will, forming with it a urate twelve times more soluble than that of lithium. It is said to be a solvent of oxalic and phosphatic, as well of uric acid concretions, and to be serviceable topically as well as internally in reducing gouty swellings. The latter statement, however, has been controverted. A case of urticaria in a gouty patient has been attributed to its use. The daily amount of piperazine recommended is Gm. 1–3 (gr. xv–xlv) a day, given in divided doses and dissolved in an abundance of carbonated water.

PIPERINUM, *U. S.*—Piperin.

Pipérine, Fr.; *Piperin*, G.

Formula $C_{17}H_{19}NO_3$. Molecular weight 284.34.

A neutral principle obtained from pepper, and occurring also elsewhere in plants of the nat. ord. Piperaceæ.

Origin.—Piperin was discovered by Oerstedt (1819), and obtained pure by Pelletier and Pontet (1820). It has been prepared from black, white, and long pepper, and by Stenhouse (1855) from the fruit of Cubeba Clusii. *Miquel.*

Preparation.—It is most readily prepared from the alcoholic extract of white pepper by treating it with potassa solution, which dissolves the resin, washing the residue with water, and purifying it by repeated crystallization from alcohol. On neutralizing the potassa solution with an acid the pungent resin is obtained. Wittstein's process is as follows: 16 parts of black pepper are exhausted with cold water, and afterward with alcohol; the alcoholic extract is washed with water, digested with alcohol and 1 part of slaked lime, and the solution concentrated; the crystals are purified by recrystallization and treatment with animal charcoal. The yield varies between 5 and 9 per cent.

Properties.—Pure piperin crystallizes in colorless flat, four-sided prisms of a glassy lustre and is almost tasteless. As usually met with, it is of a yellowish color, inodorous, and has at first a slight, but on continued mastication or in alcoholic solution a sharp, peppery taste. It remains unaltered on exposure, has a neutral reaction to test-paper, is nearly insoluble in water, and dissolves in volatile oils, in 60 parts of cold ether (Merck), in 30 parts of cold and 1 part of boiling 80 per cent. alcohol (Wittstein), and freely in acetic acid; the last two solutions are precipitated on the addition of water. It is likewise soluble in chloroform, benzene, and benzin. At 130° C. (266° F.) it melts like wax to a yellowish oily liquid, which on cooling congeals to a mass of resinous appearance; when fused it may be ignited and burns with a bright flame, leaving a light charcoal, which is readily consumed by heating it in the air. Sulphuric acid colors it blood-red, the color disappearing on the addition of water, leaving the piperin unaltered if the action of the acid had not been prolonged (Pelletier). The solution of piperin in sulphuric acid is yellow, becoming dark-brown, and finally green-brown (Dragendorff). Nitric acid colors piperin successively greenish-yellow, orange, and red, and dissolves it with a yellow color, the solution separating yellow floccules on the addition of water; by prolonging the action of the acid oxalic acid and a yellow bitter compound are produced (Pelletier). The resin resulting from this reaction becomes blood-red on the addition of potassa, and on heating the mixture piperidine is given off (Anderson, 1850). Piperin is a very weak base, and its salts are decomposed by water; crystallizable double salts, soluble in alcohol, may be obtained with the chlorides of mercury, platinum, and cadmium. By dry distillation with soda-lime piperidine is obtained. Boiled with alcoholic solution of potassa, piperin was found by Babo and Keller (1856) to be resolved into *piperic acid*, $C_{12}H_{10}O_4$, and *piperidine*, $C_5H_{11}N$. Piperic acid is in hair-like yellowish needles which fuse at 150° C. (302° F.), and at a higher temperature volatilize partly unaltered, at the same time giving off a coumarin-like odor. Piperidine is a colorless liquid of an ammoniacal and pepper-like odor, and when largely diluted of a bitter taste. It boils at 106° C. (222.8° F.), has a strong alkaline reaction, dissolves freely in water and alcohol, and yields with acids crystallizable salts; the piperate of piperidine crystallizes in silky

scales, which on being heated give off a part of the alkaloid. Ladenburg (1884) obtained a small quantity of piperidine synthetically by treating an alcoholic solution of pyridine with sodium.

Derivative Compounds.—Piperonal, Heliotropin, $C_8H_6O_3$. By boiling piperin for some time (twenty-four hours) with an alcoholic solution of potassa, potassium piperate is formed and crystallizes in shining prisms; this is dissolved in 40–50 parts of hot water and slowly mixed, under constant stirring, with a solution of potassium permanganate (2 parts of the latter salt to 1 of the piperate). The resulting magma is put on a strainer and repeatedly washed with hot water until the odor of heliotropin entirely disappears; the united liquids are distilled, and from the first portions of the distillate the larger portion of piperonal separates in crystals: the remainder is obtained by shaking the distillate with ether. Piperonal occurs in small white crystals, soluble in about 600 parts of cold water, and very readily soluble in alcohol and ether. It has been used as an antiseptic and antipyretic in doses of 10–15 grains every three hours, but is chiefly employed in perfumery.

Uses.—Piperin has been chiefly used as an adjuvant to or a substitute for quinine in the treatment of *intermittent fever*, and in doses of Gm. 0.5 (gr. vi) three or four times a day. Piperonal is said to be antiseptic and antipyretic. It has been prescribed in doses of Gm. 1 (gr. xv).

PISCIDIA.—Piscidia.

Jamaica dogwood, E.; *Bois énivrante, Piscidie*, Fr., G.; *Colorin de peces*, Sp.

The bark of the root of Piscidia Erythrina, *Jacquin.*

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—This is a West Indian tree, about 6 M. (20 feet) high. It has impari-pinnate leaves, with about seven ovate entire leaflets, and paniculate racemes of whitish and deep-red flowers, producing linear four-winged racemes. The wood of the trunk is heavy, brown, coarse-grained, and very durable.

Description.—Piscidia-bark comes in quills about 12 Mm. ($\frac{1}{2}$ inch) in diameter, or in flat or curved sections 25 or 50 Mm. (1 or 2 inches) broad, 10 or 15 Cm. (4 or 6 inches) long, and from 2 to 4 or 6 Mm. ($\frac{1}{12}$ to $\frac{1}{6}$ or $\frac{1}{4}$ inch) thick. It is covered with a corky layer having a bright orange-brown, or occasionally a whitish, color, and a roughish wrinkled or somewhat fissured appearance. When the cork is detached the outer surface of the bark is of a dark ash-gray color, with a brown or blackish tint, and has slight wavy longitudinal wrinkles and thin transverse ridges. The inner surface is brownish and smooth, or from the bared bast-bundles more or less fibrous. In the interior the tissue is of a brownish-green or blue-green color, apparently due to chlorophyll contained in the parenchyma. The bark consists mainly of the liber, in which the transversely elongated bast-bundles are arranged in irregular circles separated by parenchyma, and in radial rows between the rather broad medullary rays. It breaks with a tough fibrous fracture, the bast-bundles adhering in bands. When broken, the bark has a narcotic odor, resembling that of opium; the taste is at first slight, afterward bitter and acrid.

Constituents.—The active principle, according to E. Hart (1883), is a neutral compound, *piscidin*, $C_{29}H_{24}O_8$, which may be obtained from the concentrated tincture by treating it with lime, filtering, adding a little water, and crystallizing; after recrystallization from alcohol it forms colorless prisms, which melt at 192° C. (377.6° F.), are insoluble in water, slightly soluble in ether and in cold alcohol, and easily soluble in benzene and chloroform. It is not a glucoside. The other constituents have not been investigated. Resinous and oily compounds are present, and crystals of calcium oxalate are observed in the tissue.

Pharmaceutical Uses.—Extractum piscidiæ fluidum, Fluid extract of piscidia, may be prepared in the same manner as fluid extract of serpentaria, using a menstruum composed of 3 parts of alcohol and 1 part of water.

Action and Uses.—The bark of *Piscidia erythrina* was first known in Europe as having been used in the West Indies to catch fish by benumbing them (Wibmer, *Wirkung d. Arzneimittel*, iv. 222). Many years ago (1844), in England, Dr. Hamilton took a drachm of the tincture of this bark while suffering from a severe toothache. It caused a burning sensation in the stomach and copious perspiration, followed by deep sleep. He also applied it with success to aching carious teeth (*Jour. Phil. Coll. Phar.*, v. 159). It appears to have been lost sight of until 1880, when it was stated to be a powerful anodyne, relaxing the system, producing salivation and sweating, and affording marked relief in neuralgia of the face (*Phil. Med. Times*, xi. 57). In 1881 the experiments of Dr. Isaac Ott led him to conclude that piscidia contains a narcotic principle

which does not affect the motor nerves, but acts on the sensory ganglia of the spinal cord, producing convulsions, partly by stimulating the cord and partly by heightening the excitability of the muscles. He also found that it reduced the frequency of the pulse by a direct action upon the heart, first increasing and then diminishing the arterial tension, and that it first contracts and then dilates the pupils (*Medical News, etc.*, xxxix. 212). Ott also concluded it to be a sialagogue and diaphoretic, slowing the pulse but increasing the arterial tension, and that it is distinctly hypnotic. The last-named action is generally admitted, but some hold that it produces sleep only by annulling the pain which maintains wakefulness. Seifert used an extract of piscidia which, when given in the dose of Gm. 0.20–0.40 (gr. iv–viij) to relatively healthy persons, caused sound sleep, after which some lightness of the head was felt, as after a dose of morphine; but it did not affect the pulse or temperature. In two cases of *phthisis* in which morphine had ceased to allay the cough this medicine palliated it, and in others in which no morphine had been used it acted in a similar manner, but in one instance it occasioned sweats which were checked by atropine. In several other affections its utility was less evident (*Centralbl. f. d. ges. Therapie*, i. 427). Some reporters have discredited their statements by declaring that its hypnotic and analgesic effects are nearly equal to those of opium. In trials made by Berger the results were entirely negative (*ibid.*, ii. 121). Piscidia has had the credit of curing *neuralgia*, and there is little doubt of its having in numerous instances palliated that affection, as well as nervous *headache*, hysterical *delirium*, *chorea*, and acute (muscular) *rheumatism*. It is also said to allay irregularity of the *heart* due to organic disease. One or more fluidrachms (Gm. 4) may be given of the fluid extract, but efficient doses of it frequently produce nausea. This preparation has been used topically to allay the pain of *burns*.

PIX BURGUNDICA, *U. S., Br.*—Burgundy Pitch.

Poix de Bourgogne, P. des Vosges, P. jaune, F. Cod.; *Burgunder Harz* (*Pech*), G.; *Pez de Borgona, P. amarilla*, Sp.

The prepared resinous exudation from the spruce fir, Abies (Pinus, *Lamarck*, Picea, *Link*) excelsa, *Poiret*, s. Pinus Abies, *Linné*, s. Pinus Picea, *Du Roi*. Woodv., *Med. Bot.*, pl. 208; Bentley and Trimen, *Med. Plants*, 261.

Nat. Ord.—Coniferæ.

Origin.—The *spruce fir*, or *Norway spruce fir*, is a stately tree growing in Northern Asia and Northern Europe, and in the latter continent southward in mountainous regions to the Pyrenees and Alps; it is frequently cultivated in the United States. It has spreading, nearly horizontal branches, pendulous branchlets, scattered, somewhat four-angled leaves, about 19 Mm. (¾ inch) long, and pendulous, light-brown, nearly cylindrical cones, which are from 15–17 Cm. (6 to 7 inches) in length. The Siberian variety, Picea (Pinus, *Antoine*) obovata, *Ledebour*, differs mainly in having smaller and more slender ovate cones.

Collection.—The oleo-resinous exudation of the spruce fir, which flows from incisions, is collected in Finland, South-western Germany, Austria, and Switzerland, and is melted in water and strained; but the manufacture is on the decline, at least in Germany. That collected in some districts of the Bernese Jura is known in commerce as *poix blanche* (*Pharmacographia*).

Description.—Burgundy pitch is thus described by the British Pharmacopœia: "Hard and brittle, yet gradually taking the form of the vessel in which it is kept; opaque, varying in color, but generally dull reddish-brown; of a peculiar, somewhat empyreumatic perfumed odor and aromatic taste, without bitterness; free from vesicles: gives off no water when heated." The following additional characters of true Burgundy pitch were ascertained by Hanbury (1867): "Fracture shining, conchoidal, translucent; some samples contain much water and are opaque and of a dull-gray color, and require straining to free them from impurities; not wholly soluble in alcohol of 0.838, but leaves a small amount of white flocculent matter; placed in contact with double its weight of glacial acetic acid in a vial, it is dissolved, with the exception of a small amount of flocculent matter." The description of the U. S. Pharmacopœia agrees with the above.

Constituents.—Burgundy pitch contains *volatile oil*, which is most likely isomeric with oil of turpentine, and *resin*, which probably consists mainly of Maly's *abietic acid*. (See Terebinthina.)

Adulterations and Substitutions.—The German Pharmacopœia has very properly dismissed Burgundy pitch; that of 1872 recognized the product of *various* spe-

cies of Abies, which were not enumerated, under the designations *Resina pini*, *Resina pini burgundica*, and *Pix alba* (*Poix blanche*), and gave the following description: "It is a yellow or yellowish-brown, opaque, or diaphanous, fragile resin, having a glossy fracture, becoming soft when held in the hand, of a terebinthinate odor, and almost completely soluble in alcohol."

The substance commonly sold in England is made by melting together colophony with palm oil or some other fat, water being stirred in to render the mixture opaque (*Pharmacographia*). Hanbury described artificial Burgundy pitch as varying in color between tawny-yellow, orange-yellow, and orange-brown. The fracture is wax-like or shining or conchoidal, always opaque, but becoming gradually transparent on the surface by the loss of water; the odor is weak, terebinthinous, and hardly aromatic; it is less soluble in alcohol of 0.838, and with glacial acetic acid forms a turbid mixture which separates into two layers—a thick oily liquid above and a bright solution below.

Derivatives.—Retinol (resinol). A product of the destructive distillation of Burgundy pitch; it was obtained as far back as 1838, and was known as resin oil. It is a yellowish oily liquid which boils at temperatures above 280° C. (536° F.). It is a good antiseptic and not irritating, but is insoluble in water. Retinol is a useful solvent for iodol, aristol, cocaine, carbolic acid, phosphorus, and many alkaloids. The solution of phosphorus is very stable, and has been recommended for external and internal use.

Action and Uses.—Applied to the skin as a plaster, it produces itching, redness, and a papular eruption, and upon a delicate integument may occasion a vesicular, and even a pustular, eruption, with superficial ulcers. This eruption has been attributed to the retention by the impermeable plaster of the cutaneous secretions, but the better opinion is that it depends upon the inherent properties of the resin.

In the form of plaster Burgundy pitch is in general use to protect, sustain, or stimulate the part to which it is applied. In most cases these several objects are attained together. Thus, in the popular use of it as a remedy for *lumbago* particularly, but of other forms also of *muscular rheumatism*, it supports the part mechanically, protects it from external impressions, and stimulates it to the production of perspiration, or even to the formation of an eruption, as already mentioned. In the latter way it acts revulsively upon the deeper-seated parts, and is habitually used to relieve internal congestions and diminish secretions, as in *chronic bronchitis* and chronic *pulmonary tuberculosis*. In chronic and in subacute *pleurisy* its counter-irritant action is resorted to for promoting absorption of the effusion. In these several affections it also, if applied in a plaster of proper dimensions, gives to the chest a greatly-needed mechanical support during the act of coughing. Some obstinate cases of *sciatica* have been cured by enveloping the buttock and thigh in a Burgundy pitch plaster, and leaving it permanently in place. In like manner this plaster has been used to relieve chronic *diarrhœa* following dysentery, etc., but this cannot conveniently be done when the abdomen is prominent or flaccid.

Before applying a plaster of this sort to a hairy skin the hair should be shaved off, and in removing the plaster from such a part it should first be softened by passing lightly over its free surface a bottle of hot water or a warm flat-iron. The portion of pitch which still adheres may be partially removed by pressing upon it a linen or muslin rag, to which the adhesive material will cling rather than to the skin itself, and the remainder may be washed off with warm alcohol.

Retinol has been for some years, in the treatment of *gonorrhœa*, given in capsules containing Gm. 0.50 (gr. viij), and also applied on tampons with borax and other substances in the treatment of *vaginitis*. More recently a solution of 5–10 per cent. of salol in retinol has been injected into the bladder in subacute *cystitis*. It is also used as a vehicle for applying aristol, cocaine, carbolic acid, etc.

PIX CANADENSIS.—Canada Pitch.

Hemlock pitch, E.; *Poix de Canada*, Fr.; *Canadisches Pech*, G.; *Pez de Canada*, Sp.

The prepared resinous exudation from Abies (Pinus, *Linné*, Picea, *Link*, Tsuga, *Carrière*) canadensis, *Michaux*. Bentley and Trimen, *Med. Plants*, 264.

Nat. Ord.—Coniferæ.

Origin.—The *hemlock spruce* is a common forest tree of Canada and the Northern United States, but is more rare farther south, where it grows principally in the Alleghanies. It attains a height of 18–24 M. (60 or 80 feet), has horizontal branches, the young ones drooping; has flat, obtuse, somewhat denticulate, and on the lower surface

glaucous, leaves, and elliptic-ovate cones about 25 Mm. (1 inch) in length. The wood is light, coarse-grained, and less valuable for boards than that of other pines. The bark is very astringent, and by treatment with water furnishes an extract rich in tannin, and is largely employed in tanning under the name of *extract of hemlock-bark*. By distilling the branches with water a volatile oil is obtained, which is sold as *oil of spruce* or *oil of hemlock;* 8 pounds of the boughs yield about 1 ounce of oil (Stearns, 1858).

Collection.—According to Stearns, there are two methods of collecting Canada pitch, one of which consists in cutting cup-like incisions into the living tree and removing the soft oleoresin as it exudes; the other and most common one is to remove the wood and bark around the knobs or knots of the felled trees, which are rich in resin; these being placed in water in a large kettle, the resin is boiled out, and rising upon the top is skimmed off, and further purified by remelting and straining.

Description.—Canada pitch is found in the market in opaque reddish-brown masses, which gradually become translucent on the surface. It is brittle at the ordinary temperature, but usually takes the form of the vessel in which it is kept; it is of a somewhat lighter color internally, breaks with a shallow conchoidal and glossy fracture, is softened by the heat of the hand, and has a weak somewhat terebinthinate odor.

Constituents.—It is composed of one or more resins and of a minute quantity of volatile oil, which have not yet been examined.

Adulteration.—Stearns states that Canada pitch is often adulterated by the collectors with common rosin to the extent of 70 per cent. Such an addition must render it harder and less fusible, but no test is known by which to determine the sophistication.

Action and Uses.—Canada pitch is almost identical with Burgundy pitch in its action and uses, but owing to its greater softness is less convenient for making plasters. Its volatile oil, known as oil of spruce and oil of hemlock, is said to have been employed to produce abortion. There is no reason for attributing to it a specific action on the uterine system.

PIX LIQUIDA, *U. S., Br., P. G.*—Tar.

Resina empyreumatica liquida.—Goudron végétal, Fr. Cod.; *Theer*, G.; *Alquitran*, Sp.

An empyreumatic oleoresin obtained by destructive distillation from the wood of Pinus palustris, *Miller*, and of other species of Pinus. Bentley and Trimen, *Med. Plants*, 258.

Nat. Ord.—Coniferæ.

Origin.—The principal species used for the production of tar are Pinus palustris, *Miller*, P. Tæda, *Linné*, P. rigida, *Miller*, which grow in North America, and P. sylvestris, *Linné*, and Larix sibirica, *Ledebour*, indigenous to Northern Europe. (See Terebinthina.) Sufficient tar is produced in the United States to supply the domestic market and leave a portion for exportation. 60,393 barrels of tar and pitch were exported in 1882.

Preparation.—Pine wood which is unfit for use as timber is usually employed. It is cut into billets of suitable size, which are arranged into large conical stacks, or, as is sometimes the case in Europe, are closely packed in clay furnaces of a similar shape. The stacks or piles are covered with a layer of earth and ignited above, and the draft is regulated so as to sustain a slow combustion without flame. The tarry products, as they are formed, gradually descend and collect in a cavity or ditch at the base of the pile, from which they are transferred into barrels. The process is one of destructive distillation, in which, however, the pyroligneous acid and volatile oil of the wood are lost. These products may likewise be saved by the use of furnaces or stills, in which the distillation may be carried on in the same manner as in the stacks; but the charcoal obtained is said to be inferior to that made in the ordinary way. The tar obtained by slow combustion as described above is largely employed in the arts for various purposes, for some of which the tar resulting in the prepararion of pyroligneous acid cannot be substituted.

Description.—Tar is a thick, viscid, semi-fluid mass, heavier than water, of a deep blackish-brown color, transparent in thin layers if free from water, and has an unpleasant empyreumatic odor and a sharp and bitter taste. On standing, it usually separates a granular crystalline matter consisting of *pyrocatechin* (catechol), and often assumes the consistence of thick honey. It has an acid reaction, which, together with a light-brown color and sharp bitterish taste, is imparted to water agitated with it. On the application of heat, water and acetic acid distil over, together with a yellow volatile oil (see p. 18). Tar is soluble in alcohol, ether, chloroform, fixed and volatile oils, and caustic alkalies. The aqueous infusion of tar is colored transiently green by ferric chloride, due

to the presence of pyrocatechin, and with lime-water acquires permanently a brown-red color.

Constituents.—Tar is of a very complex composition, which varies with the kind of wood, the amount of resins present therein, and the care with which it has been prepared. It contains *acetic acid*, *acetone* (page 11), *methylic alcohol* (page 157), *mesit*, $C_6H_{12}O_2$, *toluene*, C_7H_8, *xylene*, C_8H_{10}, *cumene*, C_9H_{12}, *methene*, C_9H_{12}; likewise phenol, C_6H_6O (see p. 37), cresol, C_7H_8O (see p. 40), creosote (see p. 547), *paraffin*, naphtalene (page 1071), pyrene, $C_{16}H_{10}$, chrysene, $C_{18}H_{12}$, retene, $C_{18}H_{18}$, and others. Of the compounds mentioned, the first series up to methene pass over with the light tar oil, which also contains Reichenbach's *eupion*, a very light oily product of low boiling-point. The *heavy tar oil* contains the other compounds named, and in addition *cedriret*, *kapnomor*, *picamar*, and *pittakal*, which names were introduced by Reichenbach to designate various substances not yet obtained in a pure state. After distilling from tar the light and most of the heavy oil a substance is left behind which is still recognized in some pharmacopœias as

PIX NAVALIS, s. *Pix nigra*, s. *solida*, s. *Resina pina empyreumatica*.—Pitch, Black pitch, *E.*; Poix noire, *Fr. Cod.*; Schwarzes Pech, Schiffspech, *G.*; Pez negra, *Sp.*—It is a black, resinous, brittle mass, which becomes soft when held in the hand, and has the odor of tar.

Allied Drug.—PIX BETULÆ, s. BETULINUM, Oleum betulæ empyreumaticum, Oleum rusci.—Birch tar, *E.*; Huile russe, Huile de bouleau, *Fr.*; Birkentheer, Birkenöl, *G.*—It is prepared in Russia from the wood and bark of Betula alba, *Linné*, and is also known in commerce under the name of *dagget* or *degutt*. It resembles wood-tar in appearance, but remains liquid and has a peculiar penetrating odor, like that of Russia leather, in the manufacture of which it is used. It was partly examined by Sobrero (1842), who obtained from it a yellowish volatile oil, $C_{10}H_{16}$, of an agreeable odor, like that of birch-bark, and boiling at 156° C. (312.8° F.). (See also page 338.)

Pharmaceutical Products.—SACCHARATED TAR, tar purified by dissolving in warm alcohol, straining, and evaporating, 4 parts, sugar 96 parts; mix (Roussin, 1871).

AQUA PICIS, s. PICEA, *P. G.*; INFUSUM PICIS LIQUIDÆ, *U. S.* 1870.—Tar-water, Infusion of tar, *E.*; Eau de goudron, *Fr.*; Theerwasser, *G.*—Mix well tar 1 part with powdered pumice-stone 3 parts, and agitate the mixture, which may be kept on hand, for 5 minutes with water 10 parts. Tar-water is to be made fresh when wanted.—*P. G.*

Prepared in this manner, the water is enabled to exert its solvent action upon all the constituents of tar. Magnesia is unsuited for dividing the tar, owing to the formation of soluble salts. Magnes-Lahens (1876) pulverized the tar by mixing it with twice its weight of inert sawdust; 27 Gm. of this mixture will give with 1 liter of water a saturated solution containing 6 Gm. of extract. The large quantity of resinous and oily principles present in tar interferes with the solvent action of water; hence an excess of tar must be used, the first infusion being strongly acid, and, according to the French Codex, is rejected. Lefort (1868) determined the amount taken up by hot water to be 2 Gm. to the liter.

GLYCERITUM PICIS LIQUIDÆ, *U. S.* 1870.—Glycerite (glycerol) of tar, *E.*; Glycérolé de goudron, *Fr.*; Theerglycerit, *G.*—Triturate tar 1 troyounce with magnesium carbonate 2 troyounces; afterward with portions of a mixture composed of glycerin 4 fluidounces, alcohol 2 fluidounces, and water 10 fluidounces: express the liquid, put the residue into a percolator, and displace first with the expressed liquid, and afterward with water, until 18 fluidounces of percolate are obtained. This is essentially the formula proposed by J. B. Moore in 1869. The glycerite is of a rich reddish-brown color, and perfectly transparent when recently prepared, but gradually deposits blackish resinous matter, which should be filtered off.

TINCTURA PICIS BETULÆ, TINCTURA RUSCI, Tincture of birch-tar. Dissolve birch-tar 1 part in alcohol 10 parts, and filter.

Action and Uses.—Anciently, tar was used as a dressing for wounds and sores and various cutaneous eruptions in man and beast, and was administered internally as a remedy for chronic pulmonary complaints. These are the affections for which even now it is principally employed. Tar-water is prepared by stirring 1 part of tar with 10 parts of pure water, and allowing them to stand for several days, and then decanting the impregnated water. It has been used with the greatest advantage in *chronic bronchitis* and in many cases of pulmonary *phthisis*, lessening the expectoration, diminishing the oppression and pain in the chest, and soothing the cough, without increasing the thirst or impairing the digestion. It has even been proposed against pulmonary hæmorrhage. But when hectic symptoms are prominent it is seldom tolerated. This is true even of the treatment of these diseases by the inhalation of tar vapors, which in the more torpid cases is sometimes remarkably beneficial. The best mode of using tar vapors is the following: In a cup placed in a small water-bath over a common night-lamp mix some tar with about a twenty-fourth part of its weight of potassium carbonate, in order to neutralize the pyroligneous acid which may be present and which would irritate the lungs. The vapors should be extricated very slowly at first, so as moderately to charge

with them the air of the chamber which the patient chiefly inhabits, and afterward they may be generated more freely. Quite as beneficial, and more convenient and agreeable, is the inhalation of tar-water, and even of wine of tar, from a steam atomizer. Still more beneficial than the preparations of tar in pulmonary diseases is the habitual breathing of the air of pine forests, especially if conjoined with a proper hygienic and dietetic regimen.

Of other internal uses of tar may be mentioned that of tar pills for the relief of *constipation*, the use of tar-water by the mouth and by injection in chronic *vesical catarrh*, *gleet*, *leucorrhœa*, etc.

The ancient use of tar in the treatment of *scabies* is sometimes still resorted to, but it is less certain than other methods of curing the disease, and it involves the ruin of the patient's body- and bed-linen. In *scaly eruptions* its efficacy is much more unequivocal, but the same objection to it exists as in the case of the disease just mentioned. Moreover, lepra and psoriasis generally get well under the use of arsenic alone. If this falls short of its purpose, tar may be employed in addition. For its efficient use it is necessary that the scales upon the skin should first be removed by a warm bath; after which tar or its ointment should in small quantity be rubbed into the patches of the eruption with a brush, and the patient rolled in a blanket and allowed to remain quiet for five or six hours, when the excess of the application can be removed with cloths and the ordinary clothing resumed. In some cases of inveterate *eczema*, when the skin has become dry, rough, and thick, tar ointment or oil of tar is a most efficient remedy, provided that its strength be duly proportioned to the sensibility of the skin. It is also useful in *herpes circinatus* and in *prurigo*.

Tar has long been employed by the vulgar for *excoriations*, *boils*, *scorbutic sores*, and *unhealthy ulcers* generally. More recently it was extensively used in the form of oakum as a dressing for such lesions, especially in hospitals. It seems especially adapted to burns which suppurate copiously. It corrects the fetor of the sores. The oakum is applied after being moistened with water, and is covered with an impermeable tissue. Tar and tar-water have been applied to *mercurial ulcers* of the mouth and throat, and the former is an excellent application to *fissured nipples* and *hæmorrhoids*. Finally, the fumes of tar are commonly used to deodorize and purify vessels, rooms, etc., tainted with *foul smells* or supposed to be infected with morbid poisons. They have also been employed advantageously in the treatment of senile *gangrene* (Post, *Trans. New York State Med. Soc.*, 1877, p. 246).

Tar may be given mixed with milk or beer, or else in pills. Gm. 2–16 (gr. xxx–℥ss) may be taken daily. The glycerite of tar is a convenient form of the medicine. Tar-water may be taken to the extent of a pint or two daily.

PLANTAGO.—Plantain.

Rib-grass, *Ribwort*, *Ripple-grass*, E.; *Plantain*, Fr. Cod.; *Wegerich*, G.; *Lanten*, Sp.
Plantago lanceolata, Linné, and *Pl. major*, Linné.

Nat. Ord.—Plantaginaceæ.

Description.—These are acaulescent perennials, with short oblique rhizomes. The first-named species has lanceolate, obscurely toothed, more or less hairy and about five-ribbed leaves, and a deeply-furrowed scape bearing a dense ovate spike. The second species has broadly ovate or elliptic, somewhat toothed, about seven-ribbed, nearly smooth, petiolate leaves and a terete scape, bearing a cylindrical elongated spike. The flowers are small, have a dry membranaceous four-lobed corolla with four stamens, and produce small capsules containing two, or in the second species about ten, peltate brown seeds. The plants are indigenous to Europe, but now grow along roadsides and in fields in most temperate countries. They are inodorous and have a somewhat astringent, saline, and bitterish taste.

Constituents.—The analyses by Sprengel, Koller, Bley, and Schlesinger showed the presence of a bitter principle, albumen, sugar, resin, and various salts. Runge (1828) stated that, in common with various Umbelliferæ and Compositæ, they contain *viridinic acid*, which forms with ammonia a yellow compound, turning green on exposure to air; it belongs doubtless to the tannins.

Allied Plants.—Plantago virginica, *Linné*, White plantain. It is common in sandy fields of the United States, has leaves radical, white-pubescent, obovate or spatulate, and a dense cylindrical spike, and agrees with the preceding ones in taste.

Plantago Rugelii, *Decaine*, agrees with the broad-leaved plantain, but has an elongated spike.

Plantago Psyllium, *Linné*, is an annual indigenous to the basin of the Mediterranean. The seeds are employed and are known as Fleaseed, *E.*; Graines de puces, *Fr.*; Flohsamen, *G.* They are boat-shaped, dark red-brown, and glossy upon the convex back, with a lighter-colored line, the hilum located in a broad groove upon the lower side. The seeds of Plantago arenaria, *Waldstein et Kittaibel*, are somewhat smaller, black and less glossy; those of Plantago Cynops, *Linné*, are somewhat larger and lighter brown. The epithelial layer of these seeds yields much mucilage; this is also obtained from

Spogel-seeds, known in India as *ispaghul*. They are pinkish-gray, and on the convex side marked with a brown-yellow spot. They are obtained from Plantago Ispaghula, *Roxburgh*, which is regarded as a cultivated variety of Pl. decumbens, *Forskal*, indigenous to Northern Africa. (See Bentley and Trimen, *Med. Plants*, 211.) The seeds of several other species are likewise mucilaginous.

Action and Uses.—Several species of plantain appear to have enjoyed the undeserved reputation of being remedies for divers diseases, including malignant ulcers, defluxions and mortifications, hæmorrhages, intermittent fever, etc. They owe whatever virtues they possess to their bitter and astringent constituents. In Europe they are still used for the same purposes as of old, and their fresh leaves are applied to wounds and inflammations of the skin. Quite recently (1883) Prof. Quinlan, observing a cottager arresting hæmorrhage by the application of the chewed leaves of P. lanceolata, "satisfied himself as to the hæmostatic power of the plant when applied to bleeding surfaces, either in the chewed form or in that of the dried leaves" (*Practitioner*, xxx. 49).

Psyllium (Plantago psyllium), *fleawort*, was anciently used in the treatment of ulcers, and was reckoned a cooling and astringent medicine. In Asia and in Southern Europe the mucilage derived from its seeds is used very much as the mucilages of quince, flaxseed, and slippery elm are applied to palliate external and also internal irritations. It has been employed with advantage to relieve habitual *constipation* by swallowing a tablespoonful of the seeds in half a tumbler of water before the principal meal. But it soon loses its original effect.

PLATINUM.—Platinum.

Platine, Or blanc, Fr.; *Platin*, G.

Symbol Pt. Atomicity bivalent and quadrivalent. Atomic weight 194.3.

Origin and Preparation.—This metal was apparently observed as early as the sixteenth century, but was more fully described and investigated after the middle of the eighteenth century by Watson, Scheffer, Lewis, Bergman, and others. It is found pure and in combination with palladium, rhodium, osmium, iridium, and other metals in California, in various parts of South America, in the Ural Mountains and other parts of Europe, and in Asia and Africa. It is often met with in auriferous sand, and occasionally in lead, iron, and other ores. The ore is treated with strong hydrochloric acid, well washed by elutriation, the residue treated with nitromuriatic acid, the acid solution evaporated, redissolved in water, and precipitated with ammonium chloride; on igniting the resulting ammonio-platinic chloride, platinum is obtained in a spongy condition.

Properties.—Spongy platinum is gray, soft, and porous, and fusible only by the aid of the oxyhydrogen blowpipe. The metal is of a silver-white color and metallic lustre, is soft like copper, possesses considerable malleability and ductility, and at a white heat may be forged. Platinum resists the action of most chemicals except mixtures of nitric with hydrochloric or hydrobromic acid, but at a high temperature it is readily attacked by most elements. With oxygen it forms a monoxide, PtO, and a dioxide, PtO_2, which are reduced to the metal at a red heat. The platinous salts are brown, red, or colorless; the platinic salts have a yellow or brown color. The following compounds have been used:

Platini chloridum.—Platinic chloride, *E.*; Perchlorure de platine, *Fr.*; Platinchlorid, *G.* $PtCl_4.5H_2O$; molecular weight 425.58.—It is prepared by dissolving 3 parts of platinum in a mixture of 16 parts of hydrochloric and 7 parts of nitric acid, evaporating the solution nearly to dryness, redissolving in hydrochloric acid, heating to expel the nitric acid, and evaporating at a moderate heat to dryness, when a red crystalline mass is left, which may be obtained from water in handsome red crystals containing 46 per cent. of platinum. When heated to 100° C. these lose $4H_2O = 16.9$ per cent., and turn brown. If the salt is permitted to crystallize in the presence of free hydrochloric acid, brownish-red needles are obtained which have the composition $PtCl_4.2HCl.6H_2O$, and contain 38 per cent. of platinum. This is the compound usually met with in commerce. Heated to above 110° C., it parts with hydrochloric acid and chlorine, and near 225° C. (437° F.)

dark-brown platinous chloride is left. Platinum chloride dissolves readily in alcohol and water, yielding reddish-yellow liquids which precipitate the potassium and ammonium chlorides.

PLATINI ET SODII CHLORIDUM, Sodium platino-chloride, Sodium and platinum chloride. The double salt, $2NaCl.PtCl_4.6H_2O$, crystallizes in light-red prisms, and is freely soluble in water and alcohol. For medicinal purposes a preparation containing an excess of the sodium salt is used, made by dissolving 3 parts of platinic chloride and 5 parts of sodium chloride in water, and evaporating to dryness, stirring continually. It is an orange-yellow powder having a saline and metallic taste.

PLATINI IODIDUM, Platinic iodide, PtI_4. A solution of platinic chloride is mixed with a solution of an equivalent quantity of potassium iodide, the deep-red mixture nearly neutralized with potassium carbonate, and digested for an hour. The precipitate, after washing and drying, is a brown-black amorphous and tasteless powder, insoluble in water, but soluble in potassium carbonate and iodide with a pale-red color.

PLATINI ET POTASSII CYANIDUM, Potassium platino-cyanide, $2KCN.Pt(CN)_2.3H_2O$. It is best prepared, according to Meillet, by mixing rather concentrated solutions of 1 part exsiccated platinic chloride and 2 parts potassium cyanide, and heating the mixture until the precipitate is redissolved: ammonium carbonate and nitrogen are given off, and on cooling the double salt crystallizes. It forms long needles and prisms, having in different positions a yellow or bright-blue color, and when exposed to the air becoming opaque and rose-red. The salt is freely soluble in hot water, and its solution precipitates cupric salts greenish-blue, mercurous nitrate bright-blue, and ferrous salts bluish-white.

Action and Uses.—There is very little to be added to the statements that were made by Höfer in 1840 respecting the compounds of this metal. He found that its chlorides were as poisonous as the chlorides of gold and mercury—the perchloride in 1-grain doses, the sodium chloroplatinate in the dose of 2 grains. The perchloride in strong solution reddens the skin and occasions a slight eruption upon it. Internally, in small doses, it irritates the stomach, causes headache, and gradually modifies the blood and the secretions. The sodium chloroplatinate, on the other hand, is not a local irritant, and its internal action is not as distinct as that of the perchloride of platinum. According to Bryk, perchloride of platinum applied to the skin produces a thick, yellowish-white, dry eschar, surrounded by intense injection and even extravasation.

According to Höfer, platinum chloride is an efficient remedy for *syphilis*, and especially for its inveterate constitutional forms, and sodium chloroplatinate is more suitable in the primary stages of the disease. The former has been described as analogous in its effects to the chlorides of gold and mercury. The *dose* of it is stated to be Gm. 0.008–0.03 (gr. $\frac{1}{8}$–$\frac{1}{2}$) several times a day in mucilage or pill. A solution of Gm. 2 in Gm. 250 (gr. xxx in f℥viij) of water has been used as an injection in *leucorrhœa* and *gleet*, and a liniment containing Gm. 0.12 to Gm. 32 (gr. ij in ℥j) of olive oil or lard has been applied to indolent *ulcers*.

PLUMBI ACETAS, *U. S.*, *Br.*—LEAD ACETATE,

Plumbum aceticum, P. G.; *Acetas plumbicus*, *Saccharum saturni*.—*Sugar of lead*, E.; *Acétate de plomb*, (*Sucre*) *de saturne*, Fr.; *Essigsaures Bleioxyd*, *Bleizucker*, G.

Formula $Pb(C_2H_3O_2)_2 3H_2O$. Molecular weight 378.

Preparation.—Take of Lead Oxide, in fine powder, 24 ounces; Acetic Acid 2 pints or a sufficiency; Distilled Water 1 pint. Mix the acetic acid and the water, add the lead oxide, and dissolve with the aid of a gentle heat. Filter, evaporate till a pellicle forms, and set aside to crystallize, first adding a little acetic acid should the fluid not have a distinctly acid reaction. Drain, and dry the crystals on filtering-paper without heat.—*Br.*

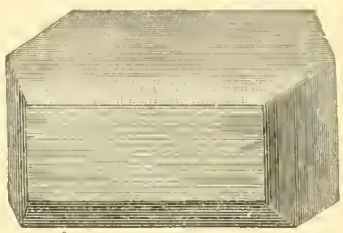
The process described is frequently followed on a large scale. Sometimes, however, metallic lead is dissolved in acetic acid, which requires to be done in the presence of air, since the metal is unable to displace the hydrogen of the acid. Plates of lead are placed endwise in open vessels containing acetic acid, one-half of their length projecting above the liquid, and as fast as the metal under these conditions is oxidized by the oxygen of the air, it is dissolved, so that the formation of the salt in both cases is the result of the action between plumbic oxide and acetic acid, water being formed at the same time; $PbO + 2C_2H_4O_2$ yields $Pb(C_2H_3O_2)_2 + H_2O$. To obtain handsome and well-defined crystals the solution must have a very distinct acid reaction; if it is permitted to become

neutral or faintly acid, a portion of the salt forms small granular crystals agglomerated into soft cauliflower-like masses, containing perhaps a basic lead compound.

For uses in the arts large quantities of impure lead acetate are prepared from wood-vinegar, and vary in color from various shades of brown to pale-red and white.

Properties.—Pure lead acetate crystallizes in colorless, glossy, transparent or translucent prisms, which are often tabular and have an acetous odor and a sweet astringent and metallic taste. It is slightly efflorescent in the air, and on continued exposure is superficially converted into lead carbonate. When heated to 40° C. (104° F.) the salt loses its water of crystallization (14.25 per cent.). It fuses at 200° C. (392° F.) with the loss of acetic acid and, when strongly heated, it is completely decomposed, with the evolution of carbon dioxide and acetone, and leaving a residue of finely divided metal mixed with oxide and carbonate. It also loses its water of crystallization over sulphuric acid and by the action of absolute alcohol, crystallizing from this liquid in an anhydrous condition; but when dissolved in hot stronger alcohol the salt crystallizes on cooling with $2H_2O$. It dissolves at 15° C. (59° F.) in 2.3 parts, and at the boiling-point in ½ part of water. The solution has a slight acid reaction and if concentrated and mixed with strong alcohol, gradually separates a portion of the salt in crystals. It dissolves also in about 1 part of boiling and in 21 parts of cold alcohol, U. S. (29 parts P. G.), and is precipitated from this solution as a crystalline powder on the addition of ether. The aqueous solution of the salt has a slightly acid reaction, and yields a black precipitate with hydrogen sulphide test-solution, a yellow one with potassium iodide test-solution, and a white one with diluted sulphuric acid. On heating the salt in the flame of the blowpipe upon charcoal globules of metallic lead are obtained, surrounded by a reddish-yellow incrustation. The salt is decomposed by the mineral and many organic acids, acetic acid being liberated.

FIG. 225.



Crystal of Lead Acetate.

Tests.—Lead acetate should yield a clear solution with distilled water. A slight turbidity resulting from the presence of a little carbonate must disappear on the addition of a small quantity of acetic acid. Perfect solubility indicates the absence of sulphate and notable quantities of chloride. The aqueous solution, completely precipitated by hydrogen sulphide, should yield a filtrate which is not precipitated by ammonia and ammonium sulphide (zinc, etc.) or oxalic acid (calcium, barium), and does not leave any fixed residue on being evaporated to dryness (alkalies). Small quantities of copper would be indicated by the blue color of the filtrate obtained after precipitating the solution of the salt with an excess of ammonia. Potassium ferrocyanide should yield a white precipitate (absence of copper, iron, etc.), and on treating the salt with sulphuric acid in the presence of a crystal of ferrous sulphate a black color should not be produced (nitrate). "A 10 per cent. solution of the salt, prepared with water which has recently been boiled, should be clear, or only slightly opalescent (limit of carbonate)."—*U. S.* "38 grains of lead acetate dissolved in water require for complete precipitation 200 grain-measures of the volumetric solution of oxalic acid."—*Br.*

PLUMBUM ACETICUM CRUDUM, *P. G.* The solution of the salt in 3 parts of distilled water may be opalescent, but should yield a white (not a colored) precipitate with potassium ferrocyanide.

Action and Uses.—Locally applied, a solution of lead acetate blanches and corrugates the skin; hence it is said to be astringent. It is shown to be a cardiac sedative by its power of reducing the pulse-rate. An overdose, besides causing a sense of constriction and sweetness in the mouth, soon excites pain in the abdomen, with vomiting and diarrhœa, which is sometimes bloody; the limbs tremble and are affected with slight spasms, or even convulsions. Sometimes there is a giddiness like that of intoxication. There may be fever, hurried respiration, and scanty urine. (Compare *Lancet*, Oct. 1889, p. 853.) Recovery from acute lead-poisoning is the rule, however severe the primary symptoms may be. Doses of from 2 to 8 drachms of the acetate have been taken without injury, but sometimes also a protracted derangement of the digestion is induced, which ultimately proves fatal. One case is recorded in which a drunken man took 3 ounces of this salt, and, although not treated for twenty-four hours, recovered (Luck). A singular case of death by lead acetate was that of a woman who while using this salt as a vaginal injection was seized with peritonitis, of which she died. A precipitate of lead sulphide was found on the surface of the peritoneum (*Amer. Jour. Med. Sci.*, Oct. 1880, p. 577).

The long-continued use of medicinal doses of lead acetate produces a metallic taste in the mouth, tenderness and swelling of the gums, and often a bluish line of lead sulphide where they are attached to the incisor teeth—especially in persons who neglect their teeth and allow food to accumulate and become decomposed between them—slowness and feebleness of the pulse, colic, a sense of constriction of the trunk, and some numbness of the hands and feet. To these symptoms may be added fetid breath, loosening of the teeth, blackened fæces, neuralgic pains in the legs first, and then in the arms, and the presence of lead in the urine and upon the skin revealed by chemical tests. It may be remarked, however, that these effects must be very rare indeed, since hardly any of the physicians who prescribe the medicine habitually have witnessed them. The most common evidence of chronic lead-poisoning is a peculiar paralysis of the extensor muscles (not of the supinators) of the hands first, and subsequently of the legs. It has been produced by hair-dyes and face-powders, by lotions, ointments, plasters, etc., containing lead; in type-founders and compositors by handling type; by the use of snuff, wine, cider, beer, water, flour, and even air loaded with particles of lead pigment or impregnated with lead, as in freshly-painted rooms; by the use of food put up in leaden coverings or cooked in leaden utensils (particularly canned food, and derived chiefly from the solder), and by chewing tobacco kept in leaden wrappers. Among those who work in lead in its manufacture or in its use as a pigment, or who drink liquors impregnated with it, the most usual effect is the so-called painter's colic, which appears to be a neuralgia with spasmodic contraction of the intestines. Poisoning due to these and analogous causes may be traced to lead in various combinations, and not to the acetate alone. Among such compounds the chromate is chargeable with many serious and even fatal consequences, particularly when it is used to give a "rich" color to pastry. (Compare Stewart, *Med. News*, l. 676; li. 753; Reese, *ib.*, li. 229.) The investigations of Friedländer into the nature of the lesions causing lead-paralysis led him to conclude that lead affects the structure of muscles as well as their function, causing wasting of the nuclei of their cells and an atrophy of their fibres. Next in order, and probably as an effect, a degeneration of the nerves of the muscles takes place. Hence a paralysis is produced which is essentially peripheral, and which leads to the rapid atrophy of the affected muscles. This opinion is opposed to that of Popow, given above.

Besides the paralysis of the extensor muscles, which is apt to result in their atrophy and a corresponding rigid contraction of the opposing flexors, other nervous symptoms arise from the same poison, and delirium, convulsion, or coma gives characteristic features to the attack. The delirium varies from mere wandering of the mind to maniacal violence; the convulsive attacks are generally epileptiform, and coma may either follow convulsion or occur independently of it. After death the only apparent lesion may be hypertrophy of the brain.

In many cases of chronic lead-poisoning albuminuria has been observed and lead detected in the bile and urine; in pregnancy the death of the fœtus and abortion are very apt to occur. Where paralysis has long continued the muscles and the nerves that supply them, as well as the corresponding brain-centres, are atrophied, and sulphuret of lead has been extracted from the spinal cord after death (Fisher. *Amer. Jour. Med. Sci.*, July, 1892, p. 51).

When a *poisonous dose* of lead acetate has been taken, magnesium sulphate in a large quantity of water, with the addition of ipecacuanha, should be given to neutralize the poison and favor its rejection by vomiting. Afterward the solution of magnesium sulphate should be continued, as an antidote to whatever portion of the lead salt may have reached the intestine and to cause its expulsion by purgation. If pain exists, it should be palliated by opiates, especially by the hypodermic injection of morphine. The ordinary treatment of *lead colic* consists in the methodical use of opiates and evacuants—the former hypodermically, the latter in the form of a solution of sulphate of magnesium or of sodium with tartar emetic, while large purgative enemata are repeatedly administered and large and warm emollient cataplasms are applied to the abdomen. Instead of saline cathartics, croton oil may be used. The action of purgatives may be aided, or even superseded, by that of induced electricity, which has the advantage of relieving the pain at the same time. Alum, as elsewhere stated, is a most valuable remedy in this affection, and by some is held to be superior to purgatives.

In the more chronic forms of *lead-poisoning* the chief dependence must be placed upon potassium iodide, which carries off the lead with the urine, and upon sulphurous baths, which remove it as it is eliminated from the skin, while means are taken to stimulate the paralyzed muscles by means of friction, massage, and, above all, by induced electricity.

It is true that the use of potassium iodide as a means of eliminating lead from the system has been objected to on the ground that it must form an insoluble iodide of lead, and therefore only confirm the hold of the poison upon the tissues. Whether this must be the result of administering the remedy or not may be left to ingenious scientists to determine for their own satisfaction, while physicians continue to cure their patients by means which time as well as reason has approved. Meanwhile, it should be observed that under the use of the potassium iodide in cases of lead-paralysis, lead is actually found in the urine (*Monthly Abst.*, Feb. 1881, p. 122; *Edinb. Med. Jour.*, xxviii. 651). A possible source of error in testing urine for lead by means of potassium iodide is the fact that if the patient is taking bismuth a yellow iodide of that metal will be formed, identical in appearance with the lead iodide (Putnam, *Boston Med. and Surg. Jour.*, Oct. 1883, p. 815). As a stimulant to the spinal centres of muscular motion strychnine is of extreme utility. The cerebral affections produced by lead are but little under the control of any medicine except opium, which is of great value in subduing delirium in the maniacal form.

Among internal *styptics* which act after absorption into the blood none is so general in its application or certain in its effects as lead acetate. It is said to be more efficient in active than in passive *hæmorrhages*, but the rule, if it be one, is not absolute. It has repeatedly and unequivocally displayed its virtues in *hæmoptysis*, not so distinctly in *uterine hæmorrhage* connected with menstruation and with parturition, and still less conspicuously, though decidedly, in hæmorrhage from the *stomach*, *bowels*, and *kidneys;* in all of which cases ergot, the chlorides of iron, creosote and its congeners, excel it.

The sedative action of lead acetate upon the heart, and its power of promoting coagulation of the blood, are thought to be illustrated by cures of sacculated *aneurism* alleged to have taken place under its use; and, although the evidence may not be conclusive, it is strong enough to inspire a certain degree of confidence in this plan of treatment. The same may be said of *hypertrophy of the heart*. But in the latter case the utility of the medicine is less demonstrable and more improbable.

In chronic *dysentery* and *diarrhœa* lead acetate is one of the most valuable medicines of its class when given by the mouth and also by the rectum; and the same is true of its use in the decline of the acute form of the first-named disease. While the febrile symptoms continue it should seldom be employed. It is best administered in doses of Gm. 0.06–0.12 (1 or 2 grains) three or four times a day, associated with a grain or less of opium or 2 or 3 grains of Dover's powder. In some cases of *tympanites* due to indigestion, and of the same condition during *typhoid fever*, it has afforded relief.

The astringency it manifests in the diseases already named has been further shown in pulmonary affections with excessive secretion. It has long been in common use for diminishing the sputa in *tubercular phthisis* and *chronic bronchitis*, as well as for checking *sweats* in both diseases. In *whooping cough* with profuse bronchial secretion it has also been used. It has been recommended as the safest and best remedial agent in *pneumonia* (*Lancet*, Dec. 1889, p. 1192), and particularly as superior to digitalis, tartar emetic, and veratrum; which may very well be, since these medicines are worse than useless in the disease.

In various nervous diseases, including *epilepsy*, *neuralgia*, *chorea*, and *hysteria*, it has been alleged to be curative; but this statement is without substantial foundation, except in regard to epilepsy, but that disease has seldom been treated by lead acetate.

Lead acetate has been less frequently employed than the subacetate as an astringent of external parts, yet it may be applied with advantage in lotions to *contusions*, *excoriations*, *sprains*, *fractures*, etc. It is more conveniently employed in collyria for *conjunctivitis*, both acute and chronic, and as an injection into the urethra in *gonorrhœa* and into the vagina in *leucorrhœa*. In chronic granular *conjunctivitis* finely-powdered acetate of lead has been applied to the mucous surface of the eyelids; but neither the powder nor the solution of any salt of lead should be applied to corneal ulcers, lest the undissolved particles should be retained during cicatrization and occasion permanent opacity. A preparation which is in reality a solution of lead subacetate has been made with lead acetate 5 parts, litharge 3½ parts, glycerin 20 parts. These ingredients, on being exposed to a temperature of 350° F. for some time and filtered through a hot-water funnel, furnish a clear viscid glycerole containing 120 grains of lead subacetate to the ounce. When used, it can be diluted with glycerin. It is stated to be peculiarly applicable to the treatment of certain forms of *chronic eczema*, especially of the lower extremities. It appears to be most useful when the affection is extensive, of a dusky hue, accompanied by much weeping, oozing, and infiltration of the skin, together with swelling of the subcutaneous tissue

and a full and varicose condition of the veins. Its diligent application should be followed by careful bandaging (Duhring and Van Harlingen).

As a styptic the *dose* of lead acetate should be not less than Gm. 0.12 (gr. ij) every hour, and generally associated with opium. As much as Gm. 0.30 (gr. v) every hour has been used successfully, and without damage, in certain cases of hæmorrhage. In diarrhœal and dysenteric affections Gm. 0.06 with Gm. 0.03 of opium (gr. j with gr. ss), three or four times a day, is the average dose; and for colliquative sweats Gm. 0.12 (gr. ij) several hours before the usual time of appearance of the symptom.

PLUMBI CARBONAS, *U. S., Br.*—Lead Carbonate.

Cerussa, P. G.; *Plumbum carbonicum, s. hydrico-carbonicum, Carbonas plumbicus.*—*White lead*, E.; *Carbonate de plomb, Blanc de plomb, Céruse*, Fr.; *Bleiweiss, Bleicarbonat*, G.

Formula $2PbCO_3.Pb(OH)_2 = Pb_3(CO_3)_2(OH)_2$. Molecular weight 772.82.

Preparation.—On passing carbon dioxide gas through a solution of lead acetate, or on adding an alkali carbonate to a solution of a neutral lead salt, a precipitate of $PbCO_3$ is obtained, which, as a pigment, has less *body* than the basic salt. The latter is obtained in two ways. One method, known as the *Dutch process*, is as follows: Cast sheets of lead are suspended in earthen pots containing a small quantity of vinegar or pyroligneous acid; a number of these pots are arranged in rows, alternating with layers of dung or spent tan, until a shed is filled, which is entirely covered with the same material. A warm and moist atmosphere, charged with carbon dioxide, is thus produced in the shed, favorable for the oxidation of the metal and its conversion by the acetic vapors into basic lead acetate, which is decomposed by the carbon dioxide, yielding white lead and neutral acetate. The latter again unites with a fresh portion of oxide, forming basic lead acetate, which is again acted upon by the carbon dioxide, and the process continues until, in the course of a few weeks, the lead is completely covered with a thick crust of white lead, which is detached, ground with water, and washed to remove lead acetate and dried. Various modifications of this process have been recommended and are in use, the most important one being that largely used in Austria, where the sheet lead is suspended in wooden boxes, vapors of acetic acid, moisture, and carbon dioxide being supplied in various ways; a number of such boxes are placed in a suitable room, where the temperature is slowly raised from about 25° to 50° C. (77° to 132° F.), until, after several weeks, the conversion is completed.

The other method is known as *Thénard's process*, according to which a solution of lead subacetate is prepared in the usual way, and carbon dioxide passed through it, the filtrate from the precipitate being again used in the preparation of the lead solution. This process has been modified by Benson, so that levigated litharge is mixed with 1 or 2 per cent. of sugar of lead and sufficient water to form a thin paste, which, with frequent stirring, is exposed to the action of carbon dioxide until this ceases to be absorbed; the carbonate is washed with water.

Properties.—Commercial lead carbonate is in pulverulent masses or forms a non-gritty, heavy, white powder, which is not altered on exposure to air unless hydrogen sulphide be present, when it turns black. It is inodorous, and at first tasteless, but gradually develops a slight sweetish and metallic taste. It is insoluble in water and alcohol, but dissolves with effervescence in diluted acetic or nitric acid. The solutions yield with sulphuric acid a white, and with potassium iodide a yellow, precipitate. The white precipitates occasioned in the solution by soda and potassa are soluble in an excess of the precipitant. Heated to 155° C. (311° F.), lead carbonate parts with its water; near 180° C. (356° F.) it begins to lose carbon dioxide and turns yellow, and when heated before the blowpipe upon charcoal it yields metallic globules of lead, surrounded by a reddish-yellow incrustation.

Tests.—Lead carbonate may be adulterated with the sulphates of lead, barium, or calcium, which would be left behind as a white residue upon treatment with dilute nitric acid; only a trifling residue should be left. On adding to this solution an excess of caustic soda, the white precipitate at first formed should be completely dissolved (calcium salt), and this alkaline solution should not be rendered permanently turbid on the addition of 1 drop of diluted sulphuric acid (barium carbonate); but on precipitating the solution completely with sulphuric acid the filtrate should be colorless, and should not be precipitated or colored by potassium ferrocyanide (zinc, etc.) or by an excess of ammonia, copper, alumina (*P. G.*). The solution in diluted nitric acid on being completely precipi-

tated by hydrogen sulphide should yield a filtrate that is not rendered turbid by sulphuric acid.

"If 2 Gm. of the salt be dissolved in a mixture of 2 Cc. of nitric acid and 10 Cc. of water, it should not leave more than 0.02 Gm. of residue (limit of insoluble foreign salts). On completely precipitating the solution with hydrogen sulphide, the filtrate should not leave more than a trifling residue on evaporation (limit of salts of the alkalies, alkaline earths, or zinc). If 1 Gm. of the salt be strongly ignited in a porcelain crucible, it should leave a residue of lead oxide weighing not less than 0.85 Gm."—*U. S.*

Composition.—White lead is an oxycarbonate, and has the formula given above, in which case it will leave a residue of 86.2 per cent. upon being heated to redness. But the composition may vary from the presence of other oxycarbonates, and the residue left on ignition has been found as low as 83.7 and as a high as 86.7 per cent.

Action and Uses.—This preparation is only used externally in the form of a powder to protect irritated surfaces, as in *erythema*, *erysipelas*, *intertrigo*, etc., and to produce constriction of the congested skin. It should never be applied where the cuticle is broken, as it is one of the most poisonous of the salts of lead. It enters into an official ointment, and it is sometimes used in the form of white paint, mixed with linseed oil, as an application to superficial *burns* and *scalds* and to *erysipelas*, but care should be taken to apply it only to the unbroken skin.

PLUMBI IODIDUM, *U. S., Br.*—Lead Iodide.

Plumbum iodatum, *Ioduretum plumbicum.*—*Iodure de plomb*, Fr.; *Jodblei*, G.

Formula PbI_2. Molecular weight 459.46.

Preparation.—Take of Lead Nitrate, Potassium Iodide, each 4 ounces; Distilled Water a sufficiency. Dissolve the lead nitrate by the aid of heat in 1½ pints and the potassium iodide in ½ pint of the water, and mix the solutions. Collect the precipitate on a filter, wash it with distilled water, and dry it at a gentle heat.—*Br.*

The reaction between the two salts results in the production of potassium nitrate, which remains in solution, and lead iodide, which precipitates: $Pb(NO_3)_2 + 2KI$ yields $2KNO_3 + PbI_2$. The quantities ordered by the Br. Ph. are almost exactly in equivalent proportions, and the yield is 5½ ounces. Boudet (1847) ascertained that lead acetate cannot be advantageously used in the preparation of the iodide, inasmuch as double iodide of lead and potassium is invariably produced, and remains dissolved in the newly-formed potassium acetate. The nitrate does not exert any similar influence; hence nearly the whole theoretical quantity of lead iodide is obtained by the official process.

Properties.—Lead iodide, if precipitated in the cold, is a bright-yellow powder, and if obtained from boiling solutions crystallizes in thin, shining, golden-yellow scales. It has the spec. grav. 6.1, is inodorous, of a slight metallic taste, and when heated turns brick-red or blackish-brown, and, if air be excluded, fuses to a red-brown liquid, and volatilizes, partly undecomposed, at a strong red heat; on cooling it gradually acquires again its yellow color. When heated in contact with air it melts, iodine is given off, and basic lead iodide remains behind, having an orange-yellow or amber-yellow color. It is permanent in a dry atmosphere, but when exposed to the light while moist is slowly decomposed, lead dioxide and carbonate being formed, besides free iodine. Denot (1834) ascertained that it requires 1235 parts of cold and 187 parts of boiling water for solution. According to Lassaigne (1831), the aqueous solution, saturated at 20° C. (68° F.), contains .17 per cent. (1 in 590) and at 100° C. .39 per cent. (1 in 200) of lead iodide. The U. S. Pharmacopœia gives its solubility in cold water (at 15° C.) as being 1 in about 2000 parts. These solutions are colorless and neutral to test-paper. The salt dissolves more readily in solutions of ammonium chloride, sodium thiosulphate, and of soluble iodides and alkali acetates, and is at least partly converted into double iodides. Alcohol dissolves very little of the salt, and, according to Vogel, boiling ether decomposes it, dissolving iodine and leaving pale-yellow oxyiodide.

Tests.—"If 1 Gm. of the salt be triturated with 2 Gm. of ammonium chloride and 2 Cc. of water, a nearly white mixture will result. If this be transferred to a test-tube and heated in a water-bath for a few minutes, a clear and almost colorless solution should be formed (absence of chromate and other insoluble foreign salts). On cooling this solution a solid mass of nearly colorless, fine, silky crystals will be produced, and on adding water or diluted sulphuric acid to this mass, yellow lead iodide will be separated. If 1 Gm. of the salt be boiled for a few minutes with 20 Cc. of water, the mixture then cooled and filtered, the lead removed from the filtrate by hydrogen sulphide, and the new filtrate

somewhat concentrated by evaporation, a portion of this liquid when mixed with a little sulphuric acid and tinted with a drop of indigo test-solution, should not become decolorized on heating (absence of nitrate). If another portion of the liquid be carefully neutralized with ammonia-water, it should not become colored red by a drop of ferric chloride test-solution (absence of acetate). If the remainder of the filtrate be evaporated to dryness, it should leave no residue (absence of soluble foreign salts)."—*U. S.*

Uses.—Lead iodide is generally used as an external application in the form of an ointment, which is official. It has, however, been given internally, with alleged advantage, to diminish malarial enlargement of the *spleen*, in the *dose* of Gm. 0.013 (gr. $\frac{1}{5}$) twice a day in pilular form, and gradually increased.

PLUMBI NITRAS, *U. S.*, *Br.*—Lead Nitrate.

Plumbum nitricum, *Nitras* (*Azotas*) *plumbicus*.—*Azotate* (*Nitrate*) *de plomb*, Fr.; *Salpetersaures Bleioxyd*, *Bleisalpeter*, G.

Formula $Pb(NO_3)_2$. Molecular weight 330.18.

Preparation.—Metallic lead dissolves slowly in warm dilute nitric acid, but litharge or lead carbonate is readily taken up by the acid, the latter with effervescence of carbon dioxide. A solution of lead nitrate is also obtained in the preparation of lead dioxide from the red oxide by digesting it with dilute nitric acid. If prepared from litharge containing copper, the resulting copper nitrate remains at first in the mother-liquor, but will contaminate the last crops of crystals, necessitating washing with water and recrystallization.

Properties.—Lead nitrate crystallizes on slow evaporation in colorless transparent octahedrons. When obtained by the cooling of hot solutions the crystals are white and translucent or opaque. It has the specific gravity 4.4, is not altered by exposure, and when heated decrepitates, fuses, and gives off oxygen and nitrous vapors, leaving finally lead oxide. It is soluble in 2 parts of water at 15° C. (59° F.) and in 0.75 part of boiling water (*U. S.*). Kremers (1854) ascertained that 1 part of the salt requires at 10° C. (50° F.) 2.07, at 25° C. (77° F.) 1.65, at 45° C. (113° F.) 1.25, and at the boiling temperature 0.72 parts of water for solution. It is likewise soluble, though less freely, in weak alcoholic liquids, but is nearly insoluble in strong alcohol and in nitric acid. The salt is inodorous, possesses a sweetish astringent and somewhat metallic taste, and deflagrates slightly on being triturated with sulphur or thrown upon red-hot charcoal. Its solution has the reactions of soluble lead salts and of nitrates, contains 62.5 per cent. of lead, and is free from water of crystallization.

Tests.—The aqueous solution, on being completely precipitated by hydrogen sulphide, should yield a filtrate which on evaporation leaves no fixed residue (zinc, earths, and alkalies). The solution should not be rendered turbid by silver nitrate (chloride), and after having been completely precipitated by sodium sulphate should yield a filtrate which is not colored red by potassium sulphocyanate (iron) nor blue by an excess of ammonia (copper), nor should this ammoniacal liquid be precipitated by ammonium sulphide or ammonium phosphate (zinc, magnesia).

Pharmaceutical Uses.—In the preparation of Plumbi iodidum.

Other Lead Salts.—Plumbi chloridum, *Lead chloride*, $PbCl_2$ (mol. weight 277.14), is obtained by precipitating a solution of lead salt with hydrochloric acid or sodium chloride. It is a white crystalline powder, which fuses when heated, and congeals to a horn-like mass (*Plumbum corneum*). It is soluble in 105 parts of water, sparingly soluble in dilute hydrochloric acid, and more freely so in the same acid when concentrated. It dissolves also in alkali acetates and thiosulphates.

Plumbi tannas, *Lead tannate*, is prepared by dropping a solution of tannin into a solution of lead acetate, washing and drying the precipitate. It is at first nearly white, but turns gradually brown.

Unguentum plumbi tannici, Plumbum tannicum pultiforme, *s.* Cataplasma ad decubitum, *P. G.*, is made by triturating tannin 1 part with solution of lead subacetate 2 parts, and incorporating the mixture with 17 parts of lard. It is prepared extemporaneously.

Action and Uses.—A solution of lead nitrate (gr. x to ℥j) may be employed as a discutient for bruises and local inflammations, but is much more useful as a deodorizing agent to correct the fetor arising from *gangrenous sores* and *offensive discharges* from the nostrils, ears, vagina, and rectum. It is a very efficient remedy for non-constitutional *ozæna* and a palliative of the syphilitic form. It is best applied by means of the nasal douche in a solution containing from Gm. 0.12–0.30 in Gm. 32 (gr. ij–v in f℥j) of water. As a cicatrizing astringent it is very useful in the treatment of *sore nipples* when dissolved in

glycerin or brandy in the proportion of Gm. 0.60 to Gm. 32 (gr. x in f℥j). It should be applied after suckling, and the child should not be allowed to take the breast again until the nipple has been thoroughly washed. If the ulcer or fissure is deep, a stronger solution than the above may be required. Powdered nitrate of lead appears to be an efficient application to the sanious fungous ulcers resulting from *onychia*. After the first dressing, it is said, the pain ceases, the swelling decreases, suppuration is lessened, and the fetid odor is destroyed. As the application is painful, it is recommended that the ulcer be first washed with a strong solution of sulphate of morphine or a preparation of cocaine. This lead salt is also stated to have cured several cases of *epithelioma* when its powder was dusted over the affected part several times (Chéron, *Practitioner*, xxviii. 46). *Chloride of lead* has been used externally in an ointment with a view of allaying pain and repressing morbid growth, very much as the ointment of carbonate (or the cerate of subacetate) of lead has been employed. It has also been used, like chloride of zinc, as a disinfectant. *Tannate of lead* has been similarly applied in ointments and liniments and in the *Cataplasma ad decubitum* above described.

PLUMBI OXIDUM, *U. S.*, *Br.*—Lead Oxide.

Lithargyrum, *Plumbum oxydatum*, P. G.—*Litharge*, E.; *Protoxide de plomb*, Fr.; *Bleioxyd*, *Bleiglätte*, G.

Formula PbO. Molecular weight 222.36.

Preparation.—Lead oxide is prepared by combining metallic lead with oxygen derived from the air. If heated to near a white heat, lead begins to volatilize, and in contact with the air burns with a bright white flame to oxide, which was formerly known as *flowers of lead*. When merely heated to fusion the metal oxidizes, forming a yellow amorphous powder known as *massicot*, but at a higher temperature the oxide melts and congeals in crystalline scales known as *litharge*, or *semi-vitrified lead oxide*. In this state it is obtained in several processes, such as that known as *cupellation*, in which the lead is oxidized, and the litharge, as it forms, removed by a blast, leaving behind any silver which may have been contained in the lead. An identical product is obtained by passing a current of air over molten lead heated to dull redness and constantly renewing the surface.

Properties.—Litharge is a more or less crystalline powder which is composed of small scales varying in color between yellowish and pale brick-red. When of a distinct yellow tint and glossy surface it has been called *argyritis*, *yellow*, or *silver litharge* (Silberglätte, *G.*), while the red-tinted kind is sometimes known as *crysitis*, *red* or *gold litharge* (Goldglätte, *G.*). Its density varies between 9.25 and 9.5. It is inodorous and tasteless; in contact with the atmosphere it gradually combines with a little carbonic acid. When heated, it acquires a red-brown color, and at a higher heat fuses, congealing on cooling in scales. In the presence of even a small proportion of silica it congeals to a glass-like mass, and in the presence of charcoal it is reduced to metallic lead. It is soluble in dilute nitric acid and in hot acetic acid, the solutions showing with reagents the behavior of lead salts. It is now generally conceded that lead oxide is completely insoluble in alcohol and water; according to older statements, it dissolves in 70,000 parts or more of water after prolonged contact. It appears to be somewhat soluble in water under increased pressure, also in glycerin and in solutions of sugar and other carbohydrates, which on being digested with it acquire a brownish color and a caramel-like odor.

Tests.—"Lead oxide should be soluble in diluted nitric acid with but little effervescence (limit of carbonate), and without the development of the odor of nitrous acid, leaving not more than a trifling residue (absence of silicate, barium sulphate, etc.). If from the solution in diluted nitric acid the lead be precipitated by sulphuric acid, the filtrate, after the addition of an excess of ammonia-water, should not assume more than a slight bluish tint (limit of copper), nor yield more than traces of a reddish-yellow precipitate (limit of iron). If 5 Gm. of the oxide contained in a small flask be shaken with 5 Cc. of water, then 20 Cc. of acetic acid added and the mixture boiled for a few minutes, and filtered, the insoluble residue, when well washed and dried, should not weigh more than 0.075 Gm. (absence of more than 1.5 per cent. of insoluble impurities). When strongly heated in a porcelain crucible the oxide should not lose more than 2 per cent. of its weight (limit of carbonate and of moisture)."—*U. S.*

Composition.—Pure lead oxide consists of 92.82 lead and 7.18 oxygen.

Pharmaceutical Uses.—Lead oxide is used in the preparation of most lead salts and of plaster.

Other Oxides and Metallic Lead.—Plumbi oxidum rubrum, Minium, *P. G.*—Red lead, *E.;* Oxyde rouge de plomb, *Fr.;* Mennige, *G.*—On heating massicot to near 450° C. (840° F.) it gradually combines with more oxygen, and is converted into red lead; the conversion of the denser litharge into red lead is attended with greater difficulties. It is a bright orange-red, granular, crystalline powder, which, on being heated, becomes deeper red, purplish, and finally black, and has a density varying between 8.7 and 9.1. It is partly soluble in dilute nitric acid, leaving lead dioxide; at a red heat it is converted into litharge, oxygen being given off; and when heated upon charcoal metallic lead is produced. When mixed with about 20 per cent. of sugar and then treated with dilute nitric acid, it is wholly dissolved. When pure it contains 90.66 per cent. of lead and 9.34 of oxygen, its formula being Pb_3O_4=2PbO.PbO_2. A variety of red lead less dense than the ordinary kind, and of a bright orange-red color, is used as a pigment under the name of *orange mineral* or *Paris red.*

Plumbi dioxidum.—Lead dioxide (peroxide) Puce oxide of lead, *E.;* Peroxyde (Oxyde puce) de plomb, *Fr.;* Bleihyperoxid, *G.* This is left behind as an insoluble powder on treating red lead with diluted nitric acid, and is also produced from solution of lead salts by mixing them with an excess of solution of chlorinated lime or chlorinated soda. It is a dark-brown powder, which, on exposure to the light, slowly gives off oxygen, leaving red lead, and by heat is converted into oxygen and litharge. When triturated with one-eighth of its weight of sugar or with its own weight of oxalic acid, it is reduced to oxide or converted into carbonate. Its mixture with sulphur may be ignited by friction—a behavior which renders it useful in the manufacture of matches. Since it readily parts with one-half of its oxygen, it is a valuable reagent for strychnine and some other organic bodies, yielding colored oxidation-products. Its formula is PbO_2, and it contains 86.61 lead and 13.39 oxygen.

Plumbum.—Lead, *E.;* Plomb, *Fr.;* Blei, *G.* Symbol Pb. Atomicity bivalent or quadrivalent. Atomic weight 206.4.—Lead has been known from the most remote period. It is found in the United States and many other countries, occasionally as oxide, more frequently as carbonate (*white lead ore*), or in combination with other acids. The most abundant lead ore is *galena*, a lead sulphide, PbS, which is frequently associated with the sulphides of zinc, iron, copper, and silver. The metal is obtained from the galena by roasting it, whereby a portion is oxidized to lead sulphate, while another portion parts with its sulphur, which escapes as sulphur dioxide, the metal being converted into oxide. The newly-formed compounds react with the unaltered galena, forming lead, which fuses, and sulphur dioxide, which escapes. A considerable quantity of lead remains in the slag, which is used in a subsequent operation. The extraction of silver is effected by cupellation (see page 287), and the lead oxide is then reduced to the metallic state by heating it with charcoal.

Lead has a bluish-gray color and a bright metallic lustre. It is a soft metal, and when cooled slowly leaves a mark on being drawn over paper. Its specific gravity is 11.4; it is very malleable and ductile, but less tenacious than most other common metals; fuses at 325° C. (617° F.) and volatilizes at a white heat. On congealing, it expands slightly, but afterward contracts considerably, and under some circumstances it may be obtained crystallized in regular octahedrons. When exposed to a moist atmosphere it is superficially oxidized and becomes covered with a grayish layer. In contact with water and air or in the presence of a minute quantity of ammonia or of nitric acid, the metal is corroded and small quantities of it are held in solution. Sulphates prevent the lead from being dissolved, or, if dissolved, precipitate an insoluble sulphate.

In addition to the three oxides described above, the existence of a suboxide, Pb_2O, has been assumed, but is doubted by many chemists. *Lead sesquioxide*, Pb_2O_3=PbO.PbO_2, has been obtained as a yellow precipitate by adding chlorinated soda to an alkaline solution of lead, and more recently (1878) by H. Debray as a greenish-brown powder by heating lead peroxide to 350° C. (662° F.).

There are two series of *lead salts*, in one of which lead is contained in the acidulous radical, while in the other it constitutes the base. The former are called *plumbates*, and are obtained by heating together lead peroxide with alkali hydroxides; the alkali plumbates are colorless, decomposed by much water, and yield plumbates of the metals by acting upon metallic salts. The *plumbic salts* are white or colorless, unless colored by the acid; mostly insoluble in water, and then usually soluble in dilute nitric acid. The salts, which are soluble in water, have a sweet and metallic taste and an acid reaction to litmus, and their solutions yield white precipitates with carbonates, sulphates, phosphates, and chlorides, the last of which is slightly soluble in water, but less soluble in hydrochloric acid, while the precipitated lead sulphate is insoluble in water and dilute sulphuric and hydrochloric acids. Alkalies produce white precipitates of plumbic hydroxide, which is insoluble in ammonia, but soluble in potassa and soda. Potassium ferrocyanide yields a white precipitate. The precipitates by potassium chromate and potassium iodide are characterized by a bright-yellow color; the latter crystallizes from hot solutions in golden-colored scales. Hydrogen sulphide precipitates black lead sulphide, which is insoluble in dilute acids and in ammonium sulphide. Iron and zinc separate from the solutions of lead salts the lead in the metallic state, and by heating the salts with sodium carbonate upon charcoal before the blowpipe, metallic globules of lead and a reddish-yellow incrustation of lead oxide are obtained.

Uses.—Oxide of lead is seldom used alone. It enters into the composition of lead plaster, and hence of most of the plasters which owe their adhesiveness to that compound. A mixture of oxide of lead with sweet oil has been applied to superficial *burns*, and

ordinary white paint, containing litharge, linseed oil, and oil of turpentine, is a popular and excellent remedy for the same affection. Care should be taken not to leave it in contact with the broken skin. Gerhardt has proposed a mixture of oxide of lead and potassa as a caustic for *condylomata* and *warts* of the glans penis and vagina. It produces a blackish slough, but does not penetrate deeply.

PODOPHYLLUM, *U. S., Fr. Cod.*—Podophyllum; May-Apple.

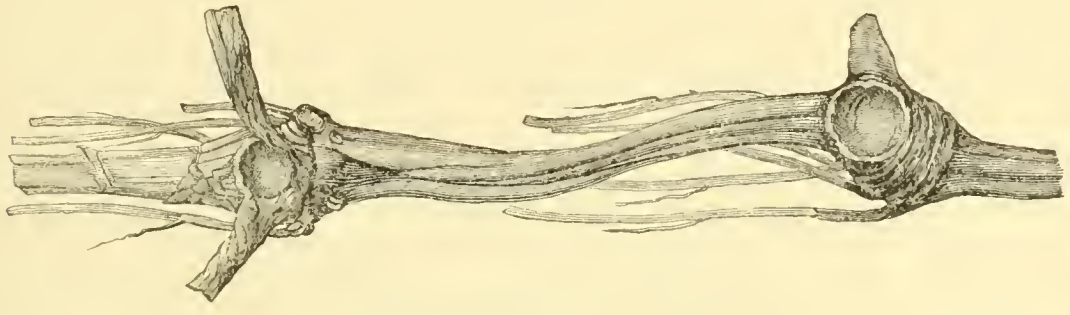
Podophylli rhizoma, Br.—*Mandrake-root*, E.; *Rhizome de podophyllum*, Fr.; *Fussblattwurzel*, G.

The rhizome of Podophyllum peltatum, *Linné*. Bentley and Trimen, *Med. Plants*, 17. *Nat. Ord.*—Berberidaceæ.

Origin.—Mandrake is an herbaceous perennial growing in rich woodlands in Canada and the United States. The pale-green stem is about 25 or 30 Cm. (10 or 12 inches) high, and bears at its summit two peltate, deeply five- or seven-lobed leaves, which are 10–15 Cm. (4 to 6 inches) in diameter, and a single white flower with six or nine petals and twice the number of hypogynous stamens. The flowerless stems generally bear only a single leaf. The fruit is a yellowish, oval, fleshy berry, and contains twelve or more seeds, which are enclosed in a pulpy arillus. Collected in autumn, the rhizome loses about 66, and in spring about 75 per cent. on drying.

Description.—The rhizome is horizontal, several feet long, but as found in commerce is always in fragments varying from 3 to 20 Cm. (1 to 6 or 8 inches) in length. It consists of joints or annual shoots 25 to 75 Mm. (1 to 3 inches) long, 3–6 Mm. ($\frac{1}{8}$ to $\frac{1}{4}$ inch) thick, and marked with distant leaf-scars. The end of each joint is enlarged to the diameter of about 12 Mm. ($\frac{1}{2}$ inch), is depressed globular in shape, and occasionally branching, has approximate leaf-scars, on the upper side a circular depressed

Fig. 226.



Rhizome of Podophyllum peltatum, *Linné*.

stem-scar containing one or two rows of wood-bundles, and on the lower side is beset with from eight to twelve nearly simple rootlets. Rhizome and rootlets are of a yellowish- or reddish-brown color externally, smooth or with longitudinal wrinkles, very brittle, and therefore the radicles often detached; nearly inodorous, and of a sweetish somewhat bitter and acrid taste. The rhizome is white and mealy inside, and has a rather thick bark and a thin circle of yellowish wood-bundles enclosing a compact central pith. The rootlets have a thick white bark and a thin yellowish central cord.

Constituents.—The analysis of podophyllum by J. R. Lewis (1847) showed the presence of starch and other common vegetable principles, and of two resins, one soluble, the other insoluble, in ether. According to H. A. Tilden (1859), the rhizome collected in April contains two resins in nearly the same proportion, but C. J. Biddle (1879) showed that the ether-soluble portion varied throughout the year only between 78 and 99 per cent. of the total resin. W. A. Saunders (1867) and Snow (1886) showed that the rootlets yield as much resin as the rhizome; and according to C. J. Biddle the yield is largest in spring and smallest in summer. The bitter principle was obtained in an impure condition by Hodgson (1831). F. F. Mayer (1863) announced the presence of berberine and another (white) alkaloid, and of saponin, but the investigations of F. B. Power (1877–78), indicate the total absence of saponin and of any alkaloid; and we have subsequently shown that at all periods of its growth the rhizome is free from alkaloid. The powdered drug, according to Kürsten (1891), yields successively fat to benzin, podophyllotoxin to chloroform, and podophylloquercetin to ether; the active *podophyllotoxin* crystallizes from hot benzene and is sparingly soluble in water, but freely soluble in acetone. *Picropodophyllin* is amorphous and more sparingly soluble than the preceding.

The dry leaves contain, according to Power and Charter (1886), 6 per cent. of soft, dark-green, bitter resin, which is less drastic than the resin of the rhizome.

Podophyllum Emodi, *Wallich*, growing in shady valleys in Kashmire and other Himalayan states, has a rhizome resembling that of the American plant, but the tuberosities and stem-scars are rather crowded; according to Dymock (1889), it yields 10 per cent. of resin, which is soluble in alcohol, ether, chloroform, and in alkalies, and is an efficient cathartic in doses of ½ grain; it is very similar to, and probably identical with, the official resin.

Tinctura Podophylli, *Br.*—Resin of podophyllum 160 grs.; rectified spirit 20 fl. oz.

Action and Uses.—Workmen employed in pulverizing podophyllum find it excessively irritating to the eyes, nose, mouth, respiratory passages, and even to the skin (*Med. Record*, xii. 357). The resin applied to an ulcer produces its characteristic purgative effects with nausea. Internally, in small doses, it is a very slow and gentle laxative, producing formed or semi-solid stools, but in large doses it is a drastic and persistent purge. Its bitter and nauseous taste, when taken in powder or in solution, causes salivation, but under any form, and however introduced into the system, it has the same effect if it occasions nausea, which it does by irritating the stomach. It excites the secretion of bile, if at all, in the same way as it does that of the saliva, by the reflex influence of the irritation produced by it in the stomach and duodenum. In the case of a woman who took 10 grains of podophyllin severe abdominal pains came on in about two hours, but did not last for more than an hour. There was very little pain, and the patient recovered (*Phila. Med. Times*, xii. 520). A dose of 88 grains of "podophyllin" was fatal to a young woman (*Boston Med. and Surg. Jour.*, Nov. 1886, p. 436). In another fatal case the dose is said to have been only 5 grains (*Med. Record*, xxxvii. 409).

According to Podwyssotski (*Arch. f. Pathol. u. Phar.*, xiii. 29), the essential constituent of podophyllum is podophyllotoxin, of which he says that the dose is from one-fourth to one-third of a grain for an adult.

Podophyllum has, like jalap, the excellent quality of causing a slow but complete evacuation of the bowels, without greatly tending to render them torpid, provided it be given in suitable doses. This quality makes it useful in habitual *constipation*. For this purpose Gm. 0.01 (⅙ grain) of podophyllum resin with Gm. 0.013 (⅕ grain) of extract of belladonna, Gm. 0.06 (1 grain) of extract of hyoscyamus, and Gm. 0.06 (1 grain) of soap may be made into a pill to be taken at bedtime. Like other active cathartics, podophyllum resin in removing constipation removes also one of the causes which tend to prolong constipation—the condition which is generally spoken of as *torpor of the liver*, and which is attended with hepatic fulness and perhaps some yellowness of the skin, and which is, in fact, generally due to the infarction of the excretory ducts of the liver with inspissated bile. It nearly always arises from sluggish habits of living, imprudence in diet, and neglect of the function of defecation. In the constipation produced by *lead* the following formula may be employed: ℞. Podophylli resin. gr. ss; Ext. nucis vom. gr. j; Ext. belladonnæ gr. ss; for a pill to be taken two or three times a day. Like other drastic cathartics, it has been used in minute doses for the treatment of *diarrhœa*.

The *dose* of powdered podophyllum as a purgative is Gm. 0.60–1.20 (gr. x–xx); the dose of the extract is about the same; as a laxative, Gm. 0.30–0.60 (gr. v–x). The strength of resin of podophyllum is uncertain, and its dose varies from Gm. 0.01–0.06 (gr. ⅙–j) and upward. It seldom begins to act in less than twelve hours. It has been given in varnished capsules, which are supposed not to dissolve before reaching the duodenum, and thus nausea and gastric irritation are alleged to be prevented. The following may be found a convenient formula: ℞. Podophyllum gr. ij; tincture of ginger f℥ij; diluted alcohol to f℥ij.—M. S. A teaspoonful in a wine-glass of water as a habitual laxative in constipation. Braun states the dose of podophyllum resin to be for a child of thirteen years from ⅙ to ½ grain, and under one year from $\frac{1}{12}$ to ⅙ grain; and of podophyllotoxin, for children under one year, from $\frac{1}{60}$ to $\frac{1}{80}$ grain; up to four years, $\frac{1}{30}$ to $\frac{1}{15}$ gr.; and above that age $\frac{1}{10}$ to ⅛ grain. It is most conveniently dissolved in the proportion of ¾ grain in about 100 drops of rectified spirit. Of this solution from 2 to 10 drops may be given in a teaspoonful of syrup (*Practitioner*, xxviii. 54).

POLYGALA.—Bitter Polygala.

Polygale, Laitier, Fr.; *Kreuzblume, Milchwurz*, G.; *Poligala amarga*, Sp.

The root and herb of Polygala rubella, *Willdenow*, s. P. polygama, *Walter*.

Nat. Ord.—Polygalaceæ.

Description.—The bitter polygala, or *bitter milkwort*, is a biennial herb growing in dry fields and pastures from Canada southward to the Gulf of Mexico. It has a fusiform root and numerous glabrous nearly simple stems which are 15–20 Cm. (6 to 8 inches) high, and bear a terminal narrow raceme of about fifteen to twenty-five purple, finally pendulous flowers. The leaves are alternate, linear-oblong or oblanceolate, narrowed below, obtuse, and somewhat mucronate. The flowers are showy and conspicuously crested; racemes of inconspicuous flowers are produced on procumbent stems, and usually fertilized in the bud. The plant is without odor and has a bitter taste.

Allied Species.—Pol. sanguinea, *Linné*. It grows in similar localities to the preceding, has the stem fastigiately branched above and leafy to the top; narrow linear or lance-linear leaves, and terminal globular heads of dark-red and inconspicuously crested flowers. Several others, like Pol. fastigiata, *Nuttall*, and Pol. Nuttallii, *Torrey et Gray*, are closely related to it.

Pol. scoparia, *Kunth*, is used in a similar manner in Mexico.

Pol. amara, *Linné*. It grows in mountainous woods and meadows of Europe, is about 15 Cm. (6 inches) high, has rosulate, obovate, or spatulate radical leaves, smaller linear or oblong linear stem-leaves, and lax racemes of blue flowers. It is used in Europe as *Herba polygalæ*.

Pol. vulgaris, *Linné*. A common European perennial about 20 Cm. (8 inches) high, with lanceolate or spatulate radical leaves, longer linear-lanceolate stem-leaves, and short or lax and elongated racemes.

Pol. major, *Jacquin*, grows in South-eastern Europe. The root, *Radix polygalæ hungaricæ*, is about 38 Mm. (1½ inches) long and 4 Mm. (⅛ inch) thick, has a thin pale yellowish-brown bark, a woody meditullium, and a sweetish, unpleasant, slightly bitter taste.

Pol. serpentaria, *Ecklon et Zeyher*. In Southern Africa the root is used as an alexipharmic. It is about 20 Cm. (8 inches) long, light-brown, and has a thin reddish-brown bark.

Pol. venenosa, *Jacquin*, a shrub of Java, with large oblong or obovate leaves, is considered to be poisonous.

Soulamea amara, *Lamarck*, indigenous to the Moluccas, is a shrub or tree, all parts of which are intensely bitter and are reputed to possess antiperiodic properties.

Monnina polystachya, *Ruiz et Pavon*, is a Peruvian shrub; the root-bark contains saponin, and is used in diarrhœa and as a substitute for soap in washing and in polishing metals.

Constituents.—Reinsch (1839) obtained from Polygala amara small quantities of solid volatile oil, tannin, and wax, considerable pectin, and a crystalline compound, *polygalamarin*, which has a very bitter taste and foams considerably when agitated with water.

Action and Uses.—Polygala rubella is said to be closely analogous in medicinal virtues to P. amara of Europe. Some of the most recent European works on the materia medica reject the latter altogether. It is, however, a mild bitter tonic, with some influence in *bronchial catarrh*, and may be convenient in domestic medicine, but scarcely deserves an official rank. P. vulgaris possesses the same virtues essentially. Its active principle is analogous to senegin.

POTASSA, *U. S.*—Potassa.

Potassa caustica, Br.; *Kali causticum fusum*, P. G.; *Potassæ* (*Potassii*) *hydras*, *Kali hydricum fusum*, *Oxydum potassicum*, *Lapis causticus chirurgorum*.—*Caustic potash*, *Potassium hydroxide*, *Potassium hydrate*, E.; *Potasse caustique*, *Potasse fondue*, *Pierre à cautère*, Fr.; *Kaliumhydroxyd*, *Aetzkali*, G.

Formula KOH. Molecular weight 55.99.

Preparation.—Take of Solution of Potash 2 pints. Boil down rapidly in a clean silver vessel until there remains a clear fluid of oily consistence, a drop of which, when removed on a warm glass rod, solidifies on cooling. Pour this into proper moulds, and when it has solidified, and while it is still warm, put it into stoppered bottles.—*Br.*

The process by which the solution is made is described and explained on p. 975. This solution is evaporated, and the remaining potassium hydroxide fused until ebullition ceases, and a glass plate laid upon the vessel ceases to become moist from condensed water; the fused mass is then poured upon a cold iron plate, and after congealing broken into smaller pieces, or it is poured into clean cylindrical iron moulds which have been previously warmed. If it is desired to obtain the potassa in powder, the melted mass while cooling is briskly stirred with a silver spatula or the solid pieces are rapidly triturated in a warm iron mortar. The finished product should in all cases be at once put into well-stoppered bottles made of hard glass. Vessels made of glass, porcelain, copper, and of most other materials are corroded by the concentrated solution and the fused hydroxide; the operation must therefore be performed in a vessel of silver or of well-cleaned iron.

Properties.—Caustic potassa is either pulverulent or in irregular pieces of crystalline texture; more generally it is in dry white cylindrical pieces, which break readily with a crystalline and somewhat translucent fracture. It is inodorous or has a faint odor of lye; its taste is strongly caustic and acridly alkaline. It dissolves at 15° C. (59° F.) in 0.50 parts of water and in 2 parts of alcohol, and is much more soluble in both liquids at the boiling temperature (*U. S.*); the taste and reactions of these solutions are strongly alkaline. The alcoholic solution is yellowish, and on keeping turns brown. Potassa is but slightly soluble in ether. On exposure to the air it rapidly absorbs moisture, liquefies, and combines with carbon dioxide. When heated to about 530° C. (986° F.) it fuses to a colorless oily liquid, and in a strong red heat it slowly volatilizes, forming white acrid vapors.

Tests.—"The aqueous solution (1 in 20) should be perfectly clear and colorless (absence of organic matter). After acidulation with hydrochloric acid it yields bright-yellow precipitates with platinic chloride test-solution and with sodium-cobaltic nitrite test-solution. A concentrated aqueous solution (1 in 10), when dropped into tartaric acid test-solution, produces at first a white crystalline precipitate, which redissolves when the potassa is added in excess. If 1 Gm. of potassa be dissolved in 10 Cc. of water and slightly supersaturated with acetic acid, 10 Cc. of the solution should not be colored or rendered turbid by the addition of an equal volume of hydrogen sulphide test-solution (absence of arsenic, lead, etc.), nor by the subsequent addition of ammonia-water in slight excess (absence of iron, aluminum, etc.) The remainder of the acidulated solution should not be rendered turbid by ammonium oxalate test-solution (absence of calcium). If a solution of 1.5 Gm. of potassa in 10 Cc. of water be slightly supersaturated with nitric acid, then 0.5 Cc. of decinormal silver nitrate solution added, and the precipitate, if any, removed by filtration, the clear filtrate should remain unaffected by the further addition of more silver nitrate solution (limit of chloride). If to a solution of 3.5 Gm. of potassa in 10 Cc. of water, strongly supersaturated with hydrochloric acid, 0.1 Cc. of barium chloride test-solution be added, and the precipitate, if any, removed by filtration, the clear filtrate should remain unaffected by the further addition of barium chloride test-solution (limit of sulphate). If 1 Gm. of potassa be dissolved in 2 Cc. of water and added to 10 Cc. of alcohol, not more than a slight colorless precipitate should occur within ten minutes (limit of silicate). After boiling this alcoholic solution with 5 Cc. of calcium hydroxide test-solution and filtering, not the slightest effervescence should take place on adding the filtrate to an excess of diluted hydrochloric acid (limit of carbonate). If 0.2 Gm. of potassa be dissolved in 2 Cc. of water and carefully mixed with 4 Cc. of pure sulphuric acid and 2 drops of indigo test-solution, the blue color should not be discharged (limit of nitrate). To test for soda, dissolve 0.56 Gm. of potassa in 5 Cc. of water, add a few drops of phenolphtalein test-solution, and then from a burette enough tartaric acid test-solution (3 Gm. in 20 Cc.) to accurately neutralize the solution. Next add another volume of the tartaric acid test-solution equal to that first used, and then enough absolute alcohol to completely precipitate the potassium bitartrate formed. Separate the precipitate by filtration and wash it with a little alcohol. The filtrate should not require more than 0.2 Cc. of normal potassium hydroxide solution to restore the red color (absence of more than 1.5 per cent. of soda). To neutralize 0.56 Gm. of potassa should require not less than 9 Cc. of normal sulphuric acid (each Cc. of the volumetric solution corresponding to 10 per cent. of pure potassium hydroxide), phenolphtalein being used as indicator."—*U. S.* The last test is not strictly accurate unless the total absence of soda is ascertained.

An impure potassa of a deep-gray or greenish color is sometimes met with. It is unfit for medicinal purposes, and may be purified by treating it with alcohol, which dissolves the alkali, and evaporating this solution to dryness.

Composition.—The formula of potassa is given above. When pure it contains 16.07 per cent. H_2O and 83.93 per cent. K_2O, but as met with in commerce there is usually an excess of water, amounting to 6 or 8 per cent.

Metallic Potassium and Salts.—Potassium, or Kalium, was first isolated by Humphrey Davy (1807), and is obtained with some difficulty by heating potassium hydroxide or sulphide with metallic iron, in which case ferric oxide or sulphide is formed; or an intimate mixture of potassium carbonate and charcoal is heated to strong redness, when carbonic oxide is produced, and the metal distils into a receiver containing petroleum.

It is silver gray, of a strong metallic lustre, harder than sodium, but softer than lead, fuses at 58° C. (136.4° F.), is brittle at the freezing-point of water, and at a red heat volatilizes, forming green vapors. Its density is 0.865, its atomic weight 39.03, and its atomicity univalent. It has

a great affinity for oxygen, and when thrown upon water decomposes this liquid, melts, and burns with a purple flame. It must be preserved under petroleum naphtha which is free from oxygen. There are three oxides of potassium known—the *monoxide*, K_2O, *dioxide*, K_2O_2, and *tetroxide*, K_2O_4, of which only the former is of importance on account of the uses in medicine and the arts to which its combinations with water and acids are put.

Potassium Salts. Potassa is a very strong base, and completely neutralizes the strongest acids. The salts are colorless, unless the acid has a distinct color, and are neutral to test-paper, except those with weak acids, which have a distinct alkaline reaction. They are mostly readily soluble in water, and in such solutions, if not too dilute, are precipitated in a gelatinous condition by hydrofluosilicic acid, and in a crystalline form by tartaric acid, acid sodium tartrate, sodium cobaltic nitrite, platinic chloride, and sodium picrate. The last three precipitates are yellow, the others white. When heated before the blowpipe the potassium salts impart a purplish tinge to the flame, which is masked by the presence of a small quantity of sodium salt. The yellow color of the latter is absorbed by looking at the flame through blue glass, and the potassium flame becomes then visible.

Potassa is used in the preparation of numerous other potassium compounds: the following new salts have been introduced during the last two or three years:

Potassii cantharidas, Potassium cantharidate, $C_{10}H_{12}K_2O_5.2H_2O$. If cantharidin be heated with twice its weight of potassium hydroxide and 100 parts of water in a flask on a water-bath, a clear solution of potassium cantharidate will be obtained; the solution is usually diluted by the gradual addition of warm water to such an extent that each Cc. shall contain 0.0002 Gm. of cantharadin. The salt may be obtained in crystals having the above composition and soluble in 25 parts of water; the addition of acids to the aqueous solution causes the separation of cantharidin, not cantharidic acid, which latter has never been obtained in a free state. Potassium cantharidate was first recommended by Liebreich in 1891 for hypodermic injection in the treatment of certain forms of tuberculosis. The average dose for adults is 1–1.5 Cc. of a solution of the salt, representing 0.0002–0.0003 Gm. ($\frac{1}{324}$–$\frac{1}{216}$ grain) of cantharidin.

Potassii osmas, Potassium osmate, $K_2OsO_4.2H_2O$. This salt is preferred by many to pure osmic acid (see page 48). It is prepared by adding potassium hydroxide to an alcoholic solution of osmium tetroxide; the liquid assumes a beautiful red color, and if concentrated, the potassium osmate will separate as a crystalline powder. Slow evaporation of dilute solutions produces deep garnet-red crystals of octahedral shape, which are readily soluble in water, of a sweetish astringent taste, and permanent in dry air; in moist air the salt deliquesces and is decomposed; hence solutions of the salt are not very stable. Potassium osmate is generally used hypodermically in form of a 1 per cent. solution; internally it may be given in pill form, in doses of 0.001–0.0015 Gm. ($\frac{1}{65}$–$\frac{1}{45}$ grain).

Potassii telluras, Potassium tellurate, K_2TeO_4. This compound and the corresponding sodium salt, Na_2TeO_4, are prepared by neutralizing an aqueous solution of pure crystallized telluric acid with potassium and sodium hydroxide respectively, evaporating the solution to dryness, and washing the residue with alcohol. Both salts occur as a white crystalline powder, readily soluble in water, but insoluble in alcohol; a 2 per cent. aqueous solution should not at once yield a black precipitate upon addition of stannous chloride solution, showing the absence of tellurious acid. The alkali tellurates have been recommended as antihydrotics in daily doses of 0.05 Gm. (about $\frac{3}{4}$ grain), to be given at bedtime; they have been used with effect in arresting the night-sweats of phthisis, but communicate an intense garlicky odor to the breath, which is but slightly modified by peppermint.

Action and Uses.—Potassa is one of the strongest caustics. It destroys animal tissue by abstracting water, neutralizing free acids, decomposing nitrogenous compounds, and forming solutions of fibrin, albumen, and gelatin. Between the fingers it has a soapy feel. In contact with the soft tissues it causes severe burning pain, and produces a moist, ashen, and then black, leathery slough, which leaves a granulating ulcer behind it.

The symptoms of poisoning by a solution of potassa are these: An acrid, urinous, and caustic taste in the mouth, burning in the throat; nausea, and vomiting of alkaline matters, which are usually bloody; intense pain in the fauces, œsophagus, stomach, and bowels; diarrhœa, convulsions, delirium; a cold, clammy skin, and, if the dose has been large and not instantly rejected, speedy death. Sometimes death takes place from inflammation of the larynx; sometimes, after several weeks from the gastro-intestinal lesions (which consist of more or less destruction of the mucous membrane, etc.); and, finally, it may occur after several months from stricture of the œsophagus. A case is recorded in which life was maintained for forty days by nutrient enemata exclusively (*Jour. Am. Med. Assoc.*, i. 558).

In small or medicinal doses potassa increases the amount of urine secreted, rendering it less acid; in larger or in long-continued doses it diminishes the coagulability of the blood, and may give rise to a cachectic condition, with paleness and œdema of the skin, passive hæmorrhages, and general emaciation—a state identical with that occurring in scurvy.

Potassa in solution is used as an antacid to correct *acidity of the stomach* which pro-

ceeds either from fermentation of the contents of the organ or from an excessive amount of its proper secretion, and which is accompanied by heartburn, sour eructations, aphthæ, spasm of the œsophagus, vomiting, gastric cramp, colic, tympanites, irregular diarrhœa, etc. In treating such conditions with alkalies the acidity is indeed palliated, but its cause must be removed to make a cure certain, and that is usually best secured by means of tonic medicines and regimen. For the relief of *calculous disorders* potassa is less appropriate than soda and its carbonates. Gm. 1.30 (20 minims) of solution of potassa largely diluted are said to prevent and also to relieve *strangury* from *cantharides*. Formerly, this medicine was considered as almost a specific in the treatment of glandular *scrofula*, but the influence of the hygienic conditions existing at the same time appears to have been underrated. It should not, however, be neglected, but given in the dose of Gm. 0.30 (5 drops), largely diluted, after meals. Solution of potassa is useful in some cases of *acne rosacea*, and in the treatment of *boils* it has been thought efficient.

Externally, potassa is used chiefly as a caustic to promote the healing of callous ulcers and sinuses and to destroy fungous granulations. It has been especially employed to destroy *chancres* in their first stage and to cauterize *poisoned wounds*. It is much used in the treatment of *ingrown nail* and *paronychia*, and was formerly employed for opening *scrofulous abscesses*. It has been applied as a counter-irritant in diseases of the *hip-joint* and other joints, and for the purpose of exciting inflammation in the ends of *ununited fractured bones;* but these uses, as well as its application to *carbuncles*, *erectile tumors*, *varicose veins*, and to the spine in *tetanus*, are well nigh obsolete, it having been superseded by more efficient and less painful remedies. The same may be said of its use in the treatment of *urethral stricture*. It is one of the most convenient agents for establishing *issues*. To prevent the caustic action from spreading laterally, a piece of adhesive plaster should be applied first, with an aperture of the size of the intended issue. Upon the skin thus exposed and moistened a small portion of fused potassa is laid, and the degree of its action regulated by the duration of its contact. The action may be arrested at any point by a sponge or cloth wet with vinegar. Milder action may be secured by applying the stick of fused potassa, duly covered, except at one end, with shellac varnish or sealing-wax, and maintaining its contact for a longer or shorter time according to the effect desired. (For other uses of potassa see Liquor Potassæ and Potassa c. Calce.)

The proper *antidote* to poisoning by potassa is vinegar or other vegetable acid.

POTASSA CUM CALCE, *U. S.*—Potassa with Lime.

Pulvis causticus cum calce, *Pulvis causticus Viennensis* (*Londinensis*).—*Vienna caustic*, E.; *Caustique* (*Poudre*) *de Vienne*, Fr.; *Wiener Aetzpulver*, G.

Preparation.—Potassa, Lime, of each 500 Gm. Rub them together in a warm mortar, so as to form a powder, and keep it in a well-stoppered bottle.—*U. S.*

Properties.—This is a grayish-white powder of a strongly caustic taste and alkaline reaction. When exposed to the air it absorbs moisture and carbon dioxide. Treated with diluted nitric or hydrochloric acid, it dissolves completely with slight effervescence, and yields a solution in which both potassium and calcium are indicated by reagents.

Causticum cum potassa et calce, *P. Cod.*, is a stronger preparation, known in France as *caustique de Filhos*, and made by fusing 100 parts of caustic potassa, adding thereto 10 parts of powdered burned lime, and pouring the mass into lead tubes of suitable size to harden.

Causticum commune mitius. Under this name a preparation was formerly employed which was made either by intimately mixing equal weights of soft soap and powdered burned lime, or caustic potassa was dissolved in three times its weight of water, and a sufficient amount of lime added until the whole was converted into a pasty mass.

Action and Uses.—This caustic is milder in its operation than pure potassa. When applied in a dry state to the skin it absorbs moisture from it and from the air, and partially deliquesces. It is best employed after being reduced to a paste with a little alcohol. Its action may be limited laterally by means of adhesive plaster, and in depth by the duration of its contact. The sticks of Filhos's caustic may be protected from the air by waxed paper, by sealing-wax, gutta-percha, or varnish. For still further mitigating the caustic action of the potassa in this preparation the alkali may be fused with gutta-percha in any required proportion. Its uses are the same as those of potassa employed as a caustic.

POTASSA SULPHURATA, *U. S., Br.*—Sulphurated Potassa.

Potassii sulphuretum ; Kalium sulfuratum, P. G. ; *Hepar sulphuris.—Sulphuret of potassium, Liver of sulphur*, E. ; *Sulfure de potasse, Foie de soufre*, Fr. ; *Schwefelleber*, G.

Origin.—The name "liver of sulphur" was introduced by Basilius Valentinus in the fifteenth century, but the process of melting together sulphur with an alkali was known already to Albertus Magnus in the thirteenth century, and the solubility of sulphur in alkalies to Geber in the eighth century. Spielmann (1766) recommended the preparation of liver of sulphur from 2 parts of potassium carbonate and 1 part of sulphur, in which proportion the ingredients are still employed.

Preparation.—Sublimed Sulphur 100 Gm. ; Potassium Carbonate, dried, 200 Gm. Rub the powdered and dried potassium carbonate with the sulphur, and heat the mixture gradually in a covered crucible until it ceases to foam and is in a state of perfect fusion. Then pour the liquid on a marble slab, and when it has solidified and become cold break it into pieces, and keep them in a well-stoppered bottle of hard glass.—*U. S.*

The different pharmacopœias prepare this compound in a like manner, and use the sulphur and potassium carbonate in the proportion given above. On heating the mixture an evolution of carbon dioxide takes place, causing the mass to swell, and when this ceases the heat is finally raised to a dull redness, so as to produce perfect fusion (*U. S., Br.*), and continued until a small portion of the mass is found to be entirely soluble in water without separating any sulphur (*P. G.*). The crucible must be kept covered to prevent the sulphur from igniting, and after the melted mass has been poured out on a slab, flagstone, an oiled iron plate, or into a porcelain mortar, it is either broken into suitable pieces as soon as it has congealed, or first allowed to cool, being in the mean time covered with a porcelain basin or bell-glass, so as to exclude the air as completely as possible (*Br.*). The yield from the quantities given in the formula is about 225 Gm.

On fusing sulphur with potassium carbonate the latter is decomposed, with the evolution of carbon dioxide, the sulphur uniting with the potassium to form a potassium polysulphide, a portion of which is oxidized by the oxygen of the carbonate, in excess over that contained in the carbon dioxide, to form potassium sulphate or thiosulphate: $4K_2CO_3 + 5S_2$ yields $K_2SO_4 + 3K_2S_3 + 4CO_2$, and $3K_2CO_3 + 4S_2$ yields $K_2S_2O_3 + 2K_2S_3 + 3CO_2$. But the degree of heat is likewise of importance, since at a high temperature the potassium thiosulphate is decomposed into pentasulphide and sulphate; $4K_2S_2O_3$ yields $K_2S_5 + 3K_2SO_4$. It is evident from this that products of very different composition are obtained by varying the proportion of the material, or, if this be used in the same relative proportions, by the injudicious application of heat, by which a part of the sulphur may be sublimed. The directions of the Pharmacopœia should therefore be strictly adhered to.

Properties.—Sulphurated potassa, when recently made or well preserved in closed vessels, is in irregular fragments, breaking with a shallow conchoidal fracture and having a liver-brown color, which in contact with moisture changes to greenish-yellow or brown-yellow. It has a slight odor of hydrogen sulphide, a bitter and acridly alkaline sulphurous taste, and an alkaline reaction to test-paper. It is partly deliquescent on exposure, and yields with water a brownish-yellow solution which has a strong odor of hydrogen sulphide, and evolves the latter freely on the addition of hydrochloric or sulphuric acid, sulphur being at the same time deposited. After boiling the hydrochloric acid solution until the hydrogen sulphide has been expelled, the liquid, freed from sulphur by filtration, will yield a yellow precipitate with platinum chloride and a white precipitate with barium chloride. The acid solution on being neutralized with soda yields, with a saturated solution of sodium bitartrate, a white crystalline precipitate of potassium bitartrate (*U. S.*). The same precipitate is obtained on dissolving sulphurated potassa in 20 parts of water, boiling with excess of acetic acid, filtering, and adding tartaric acid (*P. G.*). About one-half of the weight of sulphurated potassa is dissolved by rectified spirit (*Br.*), the insoluble portion being mainly potassium sulphate.

When intended for internal use the compound should be perfectly soluble in 2 parts of water. For external use an impurer article, *Kalium sulfuratum ad balneum*, is made like the above, with the exception that impure potassium carbonate (pearlash) is substituted for the purified.

If not protected from contact with air, sulphurated potassa becomes green, and afterward gray, being partly converted into carbonate through the carbon dioxide of the air, and partly oxidized to thiosulphate, sulphite, and sulphate, sulphur being at the same time liberated.

Tests.—"On triturating together 1 Gm. of sulphurated potassa and 1 Gm. of crystallized cupric sulphate with 10 Cc. of water, and filtering, the filtrate should remain

unaffected by hydrogen sulphide test-solution, corresponding to at least 12.85 per cent. of sulphur combined with potassium to form sulphide."—(*U. S.*) Hirsch states (*Vergleichende Uebersicht*, page 206) that 10 parts of the freshly-prepared compound, made with potassium carbonate of 90 per cent. purity, will precipitate 9 parts of crystallized cupric sulphate, but should be regarded as of good quality if from 7.5 to 8 parts of the latter salt be precipitated; Hager adopts 8 parts of the copper salt as the lowest limit. None of the pharmacopœias give a test for the detection of soda which may have been partly substituted for the potassa salt: it is best detected by accurately precipitating the aqueous solution with lead nitrate, evaporating the filtrate, powdering the residue, and leaving it in contact with alcohol of spec. grav. 0.879, of which 17 parts will dissolve 1 part of sodium nitrate, while potassium nitrate is sparingly soluble. The alcohol, previously saturated with the latter salt, will dissolve the sodium salt, the amount of which may thus be estimated.

Allied Compounds.—Potassii sulphidum, Potassium monosulphide, K_2S; molecular weight 110.04. Hydrogen sulphide gas is conducted into a solution of potassa as long as it is absorbed, and an equal bulk of potassa solution is added. The colorless liquid has a bitter taste and a strongly alkaline reaction, and on evaporation *in vacuo* yields colorless deliquescent quadrangular prisms, containing $5H_2O$, which are somewhat soluble in alcohol.

Potassii sulphocarbonas, Potassium sulphocarbonate or thiocarbonate, K_2CS_3. On agitating a solution of potassium monosulphide with carbon disulphide the liquid acquires a yellow or red-brown color, according to its concentration and purity, and on careful evaporation at 30° C. (86° F.) yields orange-yellow deliquescent crystals of the hydrated salt, or a crystalline precipitate of the same salt on mixing the brown liquid with alcohol. It has a cooling, pungent, and somewhat sulphurous taste, and is sparingly soluble in alcohol. On agitating potassa solution with carbon disulphide a brown liquid containing both potassium carbonate and sulphocarbonate is obtained. Such a solution has been employed in Europe for the destruction of the phylloxera insect which infests grapevines.

Action and Uses.—The extremely offensive smell and taste of this preparation in solution have caused its use as an internal medicine to be nearly abandoned; but even if these objections to it had not existed, it would scarcely have held its ground against the results of accurate observation. At one time it was thought to be a specific remedy for *membranous croup*, but longer experience showed that the supposed merits of the medicine were, as in so many other cases, due to errors in diagnosis, to mistaking spasmodic croup, which is seldom fatal, for pseudo-membranous laryngitis, from which recovery is rare. It is no longer used, although once regarded as a specific, for *whooping cough*; nor for *pulmonary consumption*, in which it was formerly employed; nor yet for *scrofula*, especially of the glands, which it was once believed to cure; nor does it continue to be prescribed as an antidote in acute *poisoning* by *lead*, *arsenic*, *mercury*, or *copper* salts. There is more reason to think it of service in chronic poisoning with mercury and lead. It has been used with doubtful advantage in the treatment of certain forms of *dyspepsia*, apparently those attended with mucous regurgitation or vomiting.

Externally, lotions and ointments made with sulphurated potassa have been much used in the treatment of limited eruptions of *acne*, *impetigo*, *psoriasis*, etc., and for lessening *mucous* or *purulent discharges* from the nostrils, ear, vagina, etc. It is sometimes employed in the treatment of *scabies*, as in the following liniment: R. Potass. sulphurat. ℥vj; Saponis alb. Oij; Ol. olivæ ℥iv; Ol. thymi ʒij.—M. (Jadelot); but less commonly than sulphur itself. It is, however, very efficient, although if thoroughly applied after the skin is softened by a prolonged warm bath, it is apt to produce eruptions of eczema, which require time and treatment for their cure.

The action and uses of baths containing this preparation are as follows: About Gm. 128 (℥iv) of it are sufficient for a full bath. Such a bath, even at ordinary temperatures, stimulates the skin and is apt to cause sleeplessness, but these and corresponding effects are more decided when the temperature of the water is equal to that of the skin or above it. Hence these baths are contraindicated when fever is present or a tendency to hæmorrhage exists. Such conditions apart, they are often very serviceable in *chronic rheumatism*, *scrofula*, *cutaneous eruptions*, and chronic *profluvia* from the bowels and urinary organs, and have been used in *lead-palsy* and other *paralyses*. They excite copious sweating, and, as above remarked, tend to produce papular and vesicular eruptions of the skin, particularly if the baths are prolonged, as they sometimes are, for several hours. If these effects, and especially the perspiration, are wanting, a sense of fulness, and indeed a relative plethora, may be induced, which is not free from the dangers before alluded to. In such cases a douche directly applied to the affected part is to be preferred.

Internally, the *dose* of sulphurated potassa is Gm. 0.20–0.60 (gr. iij–x).

POTASSII ACETAS, *U. S., Br.*—Potassium Acetate.

Kalium, s. Kali aceticum, P. G.; *Acetas potassicus, s. kalicus, Terra foliata tartari.*—*Acetate of potash (potassa)*, E.; *Acétate de potasse*, Fr.; *Kaliumacetat, Essigsaures Kali*, G.

Formula $KC_2H_3O_2$. Molecular weight 97.89.

Preparation.—Take of Potassium Carbonate 20 ounces; Acetic Acid 2 pints or a sufficiency. To the acetic acid, placed in a thin porcelain basin, add gradually the potassium carbonate, filter, acidulate, if necessary, with a few additional drops of the acid, and, having evaporated to dryness, raise the heat cautiously so as to liquefy the product. Allow the basin to cool, and when the salt has solidified, and while it is still warm, break it in fragments and put it into stoppered bottles.—*Br.*

On adding potassium carbonate or bicarbonate to acetic acid an effervescence of carbon dioxide takes place, and water and potassium acetate are formed; $K_2CO_3 + 2HC_2H_3O_2$ yields $2KC_2H_3O_2 + H_2O + CO_2$, and $KHCO_3 + HC_2H_3O_2$ yields $KC_2H_3O_2 + H_2O + CO_2$. On the application of heat the carbon dioxide which remains dissolved in the water is expelled, and the liquid should now have a neutral or preferably a slightly acid reaction, in which case it contains a slight excess of acetic acid. The evaporation of this solution is effected either by means of a sand-bath or over the naked fire, and the salt may be obtained dry and granulated by continued stirring at about 120° C. (248° F.); or the dry salt is fused by the cautious application of heat, so as not to char it, after which the melted salt is allowed to solidify. In making this salt potassium bicarbonate is preferable, in being nearly free from impurities and yielding at once a salt perfectly soluble in water. Potassium carbonate is less pure, but usually yields a clear solution with acetic acid, which, on being evaporated to dryness and again dissolved in water containing a little acetic acid, leaves some floccules of silica behind, from which it may be filtered and afterward again evaporated.

Potassium acetate may also be prepared from lead acetate by precipitating its solution with a slight excess of potassium carbonate, filtering, acidulating the filtrate with acetic acid, testing with hydrogen sulphide to ensure its complete freedom from lead, and evaporating.

Properties.—Potassium acetate is a white salt forming a crystalline soft mass or a dry granular powder, or more frequently it is seen as a satiny, foliaceous, crystalline mass which melts to an oily liquid at about 292° C. (557.6° F.), and at a higher temperature evolves acetic acid, acetone, empyreumatic and inflammable products, and leaves potassium carbonate and charcoal. The salt is nearly inodorous, is free from acetous odor, has a warm and somewhat pungently saline taste, and is very deliquescent in the air. It dissolves at 15° C. (59° F.) in 0.36 part of water (*U. S., P. G.*), and in 1.9 (*U. S.*), 1.4 (*P. G.*) of alcohol. According to Osann, it dissolves at 2° C. (35.5° F.) in 0.531 part, at 13.9° C. (57° F.) in 0.437 part, and at 28.5° C. (83.3° F.) in 0.321 part of water. The aqueous solution, saturated while boiling, contains 1 part of the salt to 0.125 part of water, and boils at 169° C. (336° F.) (Berzelius). Cold absolute alcohol dissolves one-third, and at the boiling temperature one-half, its weight of the salt. The alcoholic solution on the addition of ether gives a crystalline precipitate of the salt, and on passing carbon dioxide through it potassium carbonate is separated and acetic ether produced. The aqueous solution has a nearly neutral but faintly alkaline reaction, disengages acetous vapors on the addition of sulphuric acid, and yields with platinic chloride or sodium cobaltic nitrite a yellow, and with sodium bitartrate a white, crystalline precipitate, and it gives with ferric chloride a dark-red color, and on boiling a brown-red precipitate. A solution of the salt in 20 parts of water precipitates potassium bitartrate on the addition of tartaric acid. On triturating the salt with iodine it acquires an indigo-blue color, changing to brown on the addition of water.

Tests.—Potassium acetate, when strewn upon colorless sulphuric acid, should not produce effervescence nor impart any color to the latter (absence of carbonate and readily carbonizable organic impurities). Its solution in distilled water should not give a precipitate or a turbidity on the addition of hydrogen sulphide, ammonium sulphide, or potassium ferrocyanide (absence of heavy metals). A 5 per cent. solution of the salt should not give more than a faint opalescence with sodium carbonate (alkaline earths), or with barium chloride (sulphate or carbonate). The concentrated aqueous solution of the salt on being dropped into acetic acid should not produce any effervescence (carbonate), and if mixed with an excess of hydrochloric acid and evaporated to dryness the remaining salt should be completely soluble in water (silica from potassium carbonate).

"If 1 Gm. of potassium acetate be, by thorough ignition, converted into carbonate, the residue should require, for complete neutralization, not less than 10 Cc. of normal sulphuric acid (corresponding to at least 98 per cent. of pure potassium acetate), methyl-orange being used as indicator."—*U. S.* Since the other pharmacopœial tests admit only mere traces of other salts, this test is intended to prove the absence of sodium acetate and of more than 2 per cent. of moisture. The latter is more readily estimated by drying the salt at 120° C. (248° F.); considering the hygroscopic nature of the salt, 3 or 4 per cent. of moisture would seem to be admissible. The presence of notable quantities of sodium acetate is best determined by the intense yellow color imparted by the salt to a non-luminous flame. 4.9 Gm. of dry potassium acetate, evaporated to dryness with an excess of hydrochloric acid, leave a residue of KCl weighing 3.72 Gm., or, allowing for 2 per cent. of moisture, 3.645 Gm. The same weight of exsiccated sodium acetate leaves only 3.49 Gm., and of the crystallized sodium salt 2.104 Gm., NaCl. "If to a portion of the solution acidulated with nitric acid 0.1 Cc. of decinormal silver nitrate solution be added, the liquid should, after filtration, show no further change on the addition of more silver nitrate solution (limit of chloride). Addition of 0.3 Cc. of potassium ferrocyanide test-solution should effect no change in the solution within fifteen minutes (limit of iron)."—*U. S.*

Pharmaceutical Uses.—Potassium acetate, being unfit for dispensing in the dry state, is always prescribed in solution. For convenience in dispensing the German Pharmacopœia recognizes—

Liquor kalii acetici, s. Kalii aceticum solutum, which contains one-third of its weight of the dry salt, and is prepared by neutralizing 100 parts of acetic acid spec. grav. 1.041 with 48 or 50 parts of potassium bicarbonate, expelling the carbon dioxide by heat, and diluting with sufficient water to obtain 147 parts. Its specific gravity is 1.176–1.180.

Action and Uses.—Potassium acetate acts upon the blood as a solvent and diluent, upon the glands and mucous membranes as a depurative, augments the secretion of bile, urine, and sweat, and does not readily disorder the digestion. In doses of from Gm. 16–32 (½ to 1 ounce) it is a mild laxative. It is decomposed in the system, and is discharged with the urine as potassium carbonate, rendering this secretion alkaline and increasing its quantity as well as its solid contents. In large and continued doses it is said to occasion renal catarrh, and even bloody urine.

The title *sal diureticus* which was formerly applied to this salt it is justly entitled to, and there is good reason to believe that, besides increasing the quantity of the urine secreted, it also promotes the disintegration and discharge with that secretion of various effete and noxious elements. It displays this virtue notably in chronic infarctions of the *liver* accompanied with *jaundice*, in analogous congestions of the *spleen*, *uterus*, and *hæmorrhoidal vessels*, and particularly in such conditions resulting from malarial poisoning. In like manner, probably, must be explained its virtues in *gout*, *lithiasis*, *furuncle*, *carbuncles*, and various *cutaneous affections*, as well as in *acute articular rheumatism*. In the last-named disease especially are its virtues conspicuous when it is given in such doses and so frequently as to render the urine alkaline. Like other forms of the alkaline treatment of this disease, it lessens the risk of cardiac complications. In this and in other affections distinguished by an excess of uric acid it acts in the same manner as the carbonates of the alkalies.

In several forms of *dropsy* its diuretic virtue is of extreme value. Most conspicuously is it efficient in the dropsy following scarlatina and in other forms of tubular desquamative nephritis. But it is also very useful in cardiac dropsy and in ascites of hepatic origin. In an inferior degree it is useful in splenic dropsy also. According to circumstances, it may be associated with squill, digitalis, parsley, broom, dandelion, etc. Under the title *potio Riverii* potassium acetate has long been employed in acute febrile affections as a *diaphoretic*. This draught is made by saturating Gm. 8 (℥ij) of potassium carbonate with vinegar, and adding Gm. 190 (f ℥vj) of sweetened water. A tablespoonful of it every two hours is the proper dose.

This salt should always be administered in a large quantity of liquid, except when it is prescribed as a diaphoretic. In febrile affections, as a sedative, its *dose* is Gm. 0.60 (gr. x). In acute articular rheumatism Gm. 2 (gr. xxx) may be given every four hours. As an alterative it may be prescribed in the same or in still larger doses. As a laxative the dose is about Gm. 16 (℥ss).

POTASSII BICARBONAS, *U. S., Br.*—Potassium Bicarbonate.

Kalium bicarbonicum, P. G.; *Kali carbonicum acidulum*, *Bicarbonas potassicus, s. kalicus.—Bicarbonate of potash*, E.; *Bicarbonate de potasse*, Fr.; *Kaliumbicarbonat, Doppeltkohlensaures Kali*, G.

Formula $KHCO_3$. Molecular weight 99.88.

Preparation.—This salt was first prepared by Cartheuser (1757) from potash and ammonium carbonate. Cavendish originated the process which is still used, acting with carbon dioxide upon a solution of the carbonate.

The Br. Ph. (1867) directed a solution of potassium carbonate in twice its weight of distilled water to be treated with a continuous supply of carbon dioxide, generated from marble, for a week, at the end of which time the crystals of bicarbonate are removed: the mother-liquor upon concentration will yield more crystals.

Potassium carbonate, kept in flat, open vessels in localities where saccharine liquids are undergoing vinous fermentation, is gradually converted into bicarbonate. The same salt is also obtained on passing carbon dioxide over the moist carbonate. For preparing it on a small scale a rather concentrated solution of potassium carbonate in water is made, into which carbon dioxide is conducted. 1 molecule of this gas unites with 1 molecule each of potassium carbonate and water, forming 2 molecules of the bicarbonate, thus: $K_2CO_3 + H_2O + CO_2 = 2KHCO_3$. The bicarbonate being less soluble in water than the carbonate, a portion of it crystallizes out, the crystals being larger if they form slowly. To accomplish this the British Pharmacopœia (1867) directs a peculiar arrangement of the apparatus, by means of which the generation of carbon dioxide is regulated by the rapidity with which it is absorbed by the solution, an excess of it remaining in the apparatus, displacing the acid liquid from the bottle containing the marble, thereby completely stopping the further generation of the gas until after partial absorption has taken place. When somewhat larger quantities of the salt are to be prepared, it is convenient to divide the solution among three or more vessels and pass the gas successively through them. In all cases the delivery-tube of the gas dipping into the solution should be of large bore, and preferably widened in the shape of a funnel; which precaution will prevent the closing of the tube by the crystallizing bicarbonate. Since the commercial potassium carbonate is usually contaminated with silicate, silica is separated by the carbon dioxide in the form of floccula, and may afterward be removed by agitating the crystals with cold water and decanting the liquid with the suspended silica. The remaining solution is then filtered and evaporated, or the liquid may be heated to a temperature not exceeding 60° C. (140° F.) until the crystals are dissolved, then rapidly filtered while warm, and, if necessary, further concentrated at the temperature mentioned, and set aside to crystallize. The complete saturation of the solution with carbon dioxide is conveniently ascertained, according to Hirsch, by means of a very dilute solution of barium chloride, which yields no precipitate in the cold with bicarbonate, but at once a white one with potassium carbonate. The crystals should be drained and dried at the ordinary temperature.

Properties.—Potassium bicarbonate crystallizes in transparent, colorless, monoclinic prisms, which are permanent in the air, inodorous, and have a saline and slightly alkaline, but not a caustic, taste. When heated to near 200° C. (392° F.) it gives off carbon dioxide and water, suffering a loss of 31 per cent. The salt is very sparingly soluble in alcohol, and at 15° C. (59° F.) dissolves in 3.2 (*U. S.*), 4 (*P. G.*) parts of water, or in 1.9 parts at 50° C. (122° F.), (*U. S.*). According to Poggiale, 100 parts of water dissolve at 10° C. (50° F.) 23.23 parts, at 20° C. (68° F.) 26.91 parts, and at 60° C. (140° F.) 41.35 parts of the salt; the solution has a slight alkaline reaction to test-paper, effervesces briskly on the addition of acids, yields with an excess of tartaric acid a white crystalline precipitate of potassium bitartrate, and loses carbon dioxide slowly when evaporated *in vacuo*, and rapidly when heated to the boiling-point. 5 Gm. of the salt exposed to a low red heat leave 3.45 Gm. of a white residue consisting of potassium carbonate, which requires for exact neutralization 50 Cc. of the volumetric solution of oxalic acid. 20 grains of potassium bicarbonate neutralize 14 grains of citric acid or 15 grains of tartaric acid.—*Br.* A less pure potassium bicarbonate in a pulverulent state is met with in commerce under the name of *sal æratus*, but much sold as such is sodium bicarbonate.

Tests.—The presence of potassium carbonate causes the bicarbonate to become moist on exposure, and its solution in cold water to yield a white precipitate with magne-

sium sulphate and a yellow or brick-red one with corrosive sublimate; the latter reagent produces a white precipitate with pure potassium bicarbonate. "A solution of 0.5 Gm. of potassium bicarbonate in 10 Cc. of water should not at once be colored red by 1 drop of phenolphtalein test-solution (limit of carbonate). Having dissolved 2.5 Gm. of the salt in 30 Cc. of diluted acetic acid, and made up the volume to 50 Cc. with water, use 10 Cc. for each of the following tests: The addition of 0.3 Cc. of potassium ferrocyanide test-solution to a portion should not produce a blue color within fifteen minutes (limit of iron). After adding a few drops of nitric acid and 0.1 Cc. of decinormal silver nitrate solution to another portion, and filtering, the further addition of silver solution should not affect the filtrate (limit of chloride). To neutralize 1 Gm. of potassium bicarbonate should require 10 Cc. of normal sulphuric acid (corresponding to 100 per cent. of the pure salt), methyl-orange being used as indicator."—*U. S.*

Metallic salts, if present as impurities, remain behind on dissolving the salt in water, or are indicated by producing a precipitate on the addition of hydrogen sulphide. Sodium salts present as impurities will impart an intense yellow color to a non-luminous flame. The complete solubility of the salt in 4 parts of cold water excludes notable quantities of sodium bicarbonate.

Composition.—Potassium bicarbonate represents 47 per cent. K_2O, 44 per cent. CO_2, and 9 per cent. H_2O.

Action and Uses.—Potassium bicarbonate increases the quantity of the urine and renders it alkaline. The very interesting experiments of Balfe (1878) show that when taken on an empty stomach the acidity of the urine on the day of administration is only slightly depressed, while on the day following the acidity is considerably higher than on the day before the salt was taken. But when it is administered during the process of digestion the acidity of the urine entirely disappears. This fact is readily explained by the different conditions of the stomach when it is empty and when it contains food. In the former case the acid salt is received into the stomach when its secretions are either neutral or alkaline, and is absorbed undecomposed into the blood; but when, on the other hand, it is taken during digestion, the acid contents of the stomach decompose it, carbon dioxide is liberated, and escapes by the mouth, while the alkaline base passes into the system and causes the urine to assume an alkaline reaction. This explanation is, of course, as applicable to the sodium as to the potassium bicarbonate. This salt in ordinary doses of Gm. 0.60–1 (gr. x–xv) does not appreciably affect the biliary secretion (Rutherford).

In the manner now described potassium bicarbonate dissolves and eliminates an excess of *uric acid* in the system. Even when *stone* actually exists in the bladder, it lessens the irritability of the organ, diminishing the pain and the necessity of frequent urination. However theoretical inductions may favor the opinion that all potassium salts operate as diuretics, clinical observation does not support this view in regard to the bicarbonate. Doubtless, also, its primary action in the *primæ viæ* is to neutralize the excessive acidity of their contents, and thus, from the start, to prevent irritation of the nervous system. In *jaundice* depending upon high living or upon malarial poisoning, with enlargement of the liver, dyspeptic symptoms, constipation, and scanty and turbid urine, it is of signal advantage. In all of these cases its virtues probably depend upon its power of increasing the alkalinity of the blood and rendering the secretions more liquid. In *cutaneous eruptions* depending upon, or connected with, the previously mentioned conditions its virtues are unquestionable. Although sodium bicarbonate is more generally employed than the potassium salt in the treatment of *diabetes*, the latter is nevertheless of great utility, and is by some authorities preferred, as promoting more effectually the elimination of uric acid. It is prescribed in doses of Gm. 2–4 (gr. xxx–lx) in twenty-four hours, dissolved in about 3 pints of water, which should be taken partly at intervals during and after meals with red wine. The natural mineral waters which are most efficient in diabetes contain, however, a large proportion of the sodium salt and but little or none of the potassium bicarbonate. As a general rule, it may be stated, according to Balfe, that in cases of acid dyspepsia arising from the excessive formation of acid within the system, as in lithæmia, the alkaline bicarbonates should not be administered before food, but after, and that their administration before meals is indicated in those cases only where free acid is formed in the stomach itself, the result of fermentative changes of undigested food or morbid mucus, and when it is necessary to diminish the high degree of acidity thus caused in order to permit digestion to be properly performed.

POTASSII BICHROMAS, *U. S., Br.*—Potassium Dichromate (Bichromate).

Kalium dichromicum, P. G.; *Bichromas kalicus.—Bichromate of potash*, E.; *Bichromate de potasse*, Fr.; *Kaliumdichromat, Doppeltchromsaures Kali*, G.

Formula $K_2Cr_2O_7$. Molecular weight 293.78.

Origin.—The metal *chromium* was discovered by Vauquelin in 1797 in a Siberian mineral which is composed of lead chromate, but it is more abundantly found as *chrome iron ore*, which is a compound of chromic and ferrous oxides, $FeO.Cr_2O_3$. It is met with in several localities in the United States, in Russia, and in Sweden, and is used in preparing the dichromate.

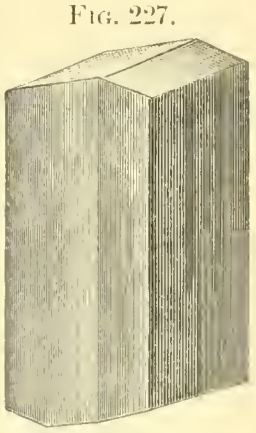
Preparation.—The finely-ground chrome-iron ore, mixed with potassium carbonate and calcium hydroxide or carbonate, is roasted in a reverbatory furnace, which causes the separation of all iron in the form of ferric oxide and the production of potassium chromate from the newly-formed chromic acid; lime or chalk is added simply to prevent fusion of the mixture. The following equation explains the reaction: $2FeOCr_2O_3 + 4K_2CO_3 + O_7 = Fe_2O_3 + 4K_2CrO_4 + 4CO_2$. After the roasting or oxidation has been completed the mass is lixiviated with water, which dissolves the yellow potassium chromate; the latter salt, upon addition of sulphuric acid, yields potassium dichromate and sulphate, the two salts being separated by crystallization: $2K_2CrO_4 + H_2SO_4 = K_2Cr_2O_7 + K_2SO_4 + H_2O$. In order to explain the constitution of dichromates it must be assumed that chromic anhydride is capable of forming two acids—namely, $CrO_3 + H_2O = H_2CrO_4$, chromic acid, and $2CrO_3 + H_2O = H_2Cr_2O_7$, dichromic acid.

Properties.—Potassium dichromate crystallizes in large yellowish-red transparent four-sided prisms or plates, which are inodorous and are not altered on exposure. The salt melts below a red heat to a transparent dark brown-red liquid, which on cooling crystallizes and finally falls into a crystalline powder. At a white heat the salt is decomposed into oxygen gas, green chromic oxide, and yellow potassium chromate, which may be separated by dissolving the latter in water. Potassium dichromate is insoluble in alcohol; it is soluble in water, 1 part of the salt requiring

at	0°	10°	20°	40°	60°	80°	100° C.,	
	20.14	11.81	7.65	3.43	1.98	1.37	0.98	parts of water (Kremers);
	21.76	13.51	8.06	3.86	2.22	1.46	1.06	" (Alluard).

The U. S. and Germ. Pharmacopœias give the solubility in water at 15° C. (59° F.), as 1 in 10 and as 1 in 1.5 parts of boiling water. The solution has an orange-red color, an acid reaction, and a bitter styptic, metallic taste, and is deoxidized, with the formation of chromic oxide or chromic salts, on the addition of hydrogen sulphide, sulphurous acid, or of sulphuric acid and alcohol, or other organic matters. Heated with hydrochloric acid, chlorine is given off. The solution yields a pale-yellow precipitate with barium chloride, a yellow one with lead acetate, and a purplish-red one with silver nitrate, the three precipitates being soluble in nitric acid. With a cold saturated solution of sodium bitartrate a white crystalline precipitate of potassium bitartrate is produced.

Fig. 227.



Crystal of Potassium Dichromate.

Tests.—As met with in commerce, the salt is usually pure. Its solution in 100 parts of water should not be precipitated on the addition of excess of potassium carbonate (absence of calcium salt), and after having been acidulated with nitric acid should not be disturbed by barium chloride (absence of sulphates) or by silver nitrate (chlorides).

Composition.—The salt is free from water, and represents 31.86 per cent. K_2O and 68.14 per cent. CrO_3: it may be regarded as a compound of chromic anhydride with potassium chromate $= K_2CrO_4.CrO_3$, or as the neutral salt of *dichromic acid*, $H_2Cr_2O_7$, which is not known in the uncombined state.

Other Chromates.—Potassium Chromate, K_2CrO_4; molecular weight 193.9. It is obtained by adding potassium carbonate to a hot solution of the dichromate as long as effervescence is observed; the solution changes in color to yellow, and yields on evaporation six-sided lemon-yellow crystals, which may be fused without decomposition and dissolve in less than 2 parts of water, the solution having an alkaline reaction. It is employed as a reagent.

Lead Chromate, $PbCrO_4$, the well-known pigment known as *chrome-yellow*, *Paris yellow*, or *lemon-chrome*, is obtained by precipitating the solution of a lead salt with potassium chromate

or dichromate. It contains 68.9 per cent. of lead oxide and 31.1 per cent. of chromic anhydride. On being digested with dilute solution of potassa or with potassium chromate, it parts with one-half of its chromic acid, leaving a bright red basic compound, which, either pure or mixed with more or less chrome-yellow, is used as a pigment under the names of *American vermilion*, *chrome-red*, and *chrome-orange*. A mixture of chrome-yellow and Prussian blue in various proportions constitutes *chrome-green*.

Pharmaceutical Uses.—In the preparation of chromic acid, valerianic acid, and, dissolved in water, as a test liquid.

Action and Uses.—A man after swallowing 3 drachms of potassium dichromate was seized with vomiting, purging, and severe abdominal pains. The whole body was cold, and the hands shrivelled and blue; the face also was dusky; the breath was cold and the voice feeble. The mouth and throat were dark, thick, bloody mucus was vomited, the thirst was excessive, the pulse feeble and frequent, the respiration hurried, and the urine was suppressed for several days. The patient recovered (*Med. News and Abst.*, Sept. 1881, p. 563). Falck refers to four cases of poisoning by this salt, of which two ended fatally, the doses in the fatal cases being respectively 8 and 15 Gm. (℥ij and ℥iv) (*Lehrbuch*, 1880, p. 144). Potassium dichromate, applied topically, acts like chromic acid, but more mildly. It should therefore be preferred where the full escharotic action of the acid is not required. We have known it to act decidedly as a caustic upon the delicate integument behind the corona glandis when applied for the removal of *venereal warts*. Ordinary warts of the softer sort may generally be destroyed by it. Drysdale recommends 1 part of potassium dichromate and 9 parts of sugar of milk to be applied after the evulsion of *polypi*, and a solution of 2 grains in an ounce of water and half an ounce of glycerin for ulcerated *sore throat* and for enlarged *glands*. It has been thought useful in progressive spinal *paralysis* and in certain ill-defined cases of chronic *dyspepsia* in doses of Gm. 0.005–0.01 ($\frac{1}{12}$ to $\frac{1}{6}$ gr.).

POTASSII BITARTRAS, *U. S.*—Potassium Bitartrate.

Potassii tartras acida, Br.; *Tartarus depuratus*, P. G.; *Cremor tartari*, *Kali bitartaricum*, *Bitartras potassicus s. kalicus.*—*Acid tartrate of potash*, *Cream of tartar*, E.; *Bitartrate de potasse*, *Crème de tartre*, *Pierre de vin*, Fr.; *Weinstein*, G.

Formula $KHC_4H_4O_6$. Molecular weight 187.67.

Origin.—Acid potassium tartrate is contained in many acidulous fruits, but is collected altogether from the juice of the grape, in which it becomes insoluble after fermentation, and is deposited in the casks in crystalline crusts. These form the *crude tartar* or *argol*, and consist of potassium bitartrate, with calcium tartrate, coloring and extractive matters, and yeast and other vegetable fragments. *Red argol* is deposited from red wines, and has a brownish-red color; *white argol*, obtained from white wines, is gray or brownish-white. Crude tartar is not used medicinally, and little is collected in the United States; but the importation of it has increased from 6,965,015 pounds in 1876 to 18,313,544 pounds in 1882, while in the same years the importation of refined and partly-refined tartar has decreased from 2,582,651 to 82,887 pounds, and to 26,448 pounds in 1883.

Purification.—Crude tartar is boiled with water, much of the coloring matter precipitated by the addition of clay, the liquid filtered through animal charcoal or otherwise clarified, and crystallized. The operation has to be repeated several times. The amount of calcium tartrate contained in crude tartar varies between about 5 and 15 per cent. Although this salt is insoluble in water, it dissolves to some extent (more in hot than in cold) solutions of tartrates; hence it cannot be completely removed from cream of tartar by simple recrystallization. However, the crystals forming on the side of the crystallizing-vats contain less of this impurity than the crusts deposited at the bottom, and by careful management the amount may be reduced to about 3 per cent. or less.

To obtain it free from calcium salt, finely-powdered cream of tartar is macerated for twenty-four hours with 8 or 10 per cent. of hydrochloric acid, previously diluted with water, or it is dissolved in boiling water, the same amount of hydrochloric acid added, and the solution continually stirred while it cools. The mother-liquor is drained off, the crystalline powder washed with cold water, and dried. A considerable proportion of potassium bitartrate remains in the mother-liquor, and may be utilized in the preparation of tartaric acid by neutralizing it with lime, when calcium tartrate is deposited.

Properties.—When a hot solution of potassium bitartrate is rapidly cooled the salt separates in very small crystals, which float on the liquid, and from this behavior it has received the name *cream of tartar*. The larger crystals, which are deposited, were

formerly distinguished as *crystalli tartari*. They are rhombic prisms, and quite pure, are colorless, but as usually seen are more or less opaque from the presence of calcium tartrate. But in this form it is rarely kept in the shops, where it is almost exclusively employed in the form of powder. This is white, somewhat gritty, not altered on exposure, inodorous, and has a pleasant acidulous taste and distinct acid reaction. Potassium bitartrate requires at 15° C. (59° F.) 201 (*U. S.*), 192 (*P. G.*) parts, and at 100° C. (212° F.) 16.7 (*U. S.*), 20 (*P. G.*) parts, of water for solution; it is freely soluble, with the formation of neutral salts, in ammonia and potassa solution, and in solution of alkali carbonates, with the evolution of carbon dioxide. It is insoluble in alcohol, is more soluble in dilute hydrochloric acid than in water, and is precipitated from this solution by alcohol; the solutions in dilute sulphuric and nitric acids, however, when mixed with alcohol, deposit potassium sulphate and nitrate. The solutions in alkaline liquids again deposit the salt on being sufficiently acidulated with hydrochloric, acetic, or other acid. In the aqueous solution of the salt, rendered neutral by potassium or sodium hydroxide test-solution, silver nitrate test-solution produces a white precipitate which, on boiling, becomes black by the separation of metallic silver. If, before boiling, enough ammonia-water be added to dissolve the white precipitate, the metal will, on boiling, form a mirror on the sides of the test-tube. When heated in a crucible it evolves inflammable gas and the odor of burnt sugar, and leaves a black residue known as *black flux*, which is a mixture of potassium carbonate and charcoal; the latter is finally consumed on continuing the ignition with free access of air, leaving potassium carbonate or *white flux*. These fluxes are often made by deflagration of intimate mixtures of 2 parts of cream of tartar with potassium nitrate, using 1 part of the latter for the black and 4 parts for obtaining the white flux. On subjecting potassium bitartrate to destructive distillation, carbon dioxide, carbonic oxide, and various hydrocarbons are obtained in the gaseous state; also an aqueous liquid containing much acetic acid, a sublimate of pyrotartaric acid, various tarry products, and in the retort potassium carbonate.

Tests.—When potassium bitartrate is treated with a hot solution of potassa, whatever remains undissolved is impurity. In this way only the coarser adulterations, such as *terra alba* (see p. 349), sand, etc., or calcium tartrate if present as impurity to a considerable extent, can be detected. Cream of tartar has been adulterated with gypsum, chalk, alum, amylaceous substances (stale bread, etc.). These substances are best detected by treating 0.5 Gm. of the powder with 3 Cc. of ammonia-water, wherein it should be completely soluble, and the solution should not be precipitated by hydrogen sulphide (absence of copper, iron, etc.). The residue left by ammonia will acquire a blue color on the addition of iodine if starch is present; cold dilute hydrochloric acid added to the residue will leave terra alba, starch, and some gypsum undissolved, and produce effervescence if chalk is present. The acid solution, mixed with an excess of ammonium or sodium acetate, should not yield white precipitates with ferric chloride (phosphates), ammonia (alumina), or ammonium carbonate (calcium salt). Chlorides and sulphates are most conveniently detected in the aqueous solution of cream of tartar, which, after addition of a few drops of nitric acid, should not be precipitated by barium nitrate (sulphates) or silver nitrate (chlorides). "204 grains heated to redness till gas ceases to be evolved leave an alkaline residue, which requires for exact neutralization at least 1000 grain-measures of the volumetric solution of oxalic acid."—*Br.* This test proves the absence of more than 7.8 per cent. of admixtures and impurities. "If 1.2 Gm. of potassium bitartrate be repeatedly agitated, during half an hour, with a mixture of 5 Cc. of acetic acid and 1 Cc. of water, and the mixture then diluted with 30 Cc. of water, and filtered, the clear filtrate should not be rendered turbid, within one minute, by the addition of 0.5 Cc. of ammonium oxalate test-solution (limit of calcium salt). No odor of ammonia should be evolved on heating the salt with a slight excess of potassium or sodium hydroxide test-solution. If 1.88 Gm. of potassium bitartrate be thoroughly ignited at a red heat, it should require for complete neutralization not less than 9.9 Cc. of normal sulphuric-acid solution (each Cc. corresponding to 10 per cent. of the pure salt), methyl orange being used as an indicator."—*U. S.* The German Pharmacopœia permits the presence of traces of chloride and of not more than ½ per cent. of calcium tartrate. For the detection of the latter it has adopted the test proposed by Biltz: 1 Gm. of the salt is repeatedly agitated and macerated for half an hour with 5 Cc. of acidum aceticum dilutum; then dilute with 25 Cc. of distilled water, and the filtrate is mixed with 8 drops of test-solution of ammonium oxalate, when it should not become cloudy in less than one minute (*P. G.*). The diluted acetic acid (*P. G.*) is nearly identical with the acetic acid (*U. S.*). In the above test with 8 drops of ammonium oxalate

solution a turbidity beginning after one-half, one, or two minutes indicates respectively $\frac{1}{3}$, $\frac{1}{4}$, or $\frac{1}{6}$ per cent. of calcium tartrate.

Composition.—Potassium bitartrate does not contain any water of crystallization. Each molecule contains 1 atom of potassium, and 25 per cent. of its weight is represented by K_2O, and on ignition 36.7 per cent. of K_2CO_3 is left.

Action and Uses.—In full doses potassium bitartrate is refrigerant, laxative, and diuretic: the last operation, however, is more evident after small doses given in a large proportion of water. It is apt to disturb digestion by causing flatulence and griping, and, when long continued, to impair nutrition. In excessive doses it may act poisonously, causing vomiting, purging, thirst, colic, and great exhaustion, even to paralysis, which may terminate fatally.

In *febrile* diseases a weak solution of the salt moderates vascular excitement and augments the secretion of urine. For this purpose it is conveniently dissolved in lemonade. As a purgative it is frequently associated with sulphur, magnesia, or jalap. With sulphur or with confection of senna it forms a convenient laxative in case of *hæmorrhoids*. With jalap it is often used as a hydragogue cathartic in *dropsy*, and especially in anasarca, and as a diuretic in the same disease dissolved in an infusion of juniper-berries. With magnesia it has been recommended in *habitual vomiting* arising from gastric acidity, and in pregnancy.

The *dose* of potassium bitartrate, as a cathartic, is from Gm. 16–32 (℥ss–j); as a diuretic, Gm. 4–8 (℥j–ij) in water, largely diluted and taken in divided doses. For the same purpose whey may be employed, prepared by adding Gm. 8 (℥ij) of the salt to a pint of milk.

POTASSII BROMIDUM, *U. S., Br.*—Potassium Bromide.

Kalium bromatum, P. G.; *Bromuretum potassicum s. kalicum.—Bromure de potassium*, Fr.; *Bromkalium, Kaliumbromid*, G.

Formula KBr. Molecular weight 118.79.

Preparation.—Combine 2 ounces of bromine with sufficient iron (1 ounce) in the presence of 24 ounces of water until a green solution is obtained; filter, add solution of $2\frac{1}{8}$ ounces of pure potassium carbonate in 24 ounces of water until it ceases to produce a precipitate; heat the mixture for half an hour; filter, wash the precipitate with hot water, evaporate the filtrate, and crystallize.—*U. S.* 1870. Take of solution of potash 2 pints; bromine 4 fluidounces or a sufficiency; wood-charcoal, in fine powder, 2 ounces; boiling distilled water $1\frac{1}{2}$ pints. Put the solution of potash into a glass or porcelain vessel, and add the bromine in successive portions, with constant agitation, until the mixture has acquired a *permanent* brown tint. Evaporate to dryness, reduce the residue to a fine powder, and mix this intimately with the charcoal. Throw the mixture in small quantities at a time into a red-hot iron crucible, and when the whole has been brought to a state of fusion remove the crucible from the fire and pour out its contents. When the fused mass has cooled dissolve it in the water, filter the solution through paper, and set it aside to crystallize. Drain the crystals and dry them with a gentle heat. More crystals may be obtained by evaporating the mother-liquor and cooling. The salt should be kept in a stoppered bottle.—*Br.*

In the first process ferrous bromide is formed by the action of bromine upon iron, and the solution of this salt, which is of a green color, is decomposed by potassium carbonate, resulting in the production of potassium bromide, which remains in solution, and of a white precipitate of ferrous carbonate; $FeBr_2 + K_2CO_3$ yields $2KBr + FeCO_3$. The latter is very bulky, but by boiling it for some time is converted into a denser ferric hydroxide, which is more readily washed out with water than the carbonate. On concentrating the filtrate, crystals of potassium bromide are obtained.

On adding bromine to solution of potassa, 5 molecules of potassium bromide and 1 of bromate are produced; $3Br_2 + 6KOH$ yields $5KBr + KBrO_3 + 3H_2O$. By evaporating the solution to dryness, mixing the salts with charcoal, and heating to redness, the bromate is deoxidized to bromide, while the oxygen unites with the charcoal, forming carbonic oxide, which escapes; $KBrO_3 + C_3$ yields $KBr + 3CO$. Dissolving in water and concentrating the solution will yield the bromide in crystals. Instead of deoxidizing with charcoal, the same result may be attained by passing hydrogen sulphide through the solution, when the hydrogen of the latter will unite with the oxygen of the bromate, forming water, while sulphur is liberated and requires to be separated by filtration; $KBrO_3 + 3H_2S$ yields $KBr + 3H_2O + S_3$.

On treating a solution of calcium bromide with potassium sulphate and filtering from the precipitated gypsum, the liquid will yield potassium bromide, requiring recrystallization for obtaining it pure. The salt is extensively manufactured in the United States.

Properties.—Pure potassium bromide crystallizes in colorless cubes which are neutral to test-paper. It is met with in commerce in the form of a granular crystalline powder or of cubical crystals, which are white and glossy, and, having been obtained from an alkaline solution, have a slight alkaline reaction. It is permanent in the air, inodorous, has a pungent saline taste, and when heated decrepitates, melts at 700° C. (1200° F.), and on cooling congeals again to a transparent mass; at a bright red or at a white heat it is slowly volatilized without decomposition. According to Kremers (1856), 1 part of this salt dissolves at 0° C. (32° F.) in 1.87, at 20° C. (68° F.) in 1.55, at 40° C. (140° F.) in 1.34, and at 100° C. (212° F.) in 0.98 part, of water. It is soluble, at 15° C. (59° F.), in about 1.6 parts of water and in 200 parts of alcohol; in less than 1 part of boiling water, and in 16 parts of boiling alcohol; also soluble in 4 parts of glycerin.—*U. S.* The aqueous solution yields a white crystalline precipitate on the addition of tartaric acid or of a saturated solution of sodium bitartrate, and on the addition of a few drops of chlorine-water liberates bromine, which dissolves in ether, chloroform, or carbon disulphide with a reddish-yellow or brown-yellow color, which in the last two solvents will have a violet tint if iodide be present. 1 Gm. of the powdered and dried salt, when completely precipitated by silver nitrate, yields, if perfectly pure, 1.579 Gm. of dry silver bromide.

Tests.—Crystals or fragments of the crystals of the salt laid upon moistened red litmus-paper should not at once produce a violet-blue stain. A little of the powdered salt taken up with the loop of a platinum wire and held in a non-luminous flame should at once impart a violet color to the latter.—*U. S.*, *P. G.* The crushed salt should not at once assume a yellow color with diluted sulphuric acid (absence of bromate).—*U. S.*, *P. G.* If 10 Cc. of the aqueous solution (1 in 20) of the salt be mixed with a little starch test-solution, the addition of a few drops of chlorine-water should not produce a blue color (absence of iodine). 10 Cc. of the aqueous solution (1 in 12) should not be rendered turbid by the addition of 0.5 Cc. of ammonia-water and of 0.5 Cc. of ammonium sulphide test-solution (absence of iron, aluminum, etc.); nor should 10 Cc., after being slightly acidulated by acetic acid, be rendered turbid by an equal volume of hydrogen sulphide test-solution (absence of metals); nor by 0.5 Cc. of ammonium oxalate test-solution (calcium); nor by 0.5 Cc. of potassium sulphate test-solution (barium); nor by 0.5 Cc. of barium chloride test-solution (sulphate); nor be colored blue by 0.5 Cc. of potassium ferrocyanide test-solution (iron). "If 1 Gm. of the salt be dissolved in 10 Cc. of a mixture of 100 Cc. of water and 0.2 Cc. of normal sulphuric acid, no red tint should be imparted to the solution by the addition of a few drops of phenolphtalein test-solution (limit of potassium carbonate)."—*U. S.* If 3 Gm. of the well-dried salt be dissolved in distilled water to make 100 Cc., and 10 Cc. of this solution be treated with a few drops of test-solution of potassium chromate, and then decinormal volumetric solution of silver nitrate be added, not less than 25.14 Cc. (*Br.*), and not more than 25.5 (*Br.*), 25.7 (*U. S.*), 25.4 (*P. G.*) Cc. of the latter should be consumed before the red color ceases to disappear on stirring. 0.3 Gm. of pure potassium bromide would require 25.25 Cc. of the volumetric solution, while 0.3 Gm. of potassium chloride would require 40.32 Cc.; hence 1 per cent. of chloride is represented by each 0.1507 Cc. of decinormal silver solution used in excess of 25.25 Cc. for 0.3 Gm. of the salt. To find the percentage of chloride present in 0.3 Gm. of any sample, subtract 25.25 from the number of Cc. of decinormal silver solution necessary to produce the permanent red color, and divide this remainder by 0.1507. Thus we find that while the U. S. Pharm. allows 3 per cent. of chloride, the Brit. Pharm. places the limit at 1.65 per cent., and the Germ. Pharm. restricts the impurity of chloride to 1 (0.995) per cent. Since the presence of iodide will decrease the amount of silver solution necessary for complete precipitation, the Br. Pharm. requirement (see above) must be considered as also including this impurity. A very delicate test for chloride is the following: To a solution of the salt are added potassium dichromate and sulphuric acid, and the mixture distilled; the distillate will contain *chlorochromic anhydride*, CrO_2Cl_2, and after neutralization with ammonia will have a yellow color and show the reaction of chromates.

Action and Uses.—The functional effects of potassium bromide, manifested after the prolonged use of the salt in daily doses of from 40 to 120 grains, are usually such as these: The fetid odor of bromine upon the breath, redness of the soft palate, and an increased or diminished secretion of saliva; diminution, and even abolition, of

the reflex sensibility of the palate, the root of the tongue, and the epiglottis, without lessened sensibility of those parts to contact and to pain; frequently a craving appetite for food, but sometimes a suspension of this function; constipation; some diuresis or else arrest of the urinary secretion; sedation or suppression of sexual desire; diminution and retardation of the menses; pulmonary catarrh; a general heaviness or inertness, drowsiness, diminished clearness of the intellect; sleep, which is generally natural, but sometimes resembles profound lethargy; sedation of the excito-motor functions of the spinal marrow and of general sensibility; the memory, especially for words, is enfeebled, and they are often strangely misused; eruptions, of acne principally, sometimes of ulcers or boils, impetigo or eczema, appear upon the skin, which grows muddy or bronzed. The presence of bromine in the pustules of acne has been chemically demonstrated. (Compare Grellety, *Bull. et Mém. Soc. Thérap.*, 1887, p. 31; Amidon, *Med. Record*, xxx. 409; Tooth, *Lancet*, Apr. 1889, p. 841.) In rare cases a form of eruption occurs in infants which may be described as a hypertrophic or papillomatous dermatitis. The eruption has been compared to a half-ripe raspberry; the papules degenerate, and, if neglected, form sanious ulcers (Parker, *Trans. Clin. Soc.*, xii. 199; Seguin, *New York Med. Record*, xxii. 474; Carrington, *Trans. Clin. Soc. Lond.*, xviii. 28). The muscles are enfeebled and their co-ordinated movements imperfect; the gait is unsteady and tottering, and frequently there is a loss of flesh. In the more striking cases of bromism the patient is excessively feeble and depressed; the sight and hearing lose their acuteness; the gums are red, swollen, and painful; the nostrils are filled with hardened mucus, and diarrhœa exhausts the strength; there is sometimes profuse sweating or incontinence of urine and fæces; pulmonary catarrh impedes respiration, and occasionally death takes place, with febrile symptoms and coma. In exceptional cases mental derangement is superadded, with maniacal violence and hallucinations. Nearly all of the symptoms in this summary were cited in a case reported by Umpfenbach (*Therap. Monatsh.*, iii. 253). Only two cases have been reported of death directly due to poisoning by this salt—one of them by Hameau in 1868, and the other by Eigner in 1886 (*Archives gén.*, 1886, ii. 487). In a case of scarlatina occurring in an epileptic, who continued the use of the medicine during the fever, death having occurred, it was found that the brain contained nearly three times the proportion of the bromide that existed in the liver (*Practitioner*, xlii. 446). It is related that a hemichoreic woman took 610 grains of this salt in three days. "The patient suddenly developed delirium, which continued after the bromide was stopped. Subsequently, she became apathetic and semi-idiotic" (*Med. Record*, xx. 627).

Whatever interferes with the action of the kidneys intensifies the effects of this salt. To this category belong febrile states, obstructive diseases of these organs (Bright's disease), and old age. On the other hand, children of from seven to fifteen years of age tolerate larger doses of the bromide than other persons, and are less apt than adults to become dull and sleepy or to have their muscular co-ordination impaired. This peculiarity is probably due to the rapid elimination of the salt, especially by the salivary glands, the kidneys, and the skin. It is stated that while a nursing mother was taking 30 grains of potassium bromide daily her infant became emaciated and anæsthetic, and its urine contained potassa. The child speedily recovered on ceasing to use its mother's milk (*Med. Record*, xxii. 336).

As is usual in the history of medicines, the virtues of potassium bromide were discovered accidentally. The high price of potassium iodide, which is so largely used in the treatment of constitutional syphilis, caused a trial to be made of the bromide, in the hope that it might serve as a substitute for the more costly salt. The result showed that the scientific anticipation was totally unfounded, but at the same time it revealed the sedative, anæsthetic, and hypnotic virtues of the medicine, and led to its more suitable use in therapeutics, at first in allaying priapism and other forms of sexual excitement, then in hysteria and in hystero-epilepsy, and finally in epilepsy itself. Since then it has been employed in numerous diseases, especially of the nervous system.

In *sleeplessness* depending upon nervous excitement, exhaustion, and irritability—in hysterical and maniacal wakefulness, for example—rather than upon cerebral hyperæmia as it occurs in sthenic inflammatory diseases, the utility of the medicine is most conspicuous. This fact is not altogether incompatible with the probable theory which ascribes the hypnotic virtues of the bromide to its power of diminishing the amount of blood in the brain, but is more in accordance with the view that it causes sleep by anæsthetizing the organ, precisely as it acts upon the fauces and other parts when directly applied to them. It is a valuable substitute for opiates in those cases of infantile wakefulness which depend more upon nervous erethism than upon pain or any local disease. In the last-named cases

a dose of Gm. 0.60 (10 grains), repeated if necessary, will suffice, but in adults from Gm. 1.30–4 (20 to 40 grains) should be administered every hour or two until the proper effect is secured. This may be promoted by cold ablutions of the head or prolonged tepid general baths.

Neuralgia occurring in connection with general nervous erethism induced by exhausting causes, or with a state of hypochondriac melancholy, with more or less functional derangement of the stomach, heart, etc., or with an overstrained nervous system goaded by unsatisfied sexual desires, has been repeatedly palliated, and sometimes cured, by this medicine. The best result is most apt to be reached in the last-named form of the disease. But a case is on record in which a man of sixty-two, who had suffered from tic-douloureux for twenty-eight years was completely cured in a fortnight by the daily administration of Gm. 7 (100 grains) of the bromide, given in divided doses (Peter).

In almost all forms of *insanity* attended with excitement and insomnia this preparation is of great value, no other having an equal power of allaying the symptoms with so little risk of injury, but is generally more esteemed as a means of reinforcing the action of more direct narcotics. In *delirium tremens* it is equally efficient, but it is less so in mania-a-potu. In the latter it should be associated with cold baths. There is reason to think that in the active form of *sunstroke* this medicine may be useful as an adjuvant to the use of cold water, etc. In *chorea* no other medicine exerts as powerful a restraint upon the movements or more frequently leads to a permanent cure. But the greatest triumph of potassium bromide is shown by its control over *epilepsy*, a disease more intractable than any other that is not inherently fatal. In this connection the experiments of Albertoni are of high interest (*Archiv f. exp. Pathol, etc.*, xx. 251). In a number of animals he tested the epileptogenous zone on one side of the brain, and found that convulsive attacks were excited by irritating it. He then administered full doses of potassium bromide until its physiological effects were developed, and, having exposed the sensitive centre of the uninjured side of the brain, he found that irritation of it no longer brought on convulsions. When epilepsy is congenital or is caused by traumatic or other substantial lesions, this medicine, like all others, may be altogether inefficacious. The nearer the disease approaches to a purely functional disorder, the more amenable it is to treatment, and therefore the more so in proportion as it is of recent origin and before those alterations of nutrition have taken place in the blood-vessels and in the substance of the nervous centres which render the disease inveterate. Such, at least, is, as we conceive, the more judicious opinion; but in the judgment of some neither the cause, degree, nor duration of the disease enables one to judge how well or ill it may be affected by the medicine. All are, however, agreed that it must be administered in full doses and for a long time—in daily doses amounting to not less than Gm. 4 (℥j), and gradually increased as its active power declines. Other reputed remedies are sedatives of the circulation, and notably the most ancient of all, a vegetable diet. Animal food was prohibited in epilepsy by Celsus, Trallian, Aretæus, and others. Whether or not radical and absolute cures are ever made of genuine epilepsy is undetermined, but the great preponderance of opinion is unquestionably upon the negative side of the proposition. The most authoritative judgment is, that the epileptic is never secure against a return of his attacks, and that if he is prudent he will, in spite of an apparent cure, continue to use the medicine at intervals for the remainder of his life, or, as one has phrased it, it should become, as it were, his daily bread. It has been customary in the treatment of epilepsy to employ a prescription proposed by Dr. Brown-Séquard—viz. R. Potassium Iodide and Potassium Bromide, of each 8 parts; Ammonium Bromide 4 parts; Potassium Bicarbonate 5 parts; Infusion of Calumba 360 parts.—M. S. A teaspoonful before meals and two teaspoonfuls at bedtime. The bitter saline taste of this mixture soon renders it very disagreeable to many persons who can take without serious repugnance a simple solution in water of one or more of the salts. It may very well be questioned whether the presence in the above formula of any of the salts except the bromides of potassium and ammonium increases its efficacy.

In *tetanus*, idiopathic as well as traumatic, and including *tetanus neonatorum*, this bromide has exhibited decided curative powers, and some cases have recovered after enormous quantities of it had been taken. In one successful case about a pound of the salt was consumed in the treatment, and in another 13 ounces were used in twenty days. In *poisoning by strychnine* the results have been equally striking and conclusive, and confirm clinically what physiological experiment had before demonstrated, that potassium bromide is a true antagonist of strychnine. It is remarkable that a medicine supposed to have a special influence upon the nervous centres connected with the genital organs

should not have proved more curative of *hysteria* than of epilepsy itself. Clinical experience, however, shows its influence over hysterical attacks to be very slight and transient; and yet, on the other hand, it is efficacious in certain *local hysterical spasms*, as of the eyelids, œsophagus, and facial muscles, connected with uterine irritation. *Infantile convulsions*, arising from teething and other excentric causes of irritation, have repeatedly been arrested by this medicine, which may be administered by the rectum if it cannot be given by the mouth in doses of from Gm. 0.30–0.60 (5 to 10 grains), repeated every hour. In some cases of *puerperal convulsions* it has proved equally efficacious, but is probably a less reliable remedy than the volatile anæsthetics. In *whooping cough* potassium bromide has been employed by the stomach and also by the inhalation of its atomized solution. By the former method the spasmodic element is eliminated in part indirectly, and by the latter through a direct anæsthetic action upon the larynx. In this manner one of the most dangerous factors of the disease is removed. For inhalation there may be used a solution of Gm. 0.12 in Gm. 32 (gr. ij in f℥j) of water. *Spasmodic asthma* has been treated in the same manner, and with notable advantage. *Spasmodic vomiting*, due to reflex irritation, as in *pregnancy*, is sometimes controlled by the bromide, especially when full doses of Gm. 4–6 (gr. lx–xc) are given either by the mouth or the rectum. Usually the latter mode of administration is to be preferred, or, if the medicine is given by the stomach, it should be in small and repeated doses. It need hardly be remarked that an essential part of the treatment consists in rectal alimentation. For this purpose the pancreatic emulsion is the most appropriate agent. The *vomiting of phthisis*, which is so serious a symptom in the advanced stages of the disease, may generally be controlled by applying a strong solution of the salt to the pharynx and larynx by means of a brush or by atomization. Potassium bromide appears to be the most successful medicine hitherto used in *sea-sickness*. It should be taken in the dose of about 10 grains in cold water flavored with tincture of ginger or of capsicum or of cardamom, before meals and at whatever times nausea is marked. *Mercurial tremor* and *nervous palpitation* of the heart are favorably influenced by this bromide. The latter affection is oftenest relieved when associated with functional *angina pectoris*. This bromide is alleged by Teissier to have cured some cases of *diabetes* (*Bull. de Thérap.*, cviii. 332).

Potassium bromide, it has already been stated, even when freely used by healthy persons, blunts or suspends both sexual desire and power, and it has been employed with great advantage when erections of the penis result from morbid conditions either of *chordee* produced by gonorrhœa, of the persistent *erections* so frequently met with in infants, and those which sometimes follow the application of cantharidal blisters. The same is true of certain less ordinary cases of persistent *priapism*, as well as of the common examples of nocturnal *seminal emissions*, especially as they occur in young men of chaste life and sedentary habits and in those who have been more or less addicted to self-abuse. Not less serviceable is it in relieving nocturnal *incontinence of urine* in children. It has also been used with excellent results in those cases of hysteroidal excitement which verge on *nymphomania*. In these instances large doses of the medicine must be employed. Instead of being administered by the mouth, the bromide may be injected into the rectum or the bladder in cases like those enumerated or of more substantial disease of these organs. A solution of 1 : 20 has been found the most useful. Its anæsthetic virtues are always shown in its allaying the pain of *teething* when it is applied to the swollen gums mixed with honey or in watery solution. It alleviates *toothache* when introduced into a carious cavity. In a lotion the salt palliates the burning and stinging of *urticaria* and the itching in some other diseases of the skin. Internally it has availed to cure *acne* that occurred at the menstrual periods and was associated with ovarian irritation (*Practitioner*, xlii. 346).

Several examples have been published which go to prove that potassium bromide is occasionally successful in curing *intermittent fever* when quinine and arsenic have failed; and even when, after the cure of the paroxysmal attacks, the *spleen* remains enlarged, it is asserted that no other remedy so promptly and certainly reduces it to its normal dimensions as this preparation. It need not usually be prescribed in larger doses than Gm. 1–1.30 (gr. xv–xx) a day. In the defective sight or *amblyopia* sometimes produced by intemperance this bromide has been found very useful when given in doses at first of Gm. 0.60 (gr. x) three times a day, and gradually increased until its specific effects upon the nervous system begin to show themselves. It probably acts by diminishing the congestion of the cerebral blood-vessels. Several other diseases have been reported to be curable by it, among others *diphtheria*. But an examination of the evidence produced

in the discussion of the subject leaves no doubt that this bromide, like all topical applications whatever, has only an incidental influence on the course and issue of the disease. At best, it may hasten the separation of false membrane from the pharynx, but of this the evidence is far from conclusive.

The association of potassium bromide with quinine, and also with iron, is said to prevent the headache, throbbing, and general discomfort which some persons experience on taking those medicines, and also the nauseant and depressant effects which occasionally follow the use of opiates. A mixture of the bromides of potassium, sodium, and ammonium is thought to be more efficient than either alone.

The anæsthetic action of this medicine upon the *pharynx* and *larynx* has already been referred to in connection with ulcerated states of these organs; the same influence is resorted to for facilitating the use of the laryngoscope, and for lessening the irritability of the *urethra* when the introduction of instruments through it is required. Suppositories, ointments, and solutions containing the bromide have been introduced into the rectum for relieving *irritability of the bladder* and promoting the resolution of the enlarged *prostate gland*. Each dose may contain from Gm. 0.30–0.60 (5 to 10 grains) of the salt. In the treatment of *gangrenous sores* its antiseptic virtues may be invoked.

The *acneïform eruption* produced by the continued use of potassium bromide, and which with many patients forms a serious objection to its use, may very generally be prevented, as Echeverria first pointed out (1870), by adding to each dose of the bromide from 5 to 8 minims of Fowler's solution. This dose of the latter medicine is entirely too large, and cannot be continued, as it must be to prevent the eruption. Gowers (1878) recommended doses of from 1 to 5 minims, and stated that they need not bear any direct proportion to the degree of the eruption, which, he adds, occurs not only with potassium bromide, but also with the sodium salt, and still more readily with ammonium bromide. Duckworth recommends the use of the following lotion: ℞. Precipitated Sulphur ʒij; Spirit of Camphor fʒj; Lime-water fʒij; twice a day after washing the skin with oatmeal gruel instead of soap (*St. Bart's Hosp. Rep.*, xv. 15). In this country Indian corn meal would be preferable. Prowse recommended a solution of 1 grain of salicylic acid in an ounce of water, to be applied frequently (*Brit. Med. Jour.*, Aug. 1880, p. 127).

The commencing *dose* of potassium bromide is Gm. 0.20–2 (gr. iij–xxx), according to the age of the patient. It is necessary to repeat the dose several times a day, and in most cases to increase it until its specific effects begin to appear. It should then be reduced or for a brief space of time suspended.

POTASSII CARBONAS, *U. S.*, *Br.*—Potassium Carbonate.

Kalium carbonicum (*purum, s. e. tartaro*), P. G.; *Carbonas potassicus, s. kalicus, Potassii carbonas purus; Sal tartari.—Carbonate of potash* (*potassa*), *Salt of tartar*, E.; *Carbonate de potasse*, Fr.; *Kaliumcarbonat, Kohlensaures Kali*, G.

Formula K_2CO_3. Molecular weight 137.91.

Origin and Preparation.—Potassium carbonate is contained in many mineral waters, and is met with in the animal economy chiefly after the administration of potassium citrate or tartrate. Plants take their inorganic constituents from the soil, and when incinerated leave them behind as *ashes*. The ash of most plants contains potassium, sodium, calcium, and magnesium in combination with chlorine, carbonic, sulphuric, phosphoric, and silicic acids, usually ferric oxide, and occasionally some other elements. As a general rule, plants grown near the seashore yield an ash rich in sodium, and those grown inland an ash in which potassium salts predominate. Succulent plants or parts of plants generally yield a larger percentage of ash (calculated for the exsiccated substance) than dry or woody parts. The amount of ash and its constituents necessarily varies to a certain extent, being influenced by the nature of the soil, the age of the plant, and by various other causes; the composition of the ash and of its soluble portion must therefore vary for the same species. Among the vegetables which yield an ash rich in potassium salts must be mentioned *corn-cobs*—that is, the fully-developed axis of the fruit-spikes of Zea Mays, *Linné*, after having been deprived of the corn. Examined by H. Hazard (1872), they were found to contain, on an average, when air-dried, 0.762 per cent. of potassium carbonate, which may easily be obtained in a nearly pure state; and, estimating the corn crop of the United States at 1,100,000,000 bushels, and 14 pounds of cobs to the bushel, he calculated that 115,000,000 pounds of this alkali could be obtained from that source alone.

For a long time this article was chiefly obtained in those countries, as in some parts

of Europe and North America, where wood is cheap or where its transportation to more remunerative markets is too costly, by burning the wood and lixiviating the ashes. The solution is obtained as concentrated as possible by passing the weaker liquids through fresh portions of ash, afterward evaporated and heated in iron vessels, so that on cooling it will solidify to a very hard mass; this constitutes the *crude potash* of the market. This crude potash is of a more or less deep-brown, reddish-brown, or bluish color, due to organic impurities and to iron, copper, or manganese; it is deliquescent on exposure and has a very caustic taste. It is not recognized by any of the pharmacopœias.

Large quantities of potash are at present prepared from the ash obtained from the residue of beet-sugar manufacture, which contains about one-third its weight of this salt, and is freed from other potassium and sodium salts by allowing these to crystallize from concentrated solutions at different temperatures. On washing the fleeces of sheep with water, evaporating the solution, and igniting the residue, an ash is obtained containing but a small percentage of sodium salts and a larger proportion of potassium chloride and sulphate. The potassium salts obtained in these processes, notably in the former one in large quantities, also the potassium salts from the Stassfurt mines, are by suitable processes converted into potassium sulphate, and this salt into carbonate by a process similar to that of Leblanc for soda (see SODII CARBONAS), by heating the sulphate with lime and charcoal, whereby potassium carbonate and an insoluble calcium oxysulphide are formed. Balard (1865) found it advantageous to employ not pure potassium sulphate, but a salt containing about 20 per cent. of magnesium sulphate, which leaves the product of ignition in a porous condition, so that it may readily be exhausted by water.

Various methods of obtaining potassium carbonate from other sources have been recommended, and to some extent are used. E. Meyer (1857) proposed to ignite an intimate mixture of 10 parts of *feldspar* (aluminum and potassium silicate) with from 14 to 18 parts of lime, to boil the mass with water under pressure, and to evaporate the solution, at the same time conducting the products of combustion over the liquid, in order to convert the caustic potassa into carbonate and to precipitate the alumina which was in solution.

1. POTASSII CARBONAS IMPURUS, *U. S.* 1870; Kalium carbonicum crudum, *P. G.;* Cineres clavellati.—Impure potassium carbonate, Pearlash, *E.;* Potasse impur, *Fr.;* Rohe Potasche, *G.*—This is the white salt, still impure, the preparation of which has been described above. It is at present only recognized by the German Pharmacopœia, which for the anhydrous or nearly anhydrous salt requires it to contain 90 per cent. of potassium carbonate, and 2 Gm. of it to be neutralized by not less than 26 Cc. of normal hydrochloric (or oxalic) acid.

2. POTASSII CARBONAS, *U. S.* 1870; Kali carbonicum depuratum, *P. G.* 1872.—Potassium carbonate, *E.;* Carbonate de potasse, *Fr.;* Gereinigtes kohlensaures Kali, *G.*—This salt, no longer official, but frequently found in the shops, is prepared by treating the preceding with its own weight of cold water, decanting the clear solution, evaporating it in a bright iron vessel, and granulating.

3. OFFICIAL POTASSIUM CARBONATE. For its preparation the following directions were given in the U. S. P. 1870: Take of potassium bicarbonate, in coarse powder, 12 troyounces; distilled water 12 fluidounces. Put the potassium bicarbonate into a capacious iron crucible; heat gradually until the water of crystallization is driven off; then raise the heat to redness, and maintain that temperature for half an hour. Having taken the crucible from the fire and allowed it to cool, dissolve its contents in the distilled water and filter the solution. Pour this into an iron vessel and evaporate over a gentle fire until it thickens. Lastly, remove it from the fire, and stir constantly with an iron spatula until it forms a granular salt.

When an organic salt of potassium is ignited, the residue left contains potassium carbonate. Cream of tartar, being the most common salt available for this purpose, was formerly more extensively employed than at present for preparing pure potassium carbonate; hence the name *salt of tartar*, which is, however, in the United States usually employed as a synonym for *purified* potassium carbonate. In making carbonate from potassium bitartrate, the latter is usually mixed with saltpetre, which should be entirely free from chloride, and then deflagrated by throwing the mixture in small portions into a red-hot crucible, when the potassium of both the bitartrate and nitrate is left behind as carbonate. In this way *black* and *white flux* are prepared, of which the latter usually contains potassium nitrite. By exhausting the black flux with water and evaporating the solution a very pure potassium carbonate is obtained.

Since pearlash contains, besides carbonate, various other soluble salts of potassium and

sodium, a pure carbonate cannot be obtained from it, though many of the foreign salts may be removed by the use of cold water in small quantities in which the other salts are less soluble than the carbonate. But by converting the carbonate into bicarbonate the latter salt may be obtained nearly chemically pure, and when heated to redness will give off water and carbon dioxide, and leave an equally pure carbonate; $2KHCO_3$ yields $K_2CO_3 + H_2O + CO_2$. In these operations only silver or clean iron vessels should be employed, for reasons explained under POTASSA.

Properties.—Potassium carbonate in its pure state is a white inodorous salt, sometimes crystalline, but usually in the form of a granular powder, which has a strong alkaline reaction and a strongly alkaline but scarcely a caustic taste, and is deliquescent in the air, forming a colorless or yellowish liquid of an oily appearance (*Oleum tartari per deliquium*). It is soluble in 1.1 parts of cold water and in two-thirds its weight of boiling water, and from its concentrated solution may with some difficulty be obtained in transparent crystals containing 16.36 per cent. of water. It is insoluble in alcohol, dissolves in dilute acids with effervescence, and has the chemical behavior of potassium salts. Since solutions of sodium carbonate, unless rather diluted, yield with an excess of tartaric acid a crystalline precipitate, it is best to test for potassium with a fragment of the salt attached to the loop of a platinum wire, which should impart a violet but not a permanently yellow color to a non-luminous flame, or the salt may be dissolved in a slight excess of diluted hydrochloric acid; such a solution will give a yellow precipitate with test-solution of platinic chloride and a white crystalline precipitate with a saturated solution of sodium bitartrate. The salt when heated to redness loses all the water it may have retained or absorbed (about 16 per cent., *Br.*); this exsiccated salt melts at a bright-red heat, aad slowly volatilizes at a white heat. The U. S. and German Pharmacopœias recognize the anhydrous or nearly anhydrous salt containing at least 95 per cent. of pure potassium carbonate; hence 2 Gm. of it should be neutralized by not less than 27.4 Cc. of normal hydrochloric or sulphuric acid, which indicates 94.5 per cent. K_2CO_3. 83 grains require for neutralization not less than 980 grain-measures (*Br.*) of the volumetric solution of oxalic acid, corresponding to 82 per cent. of K_2CO_3. Before applying the volumetric test the absence of notable quantities of sodium carbonate should be proven.

Tests.—"No precipitate or coloration should be produced in the aqueous solution (1 in 20) by an equal volume of hydrogen sulphide test-solution (absence of metallic impurities). On neutralizing the solution with hydrochloric acid no odor of burning sulphur nor any white precipitate should appear (absence of thiosulphate). If 2 Cc. of the aqueous solution be carefully mixed with an equal volume of concentrated sulphuric acid, and, after cooling, 1 Cc. of ferrous sulphate test-solution be poured upon it so as to form a separate layer, no brown color should appear at the line of contact (absence of nitrate). If 0.5 Gm. of potassium carbonate be dissolved in 5 Cc. of diluted hydrochloric acid and 5 Cc. of water, the addition of 1 Cc. of barium chloride test-solution should not produce any turbidity (absence of sulphate). A solution of 0.5 Gm. of the salt in 5 Cc. of diluted hydrochloric acid test-solution mixed with 5 Cc. of water should not be colored blue within fifteen minutes by 0.3 Cc. of potassium ferrocyanide test-solution (limit of iron). If 0.5 Gm. of the salt be dissolved in 6 Cc. of diluted nitric acid and 4 Cc. of water, then 1 Cc. of decinormal silver nitrate solution be added, and the mixture filtered, no change should be produced in the filtrate by the further addition of silver nitrate solution (limit of chloride). If 10 Cc. of the aqueous solution (1 in 20) be mixed with 2 drops each of ferrous sulphate test-solution and ferric chloride test-solution, the mixture heated, and slightly supersaturated with hydrochloric acid, no blue color should appear (absence of cyanide). The addition of a few drops of lead acetate test-solution to the aqueous solution should produce a pure white precipitate (absence of sulphide). To neutralize 0.69 Gm. of potassium carbonate should require not less than 9.5 Cc. of normal sulphuric acid (each Cc. corresponding to 10 per cent. of the pure salt), methyl-orange being used as indicator."—*U. S.*

Pharmaceutical Uses.—LIQUOR KALI CARBONICI. 11 parts of pure potassium carbonate are dissolved in 20 parts of distilled water; the solution has the specific gravity 1.330 to 1.334, and 3 parts of it should contain 1 part of potassium carbonate.—*P. G.*

Pearlash is only employed for preparing purified potassium carbonate. In the preparation of most potassium salts the pure potassium carbonate or the bicarbonate may be employed.

Action and Uses.—Potassium carbonate is less irritating than potassa, but more

so than the bicarbonate. In large doses it acts as an irritant on the stomach, and even as a caustic when pure. It has been employed in baths in the treatment of *tetanus*, *puerperal convulsions*, *paralysis*, chronic *gout* and *rheumatism*, *glandular swellings*, *suppressed cutaneous eruptions*, etc. In all of these cases it probably acts through its substitutive or its counter-irritant rather than by its alkaline virtues.

Internally, potassium carbonate has been much used, in common with other ant-acids, in the treatment of *gouty* and *dyspeptic* conditions attended with a highly acid state of the urine. It is most efficient when this form of secretion, which probably depends upon the imperfect oxidation of the products of primary digestion, is corrected by bitter tonics and hygienic measures. Formerly, theoretical views of the action of alkalies led to the use of potassium carbonate in various inflammations, membranous and parenchymatous, but especially in those attended with plastic exudation. It was hence much employed in *membranous croup*, *pneumonia*, *peritonitis*, and *glandular enlargements*, and positive assertions were made of its curative powers; their value was, however, greatly impaired by the fact that in general mercury was associated with the alkaline medicine, as well as by leaving out of account the influence of hygienic measures, the natural tendency of the disease, etc. Very probably, subacute inflammation of the *lymphatic glands*, and enlargement of the liver with *jaundice* affecting intemperate eaters and drinkers, have been benefited by this medicine, since, like all the alkaline carbonates, it tends to render the blood more watery, and therefore less nutritive and less apt to produce congestions in parenchymatous organs. In this way, doubtless, it has been profitably used in hepatic and splenic *dropsy*. On the whole, there is nothing in potassium carbonate to render it superior, or even equal, to the sodium carbonates for any purpose to which alkaline medicines are applied internally.

The *dose* of potassium carbonate is Gm. 0.60–2 (gr. x–xxx). For external use a solution of Gm. 8 in Gm. 500 (℥ij in Oj), or an ointment containing Gm. 0.60–4 in Gm. 32 (gr. x–lx in ℥j) of lard, may be employed.

POTASSII CHLORAS, *U. S.*, *Br.*—Potassium Chlorate.

Kalium chloricum, P. G.; *Kali oxymuriaticum*, *Kali muriaticum oxygenatum*, *Chloras potassicus s. kalicus.*—*Chlorate of potash*, E.; *Chlorate de potasse*, Fr.; *Kaliumchlorat*, *Chlorsaures Kali*, G.

Formula $KClO_3$. Molecular weight 122.28.

Preparation.—Take of Potassium Carbonate 20 ounces; Slaked Lime, 53 ounces; Distilled Water, a sufficiency; Black Oxide of Manganese, 80 ounces; Hydrochloric Acid, 24 pints. Mix the lime with the potassium carbonate, and triturate them with a few ounces of the water, so as to make the mixture slightly moist. Place the oxide of manganese in a large retort or flask, and, having poured upon it the hydrochloric acid, dilute it with 6 pints of water, apply a gentle sand heat, and conduct the chlorine as it comes over, first through a bottle containing 6 ounces of water, and then into a large carboy containing the mixture of potassium carbonate and slaked lime. When the whole of the chlorine has come over, remove the contents of the carboy and boil them for twenty minutes with 7 pints of water; filter and evaporate till a film forms on the surface, and set aside to cool and crystallize. The crystals thus obtained are to be purified by dissolving them in three times their weight of boiling distilled water, and again allowing the solution to crystallize."—*Br.*

On passing chlorine gas into a solution of potassa, potassium hypochlorite and chloride are formed; $6KOH + 3Cl_2$ yields $3KClO + 3KCl + 3H_2O$. On boiling the solution, or on heating it to between 70° and 80° C. (158° and 176° F.), the hypochlorite is decomposed into chlorate and chloride; $3KClO$ yields $KClO_3 + 2KCl$. The entire reaction, therefore, results in the production of 1 molecule of potassium chlorate and 5 of chloride, and the two salts must be separated by recrystallization. To avoid the loss of potassium salt, Graham (1841) proposed to substitute an equivalent quantity of lime for five-sixths of the potassa; and this is the process which is now often followed in making the chlorate on the large scale, and the details of which, as recommended by the British Pharmacopœia, have been described above. It has the additional advantage that the previous preparation of caustic potash is unnecessary. In the presence of water calcium hydroxide reacts with chlorine in a manner precisely analogous to that of potassium hydroxide, yielding calcium hypochlorite and chloride (see page 381), and by heat the hypochlorite is decomposed into calcium chloride and chlorate, the latter of which by mutual decomposition with potassium carbonate produces potassium chlorate and calcium

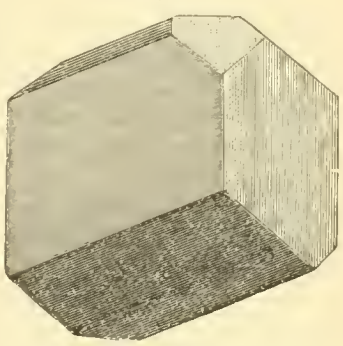
carbonate. It will be observed that the reactions in this process are apparently complicated, but, as explained above, the final results are expressed by the equation $K_2CO_3 + 6Ca(OH)_2 + 6Cl_2 = 2KClO_3 + 5CaCl_2 + CaCO_3 + 6H_2O$.

Potassium chloride is now obtained in large quantities, and this salt is advantageously used in the preparation of chlorate by a process very similar to that of Graham, as was shown by Liebig (1842). In this case the reaction results as follows: $KCl + 3Ca(OH)_2 + 3Cl_2 = KClO_3 + 3CaCl_2 + 3H_2O$. Or chlorinated lime may be boiled with potassium chloride, in which case the final products are likewise potassium chlorate and calcium chloride.

Potassium chlorate seems to have been known to Glauber (1657); it was described by Higgins (1786) as a kind of saltpetre, and was recognized by Berthollet (1786) as the compound of a hitherto unknown acid. The United States imported 474,598 pounds of this salt in 1876; at present the importation averages about 1,200,000 pounds.

Properties.—Potassium chlorate crystallizes in colorless, shining plates or in short monoclinic prisms. It is inodorous, has a cooling saline taste and neutral reaction, is permanent in the air, melts without decomposition at 234° C. (453° F.), gives off oxygen at 355° C. (671° F.); at the same time it forms potassium perchlorate, and at a higher temperature above 400° C. (752° F.) parts with all its oxygen (39.2 per cent. of its weight), leaving 60.8 per cent. of potassium chloride having the properties described below. It requires, at 15° C. (59° F.), 16.7 parts of water for solution or 1.7 parts of boiling water.—*U. S.* According to Gay-Lussac, 100 parts of water dissolve

Fig. 228.



Crystal of Potassium Chlorate.

at	0°	13.3°	15.4°	24.4°	35°	49.1°	74.9°	104.8° C.
	3.33	5.60	6.03	8.44	12.05	18.96	35.4	60.24 parts salt.

Gerardin's determinations agree with these results. Ammonium nitrate increases, but ammonium chloride and acetate decrease the solubility in water (Pearson, 1869). The salt is slightly soluble in diluted alcohol, but is insoluble in absolute alcohol. It should never be triturated together with sulphur, sugar, tannin, or other readily oxidizable substances, except in the presence of water; or, if dry mixtures are to be made, the ingredients should be powdered separately, and mixed by means of a sieve and without friction, in order to avoid violent explosions. As ordinarily met with in commerce, the salt contains traces of calcium chloride, from which it is freed by dissolving it in two or three times its weight of distilled water, and stirring the solution while cooling; it will then be obtained in small crystals, which, after draining and washing with cold water, are pure. The saturated aqueous solution of the salt yields with tartaric acid a white crystalline precipitate of potassium tartrate, and on being warmed with hydrochloric acid becomes greenish-yellow and gives off the odor of chlorine. When strong sulphuric acid is added to potassium chlorate, *chlorine dioxide*, ClO_2, is formed: this is a yellow, heavy gas, which, in the presence of combustible matter or by a slight elevation of temperature, is decomposed with a powerful explosion into oxygen and chlorine. On adding hydrochloric acid to potassium chlorate a deep-yellow, dangerously explosive gas, the *euchlorine* of Davy, is produced; it is a mixture of chlorine and chlorine dioxide.

Tests.—The aqueous solution, containing 5 (*U. S.*, *P. G.*) per cent. of potassium chlorate, should not be precipitated by barium chloride (sulphate), silver nitrate (chloride), or ammonium oxalate (calcium salt), nor should it be colored by hydrogen sulphide or by potassium ferrocyanide. If a mixture of 1 Gm. of the salt with 0.5 Gm. of zinc and 0.5 Gm. of iron, both in the state of powder, be heated with 5 Cc. of potassium hydroxide test-solution, no evolution of ammonia should be perceptible either by moistened red litmus-paper or by odor (absence of nitrate or nitrite).

Other Potassium Salts containing Chlorine.—Potassii chloridum, s. Kalium chloridum (chloratum), Chloruretum potassicum, Sal digestivum Sylvii.—Potassium chloride, *E.*; Chlorure de potassium, Sel digestif, *Fr.*; Kaliumchlorid, *G.* Formula KCl; molecular weight 74.40.—It is obtained in large quantities at Stassfurt from *carnallite*, a double chloride of potassium and magnesium, and forms white or colorless, inodorous cubes or quadrangular prisms which have a saline taste resembling that of table-salt, and which are fusible without decomposition. The salt dissolves in 3 parts of cold and a little less than 2 parts of hot water, and is slightly soluble in alcohol, but is insoluble in absolute alcohol. Its aqueous solution should have a neutral reaction, and should yield with saturated solution of sodium bitartrate a white crystalline precipitate, and

with silver nitrate a white curdy precipitate soluble in ammonia, but insoluble in nitric acid; the solution should not be affected by barium chloride (sulphate) or potassium carbonate (salts of metals). This salt should not be confounded with potassium chlorate (see above) nor with chlorinated potassa (see page 984). It is largely employed in the manufacture of other potassium compounds.

Potassii perchloras, $KClO_4$, Potassium perchlorate, molecular weight 138.24.—To obtain it, potassium chlorate is carefully heated until it melts and just begins to evolve oxygen, and is kept at this temperature until gas is no longer given off, and a portion of the residue, on being tested with strong hydrochloric acid, acquires only a faint yellow color. The saline mass is dissolved in water and freed from chloride by recrystallization. Potassium perchlorate is in colorless rhombic crystals which have a slight saline taste, and when heated to about 400° C. (752° F.) is decomposed into oxygen gas and potassium chloride. It is insoluble in alcohol, and dissolves in $5\frac{1}{2}$ parts of boiling water, but requires at 15° C. (59° F.) 65 parts, and at 10° C. (50° F.) 88 parts, of water for solution.

This salt is employed in preparing *perchloric acid*, for which Bullock (1865) devised the following process: Potassium perchlorate is distilled with twice its weight of sulphuric acid mixed with $\frac{1}{10}$ part of water. The distillate, containing perchloric, sulphuric, and a little hydrochloric acid and chlorine, is carefully treated with lead carbonate until the sulphuric acid has been completely precipitated. The liquid is filtered, freed from lead by hydrogen sulphide, filtered again, and boiled until it attains a specific gravity of about 1.6, when by distillation it may be obtained of the density 1.693. It is a colorless, oily, very acid liquid, containing 72 per cent. of $HClO_4$, boiling at 203° C., and not affected by sunlight or by sulphurous or hydrochloric acid, but readily decomposed by iodine and bromine. The acid is monobasic, forms mostly deliquescent salts, which are also soluble in alcohol, and when added to not too dilute solutions of potassium salts produces precipitates of potassium perchlorate.

Action and Uses.—The large amount of oxygen contained in potassium chlorate early led to its being used to cure a variety of diseases which, according to the fashion of the day, were supposed to depend upon putrefactive changes in the blood, etc. These theoretical notions met with their usual fate, and the medicine had been but little used for more than forty years when attention was attracted to it by its power of rapidly healing cancrum oris and aphthous ulcers of the mouth. In excessive doses it may be poisonous. In one case Gm. 20 (300 grains) were taken daily for four successive days by a consumptive patient. Obstinate vomiting and severe intestinal pain continued until death, after which inflammation of the mucous coat of the stomach was found.

No less than eleven fatal cases of poisoning by this salt are referred to by Jacobi (1879), besides several others, in which, owing to the nature of the disease, diphtheria, doubts may exist respecting the share of the medicine in their issue. It 1880, Wegschneider collected thirty cases of poisoning by potassium chlorate, but the proportion that proved fatal was not stated (*Bull. de Thérap.*, civ. 141). From that date to May, 1884, we have met with the records of ten cases of such poisoning, and of these six were fatal. Among more recent fatal cases may be noted two reported by Peabody (*Med. Record*, xxxiv. 57), and one by Anderson (*ibid.*, xxxvi. 707). In 1879 the observations and experiments of Marchand (*Virchow's Archiv*, lxxvii. 455) led him to conclude that potassium chlorate superoxidizes, and so disorganizes, the blood-corpuscles, and renders them incapable of performing their function as oxygen-carriers, and that death from it is either due to this cause or to obstruction of the kidneys with effete blood-disks and (he might have added) crystals of the chlorate. The blood itself remains liquid, and it, as well as the organs abounding in blood, are of a dark-chocolate color. This condition of the blood has also been observed by Fowler (*loc. sup. cit.*), Wilke, and others. It is ascribed to the conversion of oxyhæmoglobin into methæmoglobin. The spleen is sometimes enlarged. Besides these tissue-lesions this chlorate exhibits other evidences of activity. It is antiseptic, but not because it yields oxygen. If it did so it should stimulate the heart, but it depresses that organ, and when injected into the veins of an animal it kills by arresting the heart. Some investigators attribute its poisonous action to its potassium base, but the elimination of the salt by the kidneys without decomposition negatives this opinion.

The utility of this salt in curing *mercurial salivation* and mercurial *ulcers* of the mouth and throat is now attested by universal experience, but it is not so certain that it acts through the blood after absorption from the stomach, since the same favorable effects are observed when a solution of it is used as a topical application only. That it does not act through any relation it may have to mercury in the system is proved, not only by the fact just stated, but also by its equal efficiency in non-mercurial salivation—as, for instance, when the throat has been injured by caustic potassa—and in like manner in every form of buccal ulceration, as *ulcerative stomatitis*, *aphthæ* (follicular stomatitis),

gangrenous stomatitis, *buccal* and *pharyngeal diphtheria*, and the sore mouth produced by chronic *arsenical poisoning*. It is of utility in *burns* when applied in a solution of 4 or 5 grains to the ounce, and a saturated solution has been used in enema for inflamed *hæmorrhoids*. Although the contrary has been asserted, it is utterly useless in an affection often confounded with, but very different from, diphtheria—*thrush* or *muguet*, which is a parasitic growth from decomposed milk. It has been used internally, and also topically by atomized inhalation and in simple solution, for the treatment of *croup* (pseudo-membranous laryngitis), and although it may in a slight degree tend to soften the membrane, its favorable influence on the issue of the disease is not well established.

Potassium chlorate, which had been used by Isambert in the treatment of *diphtheria* with no radical advantage, was subsequently employed by Seeligmüller, who in publishing his results declared it a specific. He prescribed a saturated solution of the salt, or 1 part to 20 of water, to be given in spoonful doses every hour or two hours, day and night, without intermission. In 1877 he wrote as follows: "During the five years that I have ordered no other medicine against diphtheria besides our saturated solution, this remedy has proved successful in all cases of diphtheria, except a few that were neglected in the beginning, in which the blood was already profoundly altered, and systemic poisoning had occurred when I was consulted." He dwells upon the necessity of giving no food or drink immediately after its administration, lest the solution be too quickly removed, and emphatically asserts there is no need of local applications besides, "the internal medication alone being sufficient in all cases." He, however, recognizes its debilitating influence on the heart's action, and alludes to one case in which it caused death by gastric irritation. Von Becker, physician to the Children's Hospital in Vienna (1877), condemns the notion that the medicine is a specific for diphtheria, and warns against the danger of giving it to young children, adding that while it is the mildest, it is also the least efficient, of disinfecting agents. Dr. A. Jacobi of New York spoke of it in 1875 in very similar terms, and in 1879 repeated that it was useful rather as a preventive than as a cure for diphtheria. The dose, according to him, for a child two or three years old should not be larger than Gm. 2 (ʒss) in twenty-four hours. A baby of one year or less should not take more than Gm. 1.33 (gr. xx) a day. The dose for an adult should not be more than Gm. 4–8 (ʒj–ij) in the course of twenty-four hours. The doses he recommends to be administered at short intervals, so that their local impression may be maintained. He also describes the method of Seeligmüller, in order to "raise his voice against it for the reason of its dangerousness." It should here be mentioned, however, that Seeligmüller greatly reduced the doses of the medicine which he prescribed (1883). But in the protest against the original plan we heartily join, and not only for the reasons assigned by its author, that the medicine is a powerful cardiac sedative and renders those who largely use it liable to fatal nephritis, but because, in so far as it does good at all in this disease, potassium chlorate is a mere local stimulant, and diphtheria never yet was cured by local applications merely. They may modify the faucial exudation, in very slight cases may possibly prevent it, but they cannot reach that poisonous element of the disease which constitutes its principal danger, and which is only to be combated successfully by general stimulants and tonics. Cases are reported of diphtheria cured by potassium chlorate, iron, and food, and similar results from the like combination in certain manifestations of *scrofula*. There can be no doubt that in all of these cases the chlorate, so far as it was internally administered, was quite superfluous. The same remark applies to the alleged cure of the hæmorrhagic diathesis by this salt.

Several physicians have thought that a very dilute solution of the salt has been serviceable in low types of fever, and particularly in *scarlatina* and *typhoid fever*; but the ground of this opinion has, so far, been theoretical rather than practical, and the same remark is perhaps applicable to its alleged utility in *neuralgia*. Another example of the illusions to which theoretical speculations may give rise is the statement that in a case of cardiac *cyanosis* it maintained oxygenation of the blood long enough for the patient to accommodate himself to the influence of the malformation under which he suffered; and that in a case of pleural effusion, and in another of pleural hæmorrhage, it sustained life while nature effected the cure. Nature probably did this in both instances without reference to the chlorate of potassium. On the same principle have been explained numerous cases of prevented *miscarriage*. Whether the medicine acted as supposed, or acted at all, its virtues in these respects are at least testified to by eminent obstetricians of Edinburgh. According to Harkin, it increases the secretion of *milk* both in man and the lower animals.

In *ovarian dropsy* it is thought to have removed the disease or arrested its development (*Trans. Med. Soc. State of N. Y.*, 1879, p. 172), but its cures of the sort are neither so

numerous nor so well attested as those of *general dropsy* from renal disease. Its diuretic operation has been noted above, and its presence in the kidneys after death, but whether it acts as a direct stimulant of these organs or otherwise, the clinical proof of its efficacy in certain cases of dropsy appears to be established. It has also been thought useful in *chronic cystitis*, possibly by a substitutive or irritant action on the bladder.

The utility of potassium chlorate in the treatment of *ulcers* of the mouth naturally led to its use in other ulcerous affections, as those which follow syphilitic *buboes* and other *abscesses*. Its cicatrizing powers are unquestionably very great. In some cases of *phagedenic sores* the pulverized salt has arrested the progress of the disease. Enemas containing it in a moderately strong solution (℥j to f℥ij–f℥iv) may be used in chronic *dysentery*, and will tend materially to heal the rectal sores, while those seated higher up in the bowel may be entrusted to astringents or to subnitrate of bismuth. An advantage which this salt possesses as a dressing for gangrenous sores and others discharging a *fetid secretion* is its deodorizing quality; it thus makes a suitable injection in *ozæna*, an appropriate gargle in certain cases of *fetid breath*, etc. A solution of Gm. 4 in Gm. 16 (60 grains in 4 fluidounces) of water may be used for these purposes. In the treatment of *epithelioma* the topical application of the salt in strong solution has sometimes been followed by healing of the ulcer, if that existed, and less frequently by a removal of the tumor. But Verneuil declared emphatically that *epithelioma* was never cured by this agent. He held that the cases of alleged cure were ulcerated sudoriparous adenomas (*Bull. de Thérap.*, xcix. 515). Yet in 1888, Hyvernaud claimed that of 63 cases he had cured 32, benefited 15, and failed to improve the remainder. He applied daily to the sore a 6 per cent. solution of the salt. The treatment was continued for several weeks or months (*Med. News*, lii. 412).

The *dose* of potassium chlorate for children under three years of age is about Gm. 0.30 (5 grains) three times a day, and for an adult from Gm. 0.60–2 (10 to 30 grains.) It should be dissolved in hot water, and a sufficient quantity of gum and sugar added to suspend the undissolved portion when the liquid grows cold. It is best administered after meals followed by the free use of watery drinks. As a lotion from Gm. 1–2 in Gm. 32 (15 to 30 grains in an ounce) of water may be used. The iodates of potassium and sodium have been proposed as substitutes for the chlorate. On account of its richness in oxygen it is very apt to yield it to other substances associated with it; hence care must be taken that such combination do not occur explosively. The bodies especially to be excluded from combination with it by friction are sulphur, the metallic sulphides, glycerin, sugar, vegetable powders, as tannin, catechu, etc. In one case an ounce each of tannic acid and chlorate of potassium had been powdered separately, and on being immediately thereafter mixed together an explosion occurred, causing damage to persons and property (*Phila. Med. Times*, xii. 512).

Potassium Chloride, according to Ringer and Murell's experiments on frogs—1, paralyzes all nitrogenous tissues; 2, acts by an equal affinity for all protoplasms, and destroys the tissues in the order of vital movement; 3. arrests the heart; 4, by arresting the circulation it depresses the reflex function of the cord in the summer months, indirectly through arrest of the circulation in the brain. What bearing, if any, these results have upon the action of potassium salts upon man, either physiologically or therapeutically, does not appear. A case is recorded of the death of a strong man from taking Gm. x (150 grains) of this salt in divided doses (*Phila. Med. Times*, xiv. 666). An analysis of eleven cases by Chataing shows that the chief symptoms of poisoning by this salt are a slate-colored or jaundiced skin; scanty, dark, and sometimes albuminous urine; and in less subacute cases diarrhœa and vomiting (*Boston Med. and Surg. Jour.*, Jan. 1888, p. 52). It would seem that potassium chloride is very analogous to sodium chloride in its remedial powers. It has been called *sal digestivum* on this account; others have attributed to it nervous sedative powers like those of potassium bromide, and still others an arterial sedative action like that of potassium nitrate.

Potassium chloride has been tested as a remedy for *epilepsy* by Dr. Seguin, in consequence of the assertion of Prof. Binz that the virtue of the potassium bromide in that disease resided in its base. The conclusion arrived at was that potassium chloride is not efficacious in the treatment of epilepsy. The maximum dose of it in twenty-four hours is said to be Gm. 4–8 (℥j–℥ij).

Rubidium Chloride, according to Ricket (*Archives gén.*, Dec. 1885, p. 739), when administered to animals internally or subcutaneously, causes death by exhausting the nervous system and weakening the heart's action. The heart ceases to beat before the arrest of breathing, and the temperature declines. The mode of death is identical with that caused by potassium chloride.

POTASSII CITRAS, *U. S., Br.*—Potassium Citrate.

Kalium citricum, Citras potassicus s. kalicus.—Citrate of potash, E.; *Citrate de potasse*, Fr.; *Kaliumcitrat, Citronsaures Kali*, G.

Formula $K_3C_6H_5O_7.H_2O$. Molecular weight 323.59.

Preparation.—Take of Potassium Carbonate 8 ounces or a sufficiency; Citric Acid, in crystals, 6 ounces or a sufficiency; Distilled Water 2 pints (Imperial). Dissolve the citric acid in the water, add the potassium carbonate gradually, and if the solution be not neutral make it so by the cautious addition of the acid or of the carbonate; then filter, and evaporate to dryness, stirring constantly after a pellicle has begun to form till the salt granulates. Triturate in a dry, warm mortar, and preserve the powder in stoppered bottles.—*Br.*

The U. S. Pharmacopœia (1870) had a similar process, directing 14 parts of potassium bicarbonate and 10 parts of citric acid. The solution should be heated to facilitate the extrication of the carbon dioxide.

The potassium of the bicarbonate or carbonate unites with the citric acid, forming potassium citrate, while carbon dioxide is given off; $3KHCO_3 + H_3C_6H_5O_7.H_2O$ yields $K_3C_6H_5O_7 + 3CO_2 + 4H_2O$. On evaporating the clear solution the heat should not be permitted to rise high enough to burn the salt; and continued stirring is necessary toward the end of the process to prevent the salt from forming a hard layer on the bottom of the vessel and to obtain it in a granular condition. When dry it may be triturated in a warm mortar, and may thus be rendered uniformly pulverulent.

Properties.—Potassium citrate is a white granular, inodorous powder having a neutral or faintly alkaline reaction and a saline and slightly alkaline (feebly acid, *Br.*) taste. It is deliquescent on exposure, dissolves in 0.6 parts of water at 15° C. (59° F.) (*U. S.*), and is more freely soluble in boiling water. It is insoluble in absolute alcohol, and forms with dilute alcohol an aqueous solution upon which a stronger alcohol floats. Its solution gives a white crystalline precipitate with a saturated solution of sodium bitartrate, but it remains clear on the addition of calcium chloride till it is boiled, when a white precipitate of calcium citrate takes place, which is readily soluble in acetic acid. From its concentrated solution it may be procured in transparent needles which have the above composition and contain $H_2O = 5.55$ per cent. This water of crystallization is not completely expelled until the heat is raised to about 200° C. (392° F.), a portion being retained by the salt as prepared by the above process. At about 230° C. (446° F.) the salt begins to turn brown, and at a higher temperature is completely decomposed, inflammable vapors having the odor of burnt sugar being given off, while potassium carbonate remains behind mixed with charcoal, which is with difficulty completely consumed by continued heating. The salt, heated with strong sulphuric acid, yields a brown liquid, gives off an inflammable gas (carbonic oxide), and evolves the odor of acetic acid. "If 5.4 Gm. of potassium citrate are ignited until gases cease to be evolved, the alkaline residue should require for complete neutralization not less than 50 Cc. of the volumetric solution of sulphuric acid (corresponding to 100 per cent. of the pure potassium citrate)."—*U. S.* This test recognizes a salt containing 5.55 per cent. or less of water, while the Br. P. requires the anhydrous salt, of which 102 grains, heated to redness until gases cease to be evolved, leave an alkaline residue requiring for exact neutralization 1000 grain-measures of the volumetric solution of oxalic acid.

Tests.—The aqueous solution of the salt should not have an acid reaction to test-paper, and should not effervesce on the addition of acetic acid (absence of carbonate) or produce with it a crystalline precipitate (absence of tartrate). The precipitates produced by barium chloride and silver nitrate should be completely soluble in dilute nitric acid.

Action and Uses.—The medicinal virtues of this salt are described under the head of Solution of Potassium Citrate, in which form it is most usually prescribed. In solution it is an arterial sedative and a diaphoretic habitually used in *febrile affections*. Unduly acid urine becomes neutral or alkaline under its administration. Its utility in fever is increased by adding to its solution spirit of nitrous ether or antimonial wine. The *dose* of the citrate of potassium is Gm. 1.20–4 (gr. xx–lx).

POTASSII CITRAS EFFERVESCENS, *U. S.*—Effervescent Potassium Citrate.

Preparation.—Citric Acid, 63 Gm.; Potassium Bicarbonate, 90 Gm.; Sugar, 47

Gm. Powder the ingredients separately, and mix them thoroughly in a warm mortar. Dry the resulting uniform paste rapidly at a temperature not exceeding 120° C. (248° F.), and when it is perfectly dry reduce it to a powder of the desired degree of fineness. Keep the product in well-stoppered bottles.—*U. S.*

To make 4 av. ozs. of effervescent potassium citrate use 552 grains of citric acid, 788 grains of potassium bicarbonate, and 410 grains of sugar.

From the equation in the preceding article it will be seen that one molecule of citric acid requires 3 molecules of potassium bicarbonate for complete neutralization and hence 90 Gm. of the latter salt will require practically 63 (62.92+) Gm. of citric acid, for 299.64 : 209.5 : : 90 : x (62.92+). Upon solution of the effervescent salt in water, the carbonic acid present renders the taste agreeably acidulous and refreshing. The temperature prescribed by the Pharmacopœia must not be exceeded, to avoid fusion and subsequent decomposition, which would color the mixture and develop a disagreeable bitterish taste.

Uses.—This is one of the several forms of effervescing draught, and is recommended only by the convenience of its administration. It is a mild laxative in the dose of Gm. 6 (gr. xc), dissolved in a tumbler of water.

POTASSII CYANIDUM, *U. S., Br.*—Potassium Cyanide.

Kalium cyanatum, Cyanuretum potassicum s. kalicum.—Cyanure de potassium, Fr.; *Kaliumcyanid, Cyankalium*, G.

Formula KCy or KCN. Molecular weight 65.01.

Preparation.—Mix Exsiccated Potassium Ferrocyanide 8 parts with pure Potassium Carbonate 3 parts, and throw the mixture into a deep iron crucible previously heated to dull redness. Maintain the temperature until effervescence ceases and the fused mass concretes, of a pure white color, upon a warm glass rod dipped into it. Then pour out the liquid carefully into a shallow dish to solidify, ceasing to pour before the salt becomes contaminated with the precipitated iron. Break up the mass while yet warm, and keep the pieces in a well-stoppered bottle.

This process was proposed by F. and E. Rogers (1834), and is generally followed in preparing potassium cyanide on the large scale. The reaction is explained by the equation $2K_4FeCy_6 + 2K_2CO_3 = 10KCy + 2KCyO + Fe_2 + 2CO_2$, showing that, besides cyanide, potassium cyanate is also formed, carbon dioxide is evolved, and iron is separated in the metallic state: the cyanate may be removed by means of alcohol or carbon disulphide. Both salts must be well dried before they are mixed, otherwise considerable ammonia is given off; and if the carbonate is contaminated with sulphate, the fused mass will contain a corresponding amount of potassium sulphide. A portion of the product remains in the crucible with the iron, but if it is dissolved with water it becomes contaminated again with potassium ferrocyanide, which may be regenerated by digestion with sulphide of iron and crystallization to free it from potassium sulphide.

A less profitable process consists in heating dry potassium ferrocyanide to low redness, and in excluding the air until the residue has cooled. Nitrogen is liberated and escapes, and the potassium cyanide remains mixed with carbide of iron; K_4FeCy_6 yields $4KCN + FeC_2 + N_2$.

Potassium cyanide of the purity required by the U. S. Pharmacopœia is best prepared by generating hydrocyanic acid from 2 parts of potassium ferrocyanide with the requisite quantity of sulphuric acid (see page 63), and conducting the gas into a solution of 1 part of potassium hydroxide in 5 or 6 parts of strong alcohol; the bulky crystalline precipitate is drained upon a funnel, washed with strong alcohol, and dried between bibulous paper at a moderate heat.

Properties.—Thus prepared, it is a white granular powder consisting of minute transparent cubes, or after melting at a dull red heat it forms on cooling a white opaque crystalline mass. When perfectly dry it is inodorous, but when moist it is decomposed by the carbon dioxide of the atmosphere and has the odor of hydrocyanic acid. It has an alkaline and bitter taste, reacts strongly alkaline upon test-papers, is deliquescent on exposure, and is very freely soluble in water, but is nearly insoluble in absolute alcohol. 80 parts of boiling 90 per cent. alcohol dissolve 1 part of the cyanide; weaker alcohol dissolves it in larger proportion. The aqueous solution dissolves iron, zinc, copper, and nickel, with the evolution of hydrogen, and in the presence of oxygen also silver and gold. The solution yields with a saturated solution of sodium bitartrate a white crystalline precipitate, and with silver nitrate a white curdy precipitate insoluble in nitric

acid, but readily soluble in ammonia and in excess of potassium cyanide. The aqueous solution is decomposed on exposure to the air, absorbs carbon dioxide, becomes brown, and deposits a dark-brown precipitate; on boiling it is partly decomposed, yielding ammonia and potassium formate. The salt fused in contact with the air is partly oxidized to cyanate, and if fused with sulphur yields potassium sulphocyanate.

Impure potassium cyanide, as obtained by the first process, and which is extensively used in the arts, has similar properties, but is in white opaque pieces. When dissolved in water the cyanate contained in it is gradually decomposed, with the formation of potassium and ammonium carbonates; $2KCNO + 4H_2O$ yields $K_2CO_3 + (NH_4)_2CO_3$. In the pure state potassium cyanate crystallizes in a form similar to that of the chlorate; it is inodorous, and has a saline taste resembling that of saltpetre; it yields with silver nitrate a white precipitate which is soluble in ammonia and is readily decomposed by heat.

Tests.—The impurities likely to be present in medicinal potassium cyanide are carbonate and chloride. A solution of the salt in 5 parts of water should not effervesce with hydrochloric acid, or should merely disengage isolated gas-bubbles. A few drops of the aqueous solution give with silver nitrate test-solution a white precipitate, which is soluble in an excess of the solution of potassium cyanide, also in ammonia-water, and in concentrated nitric acid (distinction from silver chloride). If 5 Cc. of the solution be shaken with a few drops of ferrous sulphate test-solution, and a slight excess of hydrochloric acid then added, a precipitate of Prussian blue will be produced. The aqueous solution (1 in 20) should not produce more than a slight effervescence on the addition of diluted hydrochloric acid (limit of carbonate). After the acid has been added in slight excess, a drop of ferric chloride test-solution should produce neither a blue (absence of ferrocyanide) nor a red color (sulphocyanate)."—*U. S.* On heating to redness a mixture of 1 part of the salt with 3 parts of ammonium carbonate, dissolving the residue in water, and acidulating with nitric acid, the solution should give no (or only a faint) turbidity with silver nitrate. The U. S. Pharmacopœia requires the salt to contain at least 90 (94.9, *Br.*) per cent. of potassium cyanide, which is ascertained as follows: "If 0.65 Gm. of potassium cyanide be dissolved in 12 Cc. of water, and volumetric solution of silver nitrate be gradually added, the precipitate first formed should dissolve on stirring, and a permanent precipitate should not appear until at least 45 Cc. (47.45 Cc., *Br.*) of the volumetric solution have been used."

Action and Uses.—The action of potassium cyanide is identical with that of hydrocyanic acid, for which it may be substituted. A solution of it applied to the tongue causes a sensation of coldness, followed by irritation and constriction of the fauces, and if allowed to remain in contact with the skin, it is apt to excite a papular and even a vesicular eruption, and in powder slightly moistened or incorporated with lard it may produce an eschar. In substance or solution applied to the broken skin it may cause toxical symptoms. Internally it has been fatal in doses of from 3 to 5 grains, but recovery has occurred from the effects of from 15 to 20 grains of the salt taken on a full stomach (*Edinb. Med. Jour.*, xxxi. 85). The employment of this salt in photography has of late years greatly multiplied the number of cases of poisoning by its use. The symptoms produced by it in such cases are insensibility, muscular spasm or convulsion, a cold, clammy, and pale skin, glistening eyes and dilated pupils, stertorous breathing, fixed jaws, foam on the lips, feeble or insensible pulse of the heart and arteries, and death in convulsion or by asthenia. On examination, the body is rigid, the face pale-blue, the eyes bright, the cavities exhale the odor of hydrocyanic acid, the lungs are congested, the blood liquid, the auricles may be full and the ventricles empty, the brain is engorged, and also the lining membrane of the stomach, which presents a dark-red color streaked by the darker veins. In a word, its effects are, as above stated, those of hydrocyanic acid. (Compare Acid. Hydrocyanicum Dilutum.) Potassium cyanide is used chiefly as a topical application for the relief of *headaches* associated with dyspepsia or with imperfect menstruation, or such as are generally included under the term sick headache. It has also been employed internally, and it is asserted with remarkable success, in the treatment of acute articular *rheumatism*, but the testimony appears to us insufficient. This treatment is vaunted by Dr. Luton of Rheims (*Bull. de Thér.*, lxxxviii. 1), who prescribed the cyanide in solution to the extent of nearly Gm. 0.10 (2 grains) in the course of a day, or in pills of Gm. 0.06 (1 grain) each, one or two of which were administered within the same space of time. He stated that he did not in any case exceed the daily quantity of Gm. 0.15 (gr. iiss), and, finding that it occasioned colic and vertigo, he resumed the smaller doses. If used internally at all, for which we

can discover no necessity, it should not be prescribed at first in doses exceeding Gm. 0.008 (⅛ grain). A solution of from 2 to 4 grains of the salt in an ounce of water may be applied as a lotion to the head and as the most rapid means of removing stains produced by *silver nitrate*. It is, however, too dangerous an agent to be used without extreme caution. (For an example of its fatal use through mischance see *Edinb. Med. Jour.*, xxvii. 506). Atropine is said to be antidotal to this compound.

POTASSII ET SODII TARTRAS, *U. S.*—Potassium and Sodium Tartrate.

Soda tartarata, Br.; *Sodæ et potassæ tartras*, *Sodæ potassio-tartras*, *Tartarus natronatus*, P. G.; *Natro-kali tartaricum*, *Sal polychrestum Seignetti*, *Tartras potassico-sodicus*.—*Rochelle salt*, *Tartrated soda*, E.; *Sel de Seignette*, *Soude tartarisée*, Fr.; *Seignettesalz*, G.

Formula $KNaC_4H_4O_6.4H_2O$. Molecular weight 281.51.

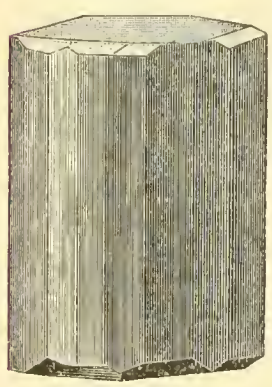
Preparation.—Take of Sodium Carbonate 12 ounces; Acid Potassium Tartrate, in fine powder, 16 ounces; Boiling Water 4 pints (Imperial). Dissolve the sodium carbonate in the water, add gradually the acid potassium tartrate, and if, after being boiled for a few minutes, the liquid has an acid or alkaline reaction, add a little carbonate or acid tartrate till a neutral solution is obtained. Boil and filter, concentrate the liquor till a pellicle forms on the surface, and set it aside to crystallize. More crystals may be obtained by again evaporating as before.—*Br.*

Since the molecular weight of potassium bitartrate is 187.67, and ½ molecule of crystallized sodium carbonate weighs 142.73, 16 parts of the former require 12⅛ parts of the latter if both salts are chemically pure. Owing to the presence of calcium tartrate in the one, and the loss of water of crystallization by the other, the proportions required must vary somewhat with different samples of the commercial salts; but there is no difficulty in rendering the solution exactly neutral if the above directions are followed. The reaction between the two salts is explained by the equation $2KHC_4H_4O_6 + Na_2CO_3 = 2KNaC_4H_4O_6 + CO_2 + H_2O$: besides the double salt, water and carbon dioxide are formed, the latter escaping with effervescence. It is advisable to keep the neutralized mixture for some time at a temperature of about 60° C. (140° F.), when much of the calcium tartrate will be deposited, and may be removed by filtration, Large and well-formed crystals are obtained if the solution is very slowly evaporated.

This double salt was first obtained in 1672 by Pierre Seignette, an apothecary of Rochelle in France, and was sold as a secret remedy. But in 1731 the process for obtaining it was communicated by Boulduc to the French Academy, and by C. J. Geoffroy to Sloane of London.

Properties.—Potassium and sodium tartrate crystallizes in large perfectly transparent, inodorous, six- or eight-sided prisms, or more frequently half-prisms, of the right rhombic order. If crystallized from a solution containing calcium tartrate, they are white and more or less opaque. In our commerce the salt is most generally met with in the state of white powder. It has a mild saline, faintly bitterish, and cooling taste, is slightly efflorescent in dry air, and dissolves at 15° C. (59° F.) in 1.4 parts of water, and in less than 1 part of boiling, but is nearly insoluble in alcohol.—*U. S.* The salt melts in its water of crystallization when carefully heated to about 75° C. (167° F.), and after cooling remains liquid and soft for some time. By the heat of the water-bath it loses 19 per cent. of water of crystallization, and at 130° C. (266° F.), or, according to Fresenius, near 215° C. (419° F.), altogether 25.5 per cent. At a higher heat it is decomposed, gives off inflammable gases which have the odor of burnt sugar, and leaves charcoal, which contains the potassium and sodium carbonates, and imparts to a non-luminous flame a yellow color, appearing red when viewed through a blue glass. The concentrated aqueous solution yields, on the addition of hydrochloric or acetic acid, a crystalline precipitate of cream of tartar; with barium chloride, a white precipitate soluble in nitric acid; and with silver nitrate, a white precipitate, turning black on boiling.

Fig. 229.



Crystal of Rochelle Salt.

Tests.—The solution in 10 parts of distilled water should be clear, of neutral reaction to test-paper, and should produce no precipitate or turbidity with ammonium oxalate (calcium salt) or with ammonium sulphide (metals); and when acidulated with nitric acid and filtered from the precipitated acid potassium tartrate, the clear solution should not be

affected by barium chloride (sulphate). Although ammonia is not likely to be present in a salt having the above properties, the U. S. and P. G. direct testing for it with caustic potassa. "If 0.36 Gm. of the salt be dissolved in 9 Cc. of water, then 1 Cc. of nitric acid and 0.2 Cc. of decinormal silver nitrate solution be added, and the mixture filtered, the filtrate should remain clear upon further addition of silver nitrate solution (limit of chloride). If 1.41 Gm. of potassium and sodium tartrate be completely decomposed by ignition, the alkaline residue should require for complete neutralization not less than 10 Cc. of normal sulphuric acid (corresponding to 100 per cent. of the pure salt), methyl-orange being used as indicator."—*U. S.*

Action and Uses.—In doses of Gm. 16–32 (℥ss–j) it operates as a gentle and cooling laxative, and seldom disagrees with the stomach. It is particularly acceptable in *Seidlitz powders*, which form an effervescing draught. In small and repeated doses it renders the urine alkaline. It is not incompatible with tartar emetic, with which it has sometimes been used as an emeto-cathartic, and also, in small doses, as a febrifuge. It may be given as a purgative in doses of about Gm. 32 (℥j). As an antilithic, Gm. 4–8 (ʒj–ij) may be taken, largely diluted, several times a day.

POTASSII FERROCYANIDUM, *U. S., Br.*—Potassium Ferrocyanide.

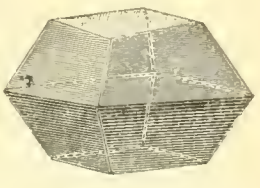
Potassæ prussias flava, Kalium ferrocyanatum, Kalium borussicum, Cyanuretum ferroso-potassicum.—Yellow prussiate of potash, E.; *Prussiate jaune de potasse, Ferrocyanure de potassium*, Fr.; *Ferrocyankalium, Blutlaugensalz*, G.

Formula $K_4FeCy_6.3H_2O = K_4Fe(CN)_6.3H_2O$. Molecular weight 421.76.

Preparation.—This salt was discovered by Macquer (1752) in boiling Prussian blue with caustic potassa. The iron contained in it was for a long time supposed to be an impurity, even after Berthollet (1787) had shown it to be one of its essential constituents. The salt is now extensively prepared by heating in suitable iron vessels potassium carbonate, which is free from sulphate, with a mixture composed of 1 part of iron filings and 28 to 33 parts of charcoal obtained from blood, hoofs, horn, hides, leather, or similar animal substances rich in nitrogen. It is less advantageous to employ these substances in the uncharred condition. 100 parts of potassium carbonate require about 75 or 80 parts of the charcoal or about 100 parts of the animal matter. An evolution of carbon dioxide and inflammable gases takes place after each addition to the melted mass, and when the whole fuses quietly the "melt," as it is termed, is ladled out, cooled, dissolved in water, decanted from the sediment, and crystallized. Before it enters commerce it requires purification by recrystallization from water. The above quantities yield about 120 parts of melt and about 25 parts of crystallized potassium ferrocyanide. The insoluble portion of the melt consists of charcoal, iron, iron sulphide, calcium phosphate, and silica. This black residue is used as manure, and is said to be destructive to the larvæ of insects. The mother-liquors, which furnish no longer well-defined crystals, are evaporated and used in another operation; they contain the excess of potash employed; also potassium sulphocyanate in case the potash was contaminated with sulphate. This salt is extensively manufactured in the United States.

Properties.—Potassium ferrocyanide crystallizes from water in large inodorous, lemon-yellow, four-sided tables or prisms, which are translucent and rather soft and friable, and, being crystallized on a cord, usually cohere in columnar masses. It has the specific gravity 1.83, a sweetish and saline taste, and dissolves with a yellow color in 4 parts of water at 15° C. (59° F.) and in 2 parts of hot water, the salt being precipitated from this solution by alcohol in pale-yellow, pearly scales. The salt is permanent at a low temperature, but near 50° C. (122° F.) it begins to lose water of crystallization, of which it contains 12.8 per cent., and it becomes anhydrous at 100° C. (212° F.), leaving a white friable mass which melts below red heat, and at a higher temperature is decomposed into nitrogen and a mixture of potassium cyanide and carbide of iron. Exposed to light in the presence of moisture, it is slowly decomposed, with the formation of Prussian blue. Its solution has a neutral reaction and produces a dark-blue precipitate with ferric salts, a bluish-white precipitate (becoming dark-blue in contact with air) with ferrous salts; a brown-red precipitate with salts of copper; and white precipitates with lead acetate and mercuric chloride; also a white crystalline precipitate with a saturated solution of sodium bitartrate. Heated with dilute sulphuric acid, hydrocyanic acid is given off. Alkalies fail to precipitate the iron from its solution, but on

Fig. 230.



Crystal of Potassium Ferrocyanide.

fusing the salt with potassium carbonate, potassium cyanide is formed and metallic iron is separated.

Tests.—The concentrated solution of the salt should not effervesce on the addition of sulphuric acid (absence of carbonate). "The aqueous solution (1 in 20), acidulated with hydrochloric acid, should, upon the addition of barium chloride test-solution, remain clear, or at most show but a trifling turbidity (limit of sulphate). If a mixture of 0.5 Gm. of the salt with 1.5 Gm. of pure potassium nitrate and 0.5 Gm. of pure, anhydrous sodium carbonate be heated to redness in a porcelain crucible, the residue dissolved in water, the filtered solution supersaturated with nitric acid, mixed with 0.1 Cc. of decinormal silver nitrate solution, and again filtered, no turbidity should be produced in the filtrate by the further addition of silver nitrate solution (limit of chloride). The precipitate produced in the aqueous solution, acidulated with nitric acid by silver nitrate test-solution should be of a pure white color, without a tinge of red (absence of ferricyanide)."—*U. S.*

Pharmaceutical Uses.—Potassium ferrocyanide is used in the preparation of Acid. hydrocyan. dilut., *U. S.*, *Br.*, of cyanides, ferrocyanides, and of the following salts:

Allied Salts.—Potassium Ferricyanide or Ferridcyanide, Red prussiate of potash. $K_6Fe_2Cy_{12}$ or K_3FeCy_6. On passing chlorine gas into a cold solution of potassium ferrocyanide the liquid changes in color from yellow to red. When it ceases to produce a blue precipitate or color with ferric chloride, it is concentrated and the crystals purified by recrystallization. The salt is in dark-red, transparent prisms, has a saline and slightly astringent taste, and dissolves in about 4 parts of cold water. On exposure to light the solution is readily altered, ferrocyanide being again produced, when it will yield a blue precipitate with ferric salt. The salt in its fresh solution is employed as a test, precipitating dark-blue with ferrous, red-brown with mercurous, brownish-yellow with cupric, and orange-colored with argentic salts. It yields no precipitates with ferric, mercuric, or lead salts.

Potassium Sulphocyanate (Sulphocyanide).—Sulfocyanure de potassium, *Fr.*; Kaliumsulfocyanat, Rhodankalium, *G.* Formula KSCN; mol. weight 96.99.—It is prepared by melting together 17 parts of potassium carbonate, 32 parts of sulphur, and 46 parts of anhydrous potassium ferrocyanide, and heating to low redness; the cold mass is treated with boiling alcohol. The salt crystallizes in colorless, four-sided, striated prisms, which are inodorous, have a pungent and saline taste, are deliquescent on exposure, and dissolve readily in water and in alcohol. A solution of the salt is used as a test for ferric salts, with which it gives a blood-red color which is not discharged by hydrochloric acid (difference from acetates and formates), but disappears on the addition of corrosive sublimate (difference from meconates).

Sodium Nitro-prusside, $Na_2Fe(CN)_5NO.2H_2O$. It is prepared by digesting 1 part of potassium ferrocyanide with 2 parts of nitric acid and 2 parts of water, until the liquid ceases to produce a blue precipitate with iron salts. On cooling, potassium nitrate crystallizes, and the mother-liquor after neutralization with sodium carbonate yields colorless crystals of potassium nitrate and red ones of sodium nitro-prusside; the latter are recrystallized from water. The salt forms ruby-colored rhombic prisms which are permanent in the air and dissolve in $2\frac{1}{2}$ parts of cold water, the solution being decomposed by light. A fragment of the salt heated with an oxygenated volatile oil darkens the latter, often producing a characteristic color; this reaction is prevented by oil of turpentine. In alkaline solution it is a delicate test for sulphides, producing with them a violet or blue color.

Action and Uses.—Potassium ferrocyanide has been reputed, on very slender authority, to possess active medicinal properties, anodyne, sedative, and astringent. A thorough investigation of its action by Regnauld and Hayem led them to conclude that it is inoperative both as a chalybeate and as a sedative, and that it may be administered for weeks in the daily *dose* of several grains without deranging the health or altering the composition of the urine. It is used as a chemical test for iron, copper, and zinc.

POTASSII HYPOPHOSPHIS, *U. S.*—Potassium Hypophosphite.

Kalium hypophosphorosum, Hypophosphis potassicus s. kalicus.—Hypophosphite de potasse, Fr.; *Kaliumhypophosphit, Unterphosphorigsaures Kali*, G.

Formula KH_2PO_2. Molecular weight 103.91.

Preparation.—This salt may be prepared in a manner similar to that by which calcium hypophosphite (see page 372) is obtained. When a solution of potassa is boiled with phosphorus, potassium hypophosphite is produced, which is freed from potassa by passing carbon dioxide into the solution, evaporating, and dissolving the hypophosphite by alcohol. It is also yielded by the double decomposition of calcium hypophosphite and potassium carbonate, when calcium carbonate is precipitated and potassium hypophosphite remains in solution; $Ca(H_2PO_2)_2 + K_2CO_3$ yields $CaCO_3 + 2KH_2PO_2$.

Properties.—It may be obtained in hexagonal tabular crystals, but, being extremely deliquescent on exposure, it is usually seen in white, opaque, crystalline masses or as a

white granular powder. It is inodorous, has a pungent saline and bitterish taste, and a neutral or faintly alkaline reaction, and is very freely soluble in water and diluted alcohol, less soluble in absolute alcohol, but insoluble in ether. "It dissolves in 0.6 part of water and in 7.3 parts of alcohol at 15° C. (59° F.), in 0.3 part of boiling water and in 3.6 parts of boiling alcohol."—*U. S.* Heated to redness when not in contact with air or in a long test-tube, it evolves easily inflammable hydrogen phosphide burning with a white (bright-yellow, *U. S.*) flame. According to Rammelsberg (1872), the gas given off consists of hydrogen and hydrogen phosphide and the residue of potassium pyrophosphate and metaphosphate. Heated in the air, the salt burns with a yellow flame, and when evaporated with nitric acid or triturated or heated with oxidizing agents it detonates violently. When boiled with potassa, hydrogen is given off; phosphite, and after the solution becomes more concentrated, phosphate, of potassium is formed. The solution yields with a saturated solution of sodium bitartrate a white crystalline precipitate of cream of tartar, and with silver nitrate, a white precipitate which rapidly turns brown and black, separating metallic silver; acidulated with hydrochloric acid, and gradually added to a solution of corrosive sublimate, it causes a white precipitate consisting of calomel, and on further addition a black precipitate of metallic mercury.

Tests.—"The aqueous solution of the salt (1 in 20) should not effervesce on the addition of an acid (absence of carbonate), nor should it be rendered turbid by ammonium oxalate test-solution (absence of calcium). After heating 5 Cc. of the aqueous solution (1 in 20) with 1 Cc. of nitric acid, the solution should remain clear upon addition of silver nitrate test-solution (absence of chloride), or of barium chloride test-solution (absence of sulphate). Not more than a slight cloudiness should be produced in the aqueous solution of the salt by the addition of magnesia mixture (limit of phosphate). If 0.1 Gm. of dry potassium hypophosphite be dissolved in 10 Cc. of water, then mixed with 7.5 Cc. of sulphuric acid and 40 Cc. of decinormal potassium permanganate solution, and the mixture boiled for fifteen minutes, it should not require more than 2 Cc. of decinormal oxalic acid solution to discharge the red color (corresponding to at least 98.7 per cent. of the pure salt)."—*U. S.*

The oxidizing effect of potassium permanganate on hypophosphites has already been explained under CALCIUM HYPOPHOSPHITE (which see). From the following equation, $4K_2Mn_2O_8 + 10KH_2PO_2 + 12H_2SO_4 = 10KH_2PO_4 + 4K_2SO_4 + 8MnSO_4 + 12H_2O$, we learn that 1 Cc. of decinormal potassium permanganate solution corresponds to 0.002598 Gm. of potassium hypophosphite, and therefore the 38 Cc. required in the official test will represent 0.987 Gm. of KH_2PO_2, or 98.7 per cent.

Uses.—This preparation has been especially recommended in the treatment of *chronic bronchitis*, but there is not sufficient proof of its efficacy in that or in any other disease, either alone or associated with the other alkaline or earthy hypophosphites. The virtue of the syrup of the hypophosphites with iron resides chiefly in its chalybeate ingredient. *Dose*, Gm. 0.30–2 (gr. v–xxx).

POTASSII IODIDUM, *U. S.*, *Br.*—POTASSIUM IODIDE.

Kalium jodatum, P. G.; *Kali hydroiodicum*, *Ioduretum potassicum*, *s. kalicum.*—*Iodure de potassium*, Fr.; *Jodkalium*, G.

Formula KI. Molecular weight 165.56.

Preparation.—The process recommended in the U. S. P. 1870 is as follows: To a hot solution of 6 ounces of potassa in 3 pints of distilled water sufficient iodine (about 16 ounces) is gradually added until the liquid remains slightly colored from excess of iodine; the solution is concentrated, 2 ounces of powdered charcoal are stirred in, the mixture is evaporated to dryness, and the powder heated for fifteen minutes to dull redness in an iron crucible; the salt is then dissolved in distilled water and crystallized.

The process of the British Pharmacopœia does not essentially differ from the preceding except in some of the details. 1 gallon (Imperial) of potassa solution and 21 ounces or a sufficiency of iodine are directed for the production of a permanent brown tint. The liquid is evaporated to dryness, the residue powdered, mixed intimately with 3 ounces of charcoal, and the mixture, in small quantities at a time, is thrown into a red-hot crucible. When the contents are fused they are poured out, and after cooling dissolved in 40 ounces of boiling distilled water, and the solution filtered and crystallized.

On dissolving iodine in solution of potassa a reaction takes place precisely analogous to that which occurs in the action of bromine or chlorine upon the same liquid. (See POTASSII BROMIDUM and POTASSII CHLORAS.) $6KOH$ and $3I_2$ yield $5KI + KIO_3 +$

$3H_2O$. The potassium iodate may be separated by evaporating the solution to dryness and treating the residue with alcohol, which dissolves the potassium iodide only; or it may be deprived of its oxygen, and thus be converted into iodide. The deoxidation may be effected in the solution by means of hydrogen sulphide, but some loss of iodine is then unavoidable, and the salt is apt to contain sulphur. The saline mass left on evaporation when heated to redness gradually parts with its oxygen, but the reduction is effected at a lower temperature and more rapidly if the mass had been previously mixed with charcoal, starch, sugar, or similar organic matter. For effecting the mixing of the charcoal with the saline mass the first directions given above are very convenient, but for reducing the iodate it is best to operate as directed by the British Pharmacopœia. If the mixture in small quantities is thrown into a red-hot crucible, each portion deflagrates, carbonic oxide is given off, and potassium iodide formed. The sudden evolution of the gas from a large quantity of the mixture heated together is likely to occasion loss. This reaction is explained by the equation $KIO_3 + C_3 = KI + 3CO$.

Various other processes have been suggested, and are serviceable, more particularly for preparing potassium iodide on a limited scale. The following deserve to be mentioned: Iodine is converted into hydriodic acid by the action of hydrogen sulphide, and the acid neutralized by potassium carbonate. Or, iodide of iron is first prepared, and the green solution boiled with an equivalent quantity of potassium carbonate, filtered from the oxide of iron, and evaporated. The iron will settle more rapidly if an additional quantity, equal to one-third of that used in preparing the solution of ferrous iodide, is added thereto before precipitation by potassa. Instead of potassa, Hesse recommends decomposing the solution by boiling with milk of lime; the filtrate is freed from excess of lime by carbon dioxide, and the calcium iodide decomposed by a hot solution of potassium sulphate; the little calcium sulphate remaining in the filtrate is decomposed by potassium carbonate, after which the clear solution is evaporated to dryness. Fuchs (1865) recommended prolonged digestion of 100 parts of iodine, 240 of water, 75 of potassium carbonate, and 30 of iron, until carbon dioxide ceases to be given off; the solution is further concentrated, exposed in a warm place until all iron has been converted into ferric oxide, then dried, heated to incipient redness, and extracted with water.

Nearly all the potassium iodide consumed here is now manufactured in the United States.

Properties.—When entirely pure, potassium iodide is in transparent colorless cubes of a neutral reaction. This is the salt directed by the U. S. P., but as generally met with it is crystallized from an alkaline solution, and the crystals are white and opaque or merely translucent, and have a slight alkaline reaction. Crystals of similar appearance are also obtained, according to Wittstein (1861), from neutral solutions at a somewhat elevated temperature, and, according to Erlenmayer, from very concentrated solutions. Potassium iodide has a slight peculiar odor, a pungent saline afterward bitterish taste, melts below a red heat (Gay-Lussac), and congeals on cooling to a pearly mass. On melting the salt in contact with air a trace of iodate is formed, a little iodine given off, and the mass acquires an alkaline reaction (Petterson, 1870); at a bright-red heat the salt is slowly volatilized. It is permanent in the air, but in a damp atmosphere or when of an alkaline reaction is somewhat deliquescent. It is freely soluble in water, requiring, according to Mulder (1864), at 15° C. (59° F.) 0.714 (0.75, U. S.), at 30° C. (86° F.) 0.657, at 60° C. (140° F.), 0.57, and at 100° C. (212° F.), 0.48 (0.5, U. S.), part of this solvent. It is likewise soluble in alcohol, requiring at the ordinary temperature 40 parts of absolute alcohol, 18 parts of alcohol sp. gr. 0.820, 12 parts of alcohol sp. gr. 0.835, 8 parts of alcohol sp. gr. 0.850, and 1½ parts of diluted alcohol. The salt dissolves in less than one-half the quantities named of boiling alcohol, and on cooling crystallizes partly in needles. The aqueous solution yields with tartaric acid or with sodium bitartrate a white crystalline precipitate of potassium bitartrate, and with a few drops of chlorine-water liberates iodine, which is recognized by the blue color it imparts to starch-paste or by the violet color of its solution in chloroform or carbon disulphide. On exposure to sunlight solutions of potassium iodide acquire a yellow or brownish color from the liberation of iodine, the decomposition being due to the influence of ozone, according to Houzeau (1858), or to the presence of carbonic or other acid, according to Bastaudier (1876). The experiments of Papasogli (1881) prove that sunlight, both diffuse and direct, does not decompose pure potassium iodide or its mixture with iodate; but carbonic anhydride liberates from the mixture a small quantity of iodine, while at low temperatures it has no effect upon either one of the pure salts, yet at high temperatures separates hydriodic acid in solutions of the pure iodide. Strong mineral acids liberate from the

salt hydriodic acid and iodine. A mixture of the salt with ammonium chloride becomes moist and brown on exposure, and when heated is decomposed, potassium chloride and iodide being left behind. Raup observed that 166 parts of the iodide dissolved in 200 parts of water will dissolve 253 parts or 2 atoms of iodine, forming a dark-red liquid, from which water throws down a portion of the iodine. If the salt is dissolved in about thirty times its weight of water, the solution takes up 1 atom of iodine. These solutions are completely decolorized when agitated with ether, chloroform, or carbon disulphide; but if the solution has been made with alcohol instead of water, carbon disulphide fails to extract the iodine, although this element is removed by the solvent mentioned from the simple tincture of iodine (Jörgensen, 1870). An aqueous solution of iodine in potassium iodide produces with lead subacetate dark-colored precipitates, which Dossios and Weith (1869) regarded as being mixtures of lead iodide with finely-divided iodine; but Piffard (1861) found the precipitate with lead acetate, after drying, could be heated to 71° C. (159.8° F.) without evolving iodine, which could likewise not be extracted with simple solvents. These facts, it seems, point to the existence of compounds of 1 atom of potassium with 1, 2, and 3 atoms of iodine. (See also LIQUOR IODI COMP. and TINCTURA IODI COMP.)

Tests.—If impurities other than bromide and chloride are present, the large cubical crystals will usually be the purest; for the following tests it is therefore advisable to triturate together crystals of different size: A little of the powdered salt taken up with the loop of a platinum wire and held in a non-luminous flame should at once impart a violet color to the latter (absence of sodium salt). "No residue should be left when 1 Gm. of the salt is dissolved in 2 Cc. of diluted alcohol of specific gravity 0.920 (absence of less soluble salts). If 1 Gm. of the salt be dissolved in water and 0.05 Cc. (one drop) of decinormal oxalic acid solution be added, no color should be produced by the subsequent addition of a drop of methyl-orange test-solution (limit of alkali). The aqueous solution (1 in 20) should not be colored or precipitated by the addition of an equal volume of hydrogen sulphide test-solution, either before or after acidulation with hydrochloric acid (absence of arsenic, lead, copper, etc.). The aqueous solution should remain clear after the addition of barium chloride test-solution (absence of sulphate). If 1 Gm. of the salt be mixed with 0.5 Gm., each, of iron and of zinc, in coarse powder or filings, and heated in a test-tube with 5 Cc. of sodium hydroxide test-solution, no ammoniacal vapors should be evolved (absence of nitrate or nitrite). No blue color should be communicated to 5 Cc. of the aqueous solution (1 in 20) by 0.1 Cc. (2 drops) of potassium ferrocyanide test-solution (absence of iron). If 0.5 Gm. of the well-dried salt be dissolved in 10 Cc. of water, and 2 drops of potassium chromate test-solution be added, it should require not more than 30.25 Cc., nor less than 30 Cc. of decinormal silver nitrate solution to produce a permanent red color of silver chromate (corresponding to at least 99.5 per cent. of the pure salt)."—*U. S.*

The absence of iodate is recognized by adding gelatinized starch to the aqueous solution of the salt, and afterward a dilute acid (sulphuric, hydrochloric, or tartaric, but not nitric), when a blue color should not at once be developed. "0.2 Gm. of the salt dissolved in 2 Cc. of ammonia-water, and then agitated with 13 Cc. of volumetric solution of silver nitrate, should yield a filtrate which on being acidulated with nitric acid should not become so turbid within ten minutes as to lose its pellucidness."—*P. G.* This test proves the absence of more than about 1 per cent. of chloride and bromide. Silver iodide is also slightly soluble in (about 3000 parts of) ammonia-water. Cyanide may be present from using impure potassium carbonate or impure iodine; its presence is determined by adding to a solution of the iodide a little ferrous sulphate, a drop of solution of ferric chloride or sulphate, and a slight excess of solution of soda. On warming the mixture and acidulating it with hydrochloric acid a blue color (of Prussian blue) should not be produced. "1 Gm. requires for complete precipitation 60.2 Cc. (60.387 Cc. for the pure salt) of the volumetric solution of silver nitrate."—*Br.*

Potassium carbonate, sulphate, iodate, nitrate, and cyanide are insoluble in strong alcohol, which dissolves only small quantities of potassium bromide and chloride. An adulteration of the iodide with more than mere traces of the last two salts may be detected by treating the iodide with eighteen times its weight of warm alcohol, and, after cooling, testing the undissolved portion. These admixtures may be estimated from the silver precipitate, which from 10 grains of pure potassium iodide weighs 14.15 grains (or 1.415 Gm. from 1 Gm. of the salt), from the same quantity of bromide, 15.8 grains, from chloride 19.2 grains, and from cyanide 20.57 grains. Moreover, the last three may be extracted from the former by ammonia, and, after acidulating this solution with nitric

acid, collected and weighed separately; or, instead of dissolving it in water, the salt to be tested may be dissolved in ammonia-water, when on the addition of silver nitrate only silver iodide will be thrown down.

Pharmaceutical Uses.—Potassium iodide is used in preparing the iodides of lead and mercury.

Potassii iodas.—Potassium iodate, *E.;* Iodate de potasse, *Fr.;* Kaliumjodat, Jodsaures Kali, *G.* KIO_3; molecular weight 213.44.—This salt is left behind on treating the product of the reaction of iodine upon potassa with alcohol; or it may be prepared, according to L. Henry (1870), by diffusing 127 parts of iodine in cold water, passing chlorine into it until iodine chloride, ICl, has been formed and dissolved in water, adding 122.5 parts of potassium chlorate and heating, when chlorine gas will be evolved, and potassium iodate crystallizes on cooling; $ICl + KClO_3$ yields $KIO_3 + Cl_2$. The salt crystallizes in translucent or milk-white cubes, dissolves in 13 parts of cold and in 3.1 parts of boiling water, and is more freely soluble in solution of potassium iodide and insoluble in alcohol. When heated, the salt fuses, and at a high temperature parts with its oxygen, leaving potassium iodide. It detonates, but less violently than the chlorate, when thrown upon burning coal. On the addition of arsenous acid or stannous chloride the solution separates iodine; if not too diluted, its solution yields white granular precipitates with salts of barium, lead, and silver.

Action and Uses.—In man potassium iodide is very rapidly absorbed and eliminated by all the emunctories without undergoing decomposition, but it is discharged mainly through the kidneys, for nearly nine-tenths of the amount used may be recovered from the urine. The elimination is not always rapid, for in some cases the salt may be detected in the urine several weeks after it has been taken. It has no uniform influence on either the amount or the quality of the urine secreted, but sometimes occasions albuminuria. According to Sée's experiments, potassium iodide primarily stimulates the heart and contracts the arteries, and secondarily produces an opposite effect (*Archives gén.*, Nov. 1889, p. 613); and Laborde has shown that the salt exerts a preponderant influence upon the central nervous system (*Bull. de l'Académie de Méd.*, 1890, p. 299). It is secreted with the milk, and in that manner has occasioned iodism in nursing infants (Cecil, *Therap. Gaz.*, xi. 749; Koplik, *Med. Record*, xxxii. 424). The continued use of potassium iodide excites eruptions of the skin, the most common of which is acne indurata. More rarely blood-blisters or watery blebs form. Cases are sometimes met with in which the smallest dose of the salt occasions urticaria (*Phila. Med. Times*, xi. 672). Iodic purpura occurs in the form of discrete purple spots upon the skin, most frequently of the legs, and which usually disappear spontaneously in two or three weeks. (Compare Mackenzie, *Times and Gaz.*, May, 1879, p. 501.) The pustular and bullar forms of the eruption seem to take their origin in the hair-follicles according to some dermatologists, in the sebaceous glands according to others. The blebs are sometimes very large, measuring an inch or more in diameter, and are filled with a clear, turbid, or bloody serum, and have been described under the name *hydroa*. They are very painful to the touch. They are of rare occurrence, and seem to depend upon some peculiarity of the patient, since they may be produced by very small doses of the medicine. They were so in a fatal case reported by Wolff (*Amer. Jour. Med. Sci.*, Jan. 1887, p. 275. Compare *Med. Record*, xxvii. 348; *British Med. Jour.*, Oct. 24, 1885; *Boston Med. and Surg. Jour.*, Sept. 1886, p. 237; *Edinb. Med. Jour.*, xxxii. 471.) The toxical effects are most apt to occur when the kidneys are obstructed (*Therap. Monatsh.*, iii. 435, 537; iv. 105). In one case an attack of hemiplegia occurred during the use of massive doses of the iodide (Hallopeau). Potassium iodide has occasioned œdema of the larynx, and is apt to cause salivation, much resembling that which occurs during pregnancy. The symptom is mild, is not accompanied with the fetor of mercurial salivation, and ceases when the medicine is suspended. A familiar effect produced by the salt is a coryza with lachrymation and a congested state of the eyes, nostrils, frontal sinuses, antrum Highmorianum, and throat; more rarely the larynx exhibits catarrhal symptoms, with hoarseness, obstruction, dyspnœa, and harassing cough, and sometimes very moderate doses have caused fulness of the head, giddiness, and trembling of the legs in walking, or marked paresis. Sometimes, also, there have been impairment of vision and articulation and a partial paralysis of the vocal organs. These effects are often produced by a prolonged or even the transient use of very small doses (Huchard, *Bull. et Mém. Soc. thérap.*, 1885, p. 72; Parker, *Med. Record*, xxvi. 587; Eliot, *ibid.*, xxvii. 348). Oppenheimer regards these as reflex effects of trigeminal irritation (*Therap. Monatsh.*, iii. 537). But sometimes very large doses, such as 40 or 60 grains a day, may be taken for weeks without causing any special phenomena, as in a case reported by Eshner (*Med. and Surg. Reporter*, Nov. 23, 1889), in which the patient took 173 grains three times daily without injury. The addition of aromatic spirit of ammonia to a solu-

tion of the iodide is said to greatly diminish the tendency to such consequences as have been now described. After a single dose of 8 grains of this iodide the mouth and throat became swollen and secreted viscid mucus and saliva; œdema affected not only the face, but gradually extended to the nostrils and throat and to the whole body; respiration was embarrassed. The symptoms were much relieved by the hypodermic injection of morphine, but did not disappear for several days (*Boston Med. and Surg. Jour.*, Oct. 1882, p. 405). A similar case is reported in which tracheotomy was required to save life (Hill and Cooper, 1881), and another by Greenhow (*Therap. Monatsh.*, iv. 105). In rare cases potassium iodide produces an effect which is not so unusual after the prolonged administration of iodine—atrophy of the testicles. Where kidney disease exists it may suppress the urine.

Potassium iodide, although sometimes successful, is not as efficacious as iodine in relieving *mercurial sore mouth;* indeed, it often aggravates the local affection. At the same time, it is the most effectual means of *eliminating mercury* from the system, and thereby curing paralysis, neuralgia, and other symptoms which occur in chronic poisoning by this metal. The same is true of *lead-poisoning* in its chronic form. If the iodide be given to a person by whom lead or mercury has been taken for a considerable period without producing characteristic toxical symptoms, those symptoms will presently be manifested in consequence of the liberation of the metal by the salt, and at the same time the former may be detected in the urine, and sometimes in the saliva, by appropriate chemical tests. To prevent a renewal of the poisoning under this treatment the iodide must be cautiously administered. According to Pouchet, during the period of aggravated symptoms the urine contains on an average 1 Mgm. of metallic lead to the liter. Under the influence of from 4 to 6 grains daily of potassium iodide the elimination of lead increases greatly for a week or ten days, and then declines below its original quantity. Hence, according to Pouchet, the remedy should not be administered continuously (*Boston Med. and Surg. Jour.*, Aug. 1881, p. 125). The power of the iodide to combine with mercury already in the system is illustrated in the treatment of *constitutional syphilis*—*i. e.* of the skin, cellular tissue, bones, and nervous system—by this medicine in persons who had taken mercury during the earlier stages of the disease. It is not unusual for them to experience the full effects of mercurial salivation. Three different explanations have been proposed for the cure of constitutional syphilis by the iodide of potassium: 1, that it revives the mercury in the system and enables it to work its specific cure; 2, that it eliminates the mercury from the system, and so removes an obstacle to the cure; and 3, that it cures syphilis by its intrinsic powers. These propositions are not incompatible with one another, and each may, in individual cases, be true. Clinical observation renders it probable that such is the case. The successful use of the iodide in this disease depends greatly upon its dose, which should never be less than 10 grains three times a day, and often must be twice or thrice as much. Indeed, not a few experts in the treatment of syphilis maintain that unless very large doses of the iodide are given, so as to saturate the system with it, its best effects will not be displayed. In one case the patient seems to have been rescued from an apparently hopeless condition by taking 300 grains of the salt daily for three weeks (Henry, *New York Med. Record*, xx. 590. See also Seguin, *Med. Record*, xxvii. 27; Otis, *ibid.*, p. 82). Lanceraux long ago (1869) condemned these excessive doses as useless, because the system cannot appropriate them, and as injurious also to the constitution. The more recent contention that syphilis creates a toleration of the medicine appears to be unfounded (Stelwagon, *Therap. Gaz.*, xiii. 674; White, *ibid.*, xii. 802, 807, 829; and others, *ibid.*, xiii. 195). Whatever dose may in any case be ultimately reached, the initial one should be small. Large doses *ab initio* have sometimes produced œdema of the larynx. The eliminative operation of this salt is also shown in chronic *arsenical poisoning* (Falck, *Toxicologie*); a striking illustration of it was presented by the case of an arsenic-eater in Philadelphia (DaCosta, *Philada. Med. Times*, xi. 385).

The value of potassium iodide in the treatment of *aneurism of the aorta* was discovered, as that of all really valuable medicines has been, "by the merest hazard;" and although the method which some have pursued in employing it included the absolute and prolonged repose of the patient, the share of the iodide in the result cannot fairly be challenged. In cases of aneurism of the aortic arch "not only has relief of neuralgic pains and of the general distress followed its administration, but the local pressure-symptoms have been mitigated, and firm thrombosis has taken place within the sac, while the area of pulsation and of percussion-dulness has exhibited sensible reduction" (Walshe). More recently Balfour (1868) and Bramwell (1878) proved, the former by reports of

fifteen, and the latter of seven cases, that this medicine, continuously given while the patient remains at absolute rest in bed and uses a non-stimulating diet, has caused a complete disappearance of all the active signs of an aneurismal tumor, and rendered possible a return to an industrious life. In 1882 a case of cure of aneurism of the aorta by this salt, given in daily doses of 75 or 80 grains and continued for several weeks, was reported by Rhett (*Med. News*, xli. 429). It is not said whether rest was conjoined or not. (Compare Schultz; DaCosta, *Ther. Gaz.*, x. 280; *Med. News*, lii. 150; Berényi, *Ther. Gaz.*, xiii. 50; Macdonnell, *Med. News*, lii. 1.) The medicine must be given in doses ranging from Gm. 1.30–2 (20 to 30 grains) thrice daily, and, with occasional intermissions when iodism occurs, should be continued for weeks or months.

Numerous cases of *dropsy* owe their cure to this medicine, including ascites due to splenic or hepatic induration, and hydrothorax depending upon cardiac obstruction. It is claimed that chronic valvular *diseases of the heart* have been greatly mitigated by it, especially those of the aortic orifice. It has cured acute hydrocephalus from *granular meningitis*, but chiefly when mercury had been previously administered, and *chronic hydrocephalus* under similar circumstances. In these intractable diseases it should never be neglected; and in regard to the former, which so rarely recovers under any treatment, the use of mercury followed by potassium iodide cannot be too strongly recommended. In not a few cases also presenting signs of *tumor of the brain*, whether syphilitic or not, the symptoms have been greatly mitigated, and sometimes quite removed, by this medicine. Seguin insisted on the necessity of administering very large doses in all such cases (*Med. Record*, xxi. 50). Similar testimony is furnished by Millikin (*Med. News*, l. 177). According to Haslund, when given in rapidly-increasing doses it is not less efficient than arsenic in the treatment of *psoriasis* (*Amer. Jour. Med. Sci.*, Jan. 1888, p. 97). These doses, beginning at 50 or 60 grains, were rapidly increased to the enormous proportion of 450, 600, and even 750, grains a day, and rarely, it is asserted, did they cause intolerance. No one has been found to imitate so rashly heroic a method. But in doses of from 10 to 20 grains three or four times a day the medicine has been prescribed by Hallopeau, Besnier, De Molènes, and others (*Archives gén.*, Jan. 1889, p. 658) with excellent effect on this most intractable disease. Stelwagon claims that *eczema* in children who are otherwise healthy may be cured by doses of from 1 to 5 grains three times a day, and in adults by doses of from 5 to 10 grains, provided that an appropriate local treatment be used at the same time (*Med. News*, xlvi. 400). In a case of persistent *priapism*, in which various topical and general remedies were for six weeks unavailingly employed, Booth prescribed 5 grains of this iodide four times a day. Improvement immediately began, and the case terminated in cure (*Lancet*, May, 1887, p. 798).

In the various forms of *muscular rheumatism* potassium iodide is one of the most efficient remedies, but especially in acute lumbago, which it often cures with marvellous rapidity. In *sciatica* and other forms of rheumatic neuralgia it is sometimes of great advantage, and even in *angina pectoris* depending upon aortic lesions it may afford relief. Huchard (1885) found the medicine successful in alleviating or arresting the paroxysms which he conceives to depend upon ossification of the coronary arteries. He prescribed from 15 to 30 grains a day (*Therap. Gaz.*, ix. 820). In like manner, Sée held it to be useful in every form of obstructive *heart disease*, but not so much by removing obstructions in the blood-vessels as by directly strengthening and stimulating the heart, and dilating its capillary blood-vessels and especially the branches of the coronary arteries (*Therap. Monatsh.*, iv. 91). Parenchymatous *goitre* is said to have been cured rapidly by daily half-ounce doses of a 5 per cent. solution of this salt (*Bull. de Thérap.*, cx. 424). It is worse than useless in acute *articular rheumatism*, but in the chronic disease, with thickening of the fibrous capsules of the joints and effusion within them, it is often the most efficient remedy. It need not, however, be given in large doses for this affection, nor for *chronic gout*, in which also it has been found of service, but its use must be long maintained. On theoretical grounds it has been used in the treatment of acute *pneumonia*. In the chronic form it may promote cure by quickening the absorption or removal of the exudation. In *chronic bronchitis* with asthma, depending upon dilatation of the bronchia or upon thickening of their walls, the iodide is often signally beneficial. The paroxysmal affection is then subordinate to the lesion of nutrition. Sée (1878) referred to twenty-four cases of "*asthma*" which he treated with this medicine and either entirely cured or materially relieved. He gave daily from Gm. 1.25–3 (20 to 45 grains) in divided doses, and continued them for several weeks. In 1882 the same physician renewed the expression of his confidence in the medicine, calling it "the remedy *par excellence* for asthma," and yet stating that it is the most useful remedy for dyspnœa of

cardiac origin. He admitted that if the treatment was too prolonged the patients were apt to suffer from bloody extravasations in the mouth and nostrils, or even pulmonary hæmorrhage when a tuberculous diathesis existed, loss of appetite and aversion to food, emaciation, atrophy of the mammæ, etc. A close scrutiny of this author's cases, so far as he describes them, and of several other cases published to confirm them, renders it probable that they were asthmatic partly because they were complicated with chronic bronchitis, a disease which the potassium iodide has often cured. It is worthy of notice that Casey (1866) reported his having employed this medicine in twenty-five or thirty cases of "asthma," in every instance with decided and unequivocal relief. But the dose prescribed by him was only from 2 to 5 grains. Ormerod (1886) found it equally advantageous in doses of 5–10 grains three times a day, although he did not regard it as a curative remedy (*Practitioner*, xxxvi. 241). Potassium iodide may be employed for the relief of asthmatic bronchitis in an atomized solution of the salt of the strength of 5 per cent. The inhalation should be frequently repeated (Everard). In cases of *paralysis* due probably to pressure upon a cerebral motor centre or upon a nervous trunk, produced by syphilitic or other swellings, the medicine is often singularly efficient, and should never be omitted from the treatment. The same remark applies to many cases of spinal paralysis, and especially to those of in-coordination of movements due to *sclerosis of the cord*. (Compare Mitchell, *Phila. Med. Times*, x. 422; Gibney, *Med. Record*, xxviii. 452.) In all of the affections mentioned in this paragraph it is probable that the iodide is operative by its causing the absorption of indurations which compress the source or the channels of nervous power. That it restrains nutrition or, perhaps, quickens denutrition, normal as well as abnormal, is shown by its emaciating operation upon the testes, mammæ, and ultimately on other organs; and that it at the same time promotes elimination is rendered probable by the history of its use in diseases of the skin and constitutional syphilis, etc., and, it may be added, by its power of rendering nutrition more active in indolent *ulcers*, especially those which remain after penetrating wounds, surgical operations, etc. (Schleich, *Therap. Monatsh.*, iv. 538).

The *dose* of potassium iodide cannot be accurately defined; according to the object to be attained, it should be given in small doses, as Gm. 0.12–0.20 (gr. ij–iij), or in very large ones, as from Gm. 0.60–1.30 (gr. x–xx), three times a day, and always in a large quantity of liquid. It should be remembered that water dissolves more than its own weight of this salt. Its unpleasant taste may be concealed by dissolving it in carbonic acid water or in artificial Vichy water. Table beer is a suitable vehicle for this salt. Currant or raspberry syrup masks it also. Milk has been used for this purpose (Keyes; Blair), but is open to the objection that lies against food as a vehicle for any medicines. Preparations of belladonna are said to prevent the coryza caused by this salt. Rohmann and Malachowski recommend sodium bicarbonate for the same purpose (*Therap. Monatsh.*, iii. 307). The iodide acts efficiently when given in enema or in suppositories, and this mode of administration is to be preferred when it is used for diseases within the pelvis (Kobner, *Therap. Monatsh.*, iii. 489). It has been used hypodermically in certain cases of its intolerance by the stomach, 8 grains being administered at each injection. According to Rabuteau, quinine sulphate should not be administered before or after potassium iodide, for mutual decomposition of the two medicines takes place and iodine is liberated, which may act poisonously.

POTASSII NITRAS, *U. S., Br.*—Potassium Nitrate.

Potassæ nitras, *Kalium nitricum*, P. G.; *Nitrum depuratum*, *Sal petræ*, *Sal nitri*, *Nitras potassicus s. kalicus*.—*Nitrate of potash*, *Nitre*, *Saltpetre*, E.; *Azotate* (*Nitrate*) *de potasse*, *Nitre prismatique*, *Salpêtre*, Fr.; *Kaliumnitrat*, *Salpetersaures Kali*, *Salpeter*, *Kalisalpeter*, G.

Formula KNO_3. Molecular weight 100.92.

Origin and Preparation.—Nitrum of the Romans was alkali carbonate, that of sodium being chiefly thus designated. Saltpetre was known to Geber in the eighth century, and in the Latin translations of his writings is called sal petræ and sal petrosum. Subsequently, it was distinguished as sal nitrum or sal nitri, until at the close of the sixteenth century it was called nitrum. (See Sodii Carbonas.) Fused by itself or with the addition of a small quantity of sulphur, it was formerly used as *sal prunelle* or *nitrum tabulatum*. Saltpetre is produced near the surface of the earth wherever nitrogenous organic substances are undergoing decomposition in the presence of air, moisture, and potassium compounds. It is present in considerable quantities in the calcareous soil near

dwellings of some parts of India. This soil becomes impregnated with urine, and after it has been exhausted of its soluble salts soon generates them again, the decomposition being hastened by the hot and moist climate. In several parts of Europe nitrates are formed in a precisely analogous manner, either by collecting the urine of domestic animals in ditches which have been previously filled with a porous calcareous earth, or by mixing in the so-called *saltpetre-beds* animal and vegetable substances with wood-ashes and marl or other material containing lime, and forming this mixture into mounds which are occasionally moistened with drainings from the dung-pit, until after two or three years the salt accumulates in the outer layer of the heap, which is then removed, lixiviated with water, and left in contact with wood-ashes in order to decompose the calcium and magnesium nitrates which are usually present. In India, which furnishes the greater part of the nitre, the process of exhausting the earth is very similar, except that it is usually packed upon wood-ashes and the whole lixiviated.

In the Mammoth Cave of Kentucky, and in other localities of the United States, saltpetre has occasionally been procured, and it may be obtained in variable quantities from most soils where vegetable and animal materials have been decaying, and from which it is taken up by the plants growing there, some of which are very rich in this salt. A. Boutin (1874) ascertained that *Amarantus melancholicus ruber* contains 16, and *Am. atropurpureus* even 22.77, per cent. of potassium nitrate, calculated for the dry herb. The same salt crystallizes in some old extracts.

Since the Stassfurt mines have been worked the large quantities of potassium chloride obtained have also been utilized in the production of saltpetre by a process of mutual decomposition effected with native sodium nitrate (Chili saltpetre). Equivalent quantities of the two salts are boiled together with water until the sodium chloride commences to separate in the boiling liquor, which is then concentrated and the chloride removed as it crystallizes. On the cooling of the solutions the crystallization of the nitre is usually disturbed by frequent stirring in order to better drain off the mother-liquor, in which most of the foreign salts remain dissolved. Variable quantities of these salts, and particularly of sodium and potassium chlorides, are always found in crude nitre, which for further purification is redissolved in water and granulated by evaporation and stirring. The last portions of adhering chlorides are in some places removed by percolating the granular powder with a concentrated solution of nitre, in which they are dissolved, while the nitrate is recovered by boiling the solution and removing the sodium chloride as it separates.

Most of the saltpetre used in the United States is purified here from the foreign crude article, of which during the year 1881–82, 11,796,091 pounds were imported, besides 453,794 pounds of refined and partly refined potassium nitrate.

Properties.—Potassium nitrate crystallizes in colorless, transparent, six-sided, striated prisms of the rhombic system, which frequently have cavities in the interior filled with mother-liquor, so that on trituration they yield a damp powder. It is often kept in the granulated state, and is then a white crystalline powder. When heated to 353° C. (667.4° F.) it fuses to a colorless liquid, and congeals again on cooling to a radiating crystalline mass; in the presence of even a small proportion of sodium chloride the radiating arrangement is less distinct, at least in the centre of the mass, or entirely wanting. At a higher temperature it gives off oxygen, and afterward oxygen and nitrogen, being gradually converted into potassium nitrite and oxide; on the addition of sulphuric acid this residue gives off nitrous vapors. Potassium nitrate is neutral to test-paper, inodorous, has a pungently saline and cooling taste, and dissolves in water with a marked diminution of temperature. 1 part of the salt dissolves

Fig. 231.

Crystal of Potassii Nitras.

at	0°	15°	30°	40°	50°	60°	80°	100°	114.1° C.
in	7.25	3.85	2.25	1.563	1.163	.901	.582	.405	.306 parts of water,

the boiling-point of the most concentrated solution being 114.1° C. (237.4° F.). The salt is insoluble in absolute and sparingly soluble in dilute alcohol. It is permanent in the air, but, according to Mulder (1864), absorbs a considerable amount of water when kept in a confined atmosphere saturated with moisture. When thrown upon red-hot coal it deflagrates. Warmed with sulphuric acid and copper, it evolves red nitrous vapors; its aqueous solution gives a white crystalline precipitate of cream of tartar on the addition of a concentrated solution of tartaric acid or of sodium

bitartrate, and if acidulated with hydrochloric acid yields a yellow precipitate with platinum chloride. The solution, mixed with an equal bulk of sulphuric acid, and afterward with ferrous sulphate, acquires a brown-black color.

Tests.—The aqueous solution of the salt (1 in 20) should have a neutral reaction, and should not be affected by hydrogen sulphide or ammonium sulphide (absence of metals), barium chloride (absence of sulphate), silver nitrate (chloride), ammonium carbonate (calcium salt), or, after the addition of ammonium carbonate, by ammonium phosphate (magnesium salt). On mixing the powdered salt or its concentrated solution with alcohol, and igniting the latter, the flame should have a violet but not a yellow color (sodium salt). On mixing 1 Gm. of the dry salt with 1 Gm. of sulphuric acid, evaporating to dryness, and igniting, the residue consists of potassium sulphate, and should weigh 0.86 Gm. In the presence of sodium nitrate the weight is less.

Pulvis temperans, s. Pulvis refrigerans. Mix by trituration potassium nitrate 1 part, potassium bitartrate 3 parts, and sugar 8 parts.—*P. G.* 1872.

An older formula directs equal weights of potassium sulphate and nitrate, and this, mixed with 10 per cent. of vermilion, is Pulvis temperans (ruber) Stahlii; Poudre tempérante de Stahl, *F. Cod.*

Action and Uses.—Potassium nitrate in small doses is diuretic, provided it be given in an abundant watery vehicle; in large doses it is a cardiac and nervous sedative and a purgative; and in excessive doses a local irritant poison, as well as a powerful sedative of all the vital functions.

When poisonous doses of nitre are taken, as an ounce and upward, there are symptoms of gastro-intestinal inflammation, and sometimes blood is vomited and passed by stool; the urine is diminished or suppressed; there is coldness of the extremities, with a feeble and thready pulse, slow respiration, great debility, tremulousness, insensibility, blindness, deafness, and even convulsions. A case is on record in which a person who had taken 3½ ounces of nitre presented no marked symptoms at first, but at the end of five hours suddenly fell from his chair and expired (*Phila. Med. Exam.*, Apr. 1855, p. 244). It is stated that two cases of sudden death followed the administration of Gm. 12 (180 grains) in acute rheumatism (*Edinb. Med. Jour.*, xxx. 654). It is remarkable, however, that poisoning by this substance generally ends in recovery, although for some time the patient may suffer from irritability of the stomach, colic, dysuria, and a sense of chilliness in the back and limbs, with weakness of the latter. After death a florid color of the lips has been noted, and a similar hue of the blood, which, indeed, other salts, as potassium chlorate, sodium chloride, magnesium chloride, etc., produce; the stomach is apt to contain blood, and its lining membrane is of a bright-red color, softened or corroded. The upper part of the small intestine may present a similar condition.

Nitre has long been used in acute *rheumatism*, given in a large amount of water or other liquid diluent, as Gm. 8–12 (℥ij–iij), and from that to Gm. 32 (℥j), in about a quart of water, which quantity was taken in twenty-four hours. There is no lack of competent authorities who declare that it subdues the fever and pain and shortens the attack, while others of equal competency allege that it is useless therapeutically and repulsive to the taste and stomach. We have no doubt that the latter is the truer judgment of the two. At the present day this method of treatment is hardly thought of in the acute, and still less in the chronic, form of rheumatism. The same remark applies to *pneumonia*, various *fevers*, etc., and even in *dropsy* the diuretic virtues of nitre are too uncertain to entitle it to any confidence. It has been claimed as a remedy for *scurvy* on theoretical and unsubstantial grounds, and also upon the ground of its efficacy when dissolved in vinegar, without due consideration of the well-established virtues of the solvent in this disease. In *spasmodic asthma*, whether complicated with *bronchitis* or not, inhalation of the fumes of burning paper impregnated with nitre renders the breathing freer and less stridulous, and sometimes by repetition cures the disease. The fumes may be employed by diffusion through the air of the patient's bedroom, or inhaled from a cigarette or from thin linen paper impregnated with a solution of nitre burned under a funnel, from the mouth of which the patient inspires. Powdered nitre, moistened with water and applied to the face night and morning, is one of the best remedies for *freckles* (lentigo). A solution of it is useful in *bruises* and *abrasions*. Nitre may be prescribed in powder in doses of Gm. 0.60–2 (gr. x–xxx) or more, or in solution, which is preferable. The effects of an overdose of nitre are best palliated by the free use of water or of some bland liquid, and by warm narcotic fomentations of the epigastrium. If syncopal symptoms arise, alcohol and heart-stimulants may be given hypodermically.

Potassium nitrite has been supposed to possess the powers of amyl nitrite, because its

physiological action is very similar. But Dr. Hinsdale (*Inaug. Thesis*, Univ. of Penna., 1881) found that it aggravated the paroxysms of *epilepsy* and rendered them more frequent. As an antidote to strychnine he concluded that it displayed no power whatever.

POTASSII PERMANGANAS, *U. S., Br.*—Potassium Permanganate.

Potassæ permanganas, Kalium permanganicum, P. G.; *Kali hypermanganicum crystallizatum, Hypermanganas potassicus, s. kalicus.—Permanganate of potash*, E.; *Permanganate de potasse*, Fr.; *Kaliumpermanganat, Uebermangansaures Kali*, G.

Formula $KMnO_4$. Molecular weight 157.67. Or $K_2Mn_2O_8 = 2KMnO_4 = 315.34$.

Potassium permanganate should be kept in well-stoppered bottles protected from light, and should not be triturated nor combined in solution with organic or readily oxidizable substances.—*U. S.*

Origin.—This salt appears to have been obtained by Glauber (1659), who by melting together magnesia (black manganese oxide) with fixed alkali (potash), and, dissolving the mass in water, found the solution to be of a purple color and to change to blue, red, and green. Chevillot and Edwards (1817) showed that for the production of this colored compound the presence of oxygen was necessary, whereby the manganese was oxidized to an acid. Forchhammer (1820) distinguished in the green and red compound two acids, the composition of which was determined by Mitscherlich (1830).

Preparation.—Take of Caustic Potash 5 ounces; Black Manganese Oxide, in fine powder, 4 ounces; Potassium Chlorate 3½ ounces; Carbon Dioxide a sufficiency; Distilled Water 2½ pints. Reduce the potassium chlorate to fine powder, and mix it with the manganese oxide; put the mixture into a porcelain basin and add to it the caustic potash, previously dissolved in 4 ounces of the water. Evaporate to dryness on a sand-bath, stirring diligently to prevent spurting. Pulverize the mass, put it into a covered Hessian or Cornish crucible, and expose it to a dull red heat for an hour or till it has assumed the condition of a semi-fused mass. Let it cool, pulverize it, and boil with 1½ pints of the water. Let the insoluble matter subside, decant the fluid, boil again with ½ pint of the water, again decant, saturate the united liquors with carbon dioxide, and evaporate till a pellicle forms. Set aside to cool and crystallize. Drain the crystalline mass, boil it in 6 ounces of the water, and strain through a funnel the throat of which is lightly obstructed by a little asbestos. Let the fluid cool and crystallize, drain the crystals, and dry them by placing them under a bell-jar over a vessel containing sulphuric acid.—*Br.*

When manganese dioxide is heated to dull redness with an excess of potassa a portion of it is oxidized to manganic acid at the expense of a part of the oxygen of another portion of the dioxide, which is thereby reduced to manganic oxide. But if oxygen is at the same time conducted into the mass, all the manganese will be converted into manganic acid, which unites with the potassa, forming potassium manganate. It is more convenient to supply oxygen by means of an oxidizing agent, such as potassium nitrate or chlorate, the former of which will supply an additional quantity of alkali for uniting with the manganic acid, while the latter will be converted into potassium chloride, which remains mixed with the manganate. In this case the result will be explained by the equation $6KOH + 3MnO_2 + KClO_3 = 3K_2MnO_4 + KCl + 3H_2O$. The proportions adopted by the British Pharmacopœia are those of Gregory, and refer to a nearly pure manganese dioxide. If the article to be used should not contain at least 93 per cent. of MnO_2, a correspondingly larger quantity should be employed. The ignited mass contains, besides the potassium manganate and chloride, all the mineral impurities which were present in the black oxide. It has a green color, and when treated with a little cold water yields a dark-green solution, which may be evaporated over sulphuric acid *in vacuo*, yielding blackish-green crystals. These dissolve unchanged in solution of potassa, but yield with water a solution which rapidly acquires a red color from the decomposition of the manganate into permanganate, manganese dioxide, and potassium hydroxide; $3K_2MNO_4 + 2H_2O$ yields $2KMnO_4 + MnO_2 + 4KOH$. On account of this change of color the green manganate was formerly known as *chameleon mineral*. The potassium hydroxide which is liberated in the reaction with water will dissolve a portion of the manganate without change until combined with carbonic, sulphuric, or other acid, when the whole of the manganate will be decomposed as stated. After the impurities and manganic oxide have subsided the clear liquid is drawn off, the sediment drained and washed upon asbestos or powdered glass (since a paper or muslin filter would decompose the permanganate), and evaporated to crystallization. The first crop or two of crystals

are usually pure; subsequently they become mixed with potassium chloride and sulphate, and require to be purified by recrystallization. Finally, the other salts accumulate in the mother-liquors to such an extent that crystals of pure permanganate can no longer be obtained, and the liquids are advantageously used for disinfecting, bleaching, or other purposes.

Graeger (1866) proposed to utilize manganic oxide, which may be obtained in large quantities and at little expense from the liquors, in the preparation of chlorine. The process of Städeler (1868) for converting the potassium manganate into permanganate by means of chlorine gas, and without separation of manganic oxide, is apt to contaminate the product with small quantities of potassium chlorate, but with due care yields the crystallized salt equal to 85 or 90 per cent. of the weight of the black manganese used.

In a process proposed by Squibb (1864) the formation of other crystallizable salts is avoided by heating the intimate mixture of potassa and maganese dioxide thoroughly to short of redness; while the mass is hot a small stream of water is directed upon it; the heating is renewed and the operation several times repeated. The mass is exhausted with water, and after the permanganate has been crystallized the mother-liquor is evaporated and used over again in place of a corresponding quantity of potassa.

Properties.—Potassium permanganate is in dark-purple or deep violet-red, nearly black rhombic prismatic crystals, which have a greenish or bluish metallic lustre, do not react upon turmeric or litmus-paper, are permanent in the air and without odor, and have a sweet, astringent taste. A small quantity of it imparts to a large quantity of water a rich purple tint, which is destroyed by organic matter and deoxidizing agents. Alcohol, acetone, acetic acid, oxalic acid, glycerin, tartaric acid, citric acid, sugar, gum, tannin, quinine, aniline, gelatin, and many other organic compounds are more or less readily oxidized in the cold or on boiling. According to Mitscherlich, the salt dissolves at 15° C. (59° F.) in 16 parts (16 parts *U. S.*) (20.5 parts *P. G.*) of water and in 2 parts (3 parts *U. S.*) of boiling water. The solution of the pure salt may be boiled without being decomposed, but in the presence of much potassa it acquires a green color from the formation of manganate, oxygen being given off at the same time; $K_2Mn_2O_8 + 2KOH$ yields $2K_2MnO_4 + H_2O + O$. A diluted solution of potassa exerts no reducing action, except in the presence of organic matter. The solution of permanganate is decolorized by hydrogen sulphide, carbon disulphide, thiosulphates, sulphites, phosphorus, hypophosphites, iodine, iodides, and many other inorganic oxidizable substances, as well as by organic compounds; the brown oxide which precipitates yields with diluted sulphuric acid a colorless or reddish solution. When heated to redness the salt parts with a portion of its oxygen and leaves a black residue of an alkaline reaction, from which water extracts potassium hydroxide. When thrown upon red-hot charcoal it deflagrates, and upon being triturated with sulphur or other inflammable bodies the mixture is decomposed with detonation. On mixing its solution in a closed vessel with glycerin, syrup, or other liquids containing organic matter a similar decomposition, accompanied by explosions, will take place. A warm concentrated solution of it, mixed with silver nitrate and allowed to cool, deposits large crystals of silver permanganate, which require over 100 parts of water for solution and are decomposed on being boiled with water. The stains produced by potassium permanganate in mortars and other utensils may be speedily removed by a strong solution of oxalic acid.

FIG. 232.

Crystal of Potassium Permanganate.

Tests.—The solution of the salt in much water should have a rose color, without a tinge of green (absence of manganate). "If 0.5 Gm. of the salt be boiled with 10 Cc. of ammonia-water and 10 Cc. of water (or with 20 Cc. of water and 4 Cc. of alcohol) until it is completely decomposed, and the liquid then filtered, the clear, colorless filtrate will serve for the following tests: 5 Cc. of the filtrate, acidulated with nitric acid, should not be rendered more than very slightly turbid by the addition of barium chloride test-solution (limit of sulphate). In another portion of 5 Cc., acidulated with nitric acid, silver nitrate test-solution should produce no precipitate or cloudiness (absence of chloride). If to another portion of 5 Cc. of the filtrate 1 drop of diphenylamine test-solution be added, and then 1 Cc. of pure concentrated sulphuric acid be poured in, so as to form a layer beneath, no blue color should appear at the line of contact (absence of nitrate or chlorate). If 0.1 Gm. of the salt be dissolved in 10 Cc. of boiling distilled water, and 1 Cc. of sulphuric acid be cautiously added, the solution should require for complete

decoloration not less than 31.3 Cc. of decinormal oxalic acid solution (corresponding to at least 98.7 per cent. of the pure salt)."—*U. S.*

The official test with oxalic acid depends upon the following reaction: $2KMnO_4 + 5H_2C_2O_4.2H_2O + 3H_2SO_4 = 10CO_2 + K_2SO_4 + 2MnSO_4 + 13H_2O$; which shows that 315.34 parts of potassium permanganate are capable of oxidizing 628.5 parts of crystallized oxalic acid. As each Cc. of decinormal oxalic acid solution contains 0.006285 Gm. of the acid, it will require 0.0031534 Gm. of potassium permanganate for oxidation: the 31.3 Cc. required by the Pharmacopœia test will correspond to 0.0987 Gm. (0.0031534 × 31.3) of $KMnO_4$, which is equivalent to 98.7 per cent.

The British Pharmacopœia requires 5 grains of the salt dissolved in water to be completely decolorized by a solution of not less than 44 grains of pure ferrous sulphate, acidulated with 2 fluidrachms of diluted sulphuric acid. This test depends upon the oxidation of 10 molecules of ferrous to ferric sulphate by 1 molecule of pure potassium permanganate.

Action and Uses.—Applied pure to the sound skin, potassium permanganate produces a brown stain; upon mucous surfaces it causes neither pain nor irritation, but smarting and burning when applied to a raw surface. Internally, it has been taken in doses of from 8 to 10 grains without injury in a very diluted solution. But even 2-grain doses have produced symptoms of irritant poisoning, and in one case, apparently, abortion (*Therap. Gaz.*, x. 746).

Internally, potassium permanganate has been used in *diphtheria*, *diabetes*, and *acute rheumatism*, but without any beneficial results. In 1882, Ringer and Murrell extolled this salt as a most efficacious remedy for *amenorrhœa* due to transient causes, such as catching cold, and even where the suspension is due to repeated pregnancies and suckling. It was given in doses of a grain at first, but gradually increased to 2 grains four times a day, as near as possible to the regular date of menstruation, and continued for three or four days. Dr. Gaillard Thomas has stated that in atonic amenorrhœa it is, when given in small doses (2–3 gr.) and continued for several weeks, "the best emmenagogue yet discovered." In uterine congestion it is said by some to be useless, while others declare it most efficient when the catamenia of strong women are suspended by cold (Boldt, *Therap. Gaz.*, xi. 31). Dr. L'voff reports it to be efficient in almost every form of amenorrhœa (*Lancet*, March 31, 1888), and Dr. Stephenson goes even farther and maintains that it controls equally excessive and scanty menstruation (*Therap. Gaz.*, xiii. 557); while Mr. Davies (*Lancet*, June, 1889, p. 1132) more recently declared that "the permanganates completely failed in numerous instances, without one partial success to redeem them from the limbo of utter worthlessness as special uterine agents." Either in pill or in solution the medicine is apt to produce a sense of substernal pressure or heartburn, and in the latter form it is very disagreeable (*Practitioner*, xxx. 128). Locally, it is chiefly employed to correct fetor in *cancer*, especially of the uterus, in corroding *ulcers*, *diphtheria*, *burns* and *frostbite*, *ozæna*, *abscesses*, *caries*, and *gangrene*. In these cases it is applied in a strong solution with a brush or sponge, or in a weaker solution upon pledgets and compresses of lint. A similar application has been made to *boils* and *carbuncles* after incision, or by injection. In *ozæna* it forms one of the best palliatives when applied with the nasal douche, and has also been used with great advantage in an atomized solution inhaled in *gangrene of the lung*. Injections of the solution and lint saturated with it are among the best means of treating fetid *otorrhœa*. In the proportion of about Gm. 0.20 in Gm. 32 (gr. iij in ℥j) of water it forms an excellent mouth-wash and gargle when *foul breath* arises from carious teeth or from the altered secretions of the faucial glands. As a wash it palliates the fetid exhalations of the *feet* and *armpits* in certain persons in a solution of 4 to 6 gr. in an ounce of water, and is useful in purifying the hands from the *smell* acquired in dissecting-rooms, in post-mortem examinations, and in various obstetrical and surgical manipulations. Solutions of from 5 to 10 grains of the salt in an ounce of water have cured obstinate eruptions of *eczema*, *impetigo*, *prurigo*, etc., and full baths containing it in the proportion of from 10 to 15 grains to a gallon of water have also been used. In *gonorrhœa* a solution of Gm. 0.06–0.12 in Gm. 32 (gr. j–ij in f℥j) of water is a very efficient injection. It seems to act partly as a stimulant of the urethral mucous membrane, and partly by its destructive action on the pus which is the vehicle of the specific virus in true gonorrhœa. In *leucorrhœa* stronger preparations may be employed, and the same may be applied to diminish the *lochial discharge* and correct its fetor. Solutions of this salt have been widely used as disinfectants. But if the infectious qualities of decomposing animal matter are to be measured by its power of decolorizing a solution of potassium permanganate, then a very curious conclusion has been reached by Dr.

Dougall (1878)—viz. that 1 ounce of such matter, represented by the alvine discharges of typhoid fever, deoxidizes not less than 10 ounces of Condy's liquid, and that 1 ounce of urine has the same effect on at least 2 ounces of that liquid. It follows from these premises that each patient whose excreta are so treated would cost five dollars a day for this item alone. It is more than probable, therefore, that the method is hardly ever efficiently carried out. This salt has been recommended as an antidote in *phosphorus-poisoning*, and also to *serpents' poison* (Lacerda, *Bull. de Thérap.*, ci. 325; civ. 556; Richards, *Times and Gazette*, Jan. 1882, p. 93). The observations and experiments that refer to the latter subject only prove that the permanganate mixed with any such poison destroys its virulence, and that if introduced into the wound made by a venomous animal immediately on the infliction of the wound no toxical phenomena will arise. Evidently, this agent destroys the constitution of the poison. The introduction of the salt in any other way than that indicated, by the mouth, by intravenous injection, or hypodermically, except at the point at which the poison entered, is useless. It seems probable that such hypodermic injection of wounds made by rabid animals would be more efficient in preventing *rabies* than any other form of cauterization.

Water contaminated by organic matter may be purified and rendered palatable by adding to it drop by drop a solution of the permanganate until the pink color of the solution ceases to be destroyed after the lapse of twenty-four hours. The clear liquor may then be decanted and used without danger.

A solution of not more than Gm. 0.12 in Gm. 32 (gr. ij to f℥j) of pure water is most appropriate as a commencing injection for the vagina or urethra and as a wash for simple wounds and ulcers. A solution of Gm. 0.50 in Gm. 32 (gr. viij in f℥j) may be used for disinfecting purposes. Sternberg has proposed a solution of 2 drachms each of mercuric chloride and potassium permanganate in a gallon of water. Internally, it may be given in *doses* of Gm. 0.13–0.30 (gr. ij–v) dissolved in a large quantity of water, or, preferably, in pills made with kaolin, soft paraffin, or lanolin, and administered when the stomach contains food. The oleate of manganese has been suggested as less irritating than the officinal preparations. The stains left by this salt upon linen may be removed by washing it in water acidulated with sulphurous or muriatic acid, oxalic acid, salt of sorrel, or simply by lemon-juice, or finally by a weak solution of sulphate of iron.

POTASSII SULPHAS, *U. S.*, *Br.*—Potassium Sulphate.

Potassæ sulphas, *Kalium sulfuricum*, P. G.; *Sulfas potassicus s. kalicus*; *Arcanum duplicatum*, *Tartarus vitriolatus*, *Sal polychrestum Glaseri.*—*Sulphate of potash*, E.; *Sulfate de potasse*, Fr.; *Kalium Sulfat*, *Schwefelsaures Kali*, G.

Formula K_2SO_4. Molecular weight 173.88.

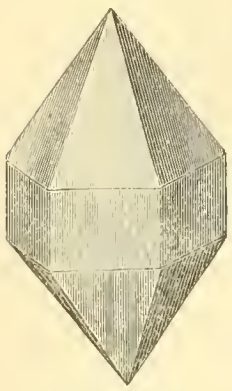
Origin.—This salt is present in sea-water and in various mineral waters, in the ashes of many plants, in many salt-beds, and in the lava of different volcanoes. It is obtained as a secondary product in many chemical processes, such as the preparation of iodine from kelp, of nitric acid from potassium nitrate, of hydrochloric acid from potassium chloride, and in the purification of potash, etc. It appears to have been prepared in the fourteenth century from the saline residue left in the preparation of nitric acid, and to have been used medicinally by Paracelsus in the sixteenth century. Glaser (1663) prepared it by adding sulphur to melted saltpetre.

Preparation.—In the manufacture of the products of the Stassfurt mines it is obtained by decomposing potassium chloride with a hot concentrated solution of *schœnite* (magnesium and potassium sulphate), and by separating the potassium sulphate from the double chloride of potassium and magnesium, which is formed at the same time, before the latter can crystallize. In Kalusz, Galicia, the salt is prepared from *kainite*, a mixture of magnesium and potassium sulphate and chloride, by exhausting with a little water, boiling the residue with potassium chloride, and granulating the newly-formed potassium sulphate.

Properties.—Potassium sulphate crystallizes in transparent, colorless, and hard six-sided rhombic prisms or pyramids, or combinations of the two forms. It is permanent in the air, inodorous, has a somewhat sharp and saline bitterish taste, is neutral to test-paper, has the specific gravity 2.65, and yields a white powder. The salt dissolves at 15° C. (59° F.) in 9.5 parts of water and in 4 parts of boiling water (*U. S.*). It is insoluble in alcohol, but dissolves in about 500 parts of diluted alcohol. The aqueous solution, acidulated with hydrochloric acid, gives with barium chloride a white, with platinic chloride a yellow, and with saturated solution of sodium bitartrate a white crys-

talline, precipitate.

Fig. 233.



Crystal of Potassium Sulphate.

When heated it decrepitates strongly, melts at a bright-red heat without decomposition, and at a white heat volatilizes slowly in white non-alkaline vapors, leaving a residue which on cooling is crystalline and has an alkaline reaction; when mixed with an excess of ammonium chloride and ignited it leaves potassium chloride. It imparts a purple color to the flame.

Tests.—The aqueous solution of potassium sulphate should not be affected by hydrogen sulphide or ammonium sulphide (absence of heavy metals), nor should it be precipitated by ammonium carbonate or oxalate (calcium, etc.) or by silver nitrate (chloride). The solution, mixed with an equal volume of sulphuric acid, should not give a brown or black color on the addition of ferrous sulphate (nitrate). Held in a non-luminous flame, this should not be permanently colored yellow. 1 Gm. of potassium sulphate, when completely precipitated by barium chloride, yields 1.338 Gm. of dry barium sulphate.

Allied Salt.—Potassii bisulphas, $KHSO_4$; molecular weight 135.85. Potassium bisulphate or acid sulphate is the saline mass remaining in the retort on preparing nitric acid from potassium nitrate and sulphuric acid, and may be obtained in needle-shaped prisms by dissolving it in less than its own weight of boiling water and cooling. The crystals are colorless and transparent, have a strongly acid taste, an acid reaction to litmus, are fusible when heated, congealing on cooling to a translucent mass, and at a higher heat are decomposed, with the evolution of oxygen and sulphur dioxide, neutral potassium sulphate being left. The salt dissolves without change in 2 parts of cold water, but when dissolved in a larger quantity of hot water neutral sulphate crystallizes on cooling, the liquid containing sulphuric acid. A like decomposition into neutral sulphate and acid is occasioned by alcohol.

Action and Uses.—Under the name of *Sal de duobus* or *Sal polychrest* potassium sulphate was formerly used as a purgative. It acts in a smaller dose than other salines, but is apt to occasion colicky pain and burning in the abdomen. In several instances doses of Gm. 16–132 (℥ss–ij) have caused fatal poisoning and collapse. After death inflammation of the gastro-intestinal mucous membrane was found. Its *dose* as a purgative is Gm. 8–16 (℥ij–iv), but it is seldom prescribed, nor does any good reason appear that it should be so employed. The bisulphate is represented as possessing the qualities of the sulphate in a more marked degree.

POTASSII SULPHIS.—Potassium Sulphite.

Kalium sulfurosum, Sulfis potassicus s. kalicus.—Sulfite de potasse, Fr.; *Kaliumsulfit, Schwefligsaures Kali*, G.

Formula $K_2SO_3.2H_2O$. Molecular weight 189.84.

Preparation.—On passing sulphur dioxide into a solution of potassium carbonate until the carbon dioxide has been expelled, and adding an equal weight of potassium carbonate, the sulphite, having the above composition, will crystallize on evaporation.

Properties.—Potassium sulphite crystallizes in oblique rhombic octahedrons, which are inodorous or of a slight sulphurous odor, somewhat deliquescent, dissolve freely in water, are sparingly soluble in alcohol, show an alkaline reaction to test-paper, and have a bitter saline and sulphurous taste. Rammelsberg ascertained that an aqueous solution of the salt saturated in the cold becomes turbid on heating and clear again on cooling. Fourcroy and Vauquelin determined the salt to be soluble in its own weight of cold water; others state the solubility as being 1 part in 4 parts of water at 15° C. (59° F.) and in 5 parts of boiling water. When heated the salt gives off water, evolves sulphur dioxide, and leaves finally a mixture of potassium sulphate, sulphide, and hydroxide. On exposure to the air it is oxidized and gradually converted into sulphate; it should therefore be preserved in well-stoppered bottles. On adding sulphuric or hydrochloric acid to its solution the odor of burning sulphur is given off, but no turbidity from liberated sulphur is produced (difference from thiosulphate). This solution gives the reactions of potassium salts on the addition of platinum chloride or of tartaric acid or of saturated solution of sodium bitartrate. The commercial salt is usually in the form of white opaque crystalline fragments or powder, obtained by evaporating the aqueous solution.

Composition.—The salt contains 48.5 per cent. K_2O, 33 per cent. SO_2, and 18.5 per cent. H_2O.

Tests.—A 1 per cent. aqueous solution of the salt, strongly acidulated with hydro-

chloric acid, should produce no precipitate, or at most only a white cloudiness, on the addition of a few drops of test-solution of barium chloride (limit of sulphate). If 0.485 Gm. of the salt be dissolved in 25 Cc. of water, and a little gelatinized starch added, at least 45 Cc. of the volumetric solution of iodine should be required until a permanent blue tint appears after stirring (corresponding to at least 90 per cent. of pure potassium sulphite). The same amount of the volumetric solution of iodine is required by 0.27 Gm. of pure potassium bisulphite.

Allied Salt.—Potassium bisulphite, $KHSO_3$; molecular weight 119.89. It is prepared by passing into a concentrated solution of potassium carbonate an excess of sulphur dioxide and adding strong alcohol. The salt crystallizes in white needles, has a sulphurous taste and neutral reaction to test-paper, and on exposure slowly evolves sulphur dioxide. On passing sulphurous acid gas into a warm saturated solution of potassium carbonate the liquid finally becomes greenish, and on cooling deposits hard, glossy, tabular crystals of *potassium pyrosulphite*, $K_2(SO_2)_2O$, which have a saline taste, and on heating give off sulphur and sulphur dioxide, leaving potassium sulphate.

Action and Uses.—Potassium sulphite is believed to possess the same power of controlling fermentation and putrefaction which belongs to the sulphites of sodium and magnesium. But it is much less used than either. It may be given internally, in a very dilute solution, to the extent of Gm. 8–16 (ʒij–iv) in the twenty-four hours. The thiosulphate and the bisulphite have analogous properties, and the latter has sometimes been used externally as a stimulant and deodorizer.

POTASSII TARTRAS, *Br.*—Potassium Tartrate.

Potassæ tartras, *Kalium tartaricum*, P. G.; *Tartras potassicus s. kalicus*, *Tartarus solubilis.*—*Tartrate of potash*, *Soluble tartar*, E.; *Tartrate de potasse*, *Tartre soluble*, *Sel végetale*, Fr.; *Kaliumtartrat*, *Neutrales weinsaures Kali*, G.

Formula $K_2C_4H_4O_6.H_2O$. Molecular weight 243.66.

Preparations.—This salt appears to have been known in the sixteenth century. Boerhaave (1742) prepared it by neutralizing cream of tartar with salt of tartar, and named it *tartarus tartarisatus*. That a solution of the same salt is obtained on neutralizing cream of tartar with lime was shown by Rouelle and Marggraf (1770). It is obtained in the first part of the process for making tartaric acid (see page 110), but it is usually prepared by Boerhaave's process, or preferably with potassium bicarbonate, using 25 parts of this salt, 47 parts of pure potassium bitartrate, and about 100 parts of boiling water. The neutral or faintly alkaline solution is concentrated until a pellicle forms and set aside to crystallize; the crystals are drained and dried. The mother-liquor is further concentrated, and when it begins to yield colored crystals may be decomposed by hydrochloric acid to obtain the remaining salt as bitartrate. The yield of crystallized potassium tartrate is about 55 or 56 parts.

The British Pharmacopœia directs 9 ounces of potassium carbonate, 20 ounces of acid potassium tartrate, and 50 ounces of water, and proceeds in all essential details as stated above. In the reaction between the two salts 1 molecule of cream of tartar decomposes ½ molecule of dry potassium carbonate or 1 molecule of potassium bicarbonate, forming the neutral tartrate; $2KHC_4H_4O_6 + K_2CO_3$ yields $2K_2C_4H_4O_6 + CO_2 + H_2O$, and $KHC_4H_4O_6 + KHCO_3$ yields $K_2C_4H_4O_6 + CO_2 + H_2O$. Provided the salts are pure, it will be observed that 16 parts of anhydrous carbonate will require $43\frac{2}{3}$ parts of bitartrate, and 9 parts of the former $24\frac{1}{2}$ parts of the latter, for complete neutralization. In the last formula there is a considerable excess of carbonate, which requires to be neutralized by the further addition of bitartrate. If the latter has been contaminated with calcium tartrate, this salt may be decomposed by prolonged boiling with potassium carbonate, calcium carbonate being deposited. Calcium tartrate is soluble in a solution of potassium tartrate, and, unless decomposed as stated, is best removed by evaporating the solution to dryness, granulating the salt, and treating it with twice its weight of *cold* water, when most of the calcium tartrate will be left undissolved. The same treatment, and for the same reason, is also advisable if potassium tartrate is obtained as a by-product in the manufacture of tartaric acid, by neutralizing cream of tartar, diffused in boiling water, with calcium carbonate, when potassium tartrate contaminated with calcium tartrate will remain in solution.

Properties.—Potassium tartrate crystallizes in four- or six-sided colorless and transparent crystals of the monoclinic system, which in the presence of calcium tartrate are white and rather opaque. It is more frequently met with as a granular or fine white powder, is inodorous, has a saline bitterish taste, is without action on litmus-paper, and

may be heated to 100° C. (212° F.) without losing in weight; but at 180° C. (356° F.) 1 molecule (3.8 per cent.) of water is given off (Dumas and Piria), and near 220° C. (428° F.) about 5.5 per cent. of acetone and other volatile products, the residue containing potassium carbonate; above this temperature the salt becomes colored, melts, gives off inflammable vapors with the odor of burnt sugar, and leaves a black residue having an alkaline reaction and effervescing strongly with acids. Heated with sulphuric acid, it forms a black tarry fluid, evolving inflammable gas and the odor of burning sugar. It requires 240 parts of boiling alcohol for solution, and is nearly insoluble in cold alcohol. The salt absorbs moisture on exposure to the air, and is gradually liquefied when kept in a damp atmosphere. According to Osann, it dissolves at 2° C. (35.6° F.) in .75 part, at 14° C. (57.2° F.) in .66 part, and at 64° C. (147.2° F.) in .47 part, of water. The aqueous solution yields with calcium chloride a white precipitate soluble in acetic acid and in cold potassa solution, and it gives a white precipitate with silver nitrate, becoming black on boiling. Acetic acid added to its aqueous solution causes the separation of a white crystalline precipitate consisting of potassium bitartrate.

Tests.—When 122 grains are heated to redness till gases cease to be evolved, the alkaline residue will require for exact neutralization 990 grain-measures of the volumetric solution of oxalic acid.—*Br.* If sodium is present, a larger quantity of the acid solution will be required. Sodium would also be indicated by the yellow color imparted to a non-luminous flame by the alkaline residue left on ignition. Carbonate is detected by the effervescence on the addition of an acid, and ammonia by its odor on warming the solution with potassa or soda. "A 5 per cent. aqueous solution of the salt should not be affected by ammonium sulphide (iron, zinc, lead, aluminum), nor by ammonium oxalate (calcium), nor after acidulation with hydrochloric acid by hydrogen sulphide (lead, copper, etc.), or by barium nitrate (sulphate). A similar solution of the salt acidulated with nitric acid should at most become opalescent on the addition of silver nitrate (chloride.)"—*P. G.*

Composition.—The French Codex recognizes the anhydrous salt $K_2C_4H_4C_6$, mol. weight 225.7. The Br. P. gives the formula $K_2C_4H_4O_6.H_2O$, and by its alkalimetric test admits 1 per cent. of impurity.

Other Soluble Tartars.—The name of *soluble tartar* was formerly applied also to other tartrates, of which two are still recognized by European pharmacopœias:

Tartarus boraxatus, *P. G.* Cremor tartari solubilis, Kalium tartaricum boraxatum, Borax tartarisata.—Boro-tartrate of potassium and sodium, *E.*; Tartro-borate de potasse et de soude, *Fr.*; Boraxweinstein, *G.*—2 parts of borax are dissolved in 15 parts of distilled water and digested with 5 parts of cream of tartar. When entirely dissolved the filtered liquid is evaporated with constant stirring, the resulting residue dried in thin layers, and while still warm reduced to powder and preserved in well-corked bottles.—*P. G.* It is a white, amorphous, deliquescent powder of an agreeably acidulous taste and acid reaction. It is soluble in its own weight of cold and less than half its weight of boiling water, insoluble in alcohol, and when heated is decomposed, leaving a residue of borax potassium carbonate and charcoal. The aqueous solution of the salt is not disturbed by acetic acid or by a small quantity of diluted sulphuric acid, but after the addition of tartaric acid a crystalline precipitate is produced. Moistened with sulphuric acid, the salt imparts a green color to the flame of alcohol. A 10 per cent. aqueous solution should not be altered by ammonium sulphide (metals), should not evolve ammonia on being warmed with potassa, should not be precipitated by ammonium oxalate (calcium), and after the addition of a few drops of nitric acid it should not be precipitated by barium nitrate, and should merely become opalescent with silver nitrate.

Potassii tartro-boras, Tartras borico-potassicus.—Potassium boro-tartrate, *E.*; Tartrate borico-potassique, Crême de tartrate soluble, Tartre boraté, *Fr.*; Borsäureweinstein, *G.*—4 parts of cream of tartar, 1 of boric acid, and 10 of water are heated together until dissolved; the solution is evaporated to dryness and the residue powdered.—*F. Cod.* It forms a white inodorous powder or may be obtained in thin transparent scales, has an acidulous taste, is not deliquescent, and dissolves in 2 parts of cold water. When long kept it becomes less soluble in water, but its solubility is restored on treating it with boiling water.

Ammonii et potassii tartras, Tartarus solubilis ammoniatus.—Potassium and ammonium tartrate, *E.*; Tartras de potasse et d'ammoniaque, *Fr.*; Weinsaures Ammoniak-Kali, *G.* $KNH_4C_4H_4O_6$.—It is prepared by diffusing 1 part of cream of tartar in 2½ or 3 parts of boiling water, adding ammonium carbonate as long as effervescence takes place, filtering, and crystallizing. It is well to render the solution alkaline by the addition of a little ammonia. The double salt crystallizes in transparent prisms having a pungent and cooling saline taste and becoming opaque on exposure from loss of ammonia. It is soluble in about 2 parts of cold and less than its own weight of hot water.

Action and Uses.—Potassium tartrate appears to promote the urinary secretion when given in small doses freely diluted, but in larger quantities it operates as a laxa-

tive. It is excreted by the kidneys as potassium carbonate, in full doses, rendering the urine alkaline. It may be used as a mild cooling purgative in all affections requiring saline aperients. It acts more gently than the sodium or magnesium sulphate. Like other salines, it renders the bile more liquid and promotes its secretion, and hence it may be used in cases of *hepatic* and *portal congestion*, and especially for the relief of *hæmorrhoidal swellings*. It is not unusual to associate it with senna, manna, or rhubarb, which concur in producing those effects, and with scammony and gamboge to mitigate the griping operation of those medicines. It is not very often used at present. As a purgative its *dose* is from Gm. 16–32 (℥ss–j).

Potassium and sodium boro-tartrate is a mild laxative or diuretic when given dissolved in a large proportion of water, the former in doses of from Gm. 16–32 (℥ss–j), and the latter in doses of from Gm. 0.60–2 (gr. x–xxx). Husemann mentions larger doses Gm. 25–60 (℥vj–℥ij) for purgation, and adds that the preparation is costly, and that a convenient and cheaper substitute for it may be prepared by mixing 2 parts of cream of tartar with 1 part of borax. The *ammonium and potassium tartrate* has also been used as a diuretic and a laxative in the doses first above mentioned.

PRENANTHES.—Rattlesnake-root.

Lion's-foot, White lettuce, Cancer weed, Gall of the earth.

Prenanthes (Harpalyce, *Don*) alba, *Linné*, s. Nabalus albus, *Hooker*.
Nat. Ord.—Compositæ, Ligulifloræ.

Description.—This North American perennial grows in rich soil on the borders of woods, and flowers in July and August. The stem is .9–1.8 M. (3 to 6 feet) high, purplish and glaucous, branched above, and grows from a tuberous, spindle-shaped root. The leaves are petiolate, angular, hastate, the radical ones palmately five- or seven-lobed, those of the stem ovate-roundish and sinuate-toothed; the flower-heads are in loose, racemose cymes, drooping, have a cylindrical involucre, with the linear, purplish, and white scales in a single row, and a few bractlets at the base, and contain from eight to twelve ochroleucous or purplish florets, with linear-oblong, striate, and unbeaked akenes, and a pale-brownish pappus composed of several rows of rough hairs. All parts of the plant contain a milky juice and have a bitter taste. The variety *serpentaria* has the lower leaves almost palmately divided and the stem-leaves three-lobed or deeply toothed.

No analysis of its constituents has been made.

Action and Uses.—The extreme bitterness of the root of this plant caused it to be used as a domestic tonic in the Southern States. Nearly thirty years ago it was affirmed to be a certain remedy for the *rattlesnake's bite*, in confirmation of a long antecedent tradition. "The milky juice of the plant was taken internally, and the leaves, steeped in water, were applied to the wound and frequently changed." No recent addition appears to have been made to these statements.

PRIMULA.—Primrose.

Cowslip, E.; *Primevère*, Fr.; *Schlüsselblume, Primel*, G.; *Primavera*, Sp.

Primula officinalis, *Jacquin*, s. P. veris, *Linné*.
Nat. Ord.—Primulaceæ.

Origin.—The primrose is an acaulescent perennial indigenous to woodlands and grassy places of Europe and Northern Asia and frequently cultivated in gardens.

Description.—The subterraneous portion consists of a short, upright, brownish, and scaly root-stalk, beset with a number of fleshy rootlets, and containing a thick mealy bark and a yellowish meditullium. The flowers (*flores primulæ*) are upon short or elongated scapes in umbels of ten or twelve pendulous flowers; the calyx is 12 Mm. (½ inch) or more long, pentangular, tubular, somewhat inflated, acutely lobed, and pale-yellowish; the corolla is about 25 Mm. (1 inch) long, funnel-shaped, five-lobed, the lobes obcordate, of a lemon-yellow color, and has in the throat five saffron-colored spots. The corolla alone is collected. It has when fresh a honey-like odor and a sweetish taste, and on drying usually acquires a dark-greenish color. The fresh root has a slight sweetish odor and a sweetish afterward bitterish and acrid taste.

Constituents.—The odor of the root and flowers appears to be due to a small quantity of a butyraceous volatile oil. The *primulin* of Hünefeld is considered by Gmelin to be identical with mannit. The acrid principle is either saponin or closely related to it; Saladin (1830) regarded it as identical with cyclamin.

Allied Plants.—Primula elatior, *Jacquin*. The flowers are large and inodorous; the corolla is sulphur-yellow, and has a flat margin, with emarginate, not cordate, lobes.

Primula auricula, *Linné*. The auricula is a native of mountainous regions of Europe, and, like both preceding species, often cultivated; the corolla is fragrant, in the wild state lemon-yellow, and has a flat margin; the short calyx has rather obtuse lobes.

Anagallis arvensis, *Linné*.—Red chickenweed, Red pimpernel, Weather-glass, *E.;* Mouron rouge, *Fr.:* Gauchheil, Rothe Miere, *G.*—A European weed naturalized in sandy fields of North America. It has a procumbent or ascending branched quadrangular stem and opposite or whorled sessile ovate and three-nerved leaves, entire on the margin and blackish-punctate beneath; the small flowers are axillary, long-peduncled, and have a brick-red corolla little exceeding the calyx. An. cœrulea, *Schreber*, the blue pimpernel, has a blue corolla. The plants are inodorous and have a somewhat bitter and acrid taste, which is due to saponin (D. Malapert, 1857) or to cyclamin (Saladin, 1830).

Lysimachia nummularia, *Linné*.—Moneywort, *E.:* Monnayere, *Fr.:* Pfennigkraut, *G.*—A creeping European plant, frequently cultivated and somewhat naturalized in North America. The leaves are short-petioled, roundish, smooth, and finely brown punctate; the flowers are axillary, bright-yellow, and rather large.

Lysimachia quadrifolia, *Linné*.—Crosswort. It is a common North American herb, with an erect hairy stem, with petiolate lance-ovate leaves in whorls of four and five, and with long-peduncled, axillary yellow flowers.

Action and Uses.—The bitter, astringent, and acrid taste of the root, and also the aroma of the flowers of this plant, doubtless first led to its being employed medicinally, and the discovery in it of a substance compared to saponin by some, and to mannit or senegin by others, confirms the popular belief that it possesses medicinal virtues. Pliny speaks of its popular esteem as a panacea, "In aqua potam omnibus morbis mederi tradunt." It is represented as being a stimulant of the bronchia and of the stomach, its powdered root is an active sternutatory, and the whole plant was formerly held to be anodyne, narcotic, and antispasmodic, and was used by noted physicians of the last two centuries for the relief of *toothache*, *insomnia*, spasmodic *hysterical* attacks, *hemicrania*, *dysmenorrhœa*, and muscular *rheumatism*. So fixed was the belief in its power of curing *gout* and *paralysis* that among the names it bore were *radix arthritica*, *radix paralyseos*. An infusion of the flowers was thought to be especially adapted to functional nervous disorders. A decoction of the root was given for the cure of *gravel*, and an infusion in wine or beer as a *vermifuge*. In England a fermented drink known as "cowslip wine" has long been one of the most esteemed articles of the domestic pharmacopœia, and in some parts of Germany an allied species, P. auricula, has for centuries been used as a remedy for consumption. It will be well if some of the heroic medicines of the present day shall, after as great a lapse of time, have as favorable a record of their virtues as this humble plant enjoys. The dose of the flowers is stated to be Gm. 1–1.30 (gr. xv–xx), and an infusion is made with from 5 to 10 parts to 100 of water.

Primula obconica, an English variety of primrose, is said to produce erythematous or eczematous eruptions on the skin resembling those caused by Rhus toxicodendron (*Lancet*, Oct. 1890, p. 633).

PRINOS.—Black Alder.

Winterberry, *Feverbush*, E.; *Prinos*, Fr., G.

The bark of Prinos verticillatus, *Linné*, s. Ilex verticillata, *Gray*.

Nat. Ord.—Aquifoliaceæ.

Origin.—The black alder or winterberry is a shrub growing in low swampy ground in Canada and the United States. It has alternate oval or obovate, acuminate, serrate leaves about 5 to 8 Cm. (2 or 3 inches) long, downy on the veins beneath, and narrowed into petioles about 12 Mm. ($\frac{1}{2}$ inch) long. The small whitish flowers are diœciously polygamous, have a subrotate, six-parted corolla, usually six stamens, and are in little umbels, all on very short peduncles. The fruit is a globose, bright-red, six-seeded berry, which is persistent in winter, grows in clusters, apparently verticillate, and has an acidulous and bitter taste. The plant flowers in May and June, and ripens the fruit in October.

Description.—The bark is in slender pieces, 6–12 Mm. ($\frac{1}{4}$ or $\frac{1}{2}$ inch) wide, or in fragments about 1 Mm. ($\frac{1}{25}$ inch) thick, fragile; externally of a brownish ash-color, with irregular light-gray or whitish patches lined with black and sprinkled with minute black or small brown circular spots. Older bark is marked with short, transverse, oblong, shallow scars, often margined with ridges. The inner surface is pale-greenish or orange-yellow, shortly striate, otherwise smooth, and has frequently thin sections of the white wood,

adhering. The bark breaks with a short fracture, and shows upon transverse section a green color and a tangential arrangement of tissue. It is inodorous, and has a bitter, somewhat astringent taste.

Constituents.—L. C. Collier (1880) found in the bark chlorophyll, wax, resin, tannin, sugar, starch, albumen, and an amorphous yellow bitter principle which is precipitated by basic lead acetate and by salts of platinum, silver, mercury, and tin.

Allied Species.—Prinos (Ilex, *Gray*) lævigatus, *Pursh*, grows in wet grounds in the Northern States, and southward in the mountains to Virginia, and is distinguished by its lanceolate or lance-oblong and smooth leaves, and by the staminate flowers being on slender peduncles.

Prinos glaber, *Linné*, s. Ilex glabra, *Gray*, known as *inkberry*, is found near the coast from Massachusetts southward, but chiefly in the Southern States. It has coriaceous, smooth, lanceolate, or oblong leaves, with a wedge-shaped base, and serrate near the apex; the berries are black.

Action and Uses.—The bark of black alder is astringent and tonic, and is popularly employed in *intermittent fever* and *diarrhœa*, as a topical application to *gangrenous* and other ill-conditioned *sores*, and both internally and locally in chronic *cutaneous eruptions*. It is prescribed in substance in doses of Gm. 2 (gr. xxx), and in a decoction made with Gm. 64 (℥ij) of the bark in 3 pints of water boiled to a quart, of which the *dose* is Gm. 32–96 (f℥j–iij). A saturated tincture is also prepared with the berries as well as with the bark.

PRUNUM, *U. S., Br.*—Prune.

Pruneau noir, F. Cod.; *Pflaume, Zwetsche*, G.; *Ciruela*, Sp.

The fruit of Prunus domestica, *Linné*. Bentley and Trimen, *Med. Plants*, 96.

Nat. Ord.—Rosaceæ, Amygdaleæ.

Origin.—The plum tree is indigenous to Western Asia. It has been cultivated from a very early period, and is now met with in most countries having a temperate climate. A large number of varieties have been produced, differing in the size, color, and shape of the fruit. The tree is about 6 M. (20 feet) high, without thorns, has oval-elliptic serrate leaves and whitish pedunculate flowers, either solitary or in pairs. Some botanists consider the subglobular plums to be the cultivated varieties of Prunus insititia, *Linné*, which resembles the other species, but is thorny and has elliptic or somewhat lanceolate leaves. The Br. P. orders the ovoid or oblong fruit of the var. Juliania, *DeC.*

Description.—The dried fruit is a subglobular or oblong drupe of a dark-blue or purplish-blue color, glaucous, shrivelled, with a shallow longitudinal furrow, the sarcocarp brownish-yellow, and the putamen hard, oblong, somewhat oblique, more or less flattened, smooth, or with irregular ridges. The seeds resemble the almond, but are smaller. The fleshy portion of the fruit, which is alone used, has an agreeable, sweet, and acidulous taste; the seed has the taste of bitter almond, and contains about 25 per cent. of a yellow bland fixed oil.

Constituents.—Prune contains sugar, pectin, albumen, malic acid, and various salts. The sugar of the different varieties varies in amount between about 12 and 25 per cent. of the weight of the fresh fruit.

Action and Uses.—Prunes are nutritious and laxative, but in excess are apt to create flatulence and colic, owing chiefly to the indigestibility of their skins. When stewed with sugar they relieve *costiveness*, and are more efficient when thus prepared with senna, whose tendency to gripe they partially correct. For this reason they enter into the confection of senna.

PRUNUS VIRGINIANA, *U. S.*—Wild-cherry Bark.

Écorce de cérisier de Virginie, Fr.; *Wildkirschenrinde*, G.; *Corteza de cereza*, Sp.

The bark of Prunus (Cerasus, *Loiseleur*) serotina, *Ehrhart*, s. Prunus (Cerasus, *Michaux*) virginiana, *Miller*. Bentley and Trimen, *Med. Plants*, 97.

Nat. Ord.—Rosaceæ, Amygdaleæ.

Origin.—The wild cherry is a large North American forest tree, growing from Canada to Florida and westward to Eastern Nebraska and Texas. It attains the height of 18 to 24 M. (60 or 80 feet), with the trunk sometimes 1.2 M. (4 feet) in diameter and undivided to the height of 6 or 9 M. (20 or 30 feet). When grown in the open field it is usually much smaller. The wood is compact, close-grained, and pale-red or brownish-red. The leaves are alternate lance-oblong, taper-pointed, petiolate, 7 to 12 Cm. (3 to 5 inches) long, and are finely serrate, with incurved teeth. The small white flowers are in elongated

racemes 10–12 Cm. (4 or 5 inches) long, and terminal on the branchlets. The fruit is a small, globose, purplish-black drupe of a sweet and bitterish taste. The subglobular seed has the flavor of bitter almonds, and contains about 25 per cent. of a bland green-yellow fixed oil, which readily separates a granular deposit. The leaves were suggested by Prof. Procter (1858) as a substitute for cherry-laurel leaves, and found to yield nearly $\frac{1}{10}$ per cent. of hydrocyanic acid when recently collected. This species has long been confounded with the *choke cherry*, Prunus (Cerasus, *De Candolle*) virginiana, *Marshall*, s. Prunus obovata, *Bigelow*. This is likewise a native of Canada and the United States, but grows westward to Colorado and Central Texas. It is shrubby, about 2.4 or 3 M. (8 or 10 feet) high, or arborescent, has thinner oval or obovate and abruptly pointed, sharply serrate leaves, short and close racemes, and red or purplish fruits of an astringent and bitterish taste.

Description.—Wild-cherry bark is met with in irregular fragments or slightly curved pieces; the thinner pieces are obtained from the branches and trunks of younger trees, are 2 Mm. ($\frac{1}{12}$ inch) or more thick, externally of a blackish-gray or greenish-brown color, smooth and somewhat shining, or partly deprived of the exfoliating corky layer, and then of a greenish or light yellowish-brown. Older bark has usually the outer corky layer removed, is 3 Mm. ($\frac{1}{8}$ inch) and more in thickness, and has a rather uneven outer surface of a rust-brown color. The inner surface is smooth, somewhat striate, cinnamon-colored or rust-brown. The bark is brittle, breaks with a granular fracture, is radially striate upon transverse section, and yields a pale reddish-brown powder. It has a very slight odor while dry, but when macerated in water it develops the odor of bitter almond; its taste is astringent, aromatic, and bitter, with the flavor of bitter almond. The thick corky layer of old bark, if present, should be rejected. The bark should be collected in October.

Constituents.—Stephen Procter (1834) showed the bark to contain tannin, gallic acid, resin, starch, and other common vegetable principles, and obtained by distillation a volatile oil containing hydrocyanic acid. This volatile oil was further examined by Prof. Procter (1837, 1838), and found to agree in the main with the volatile oil of bitter almond, and, like this, to be produced from *amygdalin* by the action of a proteid resembling emulsin or perhaps identical with it. It is coagulated or altered by heat, and the powdered bark, introduced into hot water, does not yield any volatile oil. J. S. Perot (1852) ascertained that the bark collected in autumn yielded three times as much hydrocyanic acid as that collected in April. From the latter he obtained .0478 per cent.; when gathered in October the yield was .1436 per cent., or $\frac{1}{7}$ grain HCy from 100 grains of the bark, which would therefore be equal to about 7 or 8 drops of official hydrocyanic acid. The same author ascertained also that the bitter principle of wild-cherry bark is not phlorizin. J. L. Williams (1875) obtained the bitter principle by concentrating the aqueous infusion, mixing it with an equal bulk of alcohol, agitating with milk of lime, evaporating the filtrate, and exhausting the residue with hot alcohol, on the spontaneous evaporation of which a transparent, brownish, somewhat gelatinous, bitter mass was left; it was insoluble in ether, somewhat soluble in water, more soluble in alcohol, and was colored brown-red by sulphuric acid. Power and Weimar (1888) deny the existence of amygdalin in the bark, but state that the volatile oil and hydrocyanic acid are produced from a body closely related to that of cherry-laurel leaves. Emulsin or synaptase could not be isolated by the process used for preparing the same. They furthermore isolated the fluorescent principle in the form of white crystals. The bark from the trunk, as well as from the root, was found by J. L. Lemberger (1871) to contain the largest proportion of tannin when collected in October, and to yield then also infusions of a dark wine-color. C. F. Kramer (1882) estimated the tannin with gelatin and found 3.42 per cent.

Action and Uses.—Wild-cherry bark is tonic through its bitter principle, and more or less sedative through the hydrocyanic acid which it generates with water. For the latter effect, however, very large doses are required. It is more used in pulmonary *consumption* than in any other disease, under the impression that it improves the appetite and strengthens the digestion, while it moderates the cough and allays the irritability of the nervous system. It is a gentle and harmless palliative in this disease, while its use may prevent the employment of opiate and expectorant mixtures, whose injurious influence on the digestion outweighs their utility in moderating the cough. It is particularly useful in cases of nervous *cough* produced by reflex action, or even by slight bronchial or laryngeal irritation. It is equally useful during *convalescence* from various acute diseases when febrile excitement is maintained by general debility of the system. *Palpitation of the heart* is reputed to be especially under its control. When this symptom depends

upon organic causes the medicine is inadequate to allay it except in a very slight degree; but when it is associated, as it more frequently is, with anæmic, chlorotic, dyspeptic, or nervous disorders, the bark is sometimes of real advantage. The cold infusion forms a useful collyrium in mild cases of acute *ophthalmia*.

The dose of the powdered bark is stated to be Gm. 2–4 (gr. xxx–lx). The cold infusion and the fluid extract are more efficient and eligible preparations; the syrup is chiefly to be recommended as a flavoring agent.

PSORALEA.—Psoralea.

Psorale, Fr.; *Psoralie, Drüsenklee*, G.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Description.—The genus is characterized by a five-cleft persistent calyx having the lowest lobe longest, by diadelphous or sometimes monadelphous stamens, by a short one-seeded pod, the pointed end of which projects from the calyx, and by the glandular dots with which the calyx, and frequently also the leaves, are more or less covered. The following species have been employed:

Psoralea melilotoides, *Michaux*, s. P. eglandulosa, *Elliott*, grows in dry soil in the Southern and Western United States, is a slender, erect, pubescent, and slightly glandular herb, and has a spindle-shaped root, trifoliate leaves with oblong-lanceolate rather obtuse leaflets, and long-peduncled, oblong, finally elongated spikes of purplish flowers; the legume is nearly orbicular and transversely wrinkled. The plant has a slight aromatic odor and a somewhat spicy and bitterish taste. It flowers in June and July, and should be collected when in full bloom.

P. esculenta, *Pursh*, has a tuberous or turnip-shaped farinaceous edible root, which is known as *bread-root* and likewise as *Indian turnip*, and formerly as *pomme blanche* and *pomme de prairie*. It grows on the prairies from Wisconsin to Missouri and westward.

P. glandulosa, *Linné*, was formerly said to yield *yerba mate* (see page 862). It is a shrub of Chili, with rough glandular petioles, ovate-lanceolate, acute glandular leaflets, and white or blue flowers. The root is emetic, and the leaves have aromatic properties, their flavor resembling that of rue.

P. pentaphylla, *Linné*, of Mexico, has a thick root, which is sometimes known as *white contrayerva* from its color and medicinal properties.

P. bituminosa, *Linné*, of Southern Europe, is suffruticose and has a disagreeable bituminous odor.

P. corylifolia, *Linné*, is indigenous to India and Arabia, has a whitish angular stem and simple ovate somewhat cordate and toothed, glandular leaves with short ovate ciliate stipules. The herb has a resinous, aromatic, and bitter taste, and, like the seeds known in India as *bauchee seeds*, is used as a tonic in skin diseases.

Several other species of Psoralea, in addition to the two named above, are indigenous to the United States. They all appear to contain resin, volatile oil, tannin, and bitter principle, but have not been sufficiently analyzed.

Action and Uses.—The leaves and the root of some of the species have a bitter, pungent, and aromatic taste, but it is most decided in the root. Psoralea has been described as a gentle stimulating and tonic nervine, and compared in its action to Chinese tea. It is said to have been used with advantage in chronic *diarrhœa* depending upon strumous conditions of the mesenteric glands, and in chronic *dyspepsia* attended with vomiting of blood. The medicine has been administered chiefly in the form of a tincture prepared with several other plants besides Psoralea, so that its special virtues cannot be extricated from the compound effect. The *dose* of the tincture is stated to be from Gm. 12–24 (f℥iij–vj) several times a day. As far as can be judged, it appears to partake of the qualities of aromatic and bitter tonics in general. (See a paper by Prof. Maisch on the genus Psoralea (*Amer. Jour. Phar.*, lxi. 345), which contains an account of the use of P. esculenta, or prairie turnip, which is used by the Indians as food.)

PTELEA.—Shrubby Trefoil.

Hoptree, Waferash, E.; *Orme à trois feuilles*, Fr.; *Hopfenbaum, Kleebaum*, G.

Ptelea trifoliata, *Linné*.

Nat. Ord.—Rutaceæ, Xanthoxyleæ.

Description.—The hop tree is a handsome North American shrub growing south-

ward and westward from New Jersey and Pennsylvania, chiefly, however, west of the Alleghanies, and is cultivated in Europe. The shrub is about 2.4 to 3.6 M. (8 to 12 feet) high, with dark-brown branches, which, like the leaves, are downy when young. The *leaves* are alternate, petiolate, light-green, and trifoliate, with sessile, pointed, indistinctly-serrate, and finely pellucid-punctate leaflets, of which the lateral ones are obliquely ovate, and very uneven toward the base, the outer half being broadest, while the larger terminal one is elliptic or obovate and wedge-shaped at the base. They are from 7 to 12 Cm. (3 to 5 inches) long, when broken exhale a rather unpleasant odor, and have a bitter and somewhat astringent taste. The small greenish-white polygamous flowers are in compound terminal cymes, have a disagreeable odor, and are followed by a flat orbicular *fruit*, which is two-celled and two-seeded, and is surrounded by a circular membranous and slightly emarginate wing, the whole fruit being about 2 Cm. ($\frac{4}{5}$ inch) in diameter and of a pleasant hop-like flavor. The fruit, leaves, and *bark of the root* have been employed. The latter is in fragments and irregular quills of a brown color, longitudinally wrinkled, lighter and smooth on the inner surface, breaks with a short fracture, and has a bitter and pungent taste.

Constituents.—G. M. Smyser (1862) found in the leaves *tannin* and *gallic acid*, in the fruit a soft acrid *resin*, and in the bark a reddish-brown *resin* soluble in ether and alcohol and of a pungent and acrid taste. All parts contain volatile oil and other principles commonly met with in plants. Justin Steer (1867) isolated *berberine* from the bark, and regards it as the bitter and tonic principle.

Allied Plant.—Ptelea angustifolia, *Bentham*, a native of Colorado, has lanceolate pubescent leaves, and a smaller more deeply notched fruit than the preceding.

Action and Uses.—The bark of the root appears to be aromatic and tonic, and has been used in tincture and infusion for *dyspepsia* and as a stimulant in *typhoid* febrile states. The leaves and young shoots have also been employed in strong infusion as anthelmintics. Of its administration we only know that a spirit made by macerating 6 ounces of the bark and $\frac{1}{2}$ ounce of ginger in 2 quarts of whisky was prescribed in the *dose* of Gm. 16–32 (1 or 2 tablespoonfuls) three times a day. How much of the stimulant effects was due to the alcohol and how much to the ginger, and how much remained for the share of the trefoil, has not been estimated.

Ptelea trifoliata is said by Shoepf to be "*anthelmintic*, for which purpose the leaves and the young shoots are used in strong infusion. The fruit is aromatic and bitter, and is stated to be a good substitute for hops."

PULSATILLA, *U. S.*—Pulsatilla.

Pasque-flower, E.; *Anémone*, *Pulsatille*, *Coquelourde*, Fr.; *Küchenschelle*, G.; *Pulsatila*, Sp.

The flowering herb of Anemone Pulsatilla, *Linné* (s. Pulsatilla vulgaris, *Miller*), and of Anemone (Pulsatilla, *Miller*) pratensis, *Linné*, collected soon after flowering. Meehan, *Nat. Flowers*, i. p. 49.

Nat. Ord.—Ranunculaceæ, Anemoneæ.

Origin.—The first two species are indigenous to the greater portion of Europe, and grow also in Siberia in sandy soil and in dry, open woodlands. The section Pulsatilla differs from the other species of Anemone in having a narrowly-divided involucre, large flowers, and long feathery styles, which are permanent in the fruit. The plants flower early in spring, from March to May. They should be collected after the flowers have expanded, and should be carefully preserved and kept not longer than one year.

Description.—A. pratensis has a dark-brown, oblique, several-headed root, and pinnately two- or three-cleft, petiolate radical leaves with linear acute segments, and at the base surrounded by several ovate lanceolate sheaths. The flowering scape is about 15 Cm. (6 inches) high, and bears a single nodding bell-shaped flower reflexed at the apex, varying in color between dark-violet and light-blue, and surrounded by a distant sessile involucre composed of three palmately-divided and cleft bracts with linear lobes. The numerous ovaries are prolonged into a feathery tail (style). All herbaceous parts are clothed with long, soft, silky hairs, are nearly inodorous, but when rubbed exhale a very acrid vapor and have a burning, acrid taste. A. pulsatilla closely resembles the former, but has the flowers erect and sepals spreading above, but not reflexed.

Constituents.—The fresh plants of the section Pulsatilla, when distilled with water, yield a distillate from which ether extracts a very acrid yellow oil, which is gradually or more rapidly in the presence of water, converted into *anemonin* and *anemonic* acid,

from which hot alcohol dissolves the former. Basiner (1881) found the yellow oil as well as the anemonin to be soluble in glacial acetic acid, from which solution they are removed by agitation with benzene. Anemonin, which was first observed by Störck (1771), and investigated by Heyer (1779), forms colorless friable crystals which are neutral, inodorous, and when fused exceedingly acrid, soluble in chloroform, nearly insoluble in ether and water; the composition of these crystals, according to Fehling (1841), is $C_{15}H_{12}O_6$. Löwig and Weidmann (1839) and Fehling (1841) observed that boiling baryta-water converts it into a brown amorphous acid. Anemonic acid, $C_{15}H_{14}O_7$, is a white crystalline tasteless powder insoluble in most simple solvents, and dissolves in alkalies with a yellow color. Similar results were obtained with American pulsatilla by A. W. Miller (1862) and F. E. Miller (1873).

Pharmaceutical Preparation.—EXTRACTUM PULSATILLÆ. The expressed juice of the fresh flowering herb is heated, strained to remove albumen, evaporated to a small bulk, mixed with an equal measure of alcohol, filtered, and evaporated to the proper consistence.

Allied Plants.—Acrid properties resembling those of the preceding plants are met with in most species of Anemone, which are distinguished from the section Pulsatilla chiefly by the styles being much shorter and not feathery. An. nemorosa, *Linné*, *wind-flower* or *wood anemone* (Anemone des bois, Sylvie, *Fr. Cod.*), a native of the northern hemisphere, has a long-petiolated trifoliate leaf with ovate or elliptic cut and toothed leaflets, an involucre of three similar leaves, and a white or purplish flower. An. coronaria, *Linné*, has been employed in the Levant, where it is indigenous; it is sometimes met with in gardens. An. sylvestris and An. ranunculoides, *Linné*, indigenous to Northern Asia and Europe, are used in Siberia. These species lose some of their acrid properties by drying, and rapidly deteriorate on keeping.

Action and Uses.—The bruised fresh plant rubbed upon the skin irritates and may even vesicate it. The extract and tincture cause a sense of burning and numbness in the mouth. Internally, pulsatilla may inflame the stomach and bowels and cause fatal convulsions. In medicinal doses it is reported to act as a general excitant (Schrofl). Anemonin applied to the tongue occasions a severe burning pain and persistently benumbs its sensibility. Internally, it acts as a general stimulant and a diuretic. Heyer (1779) related that an amaurotic patient who was taking about Gm. 0.03 ($\frac{1}{2}$ grain) of anemonin twice a day experienced a dreadful sense of tension in the head and copious diuresis (Husemann). Brunton states that the extract of pulsatilla, when given in a fatal dose, always causes convulsions.

Different species of Anemone were recognized by ancient physicians as being identical in their medicinal power. According to Galen, the anemones are endowed with acrid, drawing, cleansing, and opening virtues. When chewed, anemone excites a secretion of mucus, its juice cleanses the brain and nostrils, and lessens or removes opacities of the cornea. It purifies foul ulcers, cures lepra and pityriasis, is emmenagogue and galactagogue. Neither Dioscorides, Pliny, nor the Arabians added anything to this enumeration, and the medicine seems to have been almost forgotten until the close of the eighteenth century. Pulsatilla nigricans was then highly praised by Störck and some of his contemporaries as an efficient remedy for *opacities of the cornea*, *cataract*, *paralysis*, *rheumatism*, *amenorrhœa*, *melancholy*, constitutional *syphilis*, old *ulcers*, and scaly *diseases of the skin*. In the last-named affections he held it to be peculiarly useful, generally prescribing the extract in doses of 1 or 2 grains, and gradually increasing them to Gm. 0.10–1 (15 grains). But subsequent observers of the best repute imitated Störck's practice without obtaining his results. The author who relates this history of Störck's use of the drug (Cazin) suggests that its more recent failures were due to the use of an improperly made extract. He refers to several physicians of previous generations who wrote of its singular efficacy in *whooping cough*, *visceral engorgements*, *gravel*, *comatose attacks*, and *obstructions of the nostrils*. Denian used pulsatilla in several nervous disorders, and concluded that the medicine is "a direct sedative of nervous irritability, but only indirectly a vascular sedative" (*Bull. de Thérap.*, civ. 81). By the greater number of recent writers on the materia medica the medicine is either wholly unnoticed or its virtues are described in accordance with the above history, which, it will be observed, assigns to it the characters of a panacea, so diverse and numerous are the diseases which it is reported to have cured. This list of incongruous diseases benefited by pulsatilla may be lengthened by *nervous headache* produced by overtaxing the mind (Tucker), and by *dysmenorrhœa*, which in several cases was cured by 2 drops of a tincture of pulsatilla taken before meals for three days before the menstrual epoch (Piffard). The latter physician reports that in *epididymitis* he administered 5-drop doses of the tincture with the effect of aggravating the

inflammation, while he rapidly cured seven or eight cases of the disease by doses of "one-tenth of a minim well diluted, and administered every two or three hours." No other treatment was employed. Similar statements have been made by Sturgis (*Med. News*, xlii. 267); Lawson (*Therap. Gaz.*, viii. 271); Martel (*Bull. de Thérap.*, cviii. 129; cx. 207); Smith (*Edinb. Jour.*, xxxii. 747); Bovet, Dornand (*Ann. de Thér.*, 1889, p. 187); but Carter (*Lancet*, Aug. 1889, p. 216) did not find that it influenced at all the course of epididymitis. From this summary it may fairly be concluded that pulsatilla is either a remedy of extraordinary and incomprehensible power, or that the reporters of its cures have been misled by their imagination or a neglect of the precautions necessary in studying the virtues of medicines.

The powdered herb was formerly prescribed in *doses* of Gm. 0.25–0.30 (gr. iv–v), and an infusion made with the fresh plant in wine or water Gm. 4 in Gm. 100 (ʒj–ʒiij) was given during the day in divided doses.

A tincture of the fresh root, made with equal weights of the root and of 90 per cent. alcohol, has been given in the dose of 10–20 drops three times a day. The alcoholic extract may be used in doses of from Gm. 0.03–0.20 (gr. ss–iij). Anemonin is directed in doses of Gm. 0.01–0.03 (gr. $\frac{1}{6}$–$\frac{1}{2}$) in pilular form.

PULVERES.—Powders.

Poudres, Fr.; *Pulver*, G.

Preparation.—All solid drugs may be reduced to powder, but the means by which pulverization is effected must vary very considerably according to the nature of the drug. The large majority of crystallized chemical compounds are readily powdered by *trituration* in a porcelain or Wedgewood mortar; many of those which are insoluble or sparingly soluble in alcohol may be powdered by *precipitating* them from their concentrated solution by pouring it slowly and with continual agitation into alcohol. Compounds which are insoluble in water may frequently be obtained in a more or less fine powder, which is either amorphous or crystalline, by means of double decomposition and *precipitation*. Soluble compounds may also be powdered by evaporating their solution, and, as it thickens, by stirring it continually, so as to disturb crystallization or prevent the compound from separating as a solid mass. This process is termed *granulation*, and is equally applicable to fusible substances, which, after having been liquefied by heat, are stirred or triturated while they are cooling and congealing. Volatile compounds and elements (calomel, sulphur, etc.) may be finely powdered by *sublimation*, and by suddenly condensing their hot vapors in a large chamber with a current of air, or, if insoluble in water, with a current of steam.

In several of these processes the powder is not obtained of uniform fineness, and then requires to be *sifted*, or the finer particles are separated from the coarser by means of *elutriation*, which process consists in diffusing the powder in water and decanting from the heavy sediment. The fine powder, which remains longest in suspension, is then permitted to subside, and, after withdrawing the liquid, dried. It is evident that only those substances are adapted to this treatment which are heavier than water, and which are entirely insoluble therein; elutriation is usually preceded by *levigation*, which is simply a process of trituration in the presence of sufficient moisture to render the mass soft. The operation is performed either in a mortar or upon a slab by the aid of a muller.

Drugs which are composed of vegetable tissue or which consist of exudations cannot, as a rule, be reduced to powder by these means. In these cases *contusion* is required, and this is the method most frequently employed. The substance is placed in a rather deep mortar, and broken by perpendicular strokes with the flattened surface of a heavy pestle. The process is called *bruising* if the substance is to be broken merely into a coarse powder. If the drug contains a certain amount of oil or resin, the heat produced by the pounding will often render the material more or less soft or adhesive. This result is best prevented by exposing the drug to a low temperature and powdering in the cold, when it will retain its pulverulent condition at ordinary temperatures, or, if it conglomerates, it may be rubbed into powder by slight trituration. Mortars made of iron or brass are best adapted for preparing powders by contusion. Some tough materials are conveniently reduced to powder by *rasping*.

Most of the vegetable powders are, however, prepared on a large scale at the drug-mills by *grinding*, the grinding surface being a bed of hard stone upon which either iron balls

or millstones are made to revolve. A draught is thereby created which carries the fine powder up to a certain height, and if this alone is collected it is called a *dusted powder*. Oily seeds and similar material cannot profitably be powdered in this manner, because by the pressure and heat created by the grinding the oil rises to the surface and agglutinates a part of the powder. Such material is best ground, or rather cut, between horizontal millstones suitably prepared for the purpose. A number of drug-mills which may be worked by hand have been constructed, and serve a good purpose for the use of the pharmacist in preparing the coarser kind of powders, but none have been made which could be used with advantage for finely powdering moderate quantities.

Whether contusion or grinding is resorted to, the drugs to be powdered should be deprived of the moisture remaining in them by exposing them in a drying-room to a temperature of about 50° C. (122° F.). Drugs, however, which owe their virtues to volatile oil, and which should be powdered in the air-dry condition or on a small scale, are conveniently dried over burnt lime. The different tissues of plants are not reduced to powder with equal facility; the fibro-vascular bundles and the bast-fibres are usually more refractory than parenchyma-tissue, and more or less of the former generally remains behind as a coarse powder. When the powder is intended to be exhausted by percolation or otherwise, the coarse particles are utilized with the fine powder; but in case the latter be intended for dispensing, the coarser portion is removed by a sieve. The fine powder which may be sifted off from time to time during the process of powdering should be carefully mixed to ensure uniformity in composition. The fibrous portion of vegetable drugs is usually less active than the remainder, and if in such a case the whole of it be rejected, the resulting powder must necessarily be stronger than the crude drug from which it has been prepared; thus, if the bark of ipecacuanha-root be separated from the wood and powdered by itself, such powdered ipecacuanha will possess an activity about 20 per cent. greater than the root itself.

Fineness of Powders.—The United States Pharmacopœia designates five degrees of fineness—namely, *very fine*, when passed through a sieve of eighty or more meshes to the linear inch; *fine*, when passed through one of sixty meshes; *moderately fine*, through one of fifty meshes; *moderately coarse*, through one of forty meshes; and *coarse*, if passed through a sieve of twenty meshes to the linear inch. The fineness of powders is often conveniently described as being No. 20, etc., indicating that it has been passed through a sieve of that size (see page 605).

Compound Powders.—Since nearly all solid drugs may be obtained and kept in the state of powder, the pharmacopœias give special directions only for those powders which are composed of two or more ingredients. In preparing these it is generally advisable to reduce each substance separately to powder; the powders are then weighed out and mixed in a mortar, or are passed repeatedly through a suitable sieve. Some special observations will be made in connection with several official powders.

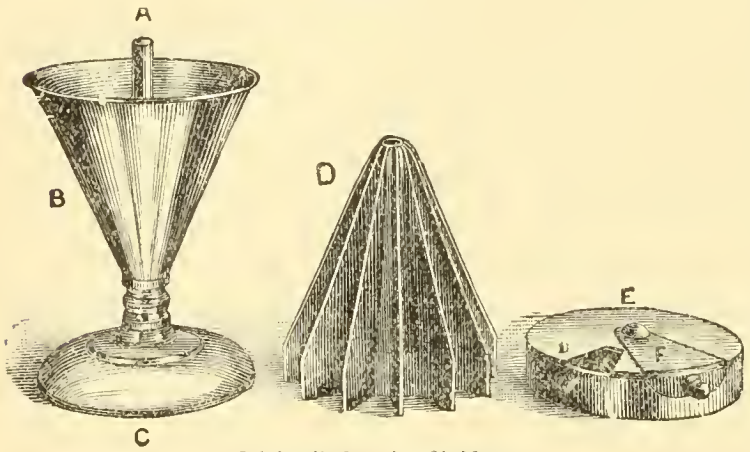
Mixtures of powdered charcoal or powdered rhubarb with calcined magnesia are likely to cake when made in a mortar with anything like pressure of the pestle; uniformity of mixture is readily obtained by stirring gently together and then passing repeatedly through a bolting-cloth sieve.

Dispensing of Powders.—In the majority of cases when powders are prescribed the ingredients are such as are kept on hand pulverized or in such a condition that they may be easily powdered by trituration in a mortar. The latter ingredients are then weighed out first, and rubbed fine before the powders are added. As in the case of pills, small quantities of toxic remedies are best triturated with some sugar of milk before mixing them with the other powders, so as to ensure more uniform distribution. Should soft substances, such as extracts, or liquids, such as volatile oils, be directed, they are triturated with the sugar which usually is a constituent of magistral powders until reduced to powder, when the other articles are added and well mixed. In most cases, perhaps, it will be of advantage not to use finely-powdered sugar, but to employ sugar in small lumps, which, while being rubbed to powder in the presence of the other ingredients, will tend to cause their still greater subdivision through the prolonged attrition. There are, however, occasional exceptions to the procedure as described, for in consequence of the elevation of temperature produced by the trituration chemical processes are likely to be induced which would interfere with the stability of the powder; such instances are the mixing of oxidizing agents like potassium chlorate with vegetable substances, which under the pressure of the pestle would cause an explosion; or the mixing of salts, which in the presence of a little moisture would result in liquefaction, as in triturating together lead acetate and zinc sulphate. Compound powders of this nature ought invariably to

be made by powdering the constituents separately in a mortar; if necessary, they should then be well dried, and finally mixed upon smooth paper with the aid of a spatula, without exerting any friction. Powders intended for external application by "dusting" should be dispensed in an impalpable condition if possible, and for this purpose are best passed through a bolting-cloth sieve of 110–130 meshes to the inch.

Powders are rarely prescribed in bulk, except when intended for external use; in nearly all cases they are divided by the pharmacist, each dose being dispensed in a separate paper. Fig. 234 represents a very ingenious apparatus for the accurate division of powders. The thoroughly mixed powder is placed in the metallic cup B, and after shaking down the metallic divider D is slipped over the rod A, and by slight manipulation is made to divide the powder into as many equal parts as wings are attached to the divider; the cap E having been placed over the cup, the latter is inverted, and the material in each division transferred to paper by means of the slide F. Very accurate and rapid work can be done with the divider. Deliquescent and volatile powders should be dispensed in parchment, paraffined, or waxed paper.

Fig. 234.



Michael's Powder-divider.

Administration.—Powders are generally taken suspended in water or in a liquid flavored with syrup or some pleasant aromatic. The nauseous taste will not always thus be disguised. To remedy this difficulty it has been customary in some countries to envelop the powder in a wafer of sufficient size and soften this by a brief immersion in water, when it may be swallowed without any inconvenience. *Cachets de pain*, or *wafer-capsules*, an elegant modification of this process, were introduced by M. Limousin (1873). The sheet wafer is punched into circular disks; these are dampened, and then pressed between two warmed plates of the desired shape, whereby they become concave on one side. A dose of the powder is placed on this side, the margin is very slightly dampened, and an empty disk is placed upon and fastened to it by sufficient pressure. Various apparatuses have been suggested for sealing the wafers. In taking such a wafer-capsule it is first dipped in water for a moment, then at once placed upon the back part of the tongue, and swallowed with a draught of water or other suitable liquid. Nauseous powders of small bulk are conveniently administered in unsealed gelatin-capsules, one of which is slipped over the open end of another one containing the powder (see page 768).

Granular Powders.—These are made in various ways. A method of granulating vegetable and similar powders was suggested by Dr. Thomas Skinner (1862), and is executed by triturating the powder with sufficient mucilage until a crummy non-adhesive mass is obtained, which is dried in thin layers, bruised, and separated by sieves into powders as desired; these granules may then be covered with tolu in the same manner as pills. Various saline mixtures, usually of an effervescing nature, have been granulated by powdering separately citric or tartaric acid, sugar, sodium bicarbonate, magnesium carbonate, etc., mixing them together by sifting, adding sufficient strong alcohol to render the mixture slightly damp and adherent, and rubbing with slight pressure through a No. 6 or other suitable sieve. After drying, the granules of the different sizes are separated by suitable sieves.

Preservation.—When perfectly free from moisture, vegetable powders may be preserved in hermetically-sealed vessels; but since they attract moisture on occasional exposure, it is much better to keep them in a dry place enclosed in vessels which will admit the air, but exclude the light. As a rule, such powders will be found to keep well in good paper boxes unless they contain volatile oil.

PULVIS AMYGDALÆ COMPOSITUS, *Br.*—Compound Powder of Almonds.

Confectio amygdalæ, Conserva amygdalarum.—Confection of almond, E.; *Conserve d'amandes*, Fr.; *Mandelconserve*, G.

Preparation.—Take of Sweet Almonds 8 ounces; Refined Sugar, in powder 4 ounces; Gum-Acacia, in powder, 1 ounce. Steep the almonds in warm water until their skins can be easily removed, and when blanched dry them thoroughly with a soft cloth and rub them lightly in a mortar to a smooth consistence. Mix the gum and the sugar, and, adding them to the pulp gradually, rub the whole to a coarse powder. Keep it in a lightly-covered jar.—*Br.*

Uses.—The compound powder of almonds is convenient for preparing almond mixture when mixed with water in the proportion of Gm. 75 in Gm. 500 (2½ ounces to a pint).

PULVIS ANTIMONIALIS, *U. S.*, *Br.*—Antimonial Powder.

Pulvis antimonii compositus, *Pulvis Jacobi.*—*James' powder*, E.; *Poudre antimoniale de James*, Fr.; *Jamessches Antimonpulver*, G.

Preparation.—Oxide of Antimony 33 Gm.; Precipitated Calcium Phosphate 67 Gm.; to make 100 Gm. Mix them intimately.—*U. S.*

Take of oxide of antimony 1 ounce; calcium phosphate 2 ounces. Mix them thoroughly.—*Br.*

The two formulas are practically identical. Antimonial powder is intended as a simplified substitute for a nostrum which has enjoyed considerable reputation in Great Britain and elsewhere for more than a hundred years. Another formula, formerly recognized as yielding a good substitute, requires the ignition of a mixture consisting of 1 part of antimonous sulphide and 2 parts of horn shavings by throwing this in small quantities into a red-hot crucible, powdering the product, and keeping again for some time at a red heat.

A somewhat similar preparation is known here as *Tyson's antimonial powder*, of which two kinds are sometimes employed. One, designated as No. 1, consists of antimonous oxide 10 parts and calcium phosphate 90 parts. No. 2 is made by triturating antimonous oxide 10 parts and potassium sulphate 45 parts into a fine powder, and adding 45 parts of calcium phosphate.

Action and Uses.—Antimonial powder acts in virtue of the oxide of antimony it contains, the phosphate of lime serving only to divide it minutely. Its action is essentially the same as that of tartar emetic, but slower in consequence of its inferior solubility. It is therefore less apt to act as an emetic than as a diaphoretic in *febrile states*. It may be given in *doses* of Gm. 0.20–1 (gr. iij–xv).

PULVIS AROMATICUS, *U. S.*—Aromatic Powder.

Pulvis cinnamomi compositus, Br.; *Compound powder of cinnamon*, E.; *Poudres des épices*, *P. des aromates*, *Poudre aromatique*, Fr.; *Gewürzpulver*, *Aromatisches Pulver*, G.

Preparation.—Ceylon Cinnamon, in No. 60 powder, 35 Gm.; Ginger, in No. 60 powder, 35 Gm.; Cardamom, deprived of the capsules and crushed, 15 Gm.; Nutmeg, in No. 20 powder, 15 Gm.; to make 100 Gm. Rub the cardamom and nutmeg with a portion of the cinnamon until reduced to a fine powder, then add the remainder of the cinnamon and the ginger, and rub them together until they are thoroughly mixed.—*U. S.*

To prepare 4 av. ozs. of aromatic powder use 613 grains each of Ceylon cinnamon and ginger and 262 grains each of cardamom and nutmeg.

Grated as finely as possible, the nutmeg is gradually added, with constant trituration, to the crushed cardamom-seed and a portion of the powdered cinnamon, and afterward mixed with the remaining powders. The British Pharmacopœia omits the nutmeg, and directs powdered cinnamon, cardamom, and ginger, of each 1 ounce, to be thoroughly mixed, sifted, and lightly rubbed in a mortar.

Pharmaceutical Preparations.—Confectio aromatica, Electuarium aromaticum.—Aromatic confection, *E.;* Electuaire (Confection) aromatique, *Fr.;* Aromatische Latwerge, Gewürzlatwerge, *G.*—Rub aromatic powder 4 ounces with clarified honey 4 ounces or a sufficient quantity until a uniform mass of the proper consistence is obtained. —*U. S.* 1870.

The absorption of the moisture by the vegetable tissue will render this confection gradually crummy, and necessitate the further addition of honey. If properly prepared, it will, though dry in appearance, become pliable and adhesive under the pestle.

Action and Uses.—Aromatic powder may be given internally for the relief of *nausea*, *flatulence*, *colic*, or *diarrhœa*, in the dose of Gm. 0.60 (gr. x) and upward, for

which purposes it should be mixed with syrup. The now disused aromatic confection was similarly employed. The powder is an excellent stimulant and anodyne in the cases named when it is applied enclosed in a flannel bag and saturated with a hot alcoholic liquor. In this way it is singularly efficient in allaying *nausea* and *colic*. Laudanum may be added to it in appropriate cases. Care should be taken to protect the linen from its stain, which is indelible. Instead of the official ingredients of this aromatic fomentation, the following will be found more efficient: equal parts of powdered cinnamon, ginger, allspice, and cloves, to which some add black pepper.

PULVIS CATECHU COMPOSITUS, *Br.*—Compound Powder of Catechu.

Preparation.—Take of Catechu, in powder 4 ounces; Kino, in powder, Rhatany-root, in powder, each 2 ounces; Cinnamon-bark, in powder, Nutmeg, in powder, each 1 ounce. Mix them thoroughly, pass the powder through a fine sieve, and finally rub it lightly in a mortar. Keep it in a stoppered bottle.—*Br.*

Uses.—This powder is especially useful in *diarrhœa* produced by debility or by cold after fever has subsided. *Dose*, Gm. 0.60–4 (gr. x–3j).

PULVIS CRETÆ AROMATICUS, *Br.*—Aromatic Powder of Chalk.

Confectio aromatica, Lond.—*Poudre de craie aromatique*, Fr.; *Gewürztes Kreidepulver*, G.

Preparation.—Take of Cinnamon-bark, in powder, 4 ounces; Nutmeg, in powder, Saffron, in powder, each 3 ounces; Cloves, in powder, 1½ ounces; Cardamom-seeds, in powder, 1 ounce; Refined Sugar, in powder, 25 ounces; Prepared Chalk 11 ounces. Mix them thoroughly, pass the powder through a fine sieve, and finally rub it lightly in a mortar. Keep it in a stoppered bottle.—*Br.*

Uses.—Aromatic powder of chalk is an excellent preparation for the cure of accidental *diarrhœa* produced by cold, or even by crude ingesta, provided that the offending substance has been discharged. As the symptoms corrected by chalk and those relieved by the aromatic powder are in a great measure independent of each other, the proportion of these ingredients should vary, and hence their association in fixed proportion and in an official formula is unnecessary. The *dose* of the preparation is Gm. 2–4 (grs. xxx–lx).

PULVIS CRETÆ AROMATICUS CUM OPIO, *Br.*—Aromatic Powder of Chalk and Opium.

Poudre de craie opiacée, Fr.; *Kreidepulver mit Opium*, G.

Preparation.—Take of Aromatic Powder of Chalk 9¾ ounces; Opium, in powder, ¼ ounce. Mix them thoroughly, pass the powder through a fine sieve, and finally rub it lightly in a mortar. Keep it in a stoppered bottle.—*Br.*

Uses.—This preparation is the same as the last, except that it contains 1 grain of opium in every 40 grains of the powder. It is therefore more efficient in the same class of cases. From Gm. 0.60–1.30 (gr. x–xx) may be given at a *dose*.

PULVIS CRETÆ COMPOSITUS, *U. S.*—Compound Chalk Powder.

Poudre de craie composée, Fr.; *Kreidepulver mit Gummi*, G.

Preparation.—Prepared Chalk 30 Gm.; Acacia, in fine powder, 20 Gm.; Sugar, in fine powder, 50 Gm.; to make 100 Gm. Mix them intimately.—*U. S.*

This has been introduced with the view of preparing from it the chalk mixture as wanted. It should always be made with *prepared chalk* as directed in the official formula, and not with precipitated calcium carbonate, as has been done at times.

Dose, from Gm. 1.30–4 (gr. xx–lx).

PULVIS EFFERVESCENS COMPOSITUS, *U. S.*—Compound Effervescing Powder.

Pulvis sodæ tartaratæ effervescens, Br. Add.; *Pulveres effervescentes aperientes; Pulvis aërophorus laxans*, P. G.; *P. aërophorus Seydlitzensis.—Aperient effervescing powders, Seidlitz powders*, E.; *Poudre gazifère purgative, Poudre de Sedlitz*, Fr.; *Abführendes Brausepulver, Seidlitzpulver*, G.

Preparation.—Sodium Bicarbonate, in fine powder, 31 Gm.; Potassium and Sodium Tartrate, in fine powder, 93 Gm.; Tartaric Acid, in fine powder, 27 Gm. Mix the sodium bicarbonate intimately with the potassium and sodium tartrate, and divide the mixture into 12 equal parts. Then divide the tartaric acid into 12 equal parts. Lastly, keep the parts, severally, of the mixture and of the acid in separate papers of different colors.—*U. S.*

The alkaline powder is usually put into a blue paper, each containing of sodium bicarbonate 2.58 Gm. (*U. S.; Br. Add.*) (2.5 Gm. *P. G.;* 2.0 Gm. *F. Cod.*), and of potassium and sodium tartrate 7.75 Gm. (*U. S.; Br. Add.*) (7.5 Gm. *P. G.;* 6 Gm. *F. Cod.*). The tartaric acid is wrapped in white paper, and weighs 2.25 Gm. (*U. S.*) (2.46 Gm. *Br. Add.;* 2.0 Gm. *F. Cod., P. G.*). On mixing the solutions of the contents of the two papers, Mr. Wm. Gilmour (1881) observed the formation of potassium bitartrate even in the presence of insufficient tartaric acid for producing neutral sodium tartrate; this effect is due to the liberated carbonic acid.

The mixture of Rochelle salt and sodium bicarbonate is known commercially as Seidlitz mixture: owing to its variable composition, as sold in the market, it is best prepared by the pharmacist himself, by mixing 1 part of sodium bicarbonate with 3 parts of Rochelle salt. The small wooden measures intended for dividing the saline mixture and acid are, as a rule, unreliable, and moreover the quantity of powder that can be compressed into these measures varies considerably with the condition of the atmosphere; hence the requisite quantities should be weighed for each paper, being 160 grains of Seidlitz mixture and 35 grains of tartaric acid.

Allied Preparations.—Pulveres effervescentes, *U. S.* 1870; Pulvis aërophorus anglicus. *P. G.*—Effervescing powders, Soda powders, *E.;* Poudre gazeuse, P. gazogène, P. aërophore, P. de Seltz, *Fr.;* Englisches Brausepulver, G.—Take of sodium bicarbonate, in fine powder 360 grains; tartaric acid, in fine powder, 300 grains. Divide each of the powders into 12 equal parts, and keep the parts, severally, of the bicarbonate and of the acid in separate papers of different colors.

Pulvis aerophorus, *P. G.*, is composed of 10 parts of sodium bicarbonate, 9 parts of tartaric acid, and 19 parts of white sugar. Each substance is finely powdered and well dried before the three are mixed, when the powder may be kept unaltered in well-closed vessels. But if these are opened, and from the deposition of moisture decomposition begins to take place, the change proceeds more rapidly in a closed than in an open vessel should the latter be kept in a dry and airy place. The powder keeps much better if granulated as described above. Either form of powder may serve as a vehicle for the convenient and pleasant administration of other medicines, such as salts of iron, quinine, etc., which should not be mixed with the sodium bicarbonate alone.

Action and Uses.—The compound effervescing powder is convenient for administering potassium and sodium tartrate in a state of effervescence. The acid powder should be dissolved in 1 or 2 fluidounces, and the saline in about 6 fluidounces, of water; the liquids should then be gradually mixed and drunk while effervescing. Seidlitz powders are very commonly employed to relieve moderate *constipation* and the *feverishness* that attends the first stage of many slight disorders, especially those produced by "taking cold" or by an imprudent and excessive use of food and alcohol. Like other saline laxatives, this one is more appropriate in warm than in cold weather. If a very active operation is desired, one and a half or even two pairs of powders may be given at once, or, on the other hand, they may be administered in divided portions as a febrifuge medicine.

The carbonic acid disengaged during the administration of soda powders is a direct stimulant to the stomach and nervous system, while it creates an agreeable sense of coolness in the abdomen. The sodium tartrate formed in the process is diuretic, antacid, and slightly laxative, and probably during *fever* is diaphoretic also. *Soda powders* are much used to relieve the feverish effects of imprudent eating and to remove constipation. Each powder should be dissolved in about 120 Gm. (f℥iv) of water, flavored with syrup if preferred, and the solutions, being mixed, should be taken while effervescing. In certain cases of *intestinal obstruction* due to fæcal accumulation enemata have been used consisting of the effervescing powders, dissolved and administered separately in a sufficient quantity of water (*Med. News*, xlviii. 293).

PULVIS ELATERINI COMPOSITUS, *Br.*—Compound Powder of Elaterin.

Preparation.—Take of Elaterin 5 grains; Sugar of Milk 195 grains. Rub them together in a mortar until they are reduced to fine powder and intimately mixed.—*Br.*

Action and Uses.—This preparation is a convenient one for the administration of elaterin. *Dose*, from Gm. 0.03–0.30 (gr. ss–v).

PULVIS GLYCYRRHIZÆ COMPOSITUS, *U. S., Br.*—Compound Powder of Glycyrrhiza (Liquorice).

Pulvis liquiritiæ compositus, P. G.; *P. pectoralis Kurellæ.—Poudre pectorale, Poudre de réglisse composée*, Fr.; *Brustpulver*, G.

Preparation.—Senna, in No. 80 powder, 180 Gm.; Glycyrrhiza, in No. 80 powder, 236 Gm.; Washed Sulphur 80 Gm.; Oil of Fennel 4 Gm.; Sugar, in fine powder, 500 Gm.; to make 1000 Gm. Rub them together until they are thoroughly mixed.—*U. S.*

To prepare 1 pound of compound liquorice powder use 2 av. ozs. and 385 grains of powdered senna, 3 av. ozs. and 340 grains of powdered glycyrrhiza, 1 av. oz. and 123 grains of washed sulphur, 30 minims of oil of fennel, and 8 av. ozs. of sugar.

Powdered senna 2 parts; powdered liquorice-root 2 parts; powdered fennel 1 part; washed sulphur 1 part; powdered sugar 6 parts.—*P. G., Br.*

The first formula has been adapted from that of the German Pharmacopœia, and is practically identical with it and with that of the British Pharmacopœia. The powder is of a greenish-yellow color. The British Pharmacopœia of 1867 omitted the fennel and sulphur.

The present official formula differs from that of 1880 in the use of oil of fennel in place of the fruit, and the increase of powdered liquorice-root accordingly; the quantity of oil is based on the assumption that prime fennel will yield 5 per cent. of volatile oil. We regard the change as a very desirable one, since the whole powder can now readily be passed through a No. 80 sieve, and will not assume a disagreeable odor by age, which sometimes occurs when it is made with powdered fennel.

Action and Uses.—This preparation is a mild but efficient aperient in the *dose* of Gm. 2–4 (gr. xxx–lx). A teaspoonful in a glass of water at bedtime for the relief of habitual *constipation*.

PULVIS IPECACUANHÆ ET OPII, *U. S.*—Powder of Ipecac and Opium.

Pulvis ipecacuanhæ compositus, Br.; *Pulvis ipecacuanhæ opiatus*, P. G.—*Compound powder of ipecacuanhæ, Dover's powder*, E.; *Poudre de Dower*, Fr.; *Dower'sches Pulver*, G.

Preparation.—Ipecac, in No. 60 powder, 10 Gm.; Powdered Opium 10 Gm.; Sugar of Milk, in No. 30 powder, 80 Gm.; to make 100 Gm. Rub them together into a very fine powder.—*U. S.*

To prepare 4 av. ozs. of Dover's powder use 175 grains each of powdered ipecac and powdered opium, and 1400 grains of sugar of milk.

In this formula the milk-sugar is directed to be used in a rather coarse powder; the fragments of the crystals, being very hard, serve to grind the vegetable powders still finer during the necessarily prolonged trituration. The German Pharmacopœia orders the same ingredients in the same proportions as given above, but directs all three to be separately very finely powdered, and then to be intimately mixed. Both these pharmacopœias have, without any urgent reason, substituted milk-sugar in the place of potassium sulphate, which was formerly employed in the same proportion, and is still ordered by the British Pharmacopœia. Both powders are of a pale-brown color and have the odor of opium, somewhat modified by that of ipecac; they differ but slightly in taste, that of the Br. P. being somewhat saline in addition to the bitter and nauseous taste of the other ingredients, which predominates in the powder prepared by the above formula. The Dover's powder of the French Codex is nearly the same as that originally used by Dr. Dover, the chief difference being the substitution of dry extract of opium for opium; it is composed of potassium sulphate and nitrate, each 40 parts, and dry extract of opium, ipecacuanha, and liquorice-root, each 10 parts, the whole to be made into a homogeneous powder.

Action and Uses.—Dover's powder contains in every 10 grains 1 grain each of opium and ipecacuanha and 8 grains of sugar of milk. Its physiological effects are sleep and diaphoresis. The latter is perhaps favored by the ipecacuanha, but is essentially produced by the opium. If Dover's powder has the advantage of readily causing diaphoresis, it has the disadvantages of sometimes producing nausea and leaving the mouth more pasty than opium does alone. A peculiar advantage of this combination is that it

ensures the slow solution and absorption of its active ingredients—an advantage lost in the so-called liquid Dover's powder.

This preparation is of peculiar value in the forming stages of *muscular rheumatism*, for if it occasions sweating it often terminates the attack. The use of hot drinks about an hour after the powder is administered will greatly promote its operation. A similar statement may be made of its use at the commencement of acute *inflammations*, such as coryza, sore throat, laryngitis, bronchitis, pleurisy, pneumonia, etc. It is of use in *hæmorrhage* from internal organs, and especially from the uterus; in *diarrhœa* from transient causes or from intestinal disease, as in typhoid fever, tuberculosis, dysentery, etc.; in profuse *sweats* from phthisis or other debilitating causes. It has been recommended in *diabetes*, *Bright's disease*, and *calculous affections*, but in them it is less appropriate than opium alone.

The ordinary *dose* of Dover's powder is Gm. 0.60 (gr. x), but in many cases doses only half as large, and repeated at longer or shorter intervals, are preferable. When full diaphoresis is desired the dose may be Gm. 1–1.30 (gr. xv–xx), and its operation may be promoted by hot drinks, thick bed-clothes, etc.

PULVIS JALAPÆ COMPOSITUS, *U. S.*, *Br.*—Compound Powder of Jalap.

Pulvis purgans, *Pulvis jalapæ tartaratus*, *Pulvis catharticus.—Poudre de jalap composée*, Fr.; *Jalapenpulver mit Weinstein*, G.

Preparation.—Take of Jalap, in No. 60 powder, 35 Gm.; Potassium Bitartrate, in fine powder, 65 Gm.; to make 100 Gm. Rub them together until they are thoroughly mixed.—*U. S.*

Take of jalap, in powder, 5 ounces; acid potassium tartrate, 9 ounces; ginger, in powder, 1 ounce. Mix them thoroughly, pass the powder through a fine sieve, and finally rub it lightly in a mortar.—*Br.*

Action and Uses.—This is an efficient hydragogue cathartic, particularly applicable to cases of hepatic and splenic obstruction with abdominal *dropsy*, and to other forms of dropsy in which the amount of the effusion constitutes an immediate source of danger. In the latter case the proportion of the bitartrate should be increased from 60 to 120 grains, and of the jalap to 10 or 15 grains. The *dose* of the compound powder of jalap is Gm. 0.60–2 (gr. x–xxx).

PULVIS KINO COMPOSITUS, *Br.*—Compound Powder of Kino.

Pulvis kino cum opio.—Poudre de kino opiacée, Fr.; *Kinopulver mit Opium*, G.

Preparation.—Take of Kino, in powder, $3\frac{3}{4}$ ounces; Opium, in powder, $\frac{1}{4}$ ounce; Cinnamon-bark, in powder, 1 ounce. Mix them thoroughly, pass the powder through a fine sieve, and finally rub it lightly in a mortar. Keep in a stoppered bottle.—*Br.*

Action and Uses.—This preparation is one of the many in which opiates and astringents are associated, and which are chiefly used in cases of excessive *gastric* or *intestinal secretion*, including *diarrhœa;* it is also employed in the various *dyspeptic* derangements for which kino itself is used, and for lessening the secretion of urine in *diabetes* and of perspiration in various forms of *hectic fever*. The *dose* is Gm. 0.30–1.30 (gr. v–xx).

PULVIS MORPHINÆ COMPOSITUS, *U. S.*—Compound Powder of Morphine.

Pulvis camphoræ compositus Tully.—Tully's powder, E.; *Poudre de Tully*, Fr.; *Tully'sches Pulver*, G.

Preparation.—Morphine Sulphate, 1 Gm.; Camphor, 19 Gm.; Glycyrrhiza, in No. 60 powder, 20 Gm.; Precipitated Calcium Carbonate, 20 Gm.; Alcohol a sufficient quantity. Rub the camphor with a little alcohol, and afterward with the glycyrrhiza and precipitated calcium carbonate, until a uniform powder is produced. Then rub the morphine sulphate with this powder, gradually added, until the whole is thoroughly mixed.—*U. S.*

This formula originated with Dr. William Tully of New Haven, Conn. The powder should be very carefully prepared, so that the morphine salt may be uniformly incorporated with the other ingredients. Owing to the volatilization of camphor, it is best to prepare the powder in a small quantity only, and to preserve it in a well-stoppered bottle kept in a cool place. Each grain of the mixed powders contains $\frac{1}{60}$ grain of morphine

sulphate, and practically ⅓ grain of camphor. We think the formula would look better if 20 Gm. of camphor and 19 Gm. of glycyrrhiza were ordered, instead of 19 and 20 as at present.

Action and Uses.—The evaporation of the camphor from this powder causes it to deteriorate constantly, and therefore to cease to be what it originally was. Doubtless, the combination of camphor and opium, as it is constantly used in nervous affections, with different proportions of the two ingredients, is a most valuable one, and is recognized as such in the ancient liquid preparation paregoric elixir. The addition to ordinary Dover's powder of whatever dose of camphor may be required for individual cases appears to us preferable to so unstable a preparation as this. The *dose* of it may be stated at Gm. 0.30–0.60 (gr. v–x).

PULVIS OPII COMPOSITUS, *Br.*—Compound Powder of Opium.

Preparation.—Take of Opium, in powder, 1½ ounces; Black Pepper, in powder, 2 ounces; Ginger, in powder, 5 ounces; Caraway-fruit, in powder, 6 ounces; Tragacanth, in powder, ½ ounce. Mix them thoroughly, pass the powder through a fine sieve, and finally rub it lightly in a mortar. Keep in a stoppered bottle.—*Br.*

This powder contains 10 per cent. of powdered opium.

Uses.—This powder contains the ingredients, in a dry state, of the confection of opium, and may be used for the same purposes. *Dose*, Gm. 0.10–0.30 (gr. ij–v).

PULVIS RHEI COMPOSITUS, *U. S., Br.*—Compound Powder of Rhubarb.

Pulvis magnesiæ cum rheo, P. G.; *P. infantum, s. P. antacidus.—Magnesia and rhubarb, Gregory's powder*, E.; *Poudre de rhubarbe composée*, Fr.; *Kinderpulver*, G.

Preparation.—Take of Rhubarb, in No. 60 powder, 25 Gm.; Magnesia, 65 Gm.; Ginger, in No. 60 powder, 10 Gm.; to make 100 Gm. Rub them together until they are thoroughly mixed.—*U. S.*

To prepare 4 av. ozs. of compound rhubarb powder use 1 av. oz. of powdered rhubarb, 2 av. ozs. and 263 grains of calcined magnesia, and 175 grains of powdered ginger.

The official magnesia being the light or bulky variety, it will be found very difficult to mix the powders uniformly if they are put into the mortar promiscuously: the better plan is to mix the rhubarb and ginger, and incorporate the magnesia in small quantities, gradually added, finally passing the whole mixture through a bolting-cloth sieve.

The British Pharmacopœia has adopted Dr. Gregory's formula: Powdered rhubarb 2 oz., light magnesia 6 oz., powdered ginger 1 oz.; the mixed powder is to be passed through a fine sieve. Mr. Gilmour (1881) observed that in order to render this powder readily miscible with water the rhubarb and ginger should first be triturated with about 5 per cent. of magnesium carbonate, and the calcined magnesia afterward added.

The formula of the German Pharmacopœia is as follows: magnesium carbonate, 60 parts; oil-sugar of fennel (1 drop of oil of fennel to 2 Gm. of sugar) 40 parts; powdered rhubarb 15 parts. Mix.

These powders, when freshly prepared, have a yellowish color, but on keeping gradually assume a reddish tint from the absorption of moisture and the reaction of the magnesia with the constituents of rhubarb; in the presence of water or of alcohol they become deep-red.

Action and Uses.—There does not appear to be any reason for the existence of this compound powder, the ingredients of which may very well be mixed extemporaneously in proportions adapted to the peculiarities of each case. It is a good laxative in cases of acid *dyspepsia* with constipation, and of *diarrhœa* with acid stools, especially as it is apt to occur in children. The *dose* for an adult is Gm. 1.30–4 (gr. xx–lx), and for a child Gm. 0.30–0.60 (gr. v–x).

PULVIS SCAMMONII COMPOSITUS, *Br.*—Compound Powder of Scammony.

Preparation.—Scammony Resin, in powder, 4 ounces; Jalap, in powder, 3 ounces; Ginger, in powder, 1 ounce. Mix them thoroughly, pass the powder through a fine sieve, and finally rub it lightly in a mortar.—*Br.*

Action and Uses.—The close resemblance of scammony to jalap in its mode of action in all useful respects, and its harsh and irritating operation in others, render the

conjunction of the two purgatives apparently superfluous. It is possible, however, that cases may occur in which the ruder action of scammony upon the bowels may be useful as a derivant from the brain. The *dose* of the powder is Gm. 0.60–1.20 (gr. x–xx).

PULVIS TRAGACANTHÆ COMPOSITUS, *Br.*—Compound Powder of Tragacanth.

Preparation.—Take of Tragacanth, in powder, Gum-Arabic, in powder, Starch, in powder, each 1 ounce; Refined Sugar, in powder, 3 ounces. Rub them well together.—*Br.* It is a white powder, having a sweet mucilaginous taste.

Pulvis gummosus, *P. G.*, is used for similar purposes, but has the following composition: Powdered gum-acacia 15 parts; powdered liquorice-root 10 parts; powdered sugar 5 parts. It is a yellowish-white powder, having the odor of liquorice-root, and a sweet, mucilaginous taste.

Uses.—It forms a dense mucilage used to suspend heavy powders, such as bismuth subnitrate, and is an excellent excipient powder in certain pill masses, notably those of freshly-formed ferrous carbonate.

PYRETHRUM, *U. S.*—Pellitory.

Pyrethri radix, Br., P. A.; *Radix pyrethri romani.—Pellitory-root*, *Pellitory of Spain*, E.; *Pyrèthre officinal* (Cod.), *Salivaire*, Fr.; *Römische Bertramwurzel*, G.; *Peritre*, Sp.

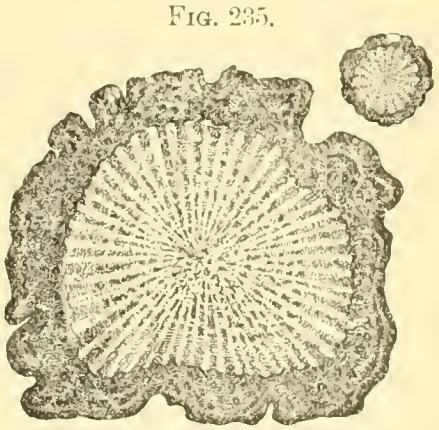
The root of Anacyclus (Anthemis, *Linné;* Matricaria, *Baillon*) Pyrethrum, *De Candolle.* Woodville, t. 20; Bentley and Trimen, *Med. Plants*, 151.

Nat. Ord.—Compositæ, Anthemideæ.

Origin.—Pellitory is a procumbent or ascending perennial which is indigenous to North-western Africa and is occasionally cultivated in gardens. It resembles the chamomile, but has broadly oval, three-toothed, white ray-florets tinged with red beneath, and compressed obovate akenes, which have a short denticulate pappus; those of the outer rows have also a narrow wing. The root is shipped from Algiers and Tunis to Italy and France, and large quantities are sent to India by way of Egypt.

Description.—Pellitory-root is nearly simple, 5–10 Cm. (2–4 inches) long, 6–15 Mm. ($\frac{1}{4}$–$\frac{3}{5}$ inch) thick, somewhat fusiform, and occasionally beset with a tuft of the hairy base of stem and leaves, annulate above, deeply wrinkled below, of a grayish or blackish-brown color externally and brownish-white internally. It breaks with a short fracture, and presents a bark about one-eighth the thickness of the root, and a radiated meditullium containing slender ligneous and medullary rays. The bark contains about two, and the medullary rays four or six, irregular circles of shining resin-cells. The root is inodorous, and has an aromatic and acrid taste, exciting a pricking sensation in the lips and tongue and a glowing heat.

Fig. 235.



Transverse sections, magnified three diameters, of the roots of —*a*, Anacyclus Pyrethrum, *D. C.*; *b*, Anacyclus officinarum, *Hayne.*

Constituents.—Pellitory-root was analyzed by John, Gautier (1823), Parisel (1832), and Koene (1835); its acridity appears to reside in a brown *resin* and in two *fixed oils*, one having a dark-brown, the other a yellow, color. Buchheim (1876) asserts that the active principle is an alkaloid, *pyrethrine*, which under the influence of alcoholic solution of potassa yields *piperidine* and *pyrethric acid*, resembling piperic acid. Pellitory yields about 5 per cent. of washed ether-extract, which has been called *pyrethrin* by C. J. G. Thompson (1886), and, like Parisel's pyrethrin, consists of resin and fat. The root contains considerable inulin, traces of tannin and volatile oil, mucilaginous matter, and other common constituents.

Allied Plants.—Anacyclus officinarum, *Hayne.*—German pellitory, *E.*; Pyrèthre allemande, *Fr.*; Bertramwurzel, *G.*—This plant (see Bentley and Trimen, 152) is not known in the wild state, but has been long cultivated near Magdeburg and in Saxony; some botanists regard it as an annual form of the above species, which it resembles in foliage and flowers, but the latter have a very convex disk. The root is only about 3 Mm. ($\frac{1}{8}$ inch) thick, has few rootlets, is externally brown-gray and internally dingy white. The bark is rather thick, and contains one irregular circle of rather large resin-cells; the meditullium consists of slender brownish wood-wedges and whitish medullary rays, which are free from resin-cells. The root is inodorous and agrees in taste with the preceding.

Chrysanthemum (Pyrethrum, *Bieberstein*) roseum and C. carneum, *Weber*.—Persian Pellitory, Persian insect-flowers, *E.;* Pyrèthre du Caucase (*Codex*), Camomille de Perse, *Fr.;* Persische Bertramblumen, *G.*—Both plants are hardy perennials, resembling chamomile in appearance, and indigenous to Western Asia from Persia to the Caucasus Mountains. The flowers are the parts employed, and are used in the form of powder for killing insects. The flower-heads are about 38 Mm. (1½ inches) broad, and have an imbricate involucre, with a brown scarious margin, a convex naked and solid receptacle, about twenty-four ray-florets, and a large number of yellow disk-florets. The ray-florets are ligulate, nerved, and three-toothed, the disk-florets tubular and five-toothed. The akenes are dark-brown, angular, not winged, and crowned with a short membranous pappus. The species roseum has rose-colored ray-florets and anthers included in the tube of the corolla, while C. carneum has purplish ray-florets, and anthers projecting with their appendages from the floret-tube. The flowers have a peculiar not very strong odor and an acrid taste. The flowers of Chr. cinerariæfolium, *Visiani*, of Dalmatia, possess similar properties, and if collected shortly after expansion are considered the most effectual. Hanaman and Koch (1863) ascribed the insecticide effects of the flowers to the volatile oil. Rother (1876) announced the isolation from insect-flowers of an oleoresinous acid, *persicein*, another acid resinous substance, *persiretin*, and the active principle, a readily soluble glucoside, *persicin*, yielding persiretin when boiled with acids. Semenoff (1876) obtained a volatile substance, probably an alkaloid, and Jousset de Bellesme (1876) regarded a crystalline *alkaloid* as the active principle. Textor (1881) found neither volatile oil nor alkaloid; he attributed the poisonous action to a soft resin, which is readily extracted by benzene, is soluble in alcohol and in potassa, is reprecipitated by an acid, and mixes readily with strong sulphuric acid, but is reprecipitated by a little water. Dal Sie (1879) believed a volatile crystallizable acid to be the active principle of Dalmatian insect-powder; but Hirschsohn proved (1890) that the effectiveness of the powder is not destroyed by age or by heat or by rendering it alkaline with ammonia; also that the petroleum-ether extract yields to alcohol a very acrid soft resin. We have observed the tincture of the flowers sometimes to produce a vesicular eruption.

Insect-powder being often adulterated with various substances, its quality, according to Kalbrunner (1874), is best ascertained by sprinkling 4 grains of it upon a fly contained in a vial, which should be stupefied in 1 minute and killed in 2 or 3 minutes. Experiments demonstrating the fatal action of Persian pellitory upon insects have been published by Carpenter (*Am. Jour. Phar.*, May, 1879, p. 246). For microscopical characteristics of the flowers see papers by G. M. Beringer (*Am. Jour. Phar.*, 1889, p. 1) and Jos. Schrenk (*Am. Drugg.*, 1889, March).

Chrysanthemum Leucanthemum, *Linné*, or *ox-eye daisy*, which is extensively naturalized in North America, is of no value as an insecticide.

Spilanthes oleracea, *Jacquin* (tribe Helianthoideæ).—Herba Spilanthis, *P. A.;* Paracress, *E.;* Cresson de Para, *F. Cod.;* Parakresse, *G.*—This annual is indigenous to South America, naturalized in India, and sometimes cultivated in gardens. The leaves and flower-heads are used. The former are opposite, pale-green or purplish, about 6.5 Cm. (2½ inches) long, ovate, three-nerved, rather obtuse, repand-crenate and rough on the margin. The flower-heads are about 12 Mm. (½ inch) broad, hemispherical, and have yellow, or in the centre brownish-red, tubular florets; the odor is rather unpleasant, the taste sharp and biting. Buchner (1831) attributed the acrid taste to a soft resin. Wolf (1859) isolated *spilanthin*, which crystallizes in needles, is insoluble in water, soluble in alcohol and ether, and is not precipitated by lead acetate.

Spilanthes Acmella, *Linné*, s. Acmella mauritiana, *Richard*, an annual East Indian herb with ovate, serrate, pellucid-punctate leaves, and small obconical yellow flower-heads, has a bitter balsamic afterward biting taste, and is used like the preceding species.

Pharmaceutical Preparations.—Pilulæ odontalgicæ, Toothache pills.—Powdered pellitory, belladonna-root, and opium, each 5 Gm.; yellow wax 7 Gm.; expressed oil of almond 2 Gm.; oil of cajuput and oil of cloves, each 15 drops. Make 500 pills and dust them with powdered cloves.—*P. G.*, 1872.

Alcoolature de Cresson de Para, Tincture of Spilanthes.—Fresh flower-heads of Paracress and alcohol, equal parts. Macerate for ten days, express, and filter.—*F. Cod.*

Tinctura Spilanthis composita, Compound tincture of Spilanthes, *E.;* Parakressentinctur, *G.;* also known as *Paraguay roux*.—Spilanthes herb 25 Gm.; pellitory 20 Gm.; alcohol 120 Gm. Digest for three days, express, and filter.

Medical Action and Uses.—Pellitory is a powerful irritant, and acts as a rubefacient upon the skin. When chewed it has an acrid taste, and excites a burning and pricking sensation in the mouth and fauces and a copious flow of saliva. A child three and a half years old one evening swallowed about 50 minims of tincture of pyrethrum. During the night no symptoms occurred except soreness of the tongue, restlessness, and profuse perspiration. At five o'clock the next morning diarrhœa commenced with pain, and at eleven the child lay in a semi-stupor, the pupils natural, the pulse 120 and feeble; twitching of the muscles of the limbs, the tongue swollen and of a drab color; no vomiting, but profuse diarrhœa with tenesmus, and involuntary evacuations of bloody mucus. At 12.30 violent convulsions, followed by profound stupor; at three o'clock and later tetanoid spasms and mental excitement, with incessant talking. The next morning the intestinal disorder and the spasms had subsided, but the pulse continued frequent for 2 days. Laudanum, wine, and coffee were administered, and ice was applied to the fore-

head and spine (Browne, *Practitioner*, xvii. 86). Its sialagogue properties have caused it to be used for the relief of *pains* about the *face* and *head*. Boiled in vinegar and applied to carious cavities in teeth, it is used to relieve *toothache*. In *paralysis* of the tongue or pharynx and in relaxation of the *uvula* it may be employed as a masticatory or in a gargle. Its powder has been recommended as a sternutatory in chronic inflammation of the *frontal sinuses*. Its *dose* as a masticatory is from Gm. 2–4 (grs. 30–60). The action and uses of *Anacyclus Pyrethrum* are identical with those of the officinal drug, but the former appears to be the more active of the two.

Every part of *Spilanthes* has an aromatic and acrid taste, which excites free salivation. In its native country it is used as a remedy for *gout*, *rheumatism*, and *gravel*, and also as a diuretic in *dropsy* and as a *vermifuge*. In Europe it has been chiefly employed for the relief of *toothache*, and for many years a tincture made from the plant has been in popular use under the name of *Paraguay roux*. When the aching tooth is hollow the tincture is applied to the carious cavity on cotton, otherwise it is painted or rubbed upon the adjacent gum. It does not act as an irritant upon the latter.

Leucanthemum vulgare, white-weed or field-daisy, is stated to be capable of producing a very intense and troublesome form of dermatitis in persons who are liable to be poisoned by other plants. It usually assumes the eczematous form, such as is produced by poison-ivy, ivy, etc. An interesting narrative of cases is given by Dr. James S. Howe (*Boston Med. and Surg. Jour.*, March, 1877, p. 227).

PYROGALLOL, *U. S.*—Pyrogallol.

Pyrogallolum, P. G.; *Acidum pyrogallicum.—Pyrogallic acid*, E.; *Acide pyrogallique*, Fr.; *Pyrogallol, Pyrogallussäure*, G.

Formula $C_6H_3(OH)_3$. Molecular weight 125.7.

A triatomic phenol obtained chiefly by the dry distillation of gallic acid. It should be kept in dark amber-colored vials.—*U. S.*

Pyrogallol was first obtained by Scheele in 1786 upon heating gallic acid, and was by him considered pure gallic acid. Gmelin pointed out the difference between the two substances, and Pelouze first showed that gallic acid when heated splits up into pyrogallol and carbon dioxide.

Preparation.—When gallic acid is heated with two or three times its weight of water for about half an hour at a temperature between 200° and 210° C. (392°–410° F.), under pressure in a suitable boiler, in such a manner that the liberated carbon dioxide can escape, a somewhat colored solution of pyrogallol is obtained: this is boiled with animal charcoal, filtered, and evaporated; when cool a scarcely colored crystalline mass is obtained, which is still further purified by sublimation. Or pyrogallol may be obtained by the direct sublimation of gallic acid (previously dried at 100° C.) in an oil-bath at 200° or 210° C. (392° or 410° F.); in this case the yield is rarely more than 25 or 30 per cent., while by the first process nearly the whole theoretical yield (about 75 per cent.) is obtained.

Properties and Tests.—Pyrogallol occurs in light white, shining laminæ or fine needles, odorless and having a bitter taste; on exposure to air and light they acquire a gray or darker tint. It is soluble at 15° C. (59° F.) in 1.7 parts of water and in 1 part of alcohol; very soluble in boiling water and in boiling alcohol; also soluble in 1.2 parts of ether. When heated to 131° C. (267.8° F.), pyrogallol melts, and may be sublimed unchanged. When ignited, it is consumed, leaving no residue. The aqueous solution, which is at first neutral and colorless, gradually acquires, by exposure to the air, a brown color and an acid reaction due to absorption of oxygen. The same change takes place very rapidly if the solution contains a caustic alkali. The aqueous solution (1 in 10) of pyrogallol reduces solutions of the salts of silver, gold, and mercury even in the cold. When freshly prepared, 1 Cc. of the aqueous solution (1 in 20) is colored brownish-red by a few drops of ferric chloride test-solution, and this color is changed to a deep bluish-black on the addition of 1 or 2 drops of ammonia-water. A bluish-black color is also produced in the aqueous solution of pyrogallol by freshly-prepared ferrous sulphate test-solution.

If lime-water be shaken with pyrogallol, the former assumes a purple color, which soon changes to brown and black, the mixture becoming turbid at the same time.

Derivative Compound.—Gallacetophenone, Gallactophenone, Trioxyacetophenone, Alizarin yellow *C.*—$C_6H_2.(OH)_3C_2H_3O$. This is a derivative of pyrogallol, in which a hydrogen atom has been displaced by the acetyl group, C_2H_3O. It is formed when a mixture of 1 part of pyrogallol

and 1½ parts each of zinc chloride and glacial acetic acid is heated for a short time to 145°–150° C. (293°–302° F.); upon adding water to the fusion while still hot, gallacetophenone separates, and may be purified by crystallization from boiling water. Thus obtained, it is a crystalline powder of dirty flesh-color and faintly acid or neutral reaction. Gallacetophenone requires 600 parts of cold water for solution, but is readily soluble in hot water, alcohol, or ether, and in all proportions in glycerin; it melts at 170° C. (338° F.).

Action and Uses.—*Pyrogallol* may act as an intense poison. Thus, in a case in which it was made into an ointment and rubbed freely into and bound upon the skin of a patient with psoriasis, it occasioned death in collapse, preceded by mucous vomiting and diarrhœa, rigors followed by fever, black and acid urine containing an abundance of globulin, and under the microscope the red corpuscles were found disorganized. Similar results were observed in experiments on animals by Neisser, who cautions those who may use the acid against corresponding dangers (*Zeitschrift f. klin. Med.*, i. 88). Besnier refers to four cases of psoriasis in which this acid produced toxical effects, and two ended fatally (*Med. News*, xlii. 128: on the dangers of employing this acid, see *Therapeutic Gazette*, ix. 59; x. 180). In some experiments upon dogs and rabbits with it changes are said to have been found in the liver identical with those produced by phosphorus-poisoning (E. Rousseau, *Inaug. Thesis.* Univ. of Penna., 1880). There does not appear to be any warrant for its internal use.

Pyrogallol was used with the best results, and without accident, in about 200 cases of *psoriasis* by Jarisch, and in a considerable number of these the application was made over a large portion of the body. It should not be applied too profusely to the diseased patches, and not at all to the sound skin (*Zeitschrift f. klin. Med.*, i. 631.). An ointment made with lard or with vaseline containing 10 per cent. of the acid was employed. But neither this nor any other topical application can effect a permanent cure of psoriasis, which is only the external and local manifestation of a systemic disease. It, however, stands hardly second to chrysophanic acid as a remedy for psoriasis. It does not stain the hair or inflame the skin so much, although it colors the skin brown. It has the advantage, also, of being inodorous. Vidal used successfully, in the treatment of phagedenic *syphilitic* ulcers, an ointment made with 1 part of the acid to 5 of vaseline, and 1 part each of acid and of starch to 3 of vaseline. His results have been confirmed by Lermoyez and Hitier (*Bull. de Thérap.*, c. 403). In *lupus* the ointment is said to attack the diseased nodules only, causing them to become necrosed and fall out, while the adjacent skin is not injured. Schwimmer, however, does not claim for this treatment a permanent cure. He found it efficient in the superficial and diffuse, rather than in the deeper and more concentrated, forms of the disease; and he held it essential to follow the caustic by an application of mercurial plaster (*Philad. Med. Times*, xv. 145). It has been employed with advantage in the treatment of *leprosy*. According to Unna, its toxical action may be prevented by administering a mineral acid (hydrochloric) internally during the application of pyrogallol to the skin (*Edinburg Med. Journ.*, xxii. 377). In *epithelioma* the mode of action is the same in kind, but is slower and less complete (Jarisch, *Centralblatt f. Therapie*, i. 17). In the use of this preparation the dangers that may attend it should be borne in mind. A 20 per cent. ointment may be employed. Its action is apt to be hastened by the repeated application of warm poultices.

Gallacetophenone has been used as a substitute for pyrogallol on account of the poisonous qualities of the latter. It has been found useful in the treatment of *psoriasis* when applied in 10 per cent. solutions.

PYROXYLINUM, *U. S.*—Pyroxylin.

Pyroxylin, Br.; *Lana collodii.—Soluble gun-cotton, Colloxylin, Collodion cotton*, E.; *Fulmicoton soluble*, Fr.; *Kollodiumwolle*, G.

Preparation.—Purified Cotton 100 Gm.; Nitric Acid 1400 Cc.; Sulphuric Acid 2200 Cc.; Alcohol, Ether, Water, each a sufficient quantity. Mix the acids gradually in a glass or porcelain vessel and, when the temperature of the mixture has fallen to 32° C. (90° F.), add the purified cotton. By means of a glass rod imbue it thoroughly with the acids, and allow it to macerate, until a sample of it, taken out, thoroughly washed with a large quantity of water, and subsequently with alcohol, and pressed, is found to be soluble in a mixture of 1 volume of alcohol and 3 volumes of ether. Then remove the cotton from the acids, transfer it to a larger vessel, and wash it, first, with cold water until the washings cease to have an acid taste, and then with boiling water, until they cease to redden blue litmus-paper. Finally, drain the pyroxylin on filtering-paper, and

dry it in small, detached pellets, by means of a water- or steam-bath, at a temperature not exceeding 60° C. (140° F.). Keep the pyroxylin, loosely packed, in well-closed vessels containing not more than about 25 Gm., in a cool and dry place, remote from lights or fire.—*U. S.*

Take of cotton 1 ounce; sulphuric acid, nitric acid, each 5 fluidounces. Mix the acids in a porcelain mortar, immerse the cotton in the mixture, and stir it for three minutes with a glass rod until it is thoroughly wetted by the acids. Transfer the cotton to a vessel containing water, stir it well with a glass rod, decant the liquid, pour more water upon the mass, agitate again, and repeat the affusion, agitation, and decantation until the washing ceases to give a precipitate with barium chloride. Drain the product on filtering-paper and dry in a water-bath.—*Br.*

The French Codex has a similar formula, but somewhat different proportions: it directs the maceration of 55 parts of well-dried cotton in a mixture of 1000 parts sulphuric acid specific gravity 1.84 and 500 parts nitric acid specific gravity 1.42, which has been cooled to 30° C. (86° F.). The German Pharmacopœia directs a mixture of 1000 parts of crude sulphuric acid sp. gr. 1.830 and 400 parts of crude nitric acid sp. gr. 1.380; when cooled to 20° C. (68° F.), 55 parts of purified cotton are to be macerated in the mixture for twenty-four hours at a temperature of 15°–20° C. (59°–68° F.).

A large number of formulas for preparing collodion cotton have been published, many with the nitric acid replaced by a nitrate, and the sulphuric acid correspondingly increased in quantity. Such mixtures may be made to yield as good results as the mixture of the two acids, but, owing to the separation of crystalline sulphates, it is more difficult to imbue the cotton thoroughly and uniformly with the mixture. Mann (1853) found the following proportions serviceable for 1 part of cotton: 20 parts potassium nitrate and 31 parts sulphuric acid specific gravity 1.830 to 1.835, or 10 parts potassium nitrate and 33 parts sulphuric acid specific gravity 1.80; the mixture is cooled to 30° C. (86° F.), and the cotton macerated at the same temperature for not less than 1 day or more than six days. Good results will also be obtained with a mixture of 17 parts sodium nitrate and 68 parts sulphuric acid specific gravity 1.78, or of 34 parts sodium nitrate and 66 parts sulphuric acid specific gravity 1.80; the cotton is introduced after twenty-four hours and macerated for five days. Klie (1877) succeeded with proportions nearly identical with those of Mann's first formula.

In making collodion cotton it is essential that due attention be paid to the strength of the acids, or, if a nitrate is used, to its freedom from chloride; likewise, that the temperature be permitted to fall as indicated before the cotton, which should be free from fat, is introduced, and the cotton be thoroughly imbued with the acid mixture If introduced at too high a temperature, other insoluble compounds will be produced or the cotton will dissolve and portions not moistened with the liquid will not be acted on, and likewise remain insoluble. Small portions of the cotton may from time to time be examined, thoroughly washed with water, afterward with alcohol, pressed, and then examined as to their solubility in a mixture of ether and alcohol. When these are found to be soluble, the cotton is withdrawn or the whole mixture added to a large bulk of water, the cotton washed with water until free from acid taste, then pressed to free it from water, steeped in alcohol, and again pressed, after which it may be dried by exposure at a moderate temperature (25° C. *P. G.*). The yield is usually about 140 per cent.

Composition and Properties.—Pelouze (1838) obtained explosive compounds by treating cotton, hemp, and paper with strong nitric acid. In 1846, Schoenbein announced the discovery of *gun-cotton*, and in the same year Otto published a process for preparing it by maceration in fuming nitric acid. In 1848, Maynard employed *collodion*. That gun-cotton is a nitrated substitution-compound of cellulose was recognized at an early day, and that the weight of the product is greater than that of the cotton employed. At one time the theory was advanced that by the action of nitric acid on cotton one, two, or more hydrogen atoms in the cellulose were displaced by the group NO_2, and thus nitro-compounds formed, to which the name of mono-, di-, tri- nitro-cellulose, etc. was given. Later investigations have proven that true nitric ethers are formed, in which one, two, or more atoms of hydrogen have been displaced by a corresponding number of atoms of the nitric-acid radical. The terms cellulose, mono-, di-, tri-, penta-nitrate, etc. are now used to designate the different compounds. All cellulose nitrates give up nitric acid when treated with alkalies, and concentrated sulphuric acid displaces the nitric acid almost completely, even in the cold. The nitrates are also converted back into cellulose by the action of reducing agents, such as ferrous acetate, potassium hydrosulphide, or a solution of stannous chloride in caustic soda. The same change occurs when the nitrate is boiled

with ferrous sulphate and hydrochloric acid, the whole of the nitrogen escaping as nitric oxide if air be excluded, according to the following equation: $2C_6H_7(NO_3)_3O_5 + 30HCl + 30FeSO_4 = C_6H_{10}O_5 + 6NO + 10Fe_2(SO_4)_3 + 5Fe_2Cl_6 + 12H_2O$. This plan may be used as a ready means of determining the amount of nitration of pyroxylin (Eder). In Germany the name "pyroxylin," which in England and this country is used to designate the soluble nitrates employed in the manufacture of collodion, is restricted to the insoluble and explosive variety better known as gun-cotton, and which is probably a penta- or hexa-nitrate; the name "colloxylin" is there given to the soluble varieties. When the mixture of nitric and sulphuric acids as directed in the official formula is allowed to act on cotton, one or more cellulose nitrates may be formed, dependent upon the temperature employed, the strength of the acids, and the length of time of immersion; the presence of sulphuric acid simply facilitates the elimination of water, which invariably accompanies the formation of ethers. The cotton is apparently not altered in structure and appearance, the staple remaining intact. Official collodion cotton is probably a mixture of cellulose dinitrate and trinitrate ($C_6H_8(NO_3)_2O_5$) and ($C_6H_7(NO_3)_3O_5$), both of which are soluble in a mixture of alcohol and ether.

Similar nitrated compounds are also obtained from other carbohydrates; thus starch yields with concentrated nitric acid a transparent jelly of *xyloidin*, $C_6H_9(NO_2)O_5$, and a similar change is produced in paper by dipping it into strong nitric acid and afterward washing with water.

Preservation.—When collodion cotton, particularly in the moist state, is kept in well-stoppered bottles, it undergoes decomposition, frequently accompanied with the evolution of nitrous vapors or with ignition and explosion. It is best preserved in a dry atmosphere and enclosed in vessels which permit the free access of air, but should never be compressed tightly.

Uses.—This article is not used medicinally.

QUASSIA, *U. S.*—Quassia.

Quassiæ lignum, Br.; *Lignum quassiæ*, P. G.—*Quassia-wood*, *Bitter-wood*, *Bitter ash*, E.; *Quassie amer*, *Bois amer*, Fr. Cod.; *Quassienholz*, *Fliegenholz*, G.; *Cuassia amarga*, Sp.

The wood of Picræna excelsa, *Lindley*, s. Quassia (Simaruba, *De Candolle*, Picrasma, *Planchon*) excelsa, *Swartz*. Bentley and Trimen, *Med. Plants*, 57.

Nat. Ord.—Simarubaceæ.

Origin.—This is a large tree common in the island of Jamaica and in some other West Indian islands. It attains a height of 18–24 M. (60 to 80 feet) and a diameter of .6–.9 M. (2 to 3 feet) and in aspect resembles the common ash. It has imparipinnate leaves, with short-stalked oval-lanceolate entire leaflets, and dense cymes of small white polygamous flowers, followed by black subglobular drupes of the size of a pea.

Description.—Jamaica quassia-wood is imported in billets varying in length from .9–1.8 M. (3 to 6 feet) and in thickness from a few to 25–50 Cm. (10 to 20 inches). It is usually deprived of the bark, is dense, tough, of medium hardness, yellowish-white in color, splitting lengthwise, coarsely splintery, and is frequently marked with irregular black lines or patches, due to the mycelium of a fungus. On a transverse section are seen a minute central pith, numerous narrow medullary rays composed of two or three rows of cells, wood-tissue containing large vessels, and irregular wavy concentric circles resembling annual rings. The wood is inodorous and has an intensely and purely bitter taste. In the shops it is usually found in raspings or chips, and the wood is turned into cups which are sold as *bitter cups* or *quassia cups*.

Constituents.—Winckler (1835) isolated the bitter principle *quassiin* or *quassin* from the concentrated decoction by precipitating pectin with lime, evaporating the filtrate, exhausting the residue with alcohol, mixing with ether, filtering, and evaporating spontaneously. A. Christensen (1882) prepared it by neutralizing the infusion of quassia with soda, precipitating with tannin, and decomposing the precipitate with lead oxide or lime. Quassin has the composition $C_{31}H_{42}O_9$ (Christensen)—according to Wiggers (1837) $C_{10}H_{12}O_3$. It crystallizes in thin rectangular plates, in small prisms, or in silky needles of a very bitter taste, is easily soluble in hot alcohol and in chloroform, sparingly soluble in ether and benzin, and dissolves slowly in cold water. Acids, alkalies, and certain salts increase the solubility of quassin in water. By treatment with warm diluted sulphuric acid it is converted into a resin and a compound which has the formula $C_{31}H_{38}O_9$, reduces silver nitrate, and is not precipitated by tannin. The yield of quassin is .05 to .15 per cent. Quassiin (*picrasmin*) was shown by Massute (1890) to represent two crystallized

principles—one, $C_{35}H_{46}O_{10}$, melting at 204° C. (399.2° F.), and the other, $C_{36}H_{48}O_{10}$, at 209°–212° C. (408.2–413.60° F.). The same author also isolated a small quantity of alkaloids, which dissolved with an ultramarine fluorescence in acidulated alcohol.

Allied Drugs.—Surinam Quassia, which is used on the continent of Europe, is the wood of Quassia amara, *Linné*, a large shrub or small tree indigenous to Surinam. It is met with in commerce in billets about 2–10 Cm. (1 to 4 inches) in diameter or in pieces not thicker than a finger; it has very fine, almost obscure, one-rowed medullary rays and smaller vessels, and is therefore apparently less porous; otherwise, it closely resembles the preceding. The German Pharmacopœia permits the use of this and the preceding variety of quassia.

Quassia-bark of Surinam is about .8–2 Mm. ($\frac{1}{30}$ to $\frac{1}{12}$ inch) thick, very fragile, externally of a gray color and nearly smooth, internally whitish and smooth.

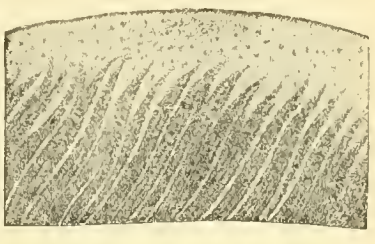
Quassia-bark of Jamaica varies from about 4–8 Mm. ($\frac{1}{6}$ to $\frac{1}{3}$ inch) in thickness, is externally blackish-gray, longitudinally furrowed and verrucose, and on the inner surface yellowish-white and smooth. When broken transversely the fracture is smooth in the outer and tough and fibrous in the inner layer; the latter portion is seen to be radially striate. Both quassia-barks are easily removed from the wood, with the bitter taste of which they agree.

Simaruba officinalis, *De Candolle*, a native of Guiana, Venezuela, and Northern Brazil.

Simaruba medicinalis, *Endlicher*, indigenous to Southern Florida, the West India Islands, and Central America. Bentley and Trimen, *Med. Plants*, 56. Simarouba, *Fr. Cod.;* Ruhrrinde, *G.;* Simaruba, *Sp.*

Simaruba-bark comes in curved or quilled pieces, varying in size. Its external surface is uneven, rough, and wrinkled, covered with a yellowish or brownish suberous layer, or, if this is removed, of a grayish-brown color. The coarsely fibrous bast-layer is thick and dull-brownish; the inner surface is of a lighter color and striate. The bark is very tough, and breaks with difficulty in a transverse direction, but may be longitudinally torn, the pieces remaining united by some of the long and tough bast-fibres. When cut transversely the outer tissue is seen to contain scattered brown-yellow granules consisting of groups of stone-cells, and the inner layer is radially striate in an oblique direction, caused by the long and wavy bast-wedges. Simaruba-bark is without odor and has a strong and persistent bitter taste. The bark of the second species is very similar to the one described, but is paler, usually thicker, of a light yellowish- or reddish-brown color, has a smoother inner surface, and is equally bitter. Simaruba-bark was analyzed by Morin (1822), and found to contain a little volatile oil, resin, traces of gallic acid, malate and calcium oxalate, and other salts. The bitter principle is not precipitated by lead salts; it was obtained as an extract-like mass, and is supposed to be identical with *quassin*.

Fig. 236.



Simaruba bark: transverse section, magnified.

Simaba cedron, *Planchon*, and Sim. ferruginea, *St. Hilaire*. These trees are indigenous, the former to Colombia and the latter to Brazil; they resemble the above, but have hermaphrodite flowers. All their parts are very bitter. The fruit is a pear-shaped drupe of the size of a hen's egg, and contains an oblong seed; the cotyledons are plano-convex, grayish or brownish, hard, inodorous, and very bitter. Lewy (1851) exhausted the seeds with ether, and afterward with alcohol, from which very bitter silky needles of *cedrin* crystallized. Tanret (1880) regards it as identical with his *valdivin*, obtained from the fruit of Simaba Valdivia, *Planchon*, by treating the alcoholic extract with chloroform and crystallizing from boiling water. Valdivin, $C_{36}H_{48}O_{20}.5H_2O$, melts at 230° C., is insoluble in ether, easily soluble in alcohol and chloroform, and soluble in 600 parts of cold water; this solution foams on agitation. Alkalies decompose the principle, which is emetic.

Samadera indica, *Gaertner* (Niota pentapetala, *Lamarck*), is a medium-sized East Indian tree, all parts of which are very bitter. The bark is red-brown, smooth, internally whitish dotted, and has a short and finely fibrous fracture. The fruit is obliquely ovate, compressed, and contains a brownish curved seed. De Vrij (1872) expressed from the seeds 33 per cent. of a light-yellow bitter oil which contains, according to Oudemans, 84 per cent. of olein and 16 per cent. of palmitin and stearin. The bitter principle *samaderin* was yellowish, and soluble in water and alcohol, and amorphous; Tonningen (1858) had obtained it from the seed and bark in white scales, which became yellow with nitric or hydrochloric acid and violet-red with sulphuric acid.

Cascara amarga, or Honduras Bark. Under this name a bitter bark has been introduced which has been referred to a species of Picramnia. It has a gray-brown, smoothish, thick cork, and is internally deep-brown, with numerous white dots of groups of stone-cells. F. A. Thompson (1884) obtained 4.5 per cent. of ash and 3 per cent. of impure amorphous alkaloid having a sweetish, afterward bitter, taste.

Action and Uses.—The bitterness of quassia is more intense than that of most other stomachic tonics: like them, it excites the appetite for food and quickens digestion, but if too long continued it produces derangement of the stomach. It may exhibit poisonous qualities, as in the following case: A concentrated infusion of the drug was by mistake given in enema to a child four years old. Within an hour the child became unconscious and collapsed, the head was thrown back and the pupils were contracted, the

respiration was inaudible, and the pulse could not be felt. It was restored by alcohol, ether, and ammonia (*Med. Record*, xviii. 404).

In debilitated states of the digestion quassia enjoys a merited reputation, especially in *dyspepsia* with regurgitation or vomiting of the food produced by an exhausted condition of the stomach and accompanied more or less frequently with sick headache. Especially is it of use in *gastric vertigo* when associated with sodium bicarbonate. In atonic *diarrhœa* due to irritation of the colon by accumulated feces the medicine is also beneficial. Quassia was once held to be a remedy for *lumbricoid worms*, which it is, partly because it improves the digestive powers. Enemas of infusion of quassia are efficient remedies for *oscarides* of the rectum.

The *dose* of the powder is stated at Gm. 1.30–2 (gr. xx–xxx), but it is seldom administered in this manner. The most appropriate form of the medicine is the infusion made with cold water. Quassin is best administered in pill made with the amorphous preparation and containing from Gm. 0.025–0.06 (gr. ss–j). Crystallized quassin is given in doses of Gm. 0.002–0.006 (gr. $\frac{1}{30}$–$\frac{1}{10}$). Campardon prefers the former, and states that the medicine does not occasion tolerance, and that its characteristic action is sometimes seen for a month after its disuse in salivation, increased flow of urine, and regularity of the stools.

QUERCUS ALBA, *U. S.*—White Oak; Oak-bark.

Cortex quercûs.—Écorce de chêne, Fr. Cod.; *Eichenrinde*, G.; *Corteza del encina*, Sp.

The bark of Quercus alba, *Linné* (*U. S.*), Q. Robur, *Linné* (*Br., P. G.*). Bentley and Trimen, *Med. Plants*, 248, 250, 251.

Nat. Ord.—Cupuliferæ.

Origin.—The oaks are shrubs or trees growing chiefly in the temperate zone, and often forming extensive forests. They have monœcious flowers, the staminate ones in slender and naked catkins, and the pistillate flowers either single or in small groups, and followed by a one-seeded nut, the *acorn*, which is enclosed at the base by a *cup* formed by the indurated scaly involucre. The leaves of some species are entire or nearly so, but most species have sinuately toothed or lobed or even pinnatifid leaves, which are coriaceous and evergreen or mostly deciduous.

The white oak is a stately tree, 18–24 M. (60 to 80 feet) high and 1.8–2.4 M. (6 to 8 feet) thick. It grows from Canada to Northern Florida, and west to Wisconsin and Eastern Texas. The wood is light-colored, strong, and durable; the leaves are sinuately-lobed, smooth, and on the lower side pale glaucous; the cup is saucer-shaped, tuberculate, and much shorter than the oblong acorn.

The European oak, which somewhat resembles the white oak, grows to the height of 30 or 40 M. (100 or 120 feet). Three varieties are known, which are regarded by some botanists as distinct species; in the variety pubescens the old leaves remain hairy, in sessiliflora they are smooth, and both have the pistillate flowers and fruit sessile, while in the variety pedunculata they are raised upon a long peduncle. The European pharmacopœias usually direct the bark to be collected from the branches or young stems.

Description.—The bark is collected early in spring, and is deprived of the greater portion of the longitudinally fissured thick suberous layer. It is in nearly flat pieces, about 5 Mm. ($\frac{1}{5}$ inch) or more thick, of a pale-brown color externally, with occasional patches of the gray scaly cork; the inner surface is somewhat lighter in color, and marked with short sharp longitudinal ridges, produced by the bast-bundles projecting from the shrunken parenchyma. The bark is tough, breaks with a coarse fibrous fracture, and has a faint tan-like odor and a strongly astringent taste. It is kept in the shops in the form of an irregular coarse and fibrous powder, which scarcely tinges the saliva. The tissue contains groups of stone-cells and crystals of calcium oxalate.

Oak-bark as used in Europe is in quills, the bark being about 2 Mm. ($\frac{1}{12}$ inch) thick; the outer surface is gray or brown-gray, glossy, and smooth or somewhat fissured; the inner surface is cinnamon-colored and somewhat rigid. The bark breaks with a smooth, and in the inner layer with a fibrous, fracture, and in odor and taste resembles the preceding.

Constituents.—The important constituent of oak-bark is tannin; gallic acid does not appear to be present. The tannin produces with ferric salt a dark blue-black precipitate, but it is not identical with gallotannic acid, since, according to Stenhouse (1842), it is incapable of being converted either into gallic or pyrogallic acid. This *quercitannic acid* is yellowish-brown, amorphous, yields a brown precipitate with lead acetate, and

was found by Stenhouse (1862) to yield sugar when boiled with dilute sulphuric acid. But, according to J. Löwe (1881), this tannin is not a glucoside; it is separated anhydrous, $C_{28}H_{24}O_{12}$, by saturating its solution with sodium chloride; it is almost insoluble in ether, but dissolves readily in acetic ether; it gives yellowish-white precipitates with gelatin, albumen, tartar emetic, and the alkaloids, and when heated with dilute acids under pressure yields *oak-red*, $C_{28}H_{22}O_{11}$. The infusion of oak-bark yields to ether a little gallic and ellagic acids. It is not known whether the tannins of the different oak-barks are alike. Bowman (1869) determined the amount of tannin in young white-oak bark, by means of gelatin, to be 11.21 per cent., and in the bark from older trunks only 6.34 per cent. Gerber (1843) obtained from the bark of the European oak a bitter principle which may also be present in the bark of other species. A decoction of the bark of older branches with very dilute sulphuric acid is mixed with lime, precipitated with potassium carbonate, evaporated, and extracted with alcohol, on the evaporation of which *quercin* remains behind in white bitter crystals.

Other Products of Oak. (See also GALLÆ, pp. 764, 765).

QUERCUS TINCTORIA, *Bartram* (s. Q. velutina, *Lamarck*). This is the *black oak*, the bark of which was formerly official, and is largely employed in the arts under the name of *quercitron-bark*. The tree grows from Canada and the New England States to Alabama and beyond the Mississippi. It has a close-grained and strong wood. The leaves are somewhat pubescent on the lower surface and bristle-pointed on the lobes; the cup is coarsely scaly, hemispherical, conical at the base, and covers fully one-half of the globular-ovate acorn. Gray regards it as a variety of Qu. coccinea, *Wangenheim*, the *scarlet oak*. The bark resembles that of the white oak, but the suberous layer, which is generally removed, is of a blackish-brown color, and the inner bark of a deep reddish-brown with a yellowish tint. Like the preceding, it is usually kept as a coarse powder; when masticated it tinges the saliva bright brownish-yellow, due to the presence of *quercitrin*, which has been met with in many plants. This is deposited from the decoction of black-oak bark on cooling, forms when pure a yellow crystalline, inodorous, and nearly tasteless powder, which is sparingly soluble in hot and nearly insoluble in cold water, dissolves in about 5 parts of alcohol, slightly in ether, is colored dark-green by ferric chloride, and dissolved in alkalies becomes dark-brown on exposure. Its formula is $C_{33}H_{30}O_{17}$ ($C_{36}H_{38}O_{20}$, Liebermann, 1879). Treated with acids, it splits into the crystalline unfermentable sugar *isodulcit*, $C_6H_{14}O_6$, and into *quercetin*, $C_{27}H_{18}O_{12}$ ($C_{24}H_{16}O_{11}$, Liebermann); the latter is likewise yellow and crystalline, is found ready formed in a number of plants, is colored dark-green by ferric chloride, precipitated brick-red by lead acetate, sublimable by alkalies resolved into phloroglucin and *quercetic acid*, $C_{15}H_{10}O_7$, and with fusing potassa yields protocatechuic acid.

QUERCUS FALCATA, *Michaux*, s. Q. elongata, *Willdenow*. This is the *Spanish oak* of the Southern and Middle United States. It has a reddish coarse-grained wood, and yields a thick bark rich in tannin.

QUERCUS NIGRA, *Linné*, s. Q. ferruginea, *Michaux*, is the *black jack* of the Middle and Southern States: it is a small tree, growing in barren soil, and is of little value.

QUERCUS VIRENS, *Aiton*, the *live-oak*, has a yellowish, very compact, and fine-grained valuable wood, and a bark rich in tannin. The live-oaks of the Pacific coast are Quercus chrysolepis, *Liebman*, Q. agrifolia, *Née*, and Q. oblongifolia, *Torrey*, the latter occurring principally in Southern California.

QUERCUS SUBER, *Linné*, the *live-oak*, grows in the basin of the Mediterranean, and has been introduced into the Southern United States. It has evergreen elliptic or ovate mostly sharp-toothed leaves, and produces an elastic suberous layer 3–5 Cm. (1¼ to 2 inches) thick, which is collected every eight or ten years and constitutes the cork of commerce. Kügler (1884) obtained from air-dry cork about .6 per cent. of ash rich in manganese, a little coniferin, about 5 per cent. of tannin and derivatives, and about 12 per cent. of chloroformic extract, including the crystallizable *cerin*, $C_{20}H_{32}O$; the fat *suberin* cannot be extracted by simple solvents, but is saponified by potassa, yielding glycerin and stearic and *phellonic acids*, the latter having the composition $C_{22}H_{42}O_3$. Finely-powdered cork has been employed as an absorbent dusting powder under the name of *suberin*.

SEMEN QUERCUS TOSTUM. Acorns are roasted in the same manner as coffee until they have acquired a brown color, when they are coarsely powdered. This is used as *acorn coffee* (Eichelkaffee, *G.*). According to Braconnot's analysis (1849), acorns contain starch, fixed oil, citric acid, uncrystallizable sugar, and another sugar which Dessaigne (1851) named *quercit* $C_6H_{12}O_5$.

Action and Uses.—In ancient times oak-bark was used in the treatment of *hæmoptysis* and *dysentery*, and pessaries made of the bruised bark were employed to restrain *uterine hæmorrhage*. The crushed leaves were applied to constringe relaxed parts. In modern times it has been resorted to for similar purposes, and also to cure *bronchial flux*. It has been maintained that persons who work in tan-pits are never attacked with *intermittent fever*, and that they enjoy a like immunity from *phthisis*. Externally, the decoction, which is official, has been applied to all the purposes of vegetable astringents; indeed, oak-bark is rarely used except in the form of decoction. Cases are reported in which vaginal injections of a decoction of oak-bark were followed by symptoms of peri-

tonitis (*Boston Med. and Surg. Jour.*, Oct. 1879, p. 523). It has been proposed to use the fluid extract of white oak for injecting hernial sacs (*Med. Record*, xxix. 388). *Suberin*, above referred to, is used as a dressing for *chapped nipples* and similar lesions in the same manner as lycopodium, to which it is preferable on account of its astringency. In many parts of England grated acorns are in common use by the rustic population as a medicine for diarrhœa, and roasted acorns, mixed with cocoa or with chocolate, are employed in like manner (*Amer. Jour. Phar.*, lviii. 597; *Therap. Gaz.*, x. 708). Fine cork is convenient for making compresses to arrest *hemorrhage*. This custom, which is a survival of ancient medicine, also prevails in various parts of France. Roasted acorns are likewise used for this purpose, as well as in the treatment of flatulent dyspepsia and of scrofula.

QUILLAJA, *U. S.*—Quillaja-bark.

Quillaia, U. S. 1880.—*Soap-bark*, E.; *Écorce de quillaya*, Fr.; *Seifenrinde*, G.; *Corteza de quillaya*, Sp.

The inner bark of Quillaja Saponaria, *Molina*.

Nat. Ord.—Rosaceæ, Roseæ.

Origin.—The tree yielding quillaja-bark is indigenous to Peru and Chili, and has evergreen, leathery, entire leaves, and small umbels of four diœcious flowers, producing five many-seeded capsules.

Description.—The bark comes in flat pieces, sometimes 60–90 Cm. (2 or 3 feet) long, several inches wide, and about 6 Mm. (¼ inch) thick. The thick brown corky layer is usually removed, small patches of it merely adhering to the outer surface, which is otherwise nearly smooth and pale-brownish white, like the inner surface. The bark is hard and tough, breaks with a splintery fracture, and shows upon transverse section a checkered appearance, due to the tangential arrangement of the light-brown bast-fibres and white bast-parenchyma, and to the white narrow radial lines of the medullary rays. The bark has no odor, but its dust is acid and sternutatory; it has a persistent acrid taste and its infusion foams like a solution of soap.

Constituents.—Quillaja-bark contains numerous minute crystals of calcium sulphate, a small quantity of starch, and considerable *saponin*. The latter principle was isolated from quillaja-bark by Le Bœuff (1850), and may be obtained by displacing the powder with hot alcohol and allowing the tincture to cool. The cold tincture retains some saponin in solution, together with resinous and oily matters, and, when evaporated and agitated with water yields a permanent emulsion. In its pure state saponin is a white amorphous powder which causes sneezing, is nearly inodorous, has a sweetish afterward acrid taste, is soluble in 4 parts of water, more soluble in weak than in strong alcohol, and insoluble in ether and volatile oils. Its aqueous solution is precipitated by baryta-water, the precipitate being soluble in pure water, but not in baryta-water (Rochleder). It has the composition $C_{32}H_{54}O_{18}$, and when treated with acids yields a saccharine body and a series of decomposition-products, the final one being *sapogenin*, $C_{14}H_{22}C_2$, a sparingly soluble, white crystalline compound. (See also Saponaria.)

Pharmaceutical Uses.—Extractum quillajæ, also called *quillaia*. Prepared with hot water, S. A. McDonnell obtained 20 to 25 per cent. of a brown not hygroscopic extract, of which 1 grain dissolved in 1 oz. of water will yield a tolerably permanent emulsion with 1 oz. of fixed oil or 1 drachm of oleoresin.

Emulsive Tincture, recommended by Nicot (1888), is prepared of quillaja 20 Gm., Tolu balsam 200 Gm., vanilla 5 Gm., the rind of two lemons, and 80 per cent. alcohol 1000 Cc.

Action and Uses.—Quillaja owes its name of soap-bark and the property of causing water in which it is macerated to froth to the saponin contained in it. In a case of poisoning by "quillajaic acid" the symptoms were rigors, epigastric cramp, cold sweats, tumors, transient syncope, a small pulse, moist skin, excessive vomiting, anxiety and distress referred to the præcordium, vesical tenesmus, and increased secretion of urine (Leselier, *Ther. Gaz.*, xi. 546). Like senega, quillaja has been found useful in *bronchitis* when the tenacious mucus provokes coughing, but it is less acrid to the taste, and therefore more acceptable than the former drug. It is less adapted to acute bronchitis than to the chronic forms or those incident to emphysema, dilated bronchia, etc. Quillaja has also been used with alleged advantage in *dropsy*, and is reported to be a sternutatory and useful in *coryza*, and also as a febrifuge. The powdered bark applied as a snuff, is said to have cured chronic *rhinitis* (*Therap. Gaz.*, xii. 720). It may be adminis-

tered in an infusion made with Gm. 32 in Gm. 500 (℥j in Oj) of water, to be taken during a day. The dry aqueous extract dissolves readily in water, and the solution may be employed for making emulsions of castor, cod-liver, and other oils. The external application of the bark appears to be the most important. It may be used instead of soap for washing the hairy scalp and other parts of the skin affected with *eruptions*, *ulcers*, etc., for removing the greasy coating which some skins exude, and for correcting the *fetor* which the feet, armpits, etc. in other persons exhale. For the latter purposes a saturated tincture may be added to water until it acquires the proper saponaceous quality. The tincture has also been used to promote the renewal of the hair in *alopecia* (*Phila. Med. Times*, xi. 29).

QUINIDINÆ SULPHAS, *U. S.*—Quinidine Sulphate.

Chinidinum (*Conchininum*) *sulfuricum.*—*Sulphate of conquinine*, E.; *Sulfate de quinidine*, Fr.; *Schwefelsaures Chinidin*, *Conchininsulfat*, G.

Formula $(C_{20}H_{24}N_2O_2)H_2SO_4.2H_2O$. Molecular weight 780.42.

The neutral sulphate of an alkaloid obtained from the bark of several species of cinchona. Quinidine sulphate should be kept in well-stoppered bottles in a dark place.

Nat. Ord.—Rubiaceæ.

Preparation.—The mother-liquors from the recrystallization of quinine sulphate yield on concentration a crop of crystals consisting chiefly of this salt, which is purified by treatment with animal charcoal and by recrystallizing it. On adding to the mother-liquors a considerable excess of ammonia, cinchonine will be precipitated and quinidine dissolved; the solution deposits the alkaloid quinidine, together with impurities, on the addition of soda. The alkaloid may then be dissolved in dilute sulphuric acid, and the salt purified by recrystallization. Since quinidine enters the mother-liquors containing the amorphous alkaloids, and is precipitated with chinoidine, it may be prepared from the latter, according to Hesse (1868), by exhausting it with ether, converting the dissolved alkaloids into sulphates, precipitating quinine and cinchonidine with Rochelle salt, purifying the filtrate with animal charcoal, and precipitating the quinidine with potassium iodide; the alkaloid is then liberated by ammonia, combined with sulphuric acid, and the salt crystallized.

Properties.—Quinidine sulphate (or of *conquinine*, according to Hesse) crystallizes in white, silky needles which resemble those of the quinine salt, but are less matted and do not effloresce on exposure even when heated to 80° C. (176° F.); when heated to 120° C. (248° F.) they part with their water of crystallization (4.6 per cent.), and on ignition are entirely consumed. The solution in dilute sulphuric acid shows the blue fluorescence of quinine solutions, and strikes an emerald green color on the successive addition of chlorine-water and ammonia, and a red color on the successive addition of chlorine-water, potassium ferrocyanide, and ammonia. The salt has also, like the corresponding quinine salt, a very bitter taste and a neutral reaction. It dissolves at 10° C. (50° F.) in 108 parts (Hesse), at 15° C. (59° F.) in 100 parts (U. S.), 98 parts (Kerner), and at the boiling-point in 7 parts of water; at 15° C. (59° F.) (*U. S.*) also in 8 parts and very soluble in boiling, alcohol, and in 14 parts of chloroform. The salt is freely soluble in hot alcohol, but is nearly insoluble in ether. The chloroform solution on evaporation leaves the salt in an amorphous state, and on exposure to diffused daylight gradually acquires a green color, but the alkaloid is not perceptibly affected thereby (Hesse, 1879). The aqueous solution yields with barium chloride a white precipitate which is insoluble in hydrochloric acid; with potassium ferrocyanide golden-yellow prisms or a yellow crystalline precipitate; and with potassium iodide from neutral solution, a white, and from acid solution a reddish-yellow, crystalline precipitate. When a drop of the solution is mixed with a drop of solution of potassium sulphocyanate, the microscope reveals groups of radiating feathery crystals; this quinidine sulphocyanate requires 1477 parts of water for solution. (For the characteristics of the alkaloid see page 490).

Fig. 237.

Quinidine Sulphate with KSCy: microscopic crystals.

Tests.—When heated on platinum-foil the salt should burn without leaving any resi-

due. Neither sulphuric nor nitric acid should impart any color to the dry salt. The thalleioquin test is applied by the Pharmacopœia as follows: "On treating 10 Cc. of an aqueous solution (about 1 in 1600) of the salt with 2 drops of bromine-water, and then with an excess of ammonia-water, the liquid will acquire an emerald-green color. With proper adjustment of the reagents, more dilute solutions will show a paler tint, while more concentrated ones will acquire a deeper color or deposit a green precipitate." De Vrij's (1878) test is applied as follows: A cold saturated, aqueous solution of the salt yields a white precipitate with potassium iodide test-solution (difference from quinine sulphate); dissolved in 50 Gm. of hot water, and 0.5 Gm. potassium iodide added, a sandy crystalline precipitate must fall, and after some hours the mother-liquor, on being tested with ammonia, should not produce an appreciable precipitate. "Quinidine sulphate should not impart more than a faintly yellowish tint to concentrated sulphuric acid (limit of readily carbonizable, organic impurities), nor produce a red color with nitric acid (difference from morphine). If a small quantity of ammonia-water be added to 3 Cc. of an aqueous solution of the salt saturated at 15° C. (59° F.), a white precipitate (quinidine) will be produced, which requires more than 30 Cc. of ammonia or more than thirty times its weight of ether to dissolve it (absence of more than small proportions of other cinchona alkaloids)."—*U. S.*

Allied Salts.—Quinidinæ bisulphas, Acid quinidine sulphate, $C_{20}H_{24}N_2O_2.H_2SO_4.4H_2O$; mol. weight 493. It is obtained by dissolving the sulphate in sufficient diluted sulphuric acid, and evaporating. It forms long colorless prisms of an asbestos-like appearance, soluble in 8.7 parts of water at 10° C. (50° F.) and losing 14.57 per cent. of water at 120° C. (248° F.).

Quinidinæ hydriodas, $C_{20}H_{24}N_2O_2HI$. It is obtained by double decomposition of neutral solutions of quinidine sulphate and potassium iodide as a white crystalline powder, or from warm and somewhat diluted solutions in colorless scaly prisms. It is slightly soluble in alcohol and in hot water, and requires at 10° C. (50° F.) 1270 part, of water for solution. The salt is anhydrous and contains 28.09 per cent. of iodine.

Quinidinæ bihydriodas, $C_{20}H_{24}N_2O_2(HI)_2.3H_2O$. It is prepared like the preceding salt, using however, a warm acidulated solution of quinidine sulphate. It forms an orange-colored crystalline powder or glossy golden-yellow prisms, turns brown-yellow at 120° C. (248° F.) from loss of water, which is absorbed again on exposure to moist air, and is soluble in 90 parts of cold water, and more freely soluble in alcohol and in hot water. The salt contains 8.5 per cent. of water and 43.77 per cent. of iodine.

Action and Uses.—As an antiperiodic in *malarial affections*, and as an antipyretic in *fever* generally, quinidine sulphate is equal to quinine sulphate, and may be used in similar doses. It has been thought less apt to disagree with the stomach and to cause unpleasant nervous symptoms (Peacock); on the other hand, "the greatest drawback to its use, especially with typhoid patients, is the subsequent vomiting which often occurs." Strümpell (*Practitioner*, xxiii. 128) makes this statement, but admits that it is not apt to occasion other disorders, especially of the nervous system.

QUININA, *U. S.*—Quinine.

Chininum.—*Quinine*, Fr.; *Chinin*, G.

Formula $C_{20}H_{24}N_2O_2.3H_2O$. Molecular weight 377.22.

An alkaloid obtained from the bark of various species of Cinchona. Quinine should be kept in well-stoppered bottles in a dark place.—*U. S.*

Preparation.—On precipitating a solution of quinine sulphate in acidulated water with an alkali, a curdy, amorphous, white precipitate is obtained, consisting of the anhydrous alkaloid, which if kept under the liquid is gradually changed to the crystalline hydrate of the above formula. It requires to be washed with distilled water and dried at a low temperature. The same hydrate may also be obtained from the solution of the alkaloid in diluted alcohol by crystallizing at a low temperature, while at 30° C. (86° F.) silky needles of anhydrous quinine are separated (Hesse). On concentrating a solution of quinine in ammonia-water the hydrate crystallizes. The precipitation of quinine should be effected without heat, and only a slight excess of ammonia should be used to prevent loss of the alkaloid.

Properties.—Hydrated quinine forms long, colorless, silky needles, or more frequently a white crystalline powder; the Pharmacopœia describes it also as flaky and amorphous. In dry air the crystals become opaque, and when kept over sulphuric acid it readily parts with $2H_2O$ (9.5 per cent.), but very slowly with the remaining 4.8 per cent. of water of crystallization. The alkaloid, like its salts, is inodorous, and has a persistently bitter taste, which, owing to its sparing solubility, is slowly developed. The

powder and its solutions in water and alcohol have an alkaline reaction. The hydrate melts at a temperature of 57° C. (135° F.); on continuing and slowly increasing the heat to 100° C. (212° F.) it loses a part of its water of crystallization (about 90 per cent.), and at 125° C. (257° F.) becomes anhydrous, turning solid, and melting again at 173° C. (343.4° F.): at a higher heat it burns slowly, without leaving any residue. Anhydrous quinine requires at 15° C. (59° F.) 1960 parts of water for solution, but the hydrate dissolves at 15° C. in 1670 parts (*U. S.*), at 20° C. (68° F.) in 1428 parts, and at the boiling-point in 760 parts, of water; these solutions on being evaporated between 60° and 80° C. (140° and 176° F.) separate the hydrate in the form of oily drops. According to Regnauld, quinine is soluble at 15° C. (59° F.) in 1.134 parts of absolute alcohol, in 1.93 parts of chloroform, and in 22.63 parts (16 to 25.5 parts, Hesse) of ether. It is soluble in 6 parts of cold and in 2 parts of boiling alcohol, in about 200 parts of glycerin, in 5 parts of chloroform, and in 23 parts of ether (*U. S. P.*); dissolves in carbon disulphide, dilute acids, and in fixed and volatile oils; also in benzin and benzene; the latter solution leaves on spontaneous evaporation a crystalline compound of quinine and benzene, which is decomposed at a moderate heat. The solutions turn polarized light to the left.

Quinine is a strong base, neutralizes the strongest acids, forming crystallizable salts, which, if soluble, have an intensely bitter taste, and displaces ammonia from its salts on being heated with their solutions. The acidulated solutions show a vivid blue fluorescence, which disappears on the addition of hydrochloric, hydriodic, and sulphocyanic acids and of thiosulphates. On passing chlorine gas into water containing quinine in suspension, the liquid acquires a reddish color, changing to violet and dark-red, and then becomes lighter, with the separation of a red compound (Pelletier). On treating 10 Cc. of an aqueous, acidulated solution (about 1 in 1500) of quinine with 2 drops of bromine-water (or chlorine-water), and then with an excess of ammonia-water, the liquid will acquire an emerald-green color. With proper adjustment of the reagents more dilute solutions will show a paler tint, while more concentrated ones will acquire a deeper color or deposit a green precipitate. The emerald-green is due to the production of *thalleioquin* or *thalleiochin* (Brandes), the color being observable in a solution containing $\frac{1}{5000}$ part of quinine; on carefully neutralizing the liquid the color changes to blue, and with an excess of acid to purplish or red; the addition of an excess of ammonia restores the green color. If to the quinine solution be added chlorine-water, then potassium ferrocyanide, and finally ammonia, a deep-red color is produced.

Quinine heated with glycerin to about 190° C. (374° F.) is converted into the isomeric base *quinicine*, which was discovered by Pasteur (1853), and may be obtained from most acid quinine salts by heating them to about 130° C. (266° F.); the salts of this base are readily crystallizable, are colored green by chlorine-water and ammonia, and yield with hypochlorites white precipitates which are turned green by ammonia.

Tests.—For the detection of other cinchona alkaloids the Pharmacopœia has adopted Kerner's test: "If 2 Gm. of quinine be mixed, in a small mortar, with 1 Gm. of ammonium sulphate and 10 Cc. of distilled water, the mixture thoroughly dried on a water-bath, the residue (which should be strictly neutral to test-paper) agitated with 20 Cc. of water, then allowed to macerate for half an hour at 15° C. (59° F.), with occasional agitation, and then filtered through a pellet of glass-wool, 5 Cc. of the filtrate, transferred to a test-tube and gently mixed, without shaking, with 7 Cc. of ammonia-water (specific gravity 0.960), should produce a clear liquid. If the temperature of maceration was 16° C. (60.8° F.), 7.5 Cc. of ammonia-water may be added; if 17° C. (62.8° F.), 8 Cc. (In each case a clear liquid indicates the absence of more than small proportions of other cinchona alkaloids.) Quinine should not impart more than a faintly yellowish tint to concentrated sulphuric acid (limit of readily carbonizable, organic impurities), nor produce a red color with nitric acid (difference from morphine)."—*U. S.* (See QUININÆ SULPHAS.)

QUININÆ BISULPHAS, *U. S.*—QUININE BISULPHATE.

Chininum bisulfuricum, Quininæ sulphas acidus.—Acid quinine sulphate, E.; *Sulfate acide (Bisulfate) de quinine*, Fr.; *Saures Chininsulfat, Chininbisulfat*, G.

Formula $C_{20}H_{24}N_2O_2H_2SO_4.7H_2O$. Molecular weight 546.88.

Quinine bisulphate should be kept in well-stoppered bottles in a dark place.—*U. S.*

Preparation.—Mix 100 grains of ordinary quinine sulphate with about 500 grains (9 fluidrachms) of warm distilled water; add to the mixture 115 grains of official diluted sulphuric acid; filter if necessary, and set aside in a moderately warm place to

crystallize; dry the crystals over sulphuric acid at a temperature of 10° or 15° C. (50°–59° F.), and preserve them in a well-stoppered bottle in a cool and dark place. The yield is 125 grains.

A solution of the salt may be prepared extemporaneously by dissolving 8 grains of quinine sulphate in water with the aid of 9 minims (or 9½ grains) of diluted sulphuric acid; the solution will contain 10 grains of acid quinine sulphate.

Properties.—The salt crystallizes in colorless rhombic prisms or plates, or it forms small needles which effloresce and become yellowish on exposure, are free from odor, and have a strong bitter taste and a decided acid reaction. At 25° C. (77° F.) it loses water, the crystals become opaque; but the last molecule of water is not expelled until heated to about 100° C. (212° F.). The salt fuses in a glass tube at 80° C. (176° F.) (*P. G.*), but heated in the air it melts near 135° C. (275° F.), and is converted into acid *quinicine sulphate*, which is easily soluble in alcohol and water, its solution in dilute sulphuric acid being yellow without any blue fluorescence, and crystallizes in long yellow prisms. According to Hesse (1873), acid quinine sulphate dissolves at 13° C. (55.4° F.) in 11 parts, and at 22° C. (71.6° F.) in 8 parts, of water, 10 parts of water at 15° C. (59° F.), *U. S.*, but it requires more alcohol (32 parts, *U. S.*) for solution, and is very soluble in both liquids heated to boiling. The solutions have a decided blue fluorescence, which may be observed in water containing $\frac{1}{100000}$ part of the salt. "On treating 10 Cc. of an aqueous solution (about 1 in 1000) of the salt with 2 drops of bromine test-solution, and then with an excess of ammonia-water, the liquid will acquire an emerald-green color. With proper readjustment of the reagents, more dilute solutions will show a paler tint, while more concentrated ones will acquire a deeper color or throw down a green precipitate."—*U. S.* The aqueous solution behaves with ammonia-water and barium chloride like quinine sulphate, giving white precipitates with both reagents, of which the former is easily soluble in excess of ammonia and twenty times its weight of ether, and the latter is insoluble in hydrochloric acid.

The pharmacopœial salt should not be confounded with the true *quinine bisulphate*, $C_{20}H_{24}N_2O_2(H_2SO_4)_2.7H_2O$, which is obtained from 100 grains of quinine sulphate and 350 grains of diluted sulphuric acid, the solution being crystallized over sulphuric acid. It contains 19.5 per cent. of water, readily acquires a brown-red color on exposure to light, is easily soluble in water with a strong blue fluorescence, and separates from boiling alcohol on cooling as a gelatinous mass, which on drying forms minute prisms.

Tests.—The salt should not impart more than a slight yellowish tint to sulphuric acid (absence of foreign organic matters), nor to nitric acid (morphine, brucine, etc.). Quinine bisulphate should not impart more than a faintly yellowish tint to concentrated sulphuric acid (limit of foreign organic matters). If 1 Gm. of the salt be dried at a temperature of 100° C. (212° F.), until it ceases to lose weight, the remainder, cooled in a desiccator, should weigh not less than 0.77 Gm. (corresponding to 7 molecules, or 23 (22.98) per cent. of water of crystallization).—*U. S.*, *P. G.* The aqueous solution should not be precipitated by silver nitrate (absence of hydrochlorate). The absence of an excess of other cinchona alkaloids is determined by Kerner's test, as follows: "If 2 Gm. of the salt, previously dried at 100° C. (212° F.), be agitated with 16 Cc. of distilled water, the mixture made exactly neutral to test-paper with ammonia-water, then brought to the volume of 20 Cc., and macerated at 15° C. (59° F.) for half an hour, upon proceeding further, as directed for the corresponding test under quinine (see QUININA), the results given for the latter should be obtained."—*U. S.* Or, "an intimate mixture of 1 Gm. of the salt and of 0.5 Gm. of ammonia-water is well dried on a water-bath, the residue treated with 10 Cc. of distilled water, and further tested with ammonia-water, as directed for Kerner's test."—*P. G.*

Uses.—When quinine sulphate is given in solution, it is generally converted into the bisulphate by the addition of aromatic sulphuric acid. The *dose* of the two salts is practically the same.

QUININÆ HYDROBROMAS, *U. S.*—QUININE HYDROBROMATE.

Chininum hydrobromicum, *s. hydrobromatum.*—*Bromhydrate de quinine*, Fr.; *Chinin-hydrobromat*, G.

Formula $C_{20}H_{24}N_2O_2HBr.H_2O$. Molecular weight 422.06.

Quinine hydrobromate should be kept in well-stoppered bottles in a dark place.—*U. S.*

Preparation.—This salt is prepared by double decomposition of quinine sulphate with barium bromide. A mixture of 100 grains of quinine sulphate and 1400 grains (3

fluidounces) of water is heated to boiling, and gradually mixed with a solution of 34 grains of barium bromide in 225 grains (½ fluidounce) of water; the precipitate is allowed to settle, and the clear hot liquid is tested for barium salt with a cold solution of quinine sulphate prepared without the aid of additional acid, and if free from barium is filtered and evaporated to crystallize. The yield is about 100 grains. Owing to the insolubility of barium chloride and the ready solubility of barium bromide in absolute alcohol, Boille (1874) recommends dissolving both the barium and the quinine salts in strong alcohol; the solutions are then mixed, taking care that the quinine sulphate is in slight excess; after filtering water is added, the alcohol distilled off, the liquid cooled, filtered from any quinine sulphate which may crystallize out, and evaporated to crystallize. If the salt be not quite white, it should be recrystallized from water.

The salt may also be prepared by dissolving quinine in warm diluted hydrobromic acid until the acid reaction has completely disappeared. Or, according to Hager, 100 parts of quinine sulphate and 27.5 parts of potassium bromide are well triturated with 100 parts of water; the mixture is moderately heated, mixed with 400 parts of alcohol, the whole digested for an hour, filtered while warm from the precipitated potassium sulphate, and crystallized. Leger's process (1880) is similar to this.

Properties.—Quinine hydrobromate is in "white, light, silky needles, odorless, and having a very bitter taste. The salt is liable to lose water on exposure to warm or dry air. Soluble at 15° C. (59° F.), in 54 parts of water and in 0.6 part of alcohol; very soluble in boiling water and in boiling alcohol; also soluble in 6 parts of ether and in 12 parts of chloroform. When heated at 100° C. (212° F.) the salt loses its water of crystallization (4.25 per cent.). At 152° C. (305.6° F.) it begins to fuse, and becomes a syrupy liquid at 200° C. (392° F.). Upon ignition it is slowly consumed, leaving no residue. The salt is neutral or has a faintly alkaline reaction upon litmus-paper. An aqueous solution, when acidulated with sulphuric acid, has a vivid, blue fluorescence. On treating 10 Cc. of an aqueous solution (about 1 in 1300) with 2 drops of bromine test-solution, and then with an excess of ammonia-water, the liquid will acquire an emerald-green color. With proper adjustment of the reagents more dilute solutions will show a paler tint, while more concentrated ones will acquire a deeper color or throw down a green precipitate. Ammonia-water added to the aqueous solution throws down a white precipitate soluble in an excess of ammonia-water, and also soluble in about twenty times its weight of ether. On precipitating a saturated aqueous solution of the salt with sodium hydroxide test-solution, filtering, supersaturating the filtrate with acetic acid, adding chloroform and a little chlorine-water, and shaking, the chloroform will separate with a yellow color. If 1 Gm. of the salt be dried at 100° C. (212° F.) until it ceases to lose weight, the residue should not weigh less than 0.957 Gm. (corresponding to 1 molecule, or 4.25 per cent. of water of crystallization)."—*U. S.*

Composition.—The U. S. Pharmacopœia formula requires 4.25 water, 18.89 bromine, and 76.61 per cent. of quinine. Boille (1874) found of these constituents respectively 4.80, 18.26, and 75.20 per cent., which closely corresponds with the official formula $C_{20}H_{24}N_2O_2HBr.H_2O$.

Tests.—"Quinine hydrobromate should not impart more than a faintly yellowish tint to concentrated sulphuric acid (limit of readily carbonizable organic impurities), nor produce a red color with nitric acid (difference from morphine). If 3 Gm. of the salt (which must have been previously ascertained to be strictly neutral or been rendered so) be mixed, in a small capsule, with 1.2 Gm. of crystallized sodium sulphate and 30 Cc. of water, the mixture thoroughly dried on a water-bath, the residue agitated with 30 Cc. of water, and then allowed to macerate for half an hour at 15° C. (59° F.), with occasional agitation, upon proceeding further as directed under quinine (see QUININIA) the results there given should be obtained."—*U. S.*

Allied Salts.—QUININÆ HYDROBROMAS ACIDUS. Acid quinine hydrobromate, $C_{20}H_{24}N_2O_2(HBr)_2.3H_2O$. Quinine sulphate is dissolved in water with the aid of sufficient dilute sulphuric acid, completely precipitated with a solution of barium bromide, avoiding an excess of the latter, the solution filtered from the barium sulphate, and evaporated to crystallize. This salt is soluble in 6 parts of water and is freely soluble in alcohol.

QUININÆ BROMAS. Quinine bromate, $C_{20}H_{24}N_2O_2.HBrO_3$, is prepared by C. A. Cameron (1882) either by neutralizing quinine with bromic acid or by precipitating barium bromate with quinine sulphate. It forms asbestos-like masses consisting of long needles, dissolves in 250 parts of cold water, freely in warm water, in diluted acids, and in alcohol; it is not decomposed at a moderate heat, but detonates in contact with strong sulphuric acid.

Action and Uses.—The acid quinine hydrobromate was introduced into prac-

tice, especially for hypodermic use, because it is more soluble in water than the acid sulphate, and probably less liable to produce abscess. This quality becomes important when quinine cannot be given by the mouth or rectum. Only in large doses can the bromine in its composition exert any sedative influence (Squibb). Thomas ascribes to it a sedative action of the circulation (*Loud. Med. Record*, Dec. 1885); and it may, perhaps, be admitted to possess special virtues in *nervous disorders* with debility, in the *typhoid state*, exhaustion from *dyspepsia*, *chronic discharges*, and the like (*Centralb. f. Ther.*, iii. 165). Its *dose* is about the same as that of the sulphate.

QUININÆ HYDROCHLORAS, *U. S., Br.*—Quinine Hydrochlorate.

Chininum hydrochloricum, P. G.; *Muriate of quinine*, E.; *Chlorhydrate de quinine*, Fr.; *Chininhydrochlorat, Salzsaures Chinin*, G.

Formula $C_{20}H_{24}N_2O_2HCl.2H_2O$. Molecular weight 395.63.

Quinine hydrochlorate should be kept in well-stoppered bottles in a dark place.—*U. S.*

Preparation.—This salt is best obtained by dissolving quinine in warm diluted hydrochloric acid until the solution is neutral, and crystallizing. On a small scale it may be prepared by double decomposition. A solution of 100 grains of quinine sulphate in hot distilled water is precipitated by a solution of 28 grains of crystallized barium chloride or of 15 grains of anhydrous calcium chloride; the filtrate is tested with quinine sulphate, evaporated to dryness, redissolved in diluted alcohol to separate calcium sulphate, and evaporated to crystallize. Rother (1883) recommends for the same amount of sulphate 13½ grains of sodium chloride and 350 grains (7½ fluidrachms) of alcohol; after sufficient digestion the filtrate is mixed with water and evaporated. The yield is 90 grains.

Properties.—Quinine hydrochlorate forms colorless needles, appearing white in mass, usually united to stellate groups, of a silky lustre, inodorous, and having a very bitter taste and a neutral (or faintly alkaline, *U. S.*) reaction. The salt is permanent in the air at low temperatures, but at a moderate heat effloresces, parting with a portion of its water, and at 120° C. (248° F.) loses all the water of crystallization, amounting to 9.08 per cent.; and when the heat is raised to about 156° C. (312.8° F.) the salt begins to melt, but is not fully melted until the temperature reaches 190° C. (374° F.). On ignition it is slowly consumed, leaving no residue. The crystallized salt requires at 10° C. (50° F.) 35 parts of water, at 15° C. (59° F.) 34 parts of water or 3 parts of alcohol (*U. S., P. G.*) for solution; it is also soluble in 1 part of boiling water and very freely soluble in boiling alcohol. The anhydrous salt forms a permanent solution with 1 part of chloroform, and differs in this respect from the concentrated solutions of the hydrochlorates of cinchonine and cinchonidine, which after a short time become thick and crystalline, owing to the formation of more sparingly soluble compounds of the salts with the solvent (Hesse, 1873). The solution in alcohol or water is free from fluorescence, and the slight one appearing on dilution is removed by the addition of sulphuric or other acid. The hydrochlorate being much more soluble in water than quinine sulphate, the latter salt is precipitated in needles on adding to a rather concentrated solution of the former a solution of a neutral sulphate. Quinine hydrochlorate on being exposed to the light gradually acquires a yellowish color, and should therefore be kept in a dark place. Its solution likewise becomes yellowish or brownish on keeping; with bromine- or chlorine-water and ammonia it yields emerald-green thalleioquin; with ammonia a white precipitate is produced, soluble in an excess of ammonia and in 20 parts of ether; and with silver nitrate a white precipitate is obtained soluble in ammonia, but insoluble in nitric acid.

Tests.—The salt on being ignited upon platinum-foil should burn without leaving any residue (absence of inorganic matter). Heated with milk of lime or with dilute potassa solution, the odor of ammonia should not be given off (ammonium salts). "If 1 Gm. of the salt be dried at 100° C. (212° F.) until it ceases to lose weight, the residue should not weigh less than 0.9 Gm. (corresponding to 2 molecules, or 9 per cent. of water of crystallization). Quinine hydrochlorate should not impart more than a faintly yellowish tint to concentrated sulphuric acid (limit of readily carbonizable, organic impurities), nor produce a red color with nitric acid (difference from morphine). The aqueous solution of the salt should not be rendered turbid by diluted sulphuric acid (absence of barium), and not be rendered more than slightly turbid by barium chloride test-solution (limit of sulphate). If 3 Gm. of the salt (which must have been previously ascertained to be strictly neutral or been rendered so) be mixed, in a small capsule, with 1.5 Gm. of

crystallized sodium sulphate and 30 Cc. of water, the mixture thoroughly dried on a water-bath, the residue agitated with 30 Cc. of water, and then allowed to macerate for half an hour at 15° C. (59° F.), with occasional agitation, upon proceeding further as directed under Quinine (see QUININA) the results there given should be obtained." —*U. S.*

Allied Salts.—QUININÆ HYDROCHLORAS ACIDUS. *Acid quinine hydrochlorate*, is either amorphous or in white or yellowish crystalline masses, which are very soluble in water and readily darkened by light.

QUININÆ IODAS. *Quinine iodate*, $C_{20}H_{24}N_2O_2.HIO_3$, according to C. A. Cameron (1882) is best prepared by digesting freshly-precipitated quinine in a molecule of iodic acid previously dissolved in 10 parts of warm water; the soft mass should be evaporated at 15.5° C. (60° F.) and dried over sulphuric acid. The salt is in minute white pearly needles, is readily soluble in alcohol, soluble in 700 parts of cold water, and is not decomposed by boiling water.

QUININÆ HYDRIODAS. *Acid quinine hydriodate*, $C_{20}H_{24}N_2O_2(HI)_2.5H_2O$. This salt crystallizes from a warm acidulated solution of quinine on the addition of potassium iodide. It forms glossy transparent prisms or scales, becomes opaque at 30° C. (86° F.), melts at 100° C. (212° F.) in its water of crystallization, and becomes completely anhydrous at 120° C. (248° F.); when exposed to a damp atmosphere the anhydrous salt combines again with $2H_2O$ (Hesse, 1865).

Action and Uses.—Quinine hydrochlorate was early made official by the Dublin Pharmacopœia, and Neligan (1854) remarked of it, "It is preferred by many practitioners to the disulphate, but is much more expensive, and the dose is the same." In 1855, Briquet, in his great work on *Cinchona*, said of it, "Being very liable to change by keeping, it cannot be depended upon, so that with good reason it is entirely disused." In the same year Trousseau and Pidoux mentioned the muriate along with several other salts as being inferior to the sulphates. In 1857, Pereira's *Materia Medica* said only that "it is employed in the preparation of the quinine valerianate." In 1864, Guibert merely stated that "German physicians set great store by this medicine;" and one of the latest German writers, Bernatzik, stated that its uses are those of quinine sulphate, and referred to its solubility and the relatively large proportion of quinine it contains. According to this authority, the dose should be one-sixth less than that of the sulphate, 100 parts by weight of quinine muriate containing as much quinine as 121 parts of the sulphate. Binz refers to pure amorphous quinine hydrochlorate as being especially adapted for subcutaneous injection, its advantages being not only that it is "very cheap," but that it dissolves in an equal weight of water, and as a rule does not give rise to abscesses. Probably it was for use in hypodermic injections that the salt was made official. MM. Beurmann and Villejean, after an exhaustive review of the subject, historically and clinically, concluded that the *neutral hydrochlorate* is the only salt of quinine that is free from the objections that lie against the other quinine salts for hypodermic use. It is soluble in two-thirds of its weight of water at ordinary temperatures, its solution does not undergo change, and it neither occasions pain nor causes inflammation (*Bull. de Thérap.*, cxiv. 193, 261). It has also been given by intravenous injection (Bacelli, *Med. News*, lvii. 314). From Gm. 0.12–0.24 (gr. ij–iv) may be stated as the average dose administered in this manner.

QUININÆ SULPHAS, *U. S., Br.*—QUININE SULPHATE.

Quiniæ sulphas; *Chininum sulfuricum*, P. G.; *Sulfas quinicus.—Sulphate of quinia*, E.; *Sulfate de quinine*, Fr.; *Chininsulfat, Schwefelsaures Chinin*, G.

Formula $(C_{20}H_{24}N_2O_2)_2H_2SO_4.7H_2O$. Molecular weight 870.22.

Quinine sulphate should be kept in well-stoppered bottles in a dark place.—*U. S.*

Preparation.—Take of Yellow Cinchona-bark, in coarse powder, 1 pound; Hydrochloric Acid 3 fluidounces; Distilled Water a sufficiency; Solution of Soda, 4 pints; Diluted Sulphuric Acid a sufficiency. Dilute the hydrochloric acid with 10 pints of the water. Place the cinchona-bark in a porcelain basin, and add to it as much of the diluted hydrochloric acid as will render it thoroughly moist. After maceration with occasional stirring for twenty-four hours place the bark in a displacement apparatus, and percolate with the diluted hydrochloric acid until the solution which drops through is nearly destitute of bitter taste. Into this liquid pour the solution of soda, agitate well, let the precipitate completely subside, decant the supernatant fluid, collect the precipitate on a filter, and wash it with cold distilled water until the washings cease to have color. Transfer the precipitate to a porcelain dish containing a pint of distilled water, and, applying to this the heat of a water-bath, gradually add diluted sulphuric acid until very nearly the whole of the precipitate has been dissolved and a neutral liquid has been obtained.

Filter the solution while hot through paper, wash the filter with boiling distilled water, concentrate till a film forms on the surface of the solution, and set it aside to crystallize. The crystals should be dried on filtering-paper without the application of heat.—*Br.* 1867.

The preparation of quinine sulphate from cinchona-bark involves the following processes: 1, extraction of the alkaloids in the form of a compound soluble in cold water; 2, precipitation of the alkaloids; and, 3, combination with sulphuric acid and separation of the various sulphates from one another and from coloring matter and other foreign principles. The alkaloids are easily extracted from the bark by water acidulated with hydrochloric or sulphuric acid, and are then in solution as hydrochlorates or sulphates. If an elevated temperature has been resorted to, derivatives of tannin and other principles will separate on cooling, and must either be filtered off or converted into insoluble compounds, which takes place on the addition of lime; this decomposes likewise the salts of the alkaloids, calcium chloride or sulphate being formed, while the alkaloids are precipitated, together with the excess of lime employed, and the kinic acid remains in solution as calcium kinate. The alkaloids are taken up from the lime precipitate by boiling alcohol, and left behind in an impure condition on the evaporation of the solvent. Soda cannot be profitably employed for precipitating the acid decoction unless it has been allowed to cool and filtered from the precipitate; or, still better, the bark is exhausted in the cold and the acid infusion rendered very slightly alkaline by caustic soda. The precipitate thus obtained will be less deeply colored than the residue left on the evaporation of the alcohol, as described before, and consists mainly of the mixed cinchona alkaloids. As obtained by one or the other process, the impure alkaloids are mixed with water, heat is applied, and sulphuric acid is dropped in, care being taken to leave a portion of the alkaloids and much coloring matter undissolved, which are removed by filtration; the hot filtrate may be treated with purified animal charcoal to remove remaining coloring matter, or even without this treatment will deposit crystals of the desired salt. If, however, sufficient sulphuric acid has been used to dissolve the whole of the impure alkaloids, the excess of the former has formed freely soluble sulphates, which would not crystallize on cooling. It is then necessary to remove not only coloring matter, but likewise the excess of sulphuric acid, which is accomplished by treatment with unpurified animal charcoal, the calcareous matter of which combines with the excess of the sulphuric acid, and on cooling the filtrate the same sulphate will crystallize that is obtained by the action of an insufficient quantity of the acid upon an excess of the impure alkaloids. The crystals of the first crop are neither sufficiently white nor free from other cinchona alkaloids, and require to be purified by three or four recrystallizations, when quinine sulphate, being the least soluble of the corresponding salts of the cinchona alkaloids, will crystallize first, leaving the coloring matter in the mother-liquor with the remaining alkaloids.

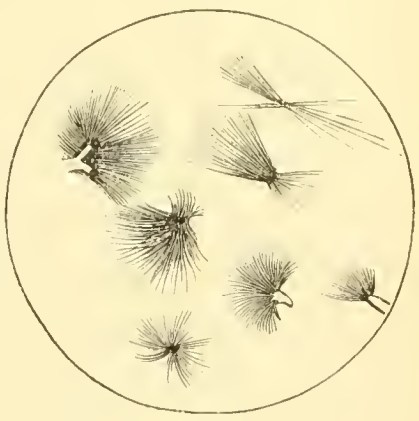
Numerous modifications of the processes described have been proposed, and are probably used by the manufacturers of cinchona alkaloids; and since it is often more economical, in the manufacture of quinine, not to use a costly bark rich in this alkaloid, but rather a cheaper one containing a smaller percentage of quinine, and in addition thereto a larger proportion of the other alkaloids, it is obvious that modifications of the processes will not unfrequently be found necessary. Of late years the so-called cuprea-bark (see page 485) has been extensively employed.

Instead of exhausting the bark with acidulated water, the natural combination of the alkaloids is sometimes broken up by a base, for which purpose ammonia, soda, and lime have been proposed. The two former remove tannin, kinic acid, cinchona-red, and other colored compounds, but at the same time dissolve a portion of quinine and the other alkaloids. By digesting the bark with lime-water some of the principles mentioned are dissolved, and the liquid may be utilized for preparing kinic acid; or milk of lime may be mixed with the powdered bark, and the mixture digested for some time, dried, and powdered. It contains then the calcium compounds of kinic acid, etc., which are nearly insoluble in strong alcohol and methylic and amylic alcohol, either of which solvents may be used in extracting the liberated alkaloids, which are then converted into sulphates and purified as stated above.

Properties.—Quinine sulphate crystallizes in thin, snow-white, flexible, inodorous, monoclinic needles, which form a loose, voluminous, and easily compressible mass, and have a silky lustre or frequently are somewhat opaque in consequence of superficial efflorescence. The salt has a persistent and purely bitter taste, and does not affect moist litmus-paper. A drop of a concentrated solution evaporated on the slide of a microscope crystallizes in stellate groups of thin needles or spikes. It effloresces rapidly on exposure to warm air, but absorbs moisture in damp air, and when kept over sulphuric acid loses all

except 2 molecules of water; the same loss occurs in dry air at a temperature of 20° to 60° C. (122°–174° F.). The remaining water, amounting to 1.60 per cent. of the effloresced salt, is expelled at and above 100° C. (212° F.), and rapidly absorbed again in a damp atmosphere at ordinary temperatures. Quinine sulphate should be kept in well-stoppered bottles, but when these are occasionally opened loss of water is unavoidable, and the salt becomes correspondingly richer in quinine. In the sunlight it acquires a yellowish color. At 160° C. (320° F.) it becomes phosphorescent on trituration, and at a red heat it is decomposed, and burns slowly without leaving any residue. It requires, according to Van Heijningen, 740 (according to Jobst and Hesse, 788) parts of water for solution at 10° C. (50° F.), and at the boiling temperature about 30 parts. The pharmacopœias state it to be soluble at 15° C. (59° F.) in 740 parts (*U. S.*), 800 parts (*P. G.*), of water and in 65 parts of alcohol (*U. S.*), and at the boiling temperature in about 30 parts (*U. S.*), in 25 parts (*P. G.*) of water, and in 3 parts (*U. S.*), in 6 parts (*P. G.*) of alcohol. It dissolves in 40 parts of glycerin, 680 parts of chloroform, and is nearly insoluble in ether. When anhydrous it requires 1000 parts of chloroform for solution. Ammonium chloride, potassium nitrate, and some other salts increase its solubility in water, while it is less soluble in the presence of sodium sulphate and magnesium sulphate or neutral tartrates. The solubility in water is very materially increased by most acids, owing to the formation of soluble acid salts. The solution in water is not fluorescent, but on the addition of sulphuric acid the characteristic blue fluorescence of quinine salts is observed. On adding to its solution an excess of chlorine-water or 2 drops of solution of bromine, followed by ammonia, an emerald-green color is produced; and if, after chlorine-water, potassium ferrocyanide is added, and then ammonia, the solution turns of a deep-red. (See QUININA.) Dissolved in distilled water, it yields white precipitates with barium nitrate or chloride and with ammonia, the former precipitate being insoluble in hydrochloric acid, while the latter is easily soluble in an excess of the reagent and in about twenty times its weight of ether. It is likewise precipitated by potassa and soda, their carbonates and bicarbonates, by lime-water, tannin, and the other general reagents for alkaloids, and it is incompatible in solution with acetates, tartrates, and with liquids containing iodine (potassium iodide and ferric salts). Its solution in water or dilute acid remains unchanged when kept in the dark, but exposed to sunlight it turns yellowish and brown. Flückiger (1878) named this brown product *quiniretin*, and found it to be of the same composition as quinine, but destitute of alkaline reaction, and, though soluble in acids, it is not able to neutralize them, and is not precipitated by tannin; it has, however, a bitter and somewhat aromatic taste.

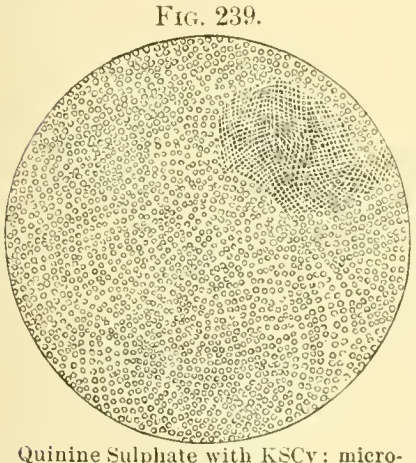
FIG. 238.



Quinine Sulphate: microscopic crystals.

Composition.—The formula of crystallized quinine sulphate has been given above; it is the one recognized by the pharmacopœias, and represents (in 100 parts) 74.31 anhydrous quinine, 11.24 sulphuric acid, and 14.45 water. It is *diquinine sulphate*, but was formerly often described as *neutral* or *basic quinine sulphate*. On drying the salt completely above 100° C. (212° F.) the residue, cooled in a desiccator, weighs theoretically 85.55 per cent., and is required to weigh not less than 85.6 (*Br.*), 85 (*P. G.*), 83.8 (*U. S.*) parts. The salt crystallizes from water with $8H_2O = 16.18$ per cent., which is the water permitted by the U. S. P., although the formula with $7H_2O$ has been adopted as the correct one. But, according to Kerner (1880), 16 per cent. of water indicates superficially adhering moisture, and, according to Jobst and Hesse, the salt should contain at most $7\frac{1}{2}H_2O$, or 15.3 per cent. After complete efflorescence the formula is $(C_{20}H_{24}N_2O_2)_2H_2SO_4.2H_2O$, and a salt of this composition will crystallize from alcohol in white permanent needles; it contains 82.87 per cent. quinine, 12.23 per cent. H_2SO_4, and 4.6 per cent. water of crystallization.

FIG. 239.



Quinine Sulphate with KSCy: microscopic granules.

Tests.—In examining the purity of quinine sulphate the following tests are of service: A drop of an aqueous solution of quinine salt

mixed with a drop of a solution of potassium sulphocyanate will at once become turbid, and under the microscope show a large number of minute globules, which even after a day are not aggregated into groups or crystals. According to Hesse (1878), quinine sulphocyanate is insoluble in solution of potassium sulphocyanate, and more soluble in water than quinine sulphate; the microscopic test must therefore vary with the quantities used; he also observed that the minute globules are usually followed in a few minutes by many-rayed stellate groups of needles. The test proposed by Liebig depends upon the greater solubility of quinine in ether as compared with quinidine, cinchonine, and cinchonidine; modified by Hesse (1878) it is very delicate: 0.5 Gm. of quinine sulphate is well agitated with 10 Cc. of water, warmed to between 50° and 60° C. (122° and 140° F.); after ten minutes the cooled liquid is filtered and 5 Cc. of it are slowly agitated with 1 Cc. (1 Gm., Rump) of ether and 5 drops of ammonia-water; after the separation of the ether both strata should be clear, even after the expiration of two hours. The Br. P. directs to recrystallize 100 gr. of the salt from 5 or 6 oz. boiling water with 3 or 4 drops diluted sulphuric acid. Use the mother-liquor for the test just described, and weigh any separated alkaloid, as *cinchonidine* or *cinchonine*. Shake the recrystallized salt with ether 1 fl. oz. and ammonia ½ oz., and add ethereal liquid from preceding test; now shake with caustic soda (10 per cent.) solution 1 fl. oz., adding water if solid matter separates; wash with ether, heat aqueous liquid to boiling, neutralize exactly with sulphuric acid, and cool, when *cupreine sulphate* will crystallize, resulting from the decomposition of *homoquinine* if present. *Quinidine* is separated as hydriodate from concentrated quinine solution by potassium iodide in the presence of a little alcohol.

Another test proposed by Hesse has been adopted by the German Pharmacopœia, as follows: 1 Gm. of quinine sulphate, on being warmed for a short time to between 40° and 50° C. (104° and 122° F.) with 7 Cc. of a mixture composed of 2 volumes of chloroform and 1 volume of absolute alcohol, should yield a perfect solution, which should remain clear after cooling. Sulphates of other cinchona alkaloids and various organic and inorganic impurities are thus detected. The following is a similar but less delicate test: 20 Cc. of absolute alcohol should dissolve 0.2 Gm. of the salt, forming a clear liquid. "Quinine sulphate should not impart more than a faintly yellowish tint to concentrated sulphuric acid (limit of readily carbonizable, organic impurities) nor produce a red color with nitric acid (difference from morphine). If 1 Gm. of the salt be dried at a temperature of 115° C. (239° F.) until it ceases to lose weight, the residue should not weigh less than 0.838 Gm. (absence of more than 8 molecules, or 16.18 per cent. of water). If 2 Gm. of the salt (which must have been previously ascertained to be strictly neutral to litmus-paper or been rendered so) be dried, as far as possible, at 100° C. (212° F.), the residue then agitated with 20 Cc. of water, and the mixture macerated for half an hour at 15° C. (59° F.) with occasional agitation, upon proceeding further as directed under Quinine (see QUININA) the results there given should be obtained (Kerner's test)."—*U. S.*

Medical History.—A knowledge of the curative powers of Peruvian bark was not due to sagacious prescience or scientific investigation, but to the simple facts that in the early part of the seventeenth century the Spanish conquerors of Peru learned its virtues from the native Indians, and that the countess of Chinchon was cured by it of a tertian fever. On her return to Spain she employed it on her lord's estates to cure the peasantry of the same disease (Markham). But learned bigotry condemned what unenlightened savages had discovered, and one religious body zealously spurned a priceless boon that had been introduced by another whose form of faith they derided. About the middle of the seventeenth century a large quantity of the bark was brought from America, and at a great council of the Jesuits at Rome was distributed to its members, who afterward carried it all over Europe; hence it was called Jesuits' bark. But it had still to encounter the sneers of the learned and the hate of bigots, and it was not until an English quack succeeded in curing by its means men of high rank that fashion broke down the prejudices which reason could not remove. Thenceforth cinchona was everywhere applied to the cure of malarial fevers and fevers of a typhoid type, as well as to various other diseases.

The discovery of the active principles of cinchona, imperfectly made by Duncan in 1803, was perfected by Pelletier and Caventou in 1820, as fas as regards quinine and cinchonine. Quinidine was discovered partially in 1833, but perfectly isolated in 1852. The introduction into practice of quinine and cinchonine dates from 1820–21.

Action and Uses.—The earlier experimenters with quinine upon the lower animals and upon man concluded that in small doses it acts as a stimulant of the nervous and circulatory systems, and in large doses as a direct sedative, producing general muscular and

cardiac debility, and, when poisonous doses are given, great acceleration of the pulse, coma, and stertorous breathing. After death the lungs and brain were found engorged with blood. Later investigations have confirmed these statements, but have also furnished minuter and more extensive information, according to which the action of quinine upon the economy may be described.

Whatever be the physiological explanation of the fact, there can be no doubt that in the greater number of experiments on man the pulse-rate falls under the *full* influence of quinine, whether in health or in disease, and that at the same time its force is diminished. This action is generally believed to be attended with a fall of *temperature* as its necessary consequence; but, although such is probably the case, it occurs by no means uniformly unless the dose be very large. In the latter case it appears to depend in part and on the one hand upon the slowness, and on the other hand upon the hurried and inefficient character, of the respiratory movements, as well as upon a like action of the heart. (Compare Sée et Rochefontaine, *Archives gén.*, Mars, 1883, p. 374.) In moderate doses quinine appears to stimulate the trophic centres and quicken tissue-change, but in larger doses it has the opposite effect. This conclusion is founded partly on the diminution of solids in the urine under the influence of quinine. The important sphygmographic experiments of Dr. Mary Putnam Jacobi upon a human brain exposed by an opening in the cranium confirms these statements, and prove that "by a tonic dose of quinine (5 grains) the energy of the cardiac systole is increased; the tonus and elasticity of the walls of the cerebral vessels are also increased, so that the blood is forced rapidly on through the capillaries, thus diminishing the resistance to the cardiac systole. More blood is admitted to the brain, but the intercranial pressure is lessened." But after a sedative dose of 20 grains there resulted "diminished energy of the cardiac contractions unfilled cerebral arteries, and great diminution in intercranial pressure."

Numerous observations concur in rendering it probable that in very large doses quinine may lessen the coagulability of the *blood*, and that this effect is sometimes produced by medicinal doses. Cutler and Bradford (1878) found that after a large dose of quinine sulphate there is in health a slight diminution of the red, and a marked increase in the number of the white, corpuscles. Hare (1886) found that in experiments upon himself 10 grains of quinine daily in divided doses caused a very considerable increase in the red blood-corpuscles. Binz and Ransonné state that while quinine does not alter the shape or size of the red corpuscles, it lessens their power of absorbing oxygen (Husemann, etc., *Die Pflanzenstoffe*, 1884, p. 1439).

When 5 or 6 grains of quinine sulphate are taken by an adult man at a single dose, or two or three times that quantity in the course of twelve hours, there is apt to be some heaviness and confusion of thought, headache, buzzing in the ears, vertigo, and unsteadiness of gait. Larger doses occasion, in addition, a sense of fulness, tension, and pulsation in the head; the face becomes suffused and animated; the eyes are bright; epistaxis sometimes occurs; the patient is restless and agitated, and complains of muscular twitching in the limbs. After several hours these phenomena are followed by some degree of exhaustion and a disposition to sleep, with slight torpor and muscular debility. If as much as 30 grains are given daily for several days, in divided doses, there may be observed great depression, apathy, somnolence, unsteadiness of gait, impaired sight and hearing, and dilatation of the pupils; the general sensibility is obtuse and the limbs tremulous. If, finally, the dose has been excessive, complete loss of consciousness may occur, the sight and hearing fail, the skin loses its sensibility, and the limbs their power of motion.

On the *respiratory organs* the primary action of quinine is stimulant, slightly increasing the rate of breathing. Poisonous doses occasion dyspnœa and noisy respiration, which is also jerking, interrupted, retarded, and finally arrested, death taking place with symptoms of asphyxia. In some cases the sputa have been bloody.

On the *digestive organs* small doses of quinine, as of all pure bitters, stimulate the appetite and digestion, but in large and continued doses it irritates the stomach and confines the bowels at first, although it may afterward cause diarrhœa.

The fact that when quinine cures intermittent fever it also contracts the *spleen*, if that organ is enlarged, is a familiar one.

Quinine is excreted with the *urine* to the extent of at least one-half and increases its amount. When given to a parturient woman it is found in the urine of the new-born child. It sometimes occasions irritation of the urinary passages, causing in different cases sexual excitement, micturition, retention of urine, and even hæmaturia. If irritation already exists in the bladder, quinine usually appeases it (*Therap. Monatsh.*, iii.

128). These facts tend to explain the occasional occurrence of *abortion* or premature labor in females taking very large doses of quinine for the cure of periodical fevers, particularly when the tendency to the accident is increased by general ill-health or malarial cachexia. There is more reason to apprehend abortion or premature labor from such causes than from the use of moderate doses of quinine, which rather tend to counteract their injurious action. When, under such bad conditions of health, labor sets in with feeble and ineffectual pains, quinine in moderate doses will, like other spinal nerve-stimulants, often render the contractions of the uterus more energetic and efficient. That there is no tendency in quinine to bring on contractions in the gravid and quiescent uterus has been proved by abundant experience. Burdel reports several cases which demonstrate that enormous doses of it can be taken without injury to the embryo and without shortening the duration of pregnancy, and is supported by experiments upon animals with young and near the end of gestation. Among the latter must be included the case of a gravid cat that died of direct poisoning by quinine without a sign of labor. A summary of the clinical experience bearing upon this subject has been prepared by Atkinson (*Amer. Jour. Med. Sci.*, Feb. 1890, p. 139), and it substantially justifies the conclusions now stated.

Quinine and cinchonine both occasionally produce erythematous or papular *eruptions* (urticaria, roseola) of the skin, which sometimes are followed by exfoliation of the cuticle. A very large number of cases illustrative of this subject have been published in the last few years.

Quinine in excessive doses may be dangerous, and even fatal to life. A description of the symptoms in one or two cases will include all that is important. In nine hours after 3 drachms of quinine sulphate had been taken at a single dose the patient, an adult male, lay motionless and pallid, the fingers were bluish and cold, and the whole surface cool, the respiration slow and suspirious, the pulse regular but slow, and hardly perceptible, the pupils widely dilated, the sight and hearing almost extinct, and the voice extremely feeble; the thirst was great, the tongue pale and moist, and the breath cold. In another case (Vorhies, *Trans. Amer. Med. Assoc.*, xxx. 411) a woman threatened with a congestive chill took more than 1300 grains of quinine within three days. On the second day she became blind. A week afterward she was extremely weak, almost pulseless, and barely able to comprehend questions, but her hearing was only slightly impaired. The face was pale, the conjunctiva anæsthetic, and there was no perception of light. The interior of the eyes showed no trace of blood-vessels. Three months later the condition of the eyes was nearly stationary, but the health in other respects was good. The ocular phenomena in this case are similar to those observed by Grüning, Michel, and others. It is said that no case of permanent blindness from quinine has been recorded (*Edinb. Med. Jour.*, xxvii. 942). But J. Marion Sims has related one concerning a lady who took 80 grains in a few hours (*N. Y. Med. Gaz.*, Oct. 22, 1881). A case is related by Grüning (*Med. Record*, xviii. 608) in which 80 grains of quinine produced deafness and blindness. The condition of the eye resembled that just described, and vision was not fully regained for several months. Others have been published by Michel and by Knapp (*Amer. Jour. Med. Sci.*, Oct. 1882, p. 616; *Practitioner*, xlv. 125; *Amer. Jour. Med. Sci.*, Oct. 1890, p. 398). It has been disputed whether the deafness due to quinine is accompanied by an anæmic or a congested state of the internal ear (*Boston Med. and Surg. Jour.*, Mar. 1883, p. 220), and the highest authority is upon the side of the latter opinion. It seems singular that the drug should congest the ear and anæmiate the eye. It indeed has been alleged that the eye is congested primarily by the medicine, but of this statement the evidence is insufficient (Roosa, *Med. Record*, xxiii. 145). Although it has been alleged that no case of death from quinine has occurred (Binz), sudden death was observed in four recorded cases of typhoid fever treated with quinine (Hardy, *Archives gén.*, Jan. 1883, p. 114); another in a case of pneumonia, and one in remittent fever (Baldwin, *loc. sup. cit.*); two cases also were reported by Kinner of St. Louis (*Med. News*, lii. 215). One, a child of eight years, died from taking 8 grains of this salt in two doses within three hours. In other cases partial loss of hearing or of sight has followed the use of the medicine, and lasted for several weeks. On the other hand, enormous doses have sometimes been used without any serious consequences. (For further illustration see *Jour. Amer. Med. Assoc.*, xiii. 433.)

Sensible physiological effects are seldom observed when the dose of quinine sulphate is less than 4 grains; those produced by a dose of 6 grains may be expected in about an hour, and by 15 grains in about a quarter of an hour. The duration of the sensible effects is in the direct ratio of the dose administered; those from 6 to 8 grains may last

for two or three hours, and from 15 grains for four or five hours. Larger doses maintain their action for a proportionately longer period.

Other things being equal, the functional disturbance is of shorter duration in children than in adults, but in old age they are apt to be both more decided and more prolonged. These facts depend probably upon the more rapid elimination of quinine by the kidneys in young than in old persons. It is more operative, in the same dose, in females than in males. Burdel, who studied the action on the new-born child of the milk of a woman who was taking quinine sulphate, states that he has known infants to be fatally poisoned in this manner. He holds, what is very probable, that the danger is greatest when the medicine is taken upon an empty stomach and during the first four or five months of the infant's life. He adds that when it becomes necessary to administer quinine soon after delivery the injurious effects upon the child may be prevented by giving it with the meals, and by emptying the mother's breast artificially three hours after its administration. Neither Dolan nor Bunge, on the other hand, could find any of the drug in the milk of a nursing woman who was taking it (*Practitioner*, xxvi. 57; xxvii. 168).

Like many other medicines, quinine is stimulant in small, but sedative in large doses; but it differs from other stimulants in the duration of its action, which is long sustained, and entitles it to be called a tonic stimulant. In the smallest medicinal doses it is purely tonic, in larger doses stimulant, and in the largest sedative, acting in each case upon the cerebro-spinal nervous system and through the ganglionic nervous system upon the heart. It possibly also modifies the vital elements of the blood, in large doses checking their development. It appears, therefore, that by its combined influence upon the nervous system and upon the blood it is capable of restraining all the processes which develop heat, organic changes, and muscular motion.

The experiments and observations made during the last century gave rise to a belief that cinchona had a special power of correcting or limiting putrefaction and fermentation, and hence it was employed as a specific remedy for all diseases in which these processes were conceived to be taking place in the blood. Among them were the continued and periodical fevers. Modern doctrines regarding these diseases involve a similar idea, and the efficacy of quinine in curing them is attributed to its power of destroying and disintegrating vibriones, bacteria, and analogous organisms. It is in fact "a powerful antizymotic" (Binz). 1 part of quinine dissolved in 20,000 parts of water will in a few minutes begin to enfeeble parameciæ, in two hours will destroy their vitality, and in a few hours more cause their disintegration. Quinine retards or arrests the alcoholic and other fermentative processes, including putrefaction and certain morbid ferments. This action it is claimed to possess upon diphtherial exudations and upon the sputa of pulmonary gangrene. Gieseler determined that fresh muscle could be preserved in a solution of $\frac{4}{5}$ of 1 per cent. of quinine sulphate, and Binz that such a solution exhibited more power of preventing the formation of new bacteria than in destroying those already existing. It appears probable that no amount of quinine capable of destroying micro-organisms in the blood of man could be taken by him without endangering life. Such, at least, is the conclusion of Vulpian and Rochefontaine, Baxter, Binz, Fickert, and others (Husemann, *Die Pflanzenstoffe*, 1884, p. 1437).

There appears to be some difference between quinine and cinchonine in their mode of action. Thus the latter is said to be more poisonous to frogs and dogs than the former. In man also cinchonine sulphate does not so speedily produce buzzing in the ears and disordered action, but, on the other hand, it more constantly occasions, and in smaller doses, a peculiar pain and sense of oppression in the frontal region, distress about the præcordia, subsultus tendinum, general debility, and faintness.

Malarial Diseases.—The antizymotic doctrine above described is thought to be supported by the power of quinine to prevent and cure malarial diseases, which are assumed to depend directly upon the introduction into the blood either of certain low and extremely minute organisms, or of a specific poison which accumulates in the system and tends to destroy its albuminous elements with the production of fever. This doctrine is at present only probable, perhaps only hypothetical, and yet none other so well explains the fundamental practical rule that the paroxysm of fever is not so much directly prevented by the primary action of quinine, whose phenomena are evident, as it is by the curative operation developed hours or even days after those sensible phenomena have disappeared. No medicine which operates simply by exalting or depressing the organic actions so distinctly possesses this peculiarity, which is difficult to comprehend except upon the supposition that its eliminative or antidotal action, and not its dynamical merely, is the chief agent in the cure of miasmatic diseases. Moreover, the efficient dose of

quinine in these diseases bears no relation to the sensible effects which it produces; indeed, in all simple intermittents, and in the great majority of other forms of periodical fevers, the cure is effected without the necessity of inducing the slightest degree of quinine intoxication. It is possible that in addition to the modes of action here alluded to quinine may be curative of malarial diseases by directly supplying to the blood that peculiar constituent upon which animal fluorescence depends, and which is found to be greatly diminished at least in chronic intermittent fever, and to regain its normal proportion as the patient renews his health (Rhoads and Pepper, *Penna. Hosp. Rep.*, 1868, p. 269; Binz, *Amer. Jour. of Med. Sci.*, Oct. 1881, p. 552). While, as we think, the specific antidotal power of quinine cannot be refused the chief place in the cure of periodical fevers, we must not lose sight of the fact that they were cured from the beginning of time down to the discovery of cinchona by a great number of agents, and they continue to be so cured even in cases where quinine has failed of its expected effect. It is equally certain that periodicity, and not malarial periodicity, is the essential condition of its curing a number of diseases which assume that type, as is more fully set forth in a subsequent paragraph. As stated elsewhere (see. OPIUM), the association of opium with quinine greatly augments its antiperiodic powers, especially in the acute forms of periodical fevers.

But whether the salts of cinchona act by modifying the powers of the nervous system or as antidotes to a material morbific cause, they are efficient in *preventing* as well as *curing periodical fevers*. Their power has been tested in all parts of the world; and it is now certain that a person under the impression of a dose of quinine or cinchonine, even within the limits of sensible cinchonism, may be exposed to malarial influences without danger. Indeed, a dose of from Gm. 0.12–0.30 (2 to 5 grains) once or twice a day has been found sufficient for this purpose. (Compare Graeser, *Therap. Monatsh.* iii. 377).

Formerly the notion prevailed that in order to render the treatment even of simple periodical fevers efficient the gastro-intestinal tube should be thoroughly cleansed by emetics and cathartics, and that sometimes mercury should be exhibited. Experience has proved that these methods, founded upon theory for the most part, are generally unnecessary and sometimes injurious, the conditions they are intended to remove depending mainly upon the malarial poisoning for which quinine is the specific cure. It may, as a rule, be administered without preliminary medication in the dose of from Gm. 0.30–0.50 (5 to 8 grains) during the intermission in *simple intermittents*. The result of a careful observation of different methods of administering the medicine has been clearly to prove that the antifebrile influence of quinine does not coincide with its physiological operation either in time or degree. A period of at least twelve hours should, if possible, intervene between the last dose of the medicine and the hour of the expected attack, and according to the severity of the paroxysms the dose should be large or small, single or divided. When once the paroxysms have been arrested, the medicine should be suspended until twenty-four or thirty-six hours before the seventh day, reckoning from the beginning of the last paroxysm, when it should be repeated in the original dose. At the next hebdomadal period it should be prescribed in half the quantity, and still further diminished in the third week. In *congestive intermittents*, while it may be necessary sometimes to employ depletion, evacuants, and revulsives and the stimulant shock of the cold dash, these and all other agents are comparatively worthless without quinine. It must be administered to the extent of not less than Gm. 2 (30 grains) during the intermission—by the mouth preferably, but if this cannot be, by the rectum, or hypodermically, or even intravenously—by the two latter methods in smaller doses. Immediate effects are not to be expected.

Hæmorrhagic malarial fever is alleged by Dr. McDaniel to be by no means as amenable to the treatment by quinine as other malarial fevers. From a large basis of observation by himself and others he draws the conclusion, "that quinine is not only not the effective and reliable remedy as is now widely taught, believed, and practised, but that it is, on the contrary, an uncertain, and even a dangerous, agent in this disease, and often seems to determine an unfavorable result" (*Medical News*, xliii. 561). This judgment, which is apparently borne out by the facts adduced in its support, is nevertheless impugned by Dr. Webb, a colleague of the reporter, who is also in full accord with the general medical experience of the region in which this disease occurs. Quinine sometimes appears to become efficient when administered hypodermically after its administration by the mouth has failed.

In *remittent fever* a preparatory emeto-cathartic treatment appears to be more distinctly indicated by the gastro-hepatic symptoms than in intermittent fever, yet observation

proves that in this case also the local disorders are under the control of the miasmatic poison, and that when it is eliminated or neutralized they cease. If the physician is able to choose his time, the medicine should be administered as soon as the remission sets in, and from Gm. 0.80–1.20 (12 to 18 grains) of quinine should be given in two or three doses at intervals of an hour; but if the paroxysm has already begun and if the symptoms are urgent, as occurs in the congestive forms of the disease, no time should be lost; the medicine should be administered in doses twice as large as those just named, and at shorter or longer intervals according to the duration of the remission. After control has been obtained over one paroxysm, the medicine may be exhibited in half the original doses, or less, for several periodical revolutions.

The prevalence of *yellow fever* in certain localities where periodical fevers also prevail gave rise to the grave error that its nature is the same as theirs, and that it may be cured by their specific remedy. The experience of competent judges has led to the following conclusions: 1. That quinine is not a specific for yellow fever, as it is for periodical fevers of every type; 2, that in mild cases, which would probably recover under good nursing and an expectant treatment, the medicine may sometimes hasten recovery; 3, that, on the whole, the results depending upon quinine are no better than—if, indeed, they are as good as—those of the treatment of symptoms which is sanctioned by general experience, and which the skill of the physician must modify to suit the genius of each epidemic of the disease.

Various *inflammatory affections* assuming a periodical type under the miasmatic influence are more successfully treated by quinine than by any other means. The more important of such affections are *pneumonia* and *dysentery*. In like manner, accidental periodical *hæmorrhages* have ceased under the influence of quinine, including even *epistaxis* (*Bull. de Thérap.*, xcvii. 373; *Med. Record*, xxi. 541).

Many functional disorders of the spinal nervous system assume more or less distinctly a periodical type, quite independently of a specific poison. Among these may be enumerated *spasmodic asthma*, *laryngismus stridulus*, *whooping cough*, periodical *palpitation of the heart*, *hiccough*, and, above all, *neuralgia*. In the last-named disorder, especially of the fifth pair, quinine divides with arsenic the honor of the greatest number of cures, especially in malarial cases and in fevers and other diseases of like origin. Cases of intermittent *paralysis* of the hemiplegic form, and also of periodical *aphonia*, have been cured by the same means; but they were miasmatic in nature. In these cases the operation of the remedy was generally stimulant and not sedative, since they were cured by comparatively small doses of quinine. But in some of the above, and still other affections of the nervous system, the cure has been brought about by large or sedative doses of quinine. Quinine was used in the treatment of *whooping cough* by Binz in 1870, and by Dawson of New York in 1873, but more generally since 1885, when Sauerhering (*Bull. de Thérap.*, cix. 372) gave it in small doses, in a dry powder with sugar, at intervals of two or three days. This method was pursued by Campbell of Montreal (*Med. News*, xlix. 301). Others, like Bachem (*Centralb. f. d. klin. Med.*, 1886) and Michael (*ibid.*), insufflated such powders into the nostrils, or, like Kohlmetz, injected these passages with a strong solution of quinine (*Deutsche med. Zeit.*, 1886); while others still gave large and frequent doses of the medicine to the production of intoxication (Parker, *Philad. Med. Times*, xvi. 710). It appears, therefore, that neither the mode of using it nor the dose of quinine has been uniform, and the data are insufficient for determining which one is preferable. Whether the medicine acts by destroying the specific cause of whooping cough or by its local action on the naso-pharyngeal mucous membrane is undetermined. The analogy of certain other remedies which have cured this disease appears to favor the latter view—viz. salicylic acid and the salicylates, carbolic acid, the exhalations of gas-works, the bromides, resorcin, nitrate of silver, etc. *Hay fever* has been treated successfully with injections into the nasal passages of a warm watery solution of quinine of the strength of from $\frac{1}{10}$ to $\frac{1}{8}$ of 1 per cent. At the same time, it should be given internally in doses of not less than Gm. 0.30 (5 grains) three times a day.

Hypodermic injections of quinine have been used with alleged, but unproved, advantage (*Centralbl. f. Ther.*, v. 571). The muscular debility and nervous excitability which often attend the second stage of *whooping cough* have been treated by bark or quinine ever since the time of Cullen. Quinine has been recommended in *influenza*, but the proofs of its utility are insufficient.

The curative effects of quinine in *sunstroke* are attested by numerous physicians, especially in the East Indies, where this accident is of more frequent occurrence than elsewhere. It is claimed that, whereas the mortality from heat-apoplexy in that country was

formerly more than 50 per cent., the success of the treatment by quinine has been constant. The medicine is most effectually administered hypodermically by several punctures, in each of which Gm. 0.10 (1½ grains) is introduced.

The history of the treatment of *acute articular rheumatism* by cinchona and by quinine is instructive, for it leads one to entertain serious doubts concerning the mode of action of these medicines. More than a century ago bark came into vogue for the cure of rheumatism, and was administered in doses representing not more than 2 or 3 grains of quinine, after depletion, emesis, and purgation. Until the introduction of quinine its efficacy was almost unquestioned, yet nothing can be plainer than that bark as formerly used can produce no such effects as quinine employed according to the fashion of the present day. The former could only act as a stimulant, the latter only as a sedative. This was the first disease in which the modern doctrine of treating febrile affections was applied—a doctrine which would seem to teach that disease is in its phenomena alone, and not in the organic condition out of which they spring. Enormous doses of the medicine were given, even to the amount of 200 grains in one day; but although far smaller and less poisonous doses were usually administered, and marvellous cures were fully set forth, the common sense of physicians revolted against the method, and it is now practically abandoned. Quinine, however, in tonic doses is of service in that condition of debility which is apt to follow or accompany the use of the most efficient treatment for acute articular rheumatism—the alkaline. It prevents the development of the scorbutic cachexia, and an increase of the weakness that denotes a tendency to such a result. It is also indicated, but less strongly, after the treatment by salicylic acid or the salicylates.

A precisely similar succession and antagonism of opinions to that which has just been sketched occurred in the history of the use of bark in *typhus*. Originally employed to counteract "putridity," it was used beneficially, because it acted as a stimulant, and was combined with other stimulants, as in the famous and still official "Huxham's tincture." In more recent times quinine was employed as an antiphlogistic and sedative in very large doses, and not a few witnesses were found to give the most positive testimony in its favor. That they were utterly mistaken is now certain. Quinine has not been shown to be of any service in typhus except at the critical stage, when a full *tonic* dose may reduce the pulse and give a favorable turn to the disease.

One of the latest and highest authorities in medical science uses the following language: Quinine does not put an end to an attack of *typhoid fever*, as it does to one of intermittent fever. In the first-named disease it has no specific operation, but only so weakens the putrid ferments that they run their career less destructively. . . . . When quinine is useless, the disease must either have assumed an exceptional and complicated form or the medicine must have been imperfectly administered (Binz). Liebermeister also denies its possessing any specific influence upon the disease or any power to arrest its course. The use of the medicine in typhoid fever rests upon the same erroneous ground as the employment of other antipyretics—an error which consists in treating fever as if it were absolutely limited by temperature and pulse-frequency, and as if nothing more essential lay behind these symptoms of the process. A few physicians continue to believe in the fitness of quinine for the treatment of typhoid fever—*e. g.* Pécholier (*Bull. de Thérap.*, cx. 479; cxii. 349), Hull (*Med. News*, xlv. 538), and Cleveland (*Med. Record*, xxx. 561); but the preponderance of opinion is entirely opposed to the medication (*ibid.*, p. 581), except in small doses and chiefly as a tonic during the decline of the attack; and by so high an authority as Jaccoud its use otherwise was pronounced dangerous (*Jour. de Méd.*, No. 20, 1888). The worst results of treating typhoid fever with quinine sulphate appear to be explicable by the large doses of it administered, as much as 35 or 40 grains for an adult man having been given in three or four doses within less than an hour. In December, 1882, Hardy called the attention of the Paris Academy of Medicine to the fact that within three months four cases of sudden death had occurred in the hospitals among patients treated with large doses of quinine (*Archives gén. de Méd.*, Jan. 1883, p. 114). It is also greatly to be apprehended that a portion of the quinine may reach and irritate the intestinal ulcers and increase the risk of perforation, one of the gravest dangers of the disease. The uselessness and occasional danger of large doses of the drug led Robin to recur to the original method of using it—that is, as a tonic. He recommends two doses only in the twenty-four hours, each from 4 to 6 grains (*Archives gén.*, Jan. 1888, p. 19).

What has been said concerning typhus and typhoid fever is equally applicable to *puerperal fever*, *scarlet fever*, *small-pox*, and *erysipelas*. There is very little doubt that

tonic and stimulant doses of quinine are serviceable in them, and that sedative doses of the medicine are mischievous. In each affection it is useful in proportion as the symptoms assume a typhoid character; thus it is advantageous in all cases of *septicæmia*, whether arising from primary blood diseases or from traumatic causes, but in this, as in the other affections enumerated, only in small and repeated doses. It has even been employed before and after surgical operations to prevent *septicæmia*, but evidently its influence, if any, would be extremely difficult to determine. This medicine has also been alleged to be more efficacious than any other in the radical treatment of *diphtheria*, but as yet satisfactory clinical proof of the statement has not been furnished. As a tonic in this disease its utility is generally recognized. The same may be said of its use in the treatment of *asthenic pneumonia*, and of *hectic fever* from whatever cause it may arise. In the numerous allied cases also of *profuse sweating* connected with general debility from exhausting diseases, whether during their progress or following their active symptoms into convalescence, quinine, especially with aromatic sulphuric acid, is one of the most reliable remedies that can be employed.

We have not in the preceding paragraphs alluded to the employment of quinine sulphate in purely inflammatory diseases—those of all others, one would suppose, which would illustrate the sedative virtues of the medicine. But neither in meningitis, pleuritis, pericarditis, or peritonitis, nor in any mucous inflammation, does it appear to have been put to the test. There remains *pneumonia*, which has long been the *pièce de résistance* upon which the virtues of active medicines have been tested. It has not escaped the administration of heroic doses of quinine. In Stockholm, Jürgensen (1871) stated that in a series of 200 consecutive cases twenty-four were fatal, or a mortality of 12 per cent. But his own statistics of the same city for 1851, when certainly the quinine treatment had not been devised, present a mortality of only 9.8 per cent., and in five of the sixteen years from 1840–55 the mortality was less than 12 per cent. This distinguished physician gave "in highly febrile states to an adult Gm. 5 (77 grains), and to a child under one year Gm. 1 (15 grains), and always in one dose." It is very desirable that a medicine as precious and costly as quinine should not be squandered, and it certainly seems to be wasted when it is administered so profusely and with no better results than these. In this country a similar, but a somewhat less extreme, method has been recommended by Palmer (1877), who gave, as near as possible to the beginning of the attack, from 6 to 10 grains of quinine with from ¼ to ⅓ grain of morphine, repeating the quinine in doses of from 4 to 8 grains once in from two to three hours, and continuing them until from 30 to 50, and sometimes 60, grains were given. Of this treatment we are told: "The effects desired, and certainly as a rule produced, are a decided reduction of temperature, a marked diminution in the frequency of the pulse, a decided moisture of the skin or free sweating, a slower and more easy respiration, or relief from pain and the feeling of fulness of the chest, a diminution of the cough and of the tenacious and bloody character of the expectoration; and, in short, not only is there a checking of the fever, but of all evidences, general and local, of the pulmonary engorgement and inflammation." These are very remarkable effects, and the statement of them would have acquired a much higher value if it had also included the number of cases for which the treatment was used, the ages of the patients, the type and grade of the disease, its mortality-rate, and the other remedies besides quinine and morphine that were employed. Another physician declares that the doses must be "large, very large" (*Jour. Am. Med. Ass.*, vii. 119); Lockie has "great faith in doses of 10 grains at night and 5 in the morning" (*Edinb. Med. Jour.*, xxxi. 421); while Atkinson claims equally good effects with doses of only 2 grains every two, three, and four hours (*Practitioner*, xxxv. 262); and Ripley found quinine "a feeble and uncertain antipyretic in pneumonia, as well as liable to occasion anorexia, nausea, vomiting, cardiac weakness, cold perspiration, etc." (*Med. Record*, xxxi. 113). In fact, there is little attempt made by reporters to indicate the special conditions (except hyperpyrexia) which call for the drug or a particular dose of it, and no adequate evidence that it is useful in any case to determine the issue of the disease.

In close pathological relation with the above-mentioned asthenic states are numerous local affections in which quinine is of great value. Such are *scrofulous ulcers* and *abscesses*, *scrofulous inflammations of the eye*, chronic *mucous fluxes* of the *pharynx*, *larynx*, *bronchia*, *stomach*, *bowels*, and *urinary organs*. It is one of the best remedies for scarlatinous and other forms of *albuminuria*, especially when it is associated with tincture of chloride of iron.

In auditory *vertigo* (mal de Ménière) the persistent use of quinine has in several cases

removed the complaint entirely. Charcot, who proposes this method, insists on the administration of 10 or 12 grains of quinine daily for at least a month, although it is apt at first to aggravate the symptoms, and then the resumption of the medicine after its suspension for a week or two (*Med. Record*, xviii. 602; *Jour. Am. Med. Assoc.*, iii. 97). Ménière himself found that it lessened or removed the vertigo and modified the deafness, but he does not profess that quinine, more than any other medicine, is a cure for the disease (*Monthly Abstract*, July, 1881, p. 407). These results are confirmed by Féré and Démars (*Bull. de Thérap.*, cii. 133). Although quinine has no power of originating contractions in the gravid uterus, it undoubtedly during *slow labor*, with insufficient expulsive pains and an exhausted condition of the system, revives the uterine energy, favors the rapid and safe termination of labor, and tends to prevent exhausting hæmorrhages. A dose of Gm. 0.30–0.60 (5 to 10 grains) may be repeated every half-hour or hour. Le Diberder claims that quinine sulphate in the dose Gm. 0.36 (6 grains) twice a day is an efficient remedy for *fissures of the nipples*, and that no active local treatment need be employed at the same time.

A solution of quinine of the strength of Gm. 0.13–0.20 in Gm. 32 (2 or 3 grains in an ounce) of water has been used with advantage as an injection for *gonorrhœa*. Probably by a similar mode of action it has been found to greatly relieve the *tenesmus* attending micturition in cases of *vesical catarrh* and *villous growths* near the neck of the bladder, whether injected into that organ or administered by the mouth. It will be remembered how large a proportion of quinine sulphate is eliminated with the urine. Most probably it acts both substitutively and by limiting the putrefaction of the mucus in the bladder. It has also been injected into the pleural cavity in cases of *empyema*, and applied as a dressing to *ulcers* and suppurating *sinuses*. A solution of 4 grains to the ounce has been applied with alleged advantage in the treatment of pseudo-membranous *conjunctivitis* (Tweedy, *Amer. Jour. of Med. Sci.*, Apr. 1882, p. 592). A strong solution of the salt is said to relieve *pruritus ani* and *pruritus vulvæ*. In these cases there is no sufficient reason for believing that it acts otherwise than as a substitutive irritant.

Warburg's Tincture is the name of a preparation which was for a long time famous as a nostrum, the secret of which was obtained by Prof. Maclean of the Army Medical School in England. This distinguished physician had on many occasions witnessed the efficacy of the medicine in India when quinine had proved unavailing. Its composition is as follows: R. Aloes (Socot.) lb.j; Rad. rhei (chinens.), Sem. angelicæ. Confect. Damocratis, āā ℥iv; Rad. helenii (s. enulæ), Croci sativi, Sem. fœniculi, Cretæ ppt., āā ℥ij; Rad. gentianæ, Rad. zedoariæ, Pip. cubebæ, Myrrhæ elect., Camphoræ, Bolet. laricis, āā ℥j. These ingredients are to be digested with 500 ounces of proof spirit in a water-bath for twelve hours; then expressed, and 10 ounces of quinine disulphate added to the mixture, which is then replaced in the water-bath until all the quinine is dissolved. The liquor when cool is to be filtered, and is then fit for use. The tincture is administered in the following manner: "Half an ounce (half a bottle) is given alone without dilution, after the bowels have been evacuated by any convenient purgative, all drink being withheld. In three hours the other half of the bottle is administered in the same way. Soon afterward, particularly in hot climates, profuse but seldom exhausting perspiration is induced. This has a strong aromatic odor, which is often detected about the patient and his room on the following day. With this there is a rapid decline of temperature and an immediate abatement of frontal headache—in a word, complete defervescence—and it seldom happens that a second bottle is required; if so, the dose must be repeated as above." To the anticipated objection that, after all, the compound is "merely quinine concealed in a farrago of inert substances," the reply of Dr. Maclean is: "I have treated remittent fevers of every degree of severity contracted in the jungles of the Deccan and Mysore and at the base of mountainous ranges in India, on the Coromandel coast, in the pestilential highlands of the northern division of the Madras Presidency, on the malarial rivers of China, and in men brought to Nettley Hospital from the swamps of the Gold Coast, and I affirm that I have never seen quinine, when given alone, act in the manner characteristic of this tincture. And although I yield to no one in my high opinion of the inestimable value of quinine, I have never seen a single dose of it given alone, to the extent of 9½ grains, suffice to arrest an exacerbation of remittent fever, much less prevent its recurrence; while nothing is more common than to see the same quantity of the alkaloid in Warburg's tincture bring about such results (*Med. Times and Gaz.*, Nov. 1855, p. 540).

The *dose* of quinine sulphate as a tonic is Gm. 0.06 (gr. j) three or four times a day. More than this is likely to act as a sedative rather than as a tonic. In simple intermit-

tent or mild remittent fever Gm. 0.40–0.50 (gr. vj–viij) are sufficient to avert the paroxysm; in severer cases of these affections the dose must be raised to Gm. 1–1.30 (gr. xv–xx), and in those of a malignant type to Gm. 2–4 (gr. xxx–lx), given, in both of the latter cases, in divided doses. In all cases of periodical fever it should be administered *as long as possible before the expected paroxysm*, and generally in regular types as soon after a paroxysm as the stomach is able to retain it. The absorption of the quinine will be hastened by the previous administration of purgatives, of which combinations of rhubarb and aloes are the best. Intermittent neuralgia requires doses sufficient to produce the physiological effects of the medicine in a marked degree, and the same is true of the various febrile and inflammatory affections in which the medicine is intended to produce sedation.

The most usual and efficient mode of administering quinine sulphate in small doses is in solution, rendered more perfect and stable by the addition of aromatic sulphuric acid in the proportion of 1 drop of the acid to each grain of the sulphate. It is also administered in powder enveloped in a wafer or in a thick mucilage, white of egg, or jelly, or in pills coated with sugar, gelatin, or gold or silver leaf, in capsules, or, finally, in the form of compressed lenticular pills of quinine disulphate. In all of these forms the concentrated action of the medicine upon the stomach tends to irritate it, and hence the solution already mentioned should be preferred. Its bitter taste may be masked by the addition of a little chloroform, and the mixture should be flavored with syrup or tincture of orange-peel, with extract of liquorice, or with syrup or fluid extract of liquorice-root. Tannic acid has been used to mitigate the bitterness of quinine in solution; it does so, indeed, but at the expense of rendering the medicine almost inert by forming with it a tannate. Moreover, it contains but 42 per cent. of quinine, whereas the sulphate contains 73.5 per cent. and the hydrochlorate 82 per cent. The last-mentioned salt is much less stable than the sulphate, but when freshly prepared is preferable on account of its superior solubility. It is a convenient associate for tincture of iron chloride in solution. Quinine sulphate or bisulphate is better tolerated in malarial fevers when given in solutions of potassium tartrate or ammonium chloride. Spirit of nitrous ether is said to dissolve "quinine" in the proportion of about 2 drachms of the latter to an ounce of the former. By the rectum quinine sulphate may be exhibited in the same doses and with nearly the same effect as by the mouth, provided it be given in watery solution. Probably the muriate is to be preferred for this purpose. Suppositories of quinine sulphate are irritating. Potassium iodide is chemically incompatible with quinine sulphate; iodine is set free.

The hypodermic injection of a solution of quinine sulphate has been extensively practised, but its tendency to cause pain, inflammation, abscess, gangrene, and even fatal tetanus (Ady; Harris, *Therap. Gaz.* ix. 698; *ibid.*, p. 133) more than counterbalances the advantages derived from the facility of its administration and the promptness of its effect. The risks alluded to should restrict the use of this method to cases in which delay may be dangerous. It is claimed that if the solution be thrown into loose subcutaneous connective tissue, this accident is not apt to occur, but sufficient proof of this claim is wanting. The addition of tartaric acid to a solution of the bisulphate is said to render it less irritating. The quinine bromohydrate is very soluble in water, and is alleged to be entirely unirritating, and therefore to be well adapted for hypodermic use. It contains a larger proportion of quinine than the sulphate. It was, however, the use of this very preparation that caused death in a case above referred to. The oleate is also appropriate for this mode of administration, and the hydrochlorate is even more so. (See QUININÆ HYDROCHLORAS.) The dose for hypodermic injection of quinine sulphate may be stated at from 2 to 4 grains. The intravenous injection of quinine muriate dissolved by means of sodium chloride has been proposed by Boulli (*Centralbl. f. Ther.*, viii. 20).

QUININÆ VALERIANAS, *U. S.*—QUININE VALERIANATE.

Quiniæ valerianas, Chininum valerianicum.—*Valerianate de quinine*, Fr.; *Baldriansaures Chinin*, G.

Formula $C_{20}H_{24}N_2O_2.C_5H_{10}O_2.H_2O$. Molecular weight 443.07.

Quinine valerianate should be kept in well-stoppered bottles in a dark place.—*U. S.*

Preparation.—Wittstein (1845) gives the following directions: Dissolve 1 part of valerianic acid in 60 parts of water; add to the solution 3 parts of quinine (recently precipitated alkaloid is preferable); heat the mixture to near boiling, filter when neutral and while hot, and set aside in a cool place. After several days decant the mother-liquor,

evaporate at a temperature not exceeding 50° C. (122° F.), and dry the salt at a very moderate temperature. At a higher temperature the solution separates oily drops, which on cooling form an amorphous resinous mass dissolving with difficulty in water.

The salt was medicinally employed in 1843 by Castiglioni, and was in the same year prepared by Lucien Bonaparte from the sulphate by decomposing it with a valerianate. Stalmann (1868) used for this purpose sodium valerianate; the quinine salt is taken up with alcohol.

Properties.—Quinine valerianate crystallizes in colorless, pearly, rhomboidal tables or in white triclinic needles having a weak odor of valerianic acid, a bitter somewhat valerian-like taste, and a neutral reaction. The salt dissolves in 100 parts of cold and 40 parts of boiling water, in 5 parts of cold and 1 part of boiling 80 per cent. alcohol, and is easily soluble in ether (Wittstein). On adding dilute sulphuric acid to the aqueous solution it becomes fluorescent, and the odor of valerianic acid is rendered more apparent. Ammonia gives a white precipitate soluble in an excess of the precipitant and in ether, and with chlorine-water and ammonia an emerald-green color is produced. The salt is permanent in the air; it melts at 90° C. (194° F.), forming a colorless liquid. When strongly heated on platinum-foil it is decomposed, and burns slowly without leaving any residue. At 100° C. (212° F.) it loses its water of crystallization and also begins to lose valerianic acid.

The aqueous solution of the salt is neutral, or has a slightly alkaline reaction upon litmus-paper. The aqueous solution, when acidulated with sulphuric acid, exhibits a blue fluorescence and emits the odor of valerianic acid.

Composition.—Wittstein obtained nearly 5 parts of valerianate from 3 parts of quinine, and determined the water to be over 23 per cent. $= 12H_2O$, and the quinine to be 51.355 per cent. L. Bonaparte regarded the loss in weight, ascertained by fusing the salt, to be water, and suggested the above formula. Stalmann, by elementary analysis, found the crystallized salt to yield carbon, corresponding with the formula $C_{20}H_{24}N_2O_2.C_5H_{10}O_2$ (mol. weight 425.11), equal to 76.06 per cent. of anhydrous quinine.

Tests.—"On treating 10 Cc. of an aqueous solution (about 1 in 1300) of the salt with 2 drops of bromine test-solution, and then with an excess of ammonia-water, the liquid will acquire an emerald-green color. With proper adjustment of the reagents, more dilute solutions will show a paler tint, while more concentrated ones will acquire a deeper color or throw down a green precipitate.

The aqueous solution should remain clear or become merely turbid (produce not more than a slight precipitate (*U. S.*) on the addition of test-solution of barium chloride. The precipitate occasioned by ammonia-water should be readily dissolved on adding an excess of the latter (absence of cinchonine). The salt is tested for fixed impurities by incineration, for ammonia salt by lime or potassa, and for organic impurities, morphine and other alkaloids, by strong sulphuric and nitric acid, as described under QUININÆ SULPHAS.

Other Salts of Quinine.—QUININÆ ACETAS. Quinine acetate crystallizes in long white needles on mixing hot solutions of quinine sulphate (17 parts of the efflouresced salt) and sodium acetate (6 parts), and allowing to cool. It is sparingly soluble in cold water, but freely soluble in boiling water and in dilute acids. It contains 84 per cent. of quinine.

QUININÆ ARSENAS. Quinine arsenate, $(C_{20}H_{24}N_2O_2)_2H_3AsO_4.8H_2O$. It is obtained in long white prisms by saturating a hot solution of arsenic acid with quinine. The salt is freely soluble in hot but sparingly soluble in cold water, and contains 74 per cent. of quinine and 10.6 per cent. of As_2O_5.

QUININÆ ARSENIS. Quinine arsenite, $(C_{20}H_{24}N_2O_2)_3H_3AsO_3.3H_2O$. Adler (1879) proposed the following process: 1 part of silver arsenite (prepared from sodium arsenite and silver nitrate) is mixed with 3 parts of quinine hydrochloride, and the mixture digested for a day with 70 per cent. alcohol. On spontaneous evaporation the salt crystallizes in white needles which are slightly soluble in water, but dissolve in 15 parts of cold and 6 of boiling alcohol, in 8 parts of chloroform, in 25 parts of ether, and in 20 parts of benzene.

QUININÆ BENZOAS. Quinine benzoate, $C_{20}H_{24}N_2O_2.C_7H_6O_2$. It is obtained by dissolving 3 parts of benzoic acid and 8 parts of quinine in hot alcohol and crystallizing. It forms small prisms containing 72.6 per cent. of quinine and requiring at 10° C. (50° F.) 373 parts of water for solution.

QUININÆ CITRAS. Quinine citrate. On saturating a warm solution of citric acid, or on decomposing a solution of quinine hydrochlorate by a solution of sodium citrate acidulated with citric acid, the salt, $(C_{20}H_{24}N_2O_2)_2.C_6H_8O_7.7H_2O$, is obtained. It crystallizes from boiling water in small white prisms which at 12° C. (53.6° F.) require 806 parts of water for solution, and which contain 67.08 per cent. of quinine. The monobasic salt has a strongly acid reaction, and at 15° C. requires 650 parts, and at 100° C. 38.5 parts, of water for solution.

QUININÆ LACTAS crystallizes in silky needles on evaporating a solution of quinine in lactic acid; it is soluble in water and alcohol.

Quininæ phenyl-sulphas. Phenylated (carbolated) quinine sulphate, $(C_{20}H_{24}N_2O_2)_2SO_3C_6H_6O.2H_2O$. 10 parts of crystallized quinine sulphate are dissolved in boiling water or in alcohol, and an equivalent quantity (nearly 1 part) of carbolic acid is added to the solution. The salt contains 75.5 per cent. of quinine, crystallizes in needles, and, after having been washed with ether and recrystallized, has neither the odor nor caustic taste of phenol; is insoluble in ether and chloroform, but dissolves freely in alcohol and in a mixture of 2 volumes of chloroform to 1 of strong alcohol, and is more freely soluble in water than the sulphate, but is nearly insoluble therein in the presence of free phenol.

Quininæ phosphas. $(C_{20}H_{24}N_2O_2)_2H_3PO_4.8H_2O$. Quinine phosphate may be prepared by dissolving quinine in warm dilute phosphoric acid or by decomposing quinine hydrochlorate with sodium phosphate. It crystallizes from hot water in long silky needles which require at 10° C. (50° F.) 784 parts of water for solution, and contain 75.85 per cent. of quinine.

Quininæ quinas. Quinine kinate (quinate) may be prepared by decomposing barium kinate with quinine sulphate and evaporating. H. Collier, who recommended it (1878) for hypodermic use, describes it as being amorphous, of neutral reaction, and freely soluble in water. A convenient strength of the solution is 1 part of the salt in 4 of the liquid.

Quininæ salicylas. Quinine salicylate is obtained as a curdy precipitate by double decomposition between quinine hydrochloride and ammonium salicylate. The salt dissolves in 225 parts of water, in 120 parts of ether, and in 20 parts of alcohol, and crystallizes from the alcoholic solution in anhydrous prisms.

Quininæ sulphovinas. Carles (1878) prepares the neutral salt by dissolving 16.6 parts of sodium sulphovinate and 42.8 parts of quinine sulphate, the former in 200, the latter in 600, parts of alcohol, mixing the solutions, filtering from the precipitated sodium sulphate, and evaporating. It crystallizes with difficulty in prisms, dissolves in 3 parts of water at 15° C. (59° F.), in a less amount of alcohol, and dissolves likewise in acetic ether and glycerin, but not in strong ether or benzene.

Quininæ tannas, Chininum tannicum. It is produced by adding a solution of 2 parts of tannin in 30 parts of cold water to a solution of 1 part of quinine sulphate in the same amount of water, with the aid of some sulphuric acid. It is a pale-yellow, amorphous, bitter, and somewhat astringent powder, which is slightly soluble in cold alcohol and water and melts when introduced into boiling water. By modifying the process so as to use water at a temperature not exceeding 70° C. (158° F.), using sulphuric acid barely sufficient to dissolve the quinine salt, washing the precipitate with water, and drying it at the ordinary temperature, tasteless quinine tannate is obtained, according to A. Bernick (1878). In testing it Jobst (1878) recommends a weighed portion to be mixed with milk of lime, the mixture to be dried and exhausted with chloroform, on the evaporation of which the cinchona alkaloids are left behind.

Action and Uses.—Quinine valerianate, which is very unstable and often falsified, has no special therapeutic virtues which entitle it to an official rank. It has been vaunted in *nervous headache* and other *neuralgiæ* of the nerves of the head, face, and chest, and even in *hysteria* and *epilepsy*. When the joint actions of valerian and of quinine are desired, it is better to associate the quinine sulphate or some other preparation of cinchona—quinetum, for instance—with the oil or the fluid extract of valerian, or to prescribe these substances separately. The *dose* of quinine valerianate is Gm. 0.06–0.12 (gr. j–ij).

Quinine Tannate. Briquet relates that Barriswill, acting on the notion that in cinchona the union of bitter principles with quinine renders the latter less stimulating, combined tannic acid with it, so as to make a sort of artificial cinchona in a small bulk. But as this tannate contains but 40 per cent. of quinine and is very insoluble, the probability is that its action must be feeble. And so Briquet found it on clinical trial. He estimated its power at about one-eighth or one-sixth of that of the sulphate, and found that it dissolved very slowly in the stomach, is a weak febrifuge, cannot be used when large doses of quinine are needed, and indeed is suitable only for nervous affections and as a substitute for bark itself, and, finally, that its dose must be three times as large as that of the quinine sulphate (*Traité du Quinquina*, 2ème ed., p. 515). Strangely, it afterward came to be recommended for its very lack of bitterness, although it was well known that this quality depended on its slight solubility (Becker, 1880), and several German physicians lauded its virtues in *whooping cough*, as already stated (see Quininæ Sulphas), but overlooked the fact that even better results have been attributed to quinine sulphate. Probably the internal use of quinine sulphate and the application of a solution of tannin to the fauces and larynx would best secure the benefits of both medicines.

Quinine salicylate is charged with producing hæmorrhage of the internal ear. The *lactate* is very soluble, and therefore suitable for hypodermic administration. It has been employed as an injection for *gonorrhœa*. Quinine biborate is pronounced by Hagens to be superfluous (*Zeitschrift f. klin. Med.*, xii. 265). Finkler and Prior ascribe to it antithermic powers, but admit that it is slow in exhibiting them (*Deutsche med. Wochensch.*, No. 6, 1884).

RANUNCULUS.—Crowfoot.

Buttercups, E.; *Renoncule*, Fr.; *Hahnenfuss*, G.; *Ranunculo*, Sp.

Ranunculus bulbosus. *Linné.*

Nat. Ord.—Ranunculaceæ.

Origin.—The bulbous crowfoot grows in grassy fields and along roadsides throughout Europe, and has been naturalized in North America. It flowers from April or May till July or August.

Description.—The stem of this species is enlarged at its base to a depressed globular tuber, which has the appearance of a tunicated bulb from the broad sheathing bases of the leaf-stalks. The radical leaves are, like the entire plant, hairy, long-petiolate, ternate, the lateral divisions sessile, the terminal one stalked, and all of a subrhomboid shape, three-cleft, toothed and wedge-shaped at the base. The stem-leaves are similar, but on shorter petioles. The flowers have a reflexed calyx and roundish, wedge-shaped, glossy yellow petals, and produce globular heads of obovate akenes having a short curved beak. The plant is inodorous, but has a strongly acrid taste, which it loses after drying.

Allied Species.—All species of Ranunculus and some allied genera appear to possess more or less the acridity of the above. The following European and North American species have occasionally been used:

Ran. repens, *Linné.* It resembles the preceding, but is without the bulbous base, produces long runners, has the divisions of the leaves stalked, a spreading calyx, and the akenes margined and furnished with a rather straight beak.

Ran. acris, *Linné.* It differs from the creeping crowfoot in being taller and without runners, and in having the divisions of the leaves all sessile.

Ran. sceleratus, *Linné.* It is very variable in size, smooth, with a hollow stem, roundish-reniform, three cleft, and lobed or toothed leaves, small pale-yellow flowers, and oblong heads of ovate and short pointed akenes.

Constituents.—On distilling fresh crowfoot with water Braconnot (1818) obtained an acrid distillate having a radish-like odor and separating on standing thin glossy scales; the distillate of Ran. repens was not acrid. The acrid principle of Ran. sceleratus was found by O. L. Erdmann (1859) to be a golden-yellow volatile oil, which is readily changed into *anemonin* and *anemonic acid.* (See Pulsatilla.) Basiner (1881) observed that petroleum benzin does not extract this yellow oil from the distillate, but that this is dissolved by benzene and by ether; it may be extracted from the fresh plant by glacial acetic acid, and removed from this solution by agitation with the liquids named; caustic alkalies decompose the oil and destroy its acrid-narcotic action.

Action and Uses.—Several of the numerous species of Ranunculus possess the same qualities as R. bulbosus. In its fresh state every part of the plant contains an acrid juice, and the bruised leaves, stems, and flowers applied to the skin occasion redness and vesication, and, if the action is prolonged, ulceration and even gangrene. It is stated that in Europe this plant was used by beggars to produce sores for the purpose of exciting pity and procuring alms. They cured their sores by means of mullein-leaves (Verbascum thapsus). The oil of R. sceleratus acts as an acrid narcotic, producing, in small doses, stupor and slow respiration, in larger doses also paralysis of the posterior and anterior extremities, and before death general convulsions. After death are found gastritis and cortical hyperæmia of the kidneys (Basiner, *Amer. Jour. of Phar.*, March, 1882, p. 130). The bruised fresh plant (R. bulbosus) has been applied as a counter-irritant for the relief of chronic affections of the *larynx* and *bronchia*, but more particularly of chronic *rheumatism* and *sciatica.* It may still be so employed where other irritants are not at hand. It is not used internally. The bruised fresh flowers and buds of R. acris have been applied for similar purposes. They cause redness of the skin in about an hour, with painful swelling, and later on discrete and thin confluent blisters, which require ten to fifteen days to heal (Froelich, *Centralbl. f. d. ges. Therap.*, iv. 465).

RESINA, *U. S., Br.*—Resin.

Colophonium, P. G.—*Rosin, Colophony*, E.; *Colophone, Arcanson*, Fr. Cod.; *Kolophonium, Geigenharz*, G.; *Colofonia, Pez griega*, Sp.

The residue left after distilling off the volatile oil from turpentine.

Preparation.—The manner in which rosin is obtained is briefly described on page 1157. The color depends in a great measure on the degree of heat used in its manufacture. From a communication of I. Zacharias (1877), however, it appears that the amount

of resin in turpentine increases with the age of the tree, and that the residuary product of the distillation becomes darker in color, probably in consequence of the greater heat employed in distilling off the oil.

Properties.—Rosin is a very brittle, pulverizable, transparent, or translucent resin, having about the density 1.070–1.080, breaking with a glossy and shallow conchoidal fracture, nearly tasteless and of a faint terebinthinate odor. It varies in color from a pale amber to a dark red-brown, and is distinguished in commerce by the shade of its color, the darkest being called *black rosin*. For pharmaceutical purposes the amber-colored variety is used. *White rosin* is a light-colored variety which is rendered opaque by containing water, on the gradual evaporation of which it becomes translucent. It dissolves readily in ether, chloroform, alkalies, and in the volatile and fixed oils; at 60° C. (140° F.) it is slowly soluble in its own weight of alcohol or of glacial acetic acid. It softens at the heat of a water-bath, melts completely above 100° C.—some varieties at about 135° C. (275° F.)—and at a higher heat burns with a dense yellow and sooty flame. When heated to above 200° C. (392° F.) it may be distilled apparently unchanged, with a current of superheated steam, but on dry distillation it yields *rosin oil*, which contains *colophene* (see page 1176), various hydrocarbons, and other products holding rosin in solution. Among the lower-boiling fractions of this rosin oil Kelbe and Warth (1882) have recognized caproic, isobutyric, œnanthylic, and other acids of the formula $C_nH_{2n}O_2$, and Reynard isolated *amylene*, C_5H_{10}, boiling near 40° C., *hexylene*, C_6H_{10}, boiling near 70° C., and several other hydrocarbons. When rosin is mixed with lime and subjected to distillation volatile oils are obtained, from which, by fractional distillation, Frémy isolated *resinone*, $C_{10}H_{18}O$, which is limpid, readily inflammable, and boils at 78° C. (172.4° F.), and *resineone*, which is thicker, boils at 148° C. (298.4° F.), and seems to have the composition $C_{30}H_{48}O$.

Composition.—According to Maly (1861, 1864), rosin is the anhydride of *abietic acid*, $C_{44}H_{64}O_5$, and is converted into the acid by agitation with warm diluted alcohol. Flückiger (1867) obtained in this way from 80 to 90 per cent. of the weight of the rosin. By treatment with strong ammonia-water, passing through muslin, and decomposing the jelly-like mass with hydrochloric acid, Emmerling (1879) obtained it as a snow-white powder, and Kelbe (1880) in rather long triclinic prisms by crystallizing it from glacial acetic acid. Abietic acid melts, without losing weight, at 165° C. (329° F.) (Maly; Kelbe); other chemists observed lower melting-points. The acid is often in irregular, glassy, crystalline points or white scales, has in alcoholic solution an acid reaction, dissolves in ether, benzene, wood-spirit, chloroform, and carbon disulphide, and yields with bases amorphous compounds. The *pinic* and *sylvic acid* of Unverdorben (1825, etc), Siewert (1859), and others are regarded by Maly as impure abietic acid, but it is not unlikely that, in addition to this one, other acids may be obtained from colophony of different origin.

Uses.—Resin is not prescribed internally. Sometimes, however, the fumes of boiling resin have been used to impregnate the air breathed by persons suffering from chronic *bronchial catarrh* unattended with fever. It is chiefly employed with essential oils to render plasters adhesive and stimulating.

Dammara australis is the source of *Kauri gum*, which, while burning, gives out a pleasant smell and is reported to neutralize the odor of putrefying substances. Diffused through the air in a fine spray, it renders the air ozonic (Richardson, *Asclepiad*, July, 1886).

RESINA COPAIBÆ, *U. S.*—Resin of Copaiba.

Acidum copaibicum.—Copaivic acid, E.; *Résine de copahu, Acide copahurique*, Fr.; *Copaivaharz, Copaivasäure*, G.

The residue left after distilling off the oil from copaiba.

Preparation.—The resin remains behind on evaporating copaiba or on distilling from it the volatile oil. (See Oleum Copaibæ.) For other processes of preparing the resin see page 538.

Properties.—The resin is amorphous, of a yellowish or brownish-yellow color, brittle, of a slight odor of copaiba, and is soluble in alcohol, amylic alcohol, ether, benzene, volatile oils, and carbon disulphide. The alcoholic solution has an acid reaction and a somewhat bitter and acrid taste. The resin is a mixture, and consists, according to the variety of copaiba used, of copaivic or metacopaivic acid, mixed with more or less of neutral resin. The crystallized copaivic acid of commerce is usually prepared from gurjun balsam (see page 538).

Action and Uses.—These have been sufficiently indicated under COPAIBA. Resin of copaiba has been administered in the *dose* of Gm. 0.30–1.00 (gr. v–xv), but more frequently in emulsion. One mode of preparing the latter is to take 3 ounces of the resin, softened by the addition of half its bulk of rectified spirit, and rub it down with 4 ounces of compound tragacanth powder (Br. Ph.) mixed with 4 pints of water: 1 ounce of this mixture contains 12 or 13 grains of the resin, and is given three times daily. Another formula is the following: Resin of copaiba 15 grains; compound powder of almonds 30 grains; water to f℥j.

RESINA DRACONIS.—DRAGON'S BLOOD.

Sang-dragon, Fr. Cod.; *Drachenblut*, G.; *Sangre de drago*, Sp.

The resin obtained from the fruit of Calamus (Dæmonorops, *Blume*) Draco, *Willdenow*. *Nat. Ord.*—Palmæ, Lepidocaryeæ.

Origin and Production.—This palm has a thin stem, which is sometimes 90 M. (300 feet) long, and climbs upon trees by means of long spines situated on the petioles. Its small, globular-ovate, scaly fruits grow in dense panicles, and are covered with a resin which exudes and hardens upon their surface. By beating and shaking the fruit in a bag the resin breaks off, is mechanically separated from the fruit, softened in the sun or by boiling water, and formed into sticks or cakes. Subsequently the fruit is bruised, boiled with water, and an inferior resin collected in cakes. The palm is indigenous to Borneo and Sumatra, and grows in other of the East Indian islands.

Properties.—Dragon's blood is seen in commerce occasionally in the form of irregular grains, or more frequently in cakes or irregular masses, and in cylindrical sticks which are about 30 Cm. (12 inches) long and 12 Mm. (½ inch) or more thick, and are wrapped in palm leaves. It is of a dark red-brown color on the surface, of a brighter red, glossy, and somewhat porous internally, transparent in very thin splinters, and breaks with a resinous but irregular fracture, caused by the fruit-scales and other impurities which are always present—in largest proportion usually in cake dragon's blood. Alcohol, amylic alcohol, benzene, and chloroform dissolve the resin readily, leaving the impurities behind; ether and oil of turpentine dissolve it less freely, and it is insoluble in petroleum benzin. It is inodorous, but when heated has a slight agreeable odor resembling that of benzoin; it is faintly sweetish, otherwise nearly tasteless, and when masticated becomes pulverulent.

Composition.—Dragon's blood contains a little fat, and is free from benzoic and cinnamic acids, as was shown by Hempel (1846). It consists of a peculiar resin, for which Johnston (1839) determined the formula $C_{20}H_{20}O_2$. By dry distillation Glénard and Boudault (1844) obtained a dark-red oil containing *draeyl* = toluene, C_7H_8, and *draconyl* = styrene, C_8H_8. Hlasiwetz and Barth (1865) obtained the following decomposition-products by fusing the resin with potassa: phloroglucin, a body giving a red reaction with iron salts, and paraoxybenzoic, protocatechuic, and benzoic acids—products which are likewise obtained by treating benzoin in the same manner.

Other Varieties.—On wounding the stem of Pterocarpus Draco, *Linné*, a papilionaceous tree of the West Indies, or the stem of Draeæna Draco, *Linné*, a liliaceous tree of the Canary Islands, exudations are obtained which resemble the dragon's blood described above. The dragon's blood of Socotra is the product of Draeæna Ombet, *Kotschy*, and is sent to Arabia under the name of *katir*. These varieties are rarely seen in our market.

Action and Uses.—Dragon's blood, or sang-dragon, has little or no virtue besides its striking name. A certain degree of astringency probably led to its use in former times in diarrhœa, slight hæmorrhage, etc. It is occasionally used as an addition to dentifrices, and was formerly an ingredient of several plasters. At present it is chiefly used for imparting a red color to spirit varnishes and for staining horn or wood; a *mahogany stain* is obtained by dissolving 1 part each of dragon's blood and aloes in 15 or 16 parts of alcohol.

RESINA JALAPÆ, *U. S.*; *P. G.*—RESIN OF JALAP.

Jalapæ resina, Br.—*Résine de jalap*, Fr.; *Jalapenharz*, G.

Preparation.—Jalap, in No. 60 powder, 1000 Gm.; Alcohol, Water, each a sufficient quantity. Moisten the powder with 300 Cc. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then

allow the percolation to proceed, gradually adding alcohol, until 2500 Cc. of tincture are obtained, or until the tincture ceases to produce more than a slight turbidity when dropped into water. Distil off the alcohol by means of a water-bath until the tincture is reduced to 400 Gm., and add the latter, with constant stirring, to 9000 Cc. of water. When the precipitate has subsided decant the supernatant liquid, and wash the precipitate twice, by decantation, with fresh portions of water. Place it upon a strainer, and, having pressed out the liquid, dry the resin with a gentle heat, stirring occasionally until the moisture has evaporated.—*U. S.*

These directions are about the same as in the former Pharmacopœia. The alcoholic tincture of the jalap containing the resin in solution is concentrated by distillation, and this liquid while still warm poured into water, stirring continually, so as to bring nearly all particles of the resinous matter in direct contact with water, whereby the solutions of those constituents which are soluble in water is facilitated. After repeated washings with fresh portions of water the resin is collected and dried. By this treatment water removes sugar and some other principles of jalap, which are also soluble in water, and which possess some medicinal activity (see p. 682).

The British Pharmacopœia directs 1 part of water for 2 parts of jalap to be added to the percolate, from which nearly the whole of the alcohol may be recovered by distillation. The residue while hot is poured into an open dish and allowed to cool, when the liquid portion is decanted, the resin washed several times with hot water, and dried.

The German Pharmacopœia directs the jalap to be exhausted by digestion with alcohol, the tincture to be concentrated, and the resinous residue to be repeatedly washed with warm water (boiling water, *Fr. Cod., P. A.*) as long as this takes up coloring matter. The resin may also be obtained by depriving jalap of its principles soluble in hot water, drying and powdering the residue, and exhausting it with alcohol. Good jalap yields about 15 per cent. of resin (not less than 12 per cent., *U. S.*).

Properties.—Resin of jalap is in yellowish-brown or brown masses or fragments, which break with a glossy resinous fracture and are translucent on the edges. By repeated solution in a little alcohol and precipitation with water it may be obtained nearly white. It is very brittle, and readily reduced to powder, varying in color between yellowish- and light-brown; it has a slight sweetish odor and a somewhat acrid taste, and is entirely soluble in alcohol, and insoluble in carbon disulphide and oil of turpentine. Ether dissolves only a small portion of it, amounting to between 5 and 10 or sometimes 12 per cent., as ascertained by C. D. Farwell (1878); on the evaporation of the ethereal solution a soft resinous mass is left, which may be dissolved in potassa solution, forming a reddish-brown liquid, and is precipitated again on the addition of an acid. The resin, which is insoluble in ether, is the *convolvulin* of W. Mayer, and is soluble in potassa solution, but not precipitated on the addition of an acid. (The chemical nature of this resin and its relation to allied resins have been explained on pp. 902, 903.)

Tests.—Resin of jalap should diminish but little or not at all in weight on being exposed for some time to the heat of a water-bath (absence of water). On being triturated with water it should lose nothing in weight, and the liquid should not become colored, showing that it has been well washed with water. To ether and to potassa solution it should have the behavior described above. Adulterations with other resins are proved by the amount soluble in ether, which should not exceed 10 per cent., or, if they are insoluble in ether, by the precipitate occasioned with acids in the potassa solution. The presence of guaiacum resin is indicated by a green or blue color produced with strong nitric acid or with tincture of ferric chloride. An adulteration with resin may be detected by the solubility in oil of turpentine, and the presence of aloes manifests itself by its bitter taste and the production of picric acid when treated with nitric acid. "Water triturated with it should neither become colored nor take up anything soluble from it (absence of soluble impurities). On digesting 1 Gm. of resin of jalap for about an hour, under frequent agitation, in a glass-stoppered vial, with 10 Cc. of ammonia-water, at a temperature of about 80° C. (170° F.), it should yield a solution which does not gelatinize on cooling (absence of common resin)."—*U. S.* "1 part of resin of jalap should dissolve in 5 parts of warm ammonia-water; on cooling the solution should not gelatinize (absence of colophony), and should remain clear after being supersaturated with an acid."—*P. G.* The last part of this test is correct only for that portion of jalap resin which is insoluble in ether; but the pharmacopœial resin, though completely soluble in about 8 parts of ammonia-water, yields with acids a precipitate which is again soluble in ammonia. The ammoniacal solution of the resin, when carefully evaporated to dryness at a moderate heat, leaves a residue which is soluble in water.

Pharmaceutical Preparations.—Sapo jalapinus, *P. G.* 4 parts each of resin of jalap and medicinal (white Castile) soap are dissolved in 8 parts of alcohol spec. grav. 0.894, and the solution evaporated with constant stirring to the consistence of a pill mass weighing 9 parts. This preparation is of a brown-yellow color, is soluble in alcohol, and yields with about 10 parts of water a nearly clear solution, which becomes somewhat cloudy, but does not separate any resin.

Pilulæ jalapæ, *P. G.* Mix jalap soap 3 parts and powdered jalap-root 1 part. Each pill is to weigh 0.10 Gm. and to be dusted with lycopodium.

Tinctura resinæ jalapæ. Jalap resin 1 part, alcohol 10 parts.—*P. G.* 1872.

Action and Uses.—This preparation contains all or nearly all the purgative elements of jalap, and may be prescribed for the same purposes in doses of Gm. 0.2–0.4 (gr. iij–vj), or, combined with other purgatives, in even smaller doses. A valuable formula is the following: ℞. Resinæ jalapæ gr. xxx; Pulv. lycopodii gr. x; Saponis medicinal. gr. xc; Amygd. dulc. excort. gr. cxx.—M., et in pil. No. cxx div. Two of these pills produce one copious stool, and seven or eight pills as many liquid evacuations.

RESINA PODOPHYLLI, *U. S., Fr. Cod.*—Resin of Podophyllum.

Podophylli resina, Br.; *Podophyllinum*, P. G.—*Resin of May-apple*, E.; *Résine de podophyllum*, Fr.; *Podophyllumharz*, G.; *Podofilina*, Sp.

Preparation.—Podophyllum, in No. 60 powder, 1000 Gm.; Hydrochloric Acid 10 Cc.; Alcohol, Water, each a sufficient quantity. Moisten the powder with 480 Cc. of alcohol, and pack it firmly in a cylindrical percolator; then add enough alcohol to saturate the powder and leave a stratum above it. When the liquid begins to drop from the percolator close the lower orifice, and, having closely covered the percolator, macerate for forty-eight hours. Then allow the percolation to proceed, gradually adding alcohol, until 1600 Cc. of tincture are obtained, or until the tincture ceases to produce more than a slight turbidity when dropped into water. Distil off the alcohol by means of a water-bath until the tincture is reduced to the consistence of honey, and pour it slowly, with constant stirring, into 1000 Cc. of water, previously cooled to a temperature below 10° C. (50° F.), and mixed with the hydrochloric acid. When the precipitate has subsided decant the supernatant liquid, and wash the precipitate twice, by decantation, with fresh portions of cold water. Spread it in a thin layer upon a strainer, and dry the resin by exposure to the air in a cool place. Should it coalesce during the drying or aggregate into lumps having a varnish-like surface, it should be removed, broken in pieces, and rubbed in a mortar. As this is liable to happen during warm weather, resin of podophyllum is preferably made during the cold season.—*U. S.*

The low temperature directed in the precipitation and drying is the chief distinction from the process of the British Pharmacopœia, which permits the resin to be dried on a stove.

On pouring the concentrated tincture of podophyllum into acidulated water the extractive matters remain in solution while the resin is precipitated. The addition of hydrochloric acid appears to exert no action on the product, and to be useful merely in hastening the deposition of the resin from the aqueous liquid. Both the British and French Pharmacopœias omit the hydrochloric acid. The yield is between 4 and 5 per cent. of the weight of podophyllum used; by exhausting the rhizome with alcohol of specific gravity 0.930, G. H. C. Klie (1877) claimed to have obtained as much as 7½ per cent.

Properties.—The color of resin of podophyllum, when pure, is grayish-white, with a slight tinge of yellow. To obtain it of this shade it is necessary that the resin be precipitated in the cold and dried at a temperature not exceeding 35° C. (95° F.). If a higher heat is used it turns darker, and finally deep-brown. If precipitated in the presence of alum or other earth salt, the resin is of a more decided yellow color. It dissolves to a limited extent in carbon disulphide; from 15 to 20 per cent. of it is soluble in ether, and about 80 per cent. is dissolved by boiling water and reprecipitated on cooling; a small portion of the resin, however, remains in solution in the water, and this solution has a bitter taste, acquires a brown color on the addition of ferric chloride, and becomes opalescent and yellow with basic lead acetate, the mixtures gradually separating orange-red floccules. Alkaline liquids dissolve the resin readily, yielding deep-yellow, afterward brown-yellow, solutions, and deposit nearly the whole of it on being supersaturated with an acid. According to Power, podophyllum resin becomes soft at 120° C. (248° F.), and is completely melted at 124° C. (255° F.). Sulphuric acid colors it intensely yellow, the color changing to purplish and to brown on the addition of a trace of nitric acid.

Among the oxidation-products by nitric acid are oxalic acid and an amorphous yellow substance.

Composition.—F. B. Power (1877) observed that the largest portion of the resin consists of at least four compounds, differing in their solubility in ether and hot water and in their behavior to alkalies, ferric chloride, and lead acetate; fused with potassa, *protocatechuic acid* was obtained, but no resorcin. The official resin contains also a little fatty matter, and yields a small proportion of ash, consisting chiefly of sodium and potassium salts. Podwissotzki (1880) obtained from podophyllum resin yellow needles resembling quercetin, a green oil, a crystalline fat acid, podophyllic acid (without activity, soluble in hot water), and two poisonous principles: one of these, *podophyllotoxin*, is obtained from the concentrated chloroform solution by treating it with benzin, which will remove the oil and fat acid; it has the composition $C_{23}H_{24}O_9$ (Kürsten, 1891), crystallizes from benzene, is white, very bitter, faintly acid, sparingly soluble in water, and by treatment with ammonia yields podophyllic acid and *picropodophyllin*. The latter is intensely bitter, freely soluble in chloroform, ether, and, according to Kürsten, has the same composition and yields the same decomposition-products as podophyllotoxin, but is more sparingly soluble.

Action and Uses.—The medicinal properties of this preparation have been sufficiently set forth elsewhere. (See PODOPHYLLUM.) Its action and uses closely resemble those of the resin of jalap. The following formula is convenient for the relief of habitual *constipation*: ℞. Resin. podophyll., Ext. belladon. āā gr. iv ad gr. vj; Ext. nucis vomicæ alcoholic. gr. viij.—M. et in pil. No. xij divid. S. One after dinner.

RESINA SCAMMONII, *U. S.*—RESIN OF SCAMMONY.

Scammoniæ resina, Br., Fr. Cod.; *Résine de scammonée*, Fr.; *Scammoniaharz*, G.; *Resina de escamonea*, Sp.

Preparation.—Take of Scammony, in No. 60 powder, 1000 Gm.; Alcohol, Water, each a sufficient quantity. Digest the scammony with successive portions of boiling alcohol until exhausted. Mix the tinctures, and reduce the mixture to a syrupy consistence by distilling off the alcohol. Then add the residue in a thin stream, with active stirring, to 2500 Cc. of water, separate the precipitate formed, wash it thoroughly with water, and dry it with a gentle heat.—*U. S.*

Take of scammony-root, in coarse powder, 8 ounces; rectified spirit a sufficiency; distilled water a sufficiency. Digest the scammony-root with 16 fluidounces of the spirit in a covered vessel at a gentle heat for twenty-four hours; then transfer to a percolator, and when the tincture ceases to pass add more spirit, and let it percolate slowly until the root is exhausted. Add to the tincture 4 fluidounces of the water, and distil off the spirit by a water-bath. Remove the residue while hot to an open dish, and allow it to become cold. Pour off the supernatant fluid from the resin, wash this several times with hot water, and dry it on a porcelain plate with the heat of a stove or water-bath. It may be prepared in a similar manner from scammony.—*Br.*

Prof. Markoe (1877) showed that the alcoholic extract of scammony yields to water only 2 per cent. of soluble matter, which is removed by washing, as directed in the first formula. The French Codex directs the alcoholic solution to be treated with animal charcoal for the purpose of removing most of the coloring matter. The yield of resin varies with the quality of scammony employed. The British Pharmacopœia permits the resin to be prepared from scammony or from scammony-root by washing the alcoholic extract with hot water; the root yields 5 to 5½ per cent. of resin.

Properties.—Scammony resin is of a brownish color, or yellowish after treatment with animal charcoal. It is brittle, of a resinous, glossy fracture, translucent on the edges, and nearly tasteless, but has a slight sweetish odor, which is stronger and peculiar, somewhat like leather, when prepared from the root. It differs from scammony in not forming an emulsion with water, and in being completely soluble in oil of turpentine and in ether. It dissolves in alcohol, ammonia-water, and warm potassa solution, and when this alkaline liquid is supersaturated with an acid it remains transparent and does not produce a precipitate. The resin softens at about 120° C. (248° F.) and fuses near 150° C. (302° F.).

Tests.—The behavior to solvents, as described, distinguishes scammony resin from most other resins. If adulterated with guaiacum, its alcoholic solution would render the fresh-cut surface of a potato blue, and it would acquire a green or blue color on the addition of chlorine-water or ferric chloride.

Constituents.—Except the coloring principle, scammony resin consists wholly of *scammonin*, which in its pure state is white, inodorous, and tasteless. F. Keller (1857) ascertained it to be the anhydride of *scammonic acid*, which is soluble in water, and on being boiled with dilute acids is converted into sugar and *scammonolic acid*. According to Spirgitis (1860), these compounds have the same composition, and are identical with jalapin, jalapic acid, and jalapinolic acid (see page 903).

Action and Uses.—The action of resin of scammony does not differ in kind, but only in degree, from that of scammony itself, but the resin is about twice as strong as scammony. In the dose of Gm. 0.50 (gr. viij) it occasions colic and watery stools, very much as jalap does, but is more apt than the latter to excite rectal irritation. Being nearly insipid, it may conveniently be given to children. It is seldom used alone, but is frequently associated with calomel, jalap, etc. in cases of *constipation* and abdominal *dropsy*, and also as a vermifuge for *lumbricoid ascarides*.

It may be prescribed in doses of from Gm. 0.30–1 (gr. v–xv), and should be made into an emulsion with milk, almonds, mucilage, or other demulcent, and sweetened. The following formula is convenient: ℞. Resin. scammon. gr. viij; rub with Sacch. alb. gr. xlv; mix gradually with Lact. vaccin. f℥iv; Aq. laurocerasi f℥j.—M. S. One or two tablespoonfuls every hour.

RESORCINUM, *U. S., P. G.*—Resorcin.

Resorcinol, Metadioxybenzene, E.; *Résorcine*, Fr.; *Resorcin*, G.; *Resorcina*, Sp.

Formula $C_6H_4(OH)_2$. Molecular weight 109.74.

A diatomic phenol; it should be kept in dark amber-colored vials.—*U. S.*

Origin.—Resorcin was discovered by Hlasiwetz and Barth (1864) on melting galbanum, ammoniac, or guaiacum resin with potassa. It is produced in a similar manner from asafetida, sagapenum, ascaroid resin, and from phenol-sulphonic acid and other derivatives of phenol; likewise on the dry distillation of extract of Brazil-wood.

Preparation.—The alcoholic extract of ammoniac or galbanum is carefully fused with three times its weight of potassa until the mass has become homogeneous, when it is dissolved in water, the solution slightly acidulated with sulphuric acid, filtered, and agitated with ether. On evaporating the ether, impure resorcin is left; the volatile fatty acids present are combined with baryta, and the resorcin is dissolved by ether and further purified by distillation and recrystallization.

Resorcin is now manufactured on a large scale from benzene: the latter is heated with about four times its weight of fuming sulphuric acid to 275° C. (527° F.), whereby benzene metadisulphonic acid is formed ($C_6H_4(HSO_3)_2$). When cool the acid is dissolved in water and neutralized with milk of lime; after removal of calcium sulphate by means of a filter-press, sodium carbonate is added, the mixture again filtered, and the solution of sodium benzene-metadisulphonate evaporated to dryness. The sodium salt thus obtained is heated for eight or nine hours at 270° C. (518° F.) with two and a half times its weight of caustic soda, sodium resorcin, $C_6H_4(ONa)_2$ being formed, together with sodium sulphite. Continued boiling of a solution of the saline mass expels the sulphurous acid, and the tar-like residue is then extracted with ether, which latter, upon distillation, leaves impure resorcin. By sublimation or recrystallization from water or benzene pure resorcin is obtained.

Properties.—Resorcin crystallizes in colorless or faintly reddish short, rhombic prisms or plates, which have a faint peculiar odor and an unpleasantly sweet and somewhat acrid taste. On exposure to light and air it becomes reddish. Soluble, at 15° C. (59° F.), in 0.6 part of water and in 0.5 part of alcohol; very soluble in boiling water or in boiling alcohol; also readily soluble in ether or glycerin; very slightly soluble in chloroform, carbon disulphide, benzin, and benzene. When heated to a temperature between 110° and 119° C. (230°–246.2° F.), resorcin melts, a higher melting-point indicating a greater degree of purity. Pure resorcin boils at 276.5° (530° F.). The aqueous solution is neutral or has only a faintly acid reaction upon litmus-paper. On adding a few drops of ferric chloride test-solution to 10 Cc. of a dilute aqueous solution (1 in 200) of resorcin, the liquid assumes a bluish-violet color. If 0.1 Gm. of resorcin be dissolved in 1 Cc. of potassium hydroxide test-solution, and a drop of chloroform added, the mixture, upon being heated, will assume an intense crimson color. If a slight excess of hydrochloric acid be then added, the color will change to a pale straw-yellow. On cautiously heating 0.05 Gm. of resorcin with 0.1 Gm. of tartaric acid and 10 drops of concentrated sulphuric acid, a thick carmine-red liquid will be formed, becoming pale

yellow when diluted with water. It burns with a bright flame, without leaving any residue. Its solution is transiently colored violet by chlorinated lime; with ferric chloride it becomes purplish-black, the color disappearing by ammonia; with copper sulphate and ammonia the solution turns black. Resorcin precipitates metallic silver from ammoniacal solution of silver nitrate. Its solution in ammonia when exposed to the air turns rose-red and brown, and, when heated, green and blue, this color being changed to red by acids. The aqueous solution of resorcin yields with bromine-water needles of tribromresorcin, $C_6Br_3H(OH)_2$.

Tests.—When carefully heated in a test-tube, resorcin should melt to a clear colorless liquid; on increasing the heat it should volatilize, producing white vapors, and leaving no residue or merely a minute amount of charcoal. Heated in a porcelain or platinum dish, it should volatilize without residue. A concentrated aqueous solution (1 in 2) of resorcin should be colorless (absence of empyreumatic bodies), and when gently heated should not emit the odor of phenol.

Chemically, resorcin is a dihydroxybenzene of which three varieties have been obtained, named, respectively, ortho-, meta-, and para-dioxybenzene; the first is known as catechol or pyrocatechin, the second as resorcinol or resorcin, and the third as hydroquinol.

Unfortunately, the name resorcinol has recently (1893) also been applied to a compound obtained by heating to the point of fusion a mixture of equal parts of resorcin and iodoform; it is an amorphous coffee-colored substance of an iodine-like odor and disagreeable taste.

Allied and Derivative Compounds.—Hydroquinol, Hydroquinone, Hydrochinone, Paradioxybenzene.—This isomer of resorcin was discovered by Wöhler (1844). It may be obtained by the dry distillation of kinic, succinic, and oxysalicylic acids, but is usually prepared by oxidation of aniline with potassium dichromate and sulphuric acid, and subsequent reduction of the quinone formed by sulphurous acid. Hydroquinol forms long colorless and odorless dimorphous crystals, which have a sweetish taste and melt at 169° C. (336.2° F.). It is soluble in about 17 parts of water at 15° C. (59° F.), and very soluble in hot water, alcohol, and ether. With ferric chloride hydroquinol in strong solution yields green quinhydrone, or, if the iron be added in excess, yellow quinone; these reactions distinguish it from resorcin.

Catechol, Pyrocatechin, Orthodioxybenzene.—This, the third of the group of isomerides having the general formula $C_6H_4(OH)_2$ is contained among the products of the destructive distillation of several tannins and vegetable extracts; it may also be obtained by fusing orthophenolsulphonic acid with caustic potassa for some time at 320°–360° C. (608°–680° F.); but the best process for manufacturing it is to heat guaiacol to 195°–200° C. (383°–392° F.), and then passing in hydriodic acid as long as methyliodide distils over. Catechol occurs in acicular crystals, readily soluble in water, alcohol, ether, and hot toluene, melting at 104° C. (219.2° F.) and boiling at 245° C. (473° F.). With ferric chloride it strikes an emerald-green color which on addition of sodium bicarbonate is changed to a beautiful violet-red.

Thioresorcin, $C_6H_4O_2S_2$, is a yellowish non-crystallizing powder, readily soluble in solutions of the alkali hydroxides, carbonates, and sulphides, but insoluble in other solvents. It is obtained by heating 1 molecule of resorcin with 3 molecules each of sulphur and sodium hydroxide, with addition of water until solution results; upon acidulating the solution, amorphous yellow flocculi separate, which may be purified by resolution in alkalies and subsequent addition of acid.

Resopyrine. When 30 parts of antipyrine and 11 parts of resorcin, each dissolved in three times its weight of water, are mixed, a crystalline mass separates, which upon resolution in alcohol may be obtained in rhombic crystals. To this compound the name resopyrine has been given. It is odorless and has a faintly pungent taste; insoluble in water, but soluble in 5 parts of alcohol, 30 parts of chloroform, or 100 parts of ether. It differs chemically from resorcin in not forming a precipitate with lead subacetate, nor a blue color with ferric chloride.

Fluorescein, or Resorcin-phtalein, $C_{20}H_{15}O_5$, is obtained by fusing together resorcin and phtalic anhydride; it occurs as dark-brown crystals, which form with ammonia a red solution, exhibiting a beautiful green fluorescence. Recommended for the diagnosis of corneal lesions and detection of minute foreign bodies imbedded in that tissue. When an aqueous solution is dropped upon the cornea, those parts, however small, which are deprived of their epithelium are colored green, while foreign bodies are surrounded by a green ring (Straub).

Action and Uses.—In the course of two hours Andeer took about Gm. 10 (160 grains) of resorcin dissolved in a quart of water. He was found fast asleep, but had no recollection of how he fell asleep. Subsequently, he took the same quantity of the drug dissolved in a pint of water in the space of a quarter of an hour. He perceived flashes before his eyes, his sight grew dim, his eyelids heavy; his hearing and smell were completely obtunded; his mouth was pasty and his tongue thick. He fell to the floor bathed in a cold sweat, and his feet were also cold. Then convulsions came on, respiration grew panting and sighing, and later spasmodic flexion of the limbs occurred, with

opisthotonos. After five hours of treatment consciousness returned, but no memory of the attack remained. On the following day restoration to health was complete. Dr. Murrell relates (*Times and Gaz.*, Oct. 1881, p. 486) the case of a woman who took 120 grains of resorcin, and almost immediately became giddy, and then insensible. She was pale and cold, drenched in sweat; the pupils were equal, and the pulse and chest movements almost imperceptible; the limbs were relaxed; there was no reflex action and no spasm; the axillary temperature was 95° F. Recovery took place within twenty-four hours. The first urine she passed presented an olive-green color. The occurrence of convulsions in the one case and their absence in the other case deserve notice. A case of poisoning by *thioresorcin* applied to an ulcer has been recorded by Amon (*Therap. Monatsh.*, iii. 534).

Resorcin has the power of retarding or preventing fermentation and putrefaction. A solution of 1 per cent., it is said, will maintain the acidity of normal urine for a month (Andeer). But, according to Platt, the antiseptic power of resorcin is greatly inferior to that of carbolic acid (*Amer. Jour. of Med. Sci.*, Jan. 1883, p. 89). Nevertheless, it is certain that a solution of the strength just mentioned has preserved from decomposition such substances as pancreas, blood, and urine, and arrested commencing putrefaction in them. Andeer claims not only that it is equal to carbolic and pyrogallic acids in antiseptic virtues, but that it has over them the great advantage of not acting poisonously when locally applied, and also of not attacking metallic instruments. It promotes healing by the first intention of punctured or incised wounds, and when applied to artificially-infected wounds of the cornea, conjunctiva, gums, etc. it destroys micro-organisms and promotes the healing of such wounds. A 1 or 2 per cent. solution does not irritate the integuments nor cause any eruption. It is as well tolerated as any other antiseptic by the respiratory tract.

According to Lichtheim (*Monthly Abst.*, Dec. 1880, p. 120; *Bull. de Thérap.*, ci. 139), if from 30 to 45 grains of this substance are given to a patient in high *fever*, almost immediately a sort of intoxicated excitement takes place, either wild or muttering, with tremor of the hands. It, however, is transient, and is followed by profuse diaphoresis, with subsidence of the pulse and temperature. It is said to produce such effects more quickly than salicylic acid or quinine, but that their duration is brief. It is not claimed that this medicine shortens the duration of idiopathic fever or of serious inflammations; and one is therefore at a loss to conjecture why the sick should be made the subjects of physiological experiments with it. In *typhoid fever* and other febrile diseases it was used without advantage by Dujardin-Beaumetz, who pronounced it too poisonous to be safe as an internal medicine (*Bull. de Thérap.*, cix. 145); and Brieger judged it similarly (*Zeitschrift f. klin. Med.*, v. 146). The former tested it in acute articular *rheumatism*, and found that it was not comparable with salicylic preparations. The statements made of its efficacy in puerperal and periodical fevers (by Andeer and Right) and erysipelas have not been confirmed. Some lauded it in all the various forms of functional gastric disease, which seem to be more common in Germany than elsewhere (catarrh, dilatation, etc.), while Andeer did not so much depend upon it to check gastric fermentation as to promote the healing of abrasions and *ulcers* of the mucous membrane of the stomach, and to moderate the destructive process in *cancer* of that organ (*Zeitschrift f. klin. Med.*, ii. 297). It has been used with more or less advantage to deodorize and disinfect *fetid stools*.

Topically, resorcin is more distinctly useful. A solution of the strength of from 1 to 3 per cent. has been found efficient in moderating mucous *profluvia* from the *nostrils*, *ears*, *vagina*, *urethra*, etc., and in removing their fetor. It has been found efficient in chronic purulent *otitis* of the middle ear when applied pure or mixed with 7 parts of boric acid. In *gonorrhœa* Brieger used a 5 per cent. solution. It was very painful, and did not cure the complaint, probably because the solution was needlessly strong. The claim made by Moncorvo in 1885, that the application of resorcin to the fauces and larynx arrested the development of *whooping cough*, has been confirmed by many observers, of whom several saw in the apparent results proof of the parasitic nature of the disease. It appears more probable that the remedy (like many others) merely obtunds the sensibility of the larynx, and of its frequent utility, whether applied in spray or with a brush, there can be little doubt, and quite as little that its failure is sometimes complete. When given internally in solution it must during deglutition act locally as well. Of the most favorable reports may be mentioned those of Concetti (*Therap. Gaz.*, xiii. 843), Leblond (*Amer. Jour. Med. Sci.*, xcix. 74), and Barlow (*Boston Med. and Surg. Jour.*, Feb. 1890, p. 198). A 2 or 3 per cent. solution is recommended for local application, on sponge or in spray, at intervals

of two or three hours. A similar or a stronger solution has been used for the relief of chronic *aphonia*, to stimulate chronic *ulcers of the larynx*, and to treat *gangrene* and *morbid growths* within this organ and elsewhere, especially for the relief of pain in them. According to Weiss (*Med. Record*, xxx. 597), the inoculation of *phlegmon* with resorcin, followed by the application of an ointment containing the preparation, will cause the inflammation to abort. In a case of *carbunculous boils* occupying a large part of the arm a rapid cure followed the application of a thick layer of "resorcin ointment and vaseline in equal parts" (*Bull. de Thérap.*, civ. 325). It has been used to lessen the sensibility of parts to be topically treated; *e. g.* the nostrils, the larynx, the urethra, vagina, etc. In this way it is alleged to have relieved persistent *vomiting*. Andeer claims for it the power of arresting the development of *sea-sickness* when taken in the dose of 12 to 24 grains, and of palliating the symptoms after they are developed (*Therap. Gaz.*, xii. 190). He states that it is equally efficient in relieving this symptom when produced by hepatic or renal colic, by menstruation, pregnancy, indigestion, gastric ulcer, alcoholic debauch, etc. (*Therap. Monatsh.*, iv. 56). It also serves as a palliative of the pain and as a wholesome stimulant in *frostbite*, simple and specific *ulcers*, *fissures*, etc., and in like manner is useful in treating various *diseases of the skin*, both acute and chronic, such as *erysipelas*, *erythema*, *eczema*, *psoriasis*, etc., the strength of the ointment being greatest in the chronic affections. Thus a strong ointment (10 to 50 per cent.) is required for *herpes tonsurans*, *alopecia areata*, and *pityriasis versicolor*. Unna (*Centralbl. f. Ther.*, viii. 43) for *eczema* recommends a 1–2 per cent. solution. In some cases he prefers the "plaster mull" as maintaining a more prolonged and vigorous action. Andeer highly commends the caustic treatment of *chancres* by means of crystals of resorcin or a saturated ethereal solution of them. Favorable reports are also furnished by Lebland, Fissiaux, and Bombin (*Med. News*, xlii. 384; xliii. 266). *Papilloma* and other outgrowths of the mucous membrane have been destroyed by this caustic, which Andeer declares to be sure and painless. *Myomas* of the eye and larynx are said to have been cured by resorcin. It is even claimed that in crystals or in powder it displays its greatest virtue in the *diphtheria* of wounds, and especially of the mouth and pharynx. "In one week, at the latest," says Andeer, "the severest form of this disease is wholly cured, and without any evil consequences." This statement has received partial confirmation, but the weight of testimony is opposed to it.

Resorcin may be given internally in *doses* of from Gm. 0.06–0.25 (1 to 4 grains), and gradually increased to five or even ten times that quantity. It is best administered in syrup or emulsion. For atomized inhalation and for injecting cavities a solution of ½ to 1 per cent. may be used; but in phagedena, syphilis, etc. a saturated solution or the crystals is preferable. In erythematous and erysipelatous complications a resorcin-vaseline ointment may be applied. The following formulæ may be used: Resorcin ʒj–ʒiij, Glycerin or Vaseline ℥j, for topical use: Resorcin gr. x–xx, Water f℥j, as a vaginal injection: Resorcin gr. 40–300, Water f℥j, for hypodermic administration. The proper antidote for the poisonous effects of resorcin is alcohol.

The action of Hydroquinone is analogous to that of resorcin, but is much more powerful. Dr. Kinnieutt found that single doses of 10 and 20 grains produced no appreciable symptoms in healthy persons. The pulse, respiration, and temperature were unaffected. A single dose of 40 grains was followed in ten minutes by a feeling of slight fulness in the head and dizziness, which disappeared in fifteen minutes.

Seifert found that in daily quantities of from Gm. 1–6 (gr. xv–xc), hydrochinone exercised a favorable antipyretic influence, and without any drawbacks, in *typhoid fever*, *pneumonia*, *scarlatina*, *pleurisy*, and *phthisis*, and that it maintained clearness of the mind and senses. In typhoid fever he observed that a dose of Gm. 1. (gr. xv) would cause a fall of temperature of from 1.8° to 3.6° F., and sometimes much more than this. Dr. Kinnieutt (*loc. cit.*) confirmed these observations in cases of general tuberculosis, erysipelas, and septicæmia, and noted that the pulse and respiration subsided along with the temperature. He also observed that the medicine rendered the urine greenish-brown or dark-brown. As a general conclusion he stated that hydroquinone is a safe and efficient antipyretic, but that it does not arrest or abridge the specific febrile process. It may therefore be added to the list of agents which have been employed for the same purpose, but whose real utility in the treatment of febrile diseases has never been demonstrated.

Hydroquinone has been given in doses of from Gm. 1–1.25 (gr. xv–xx) to control the febrile exacerbations in phthisis. Where there is a tendency to a continuously high temperature, as in pneumonia, three or four such doses may be administered in the course of twenty-four hours. By the rectum the dose should be twice as large as that by the mouth.

Pyrocatechin has been tried as an antipyretic, but on account of its mischievous effects was laid aside.

Resopyrine, on account of its constituents, was expected to be useful, but it did not answer the expectations entertained.

Thioresorcin was applied to the same purposes as iodoform as a powder and in ointments, but it turned out to be far from useful or even harmless.

RHAMNUS CATHARTICUS.—Buckthorn.

Fructus rhamni catharticæ, s. *Baccæ spinæ cervinæ*, P. G.; *Nerprun purgatif*, Fr.; *Kreuzdorn*, G.; *Ramno catartico*, *Espina cerval*, Sp.

The fruit of Rhamnus catharticus, *Linné*, s. Cervispina cathartica, *Moench*. Bentley and Trimen, *Med. Plants*, 64.

Nat. Ord.—Rhamnaceæ.

Origin and Description.—The buckthorn is a branching shrub growing in thickets throughout the greater part of Europe and in Siberia, and is naturalized to some extent and cultivated for hedges in North America. It has ovate, minutely serrate, and frequently fasciculate leaves, small, yellowish-green, diœcious flowers in umbellate clusters, and black, glossy, globular four-celled drupes about 8 Mm. ($\frac{1}{3}$ inch) in diameter, furnished at the base with the persistent eight-rayed calyx-disk, and containing four hard, dark-brown, deeply-grooved seeds enclosed in a parchment-like shell. The dried fruit is deeply and somewhat reticulately wrinkled from the shrinking of the sarcocarp. In the fresh state it contains a greenish or purplish-green sarcocarp, and yields by expression a purplish-colored juice having an acid reaction, an unpleasant odor, and a disagreeable, bitter, and rather acrid taste. The color becomes red on the addition of an acid, and greenish-yellow when rendered alkaline.

Constituents.—The various analyses of buckthorn-berries have furnished the cathartic principle *rhamnocathartin* in the form of an amorphous, translucent, yellowish, brittle mass, which Binswanger (1849) and Winckler did not succeed in crystallizing. This has the taste of the berries, is fusible, dissolves in water and alcohol, is insoluble in ether, is not destroyed during the fermentation of the juice, and yields picric acid when oxidized with nitric acid. The juice contains also a peculiar variety of tannin, sugar, gum, and *rhamnin*, which crystallizes in yellowish neutral and inodorous granules or needles, has little taste, dissolves in cold water and alcohol, and is insoluble or nearly so in ether, chloroform, benzene, and carbon disulphide. Its solution is rendered olive-green by ferric chloride, and deep-green, or with an excess red-brown, by chlorinated lime. Dilute acids split it readily into a non-fermentable sugar, a gummy substance, and *rhamnetin*. This crystallizes readily from phenol in golden-yellow scales, is sparingly soluble in water, somewhat more soluble in alcohol and ether, and is colored green-brown or black by iron salt.

Allied Drugs.—Rhamnus infectoria, *Linné*.—French berries, *E.*; Graines d'Avignon, *Fr.*; Gelbbeeren, *G.*—The shrub grows in Southern Europe, and the berries resemble buckthorn-berries in size and appearance, but are of a brownish or greenish-brown color, and are usually two- or three-furrowed.

Rhamnus amygdalina, *Desfontaines*, Rh. saxatilis, *Linné*, and probably other species growing in Western Asia, South-eastern Europe, and Northern Africa, yield the so-called *Persian berries*. They resemble the preceding, but are of a more greenish and internally yellowish color, and contain pale-brown seeds having a broad furrow. These and French berries contain one or more yellow coloring principles, the principal one being probably *xanthorhamnin*, $C_{48}H_{66}O_{29}$, which, according to Liebermann (1878), is split by acids into rhamnose or isodulcit (see Quercus Tinctoria) and rhamnetin, $C_{12}H_{10}O_5$. (See also Frangula, p. 755.)

Sap-green is prepared from unripe buckthorn-berries by bruising and fermenting them, expressing the juice, adding alum and potash, and evaporating.

Pharmaceutical Preparation.—Sirop de nerprun, *Fr. Cod.*; Sirupus rhamni catharticæ, *P. G.*—Syrup of buckthorn, *E.*; Syrupus de rhamno cathartico, *Fr.*; Kreuzdornbeeren-syrup, *G.*; Jarape de ramno, *Sp.*—The bruised fresh berries are allowed to ferment until the filtrate ceases to be precipitated by half its volume of alcohol; then dissolve 13 parts of sugar in 7 parts of the expressed and filtered juice.—*P. G.* It has a purplish-red color. In Great Britain it is customary to digest ginger and pimento in the juice before adding the sugar.

Medical Uses.—This drug is employed in making the syrup of buckthorn, of which the purgative dose is from f℥ss to f℥j. The fresh berries and their expressed juice are hydragogue cathartics, occasioning thirst, tormina, and nausea. They have been used in the treatment of *dropsy*. Their juice is said to have been employed as a popular mouth-wash for the relief of *toothache*.

RHAMNUS PURSHIANA, *U. S.*—Cascara Sagrada.

Rhamni Purshiani cortex, Br.—*Sacred bark*, *Chittem bark*, E.

The bark of Rhamnus Purshiana, *De Candolle*. Hooker, *Flora Boreali-americana*, Plate 43.

Nat. Ord.—Rhamnaceæ.

Origin.—Rhamnus Purshiana is indigenous to the Pacific coast of North America from the British possessions southward to Northern California; from there, southward, R. californica, *Eschscholtz*, takes its place, and this is often found in commerce in place of the true cascara sagrada. The species yielding the official bark is a shrub or small tree growing to the height of 4.5–6 M. (15 to 20 feet), and having somewhat pubescent twigs; the leaves are from 5–15 Cm. (2 to 6 inches) long, thin, dull in color, broadly elliptical, at the apex very obtuse or abruptly blunt-pointed, and at the base rounded; margin is irregularly and closely serrulate or denticulate, and often obscurely crenate, hairy below and above on the veins; petioles short, downy.

Description.—It is met with in quills or curved pieces varying in size from 3–10 Cm. (1¼ to 4 inches) in length and about 2 Mm. ($\frac{1}{12}$ inch) thick, externally smooth or nearly so, brownish-gray and sometimes with whitish patches. The young bark has numerous rather broad, pale-colored warts. After removal of the outer layer the bark is brown or reddish-brown in color. The inner surface is smooth or finely striate, yellowish or light brownish in color, and becomes dark-brown by age. It breaks with a smooth fracture, which in thicker pieces is somewhat fibrous in the inner layer. The bark has no odor, a bitter taste, and is colored red by solution of potassium hydroxide.

Constituents.—Prof. Prescott (1879) determined in it the presence of red resin colored brown by potassa; a resinous body not colored by potassa, but red-brown by sulphuric acid; a white sublimable crystalline compound; a brown resin colored purple-red by potassa; tannin, oxalic acid, malic acid, and other common vegetable principles. According to Eccles (1888), cascara sagrada possibly contains an alkaloid. Limousin (1885) claims that the resinous principles of Prescott were all derived from chrysophanic acid, and Schwabe (1888) obtained emodin, but could isolate no frangulin from cascara sagrada about one year old.

Allied Drugs.—Rhamnus (Frangula, *Gray*) californica, *Eschscholtz*, is somewhat smaller than the preceding, has ovate-oblong or elliptical denticulate or nearly entire leaves, produces numerous, mostly abortive flowers, and has a blackish-purple two- or three-seeded fruit. It grows throughout California, and a variety with white tomentose leaves extends through Arizona to New Mexico.

Rhamnus (Frangula, *Gray*) caroliniana, *Walter* (*Southern buckthorn*), is a shrub or small tree growing in moist localities in the southern part of the United States, northward to Southern New York, and westward to Texas and the Rocky Mountains. It has oblong serrulate leaves, short-peduncled flowers, and purplish globose three-seeded fruits. The bark has been recently recommended as a substitute for the European frangula-bark.

Action and Uses.—Attention was first drawn to the virtues of this plant in 1878 by Bunday of California, and by 1883 its preparations became well known in America and Europe (*Boston Med. and Surg. Jour.*, Oct. 1887, p. 402). Tschilzow, who tested it in experiments upon animals, found that it did not act as a purgative when administered subcutaneously or by the veins, but that, introduced into the stomach, it increased the secretions of that organ, the pancreas, and liver (*Centralbl. f. d. ges. Ther.*, iii. 362). That it is a gastro-intestinal stimulant, as all purgatives are, cannot be questioned, but there is no proof of its specific action upon either of the organs mentioned.

It acts usually with certainty and without causing irritation or any unpleasant symptoms; it produces semi-solid stools. In comparatively rare cases it has acted harshly. Thus Thompson (*British Med. Jour.*, Mar. 22, 1884) relates instances in which it occasioned severe colic, cramps, vomiting, and excessive purging. (Compare Porteous, *Edinb. Med. Jour.*, xxxi. 923; Cotter, *Ther. Gaz.*, xii. 285.) Others have accused it of producing a persistent soreness of the bowels, and at the same time of being inefficient except when associated with other purgatives. It sometimes irritates hæmorrhoids, but generally it has no such effect. It does not operate hurriedly or urgently, as those purgatives do that produce liquid stools. R. Purshiana affords an extract that is more bitter and more purgative than that of R. Catharticus.

The special virtue of cascara consists in its overcoming *constipation* without purging, and therefore without weakening. The "sluggish condition of the liver" it is said to relieve is merely that caused by the pressure of an overloaded colon. In simple constipation, or torpor of the colon without associated disease, its value is greatest. It is well suited for lying-in women. A special power of reinforcing or developing the antiperiodic virtues of quinine, which has been ascribed to it, depends chiefly upon its evacuant virtues; for it is well known that in chronic malarial disorders quinine is apt to fail until the bowels have been purged and the removal of what was formerly called "sordes" secured.

The proper method of obtaining the best effects of cascara is to administer it in relatively small but repeated doses, which in cases of habitual constipation should be gradually diminished, until a natural action of the bowels is established. The average dose of the powdered bark is Gm. 0.25 (5 grains), and of the solid extract about Gm. 0.10 (2 grains). This medicine is often associated with the extract of Berberis aquifolium, which is a tonic. A cordial in which these ingredients are conjoined with aromatics is the most usual form of administering cascara: R. Rhamni purshianæ, Gm. 100; Berberid. aquifolii, Gm. 37; Alcohol dilut., Gm. 233; Sacchar. alb., Gm. 288; Aquæ, Gm. 1000. *Dose*, Cc. 1–4 (♏xv–fʒj), two or three times a day. The dose of the fluid extract is Cc. .60–1.30. Cascara is not adapted for the rapid evacuation of the bowels, but rather for regulating their action. It should be given when the stomach is empty, and as undiluted as possible.

Rhamnus alaternus leaves in decoction are said to repress the *secretion of milk* (*Pharmaceut. Jour.*, Dec. 1885).

RHEUM, *U. S.*—Rhubarb.

Rhei radix, Br.; *Radix rhei*, P. G.—*Rhubarb-root*, E.; *Rhubarbe*, Fr.; *Rhabarber*, G.; *Ruibarbo*, Sp.

The root of Rheum officinale, *Baillon*. Bentley and Trimen, *Med. Plants*, 213, 214, 215. *Nat. Ord.*—Polygonaceæ.

Origin.—That rhubarb-root is obtained from the western and north-western provinces of China and from other parts of the highlands of Central Asia has been known for a long time. The efforts made by the Russian government since the first half of the eighteenth century to obtain the rhubarb-plant have been unsuccessful; at least the plants Rheum palmatum and Rh. undulatum, *Linné*, raised in Europe from the seeds thus procured, had roots which were not identical with true rhubarb. More recently, however, several species have become known in Europe which appear to be the source of most, if not all, rhubarb.

Rheum officinale, *Baillon*. In 1867, Dabry, French consul at Shanghai, procured from South-eastern Thibet a number of fresh root-stocks, which were sent to Paris, where they arrived in a completely decayed condition, a few buds excepted. From these plants were successfully raised, of which one flowered in 1872 and was described by Baillon under the above name. It has a stout rhizome with few roots, and produces a tall stem, from near the thick base of which numerous orbicular-ovate, five- or seven-lobed leaves grow, attaining sometimes a length of blade equal to 1.2 M. (4 feet). The inflorescence is large, much branched, racemose, with numerous clustered and drooping, small greenish-white flowers, and with pendulous, triangular, yellow fruits, nearly 12 Mm. (½ inch) long, and with a bright crimson wing on each angle.

Rheum palmatum, *Linné*. From the observations made by Lieutenant-Colonel Przewalsky during his travels (1872–73) in Central Asia, it appears that a variety of this species, which he collected near Lake Kokonor, in North-western China, was really the source of the formerly highly esteemed Russian rhubarb. Maximowicz (1874) described this variety as *Tanguticum*, and contended that its cultivation in Europe was unsuccessful on account of the principal roots decaying. Dragendorff (1877), however, compared the roots to English rhubarb in appearance. The plant grows to the height of 2.4 to 3 M. (8 or 10 feet), has large orbicular-ovate, deeply five-lobed and cut radical leaves, numerous small pale pinkish flowers, and drooping, triangular fruits, with a dull red wing on each angle. Przewalsky (1881) observed another very tall rhubarb, the root of which weighed 26 pounds.

Rheum hybridum, *Murray*, is chiefly characterized by the nearly flat and wrinkled leaves, which are heart-shaped at the base, pointed above, and undulately lobed on the

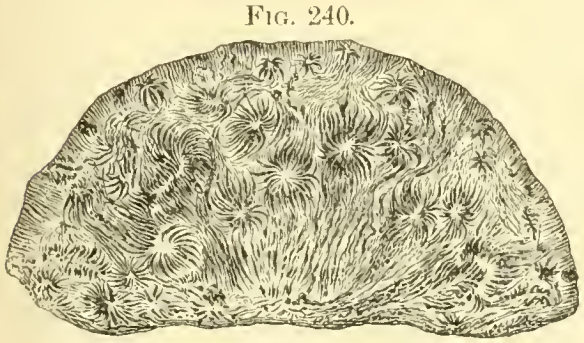
margin. A variety of this species, named Colinianum, was received by Prof. Baillon (1878) from M. Colin of Verdun, who had procured it from Central Asia; its root has the characters of rhubarb.

Production.—From the meagre accounts concerning the collection of the root and its preparation for the market, it appears that the root is dug up in autumn, deprived of its corky layer, cut into sections to facilitate the drying, and afterward exposed to the air, frequently strung on a cord, and, if necessary, dried by the aid of artificial heat. In the Chinese ports it is assorted according to its shape.

Rhubarb enters commerce now chiefly from Shanghai and other ports of Northern China, and is hence known as *Chinese rhubarb;* much of it was and is still first shipped to India before it is sent to Europe; the so-called *East India rhubarb* is therefore not distinct from the Chinese. Formerly an excellent quality of rhubarb was received through Siberia under treaty stipulations between the governments of Russia and China. This was almost exclusively received at Kiachta, and there subjected to a very stringent examination, carefully trimmed and dried, and afterward packed in waterproof chests and sent overland to Moscow and St. Petersburg. This variety was known as *Russian* or *crown rhubarb.* However, since about the year 1850 various causes have operated against the rhubarb trade through Siberia; from 1860 very little rhubarb was received at Kiachta, and the office for the inspection of this drug was finally abolished in 1863.

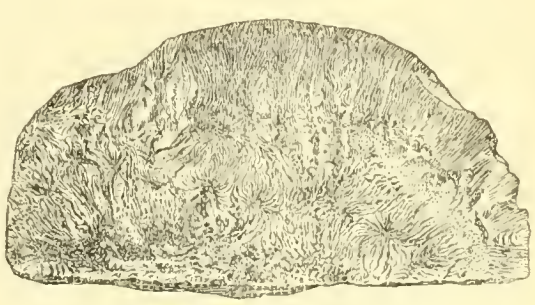
Description.—Rhubarb, as met with in commerce, consists of segments of the rhizome, which are usually assorted into *round* and *flat*, the one kind being either subcylindrical or conical, while the other is irregularly trapezoidal in outline and flattish or convex on one side. They are often perforated with a hole, in which remnants of the cord are found by which the root was suspended in drying. The outer surface is always trimmed, but patches of the corky layer, or at least of the inner portion thereof, are usually present to a small extent, and are of a dark blackish-brown color. Otherwise, the outer surface is nearly smooth or somewhat wrinkled, and after the removal of the adhering yellowish dust shows numerous brown-yellow or red-brown short striæ imbedded in a white tissue, in which an arrangement into elongated meshes is observable. The transverse surface has a marbled appearance, and consists of white parenchyma traversed by innumerable fine reddish medullary rays; these, in the centre of the pieces, are very irregular, curved, and interrupted, and show a more regular radiating arrangement only toward the circumference near the dark-colored cambium-line and in the inner bark, which is generally present in Chinese rhubarb. In Russian rhubarb the cambial zone was

FIG. 240.



Russian Rhubarb: transverse section.

FIG. 241.

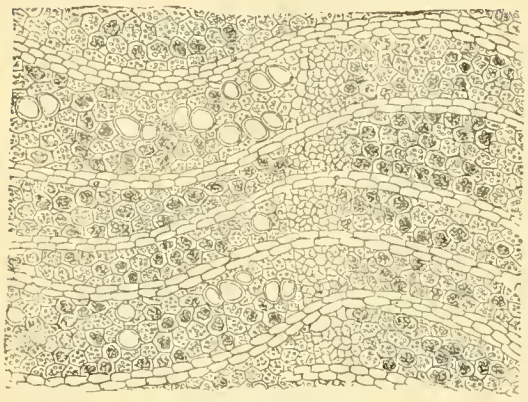


Chinese Rhubarb: transverse section.

entirely trimmed off, leaving only a narrow zone of regularly radiating nearly parallel medullary rays. Near this zone a dense circle of stellate spots was seen, consisting of small groups of medullary rays, each group radiating usually in curved lines from a common centre. These stellate spots are likewise observed in Chinese rhubarb, though not in all pieces, and are in most cases less numerous; they indicate the origin of the radical leaves, and must therefore be necessarily most numerous in old rhizomes. Rhubarb is firm, compact, and breaks with an uneven granular, not at all fibrous, fracture; it has a peculiar aromatic odor, a bitter and somewhat astringent taste, and when masticated is gritty between the teeth and imparts a yellow color to the saliva. The grittiness of rhubarb is due to the parenchyma containing aggregated tufts of microscopic crystals of calcium oxalate, the composition of which was already ascertained by Scheele (1784). Pieces which are spongy, decayed, worm-eaten, or mouldy should be rejected. Unsightly pieces are sometimes artificially improved in appearance by means of powdered turmeric, in which case the surface turns red-brown with a solution of boric acid.

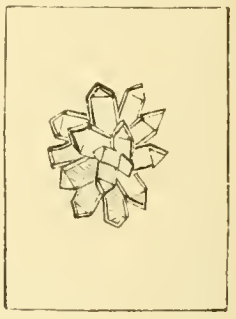
Constituents.—Rhubarb has been frequently subjected to analysis, and various more or less active substances were separated from it, and by the different investigators named *rhein*, *rhabarbarin*, *rheumin*, and *rhabarbaric acid*. In 1835, Peretti isolated from it a crystalline, yellow, sublimable principle which dissolves in potassa with a red color. This was subsequently proven by Schlossberger and Döpping (1844) to be identical with *chrysophanic acid*, $C_{15}H_{10}O_4$ (Liebermann, 1875). It was first obtained in a resinous condition by Schrader (1819) from a common lichen, Parmelia parietina, *Linné;* was obtained pure by Rochleder and Heldt (1843), and afterward found in the roots of Rumex and of cultivated rhubarb. The precipitate occurring in tincture of rhubarb yields chrysophanic acid on treating it with benzene. Or rhubarb may be exhausted with cold water, and the residue, after drying, with benzene; on concentrating the benzene solution chrysophanic acid crystallizes on cooling (Schlossberger). It forms bright-yellow needles or plates, is inodorous and nearly tasteless, fuses at 162° C. (323.6° F.), and sublimes on carefully regulating the heat. It is almost insoluble in cold water, but imparts a bright-yellow color to boiling water, and requires 224 parts of boiling 86 per cent. alcohol for solution. It crystallizes from its concentrated solution in hot alcohol, amylic alcohol, glacial acetic acid, and ether, and is freely soluble in benzene, chloroform, fixed and volatile oils, and the hydrocarbons of coal-tar. Strong sulphuric acid dissolves it with a bright-red color, and separates it again in yellow floccules on adding the solution to water. Alkalies dissolve it with a deep-red color; the solutions produce with alum a rose-colored lake, and with lead salts precipitates which may vary in color from yellowish to pinkish or bright-red. (See also Chrysarobinum, p. 473).

Fig. 242.



Rhubarb: section through and near cambium, magnified 40 diameters.

Fig. 243.



Calcium Oxalate Crystals in Rhubarb.

After washing the alcoholic extract of rhubarb with water, dissolving the residue in a small quantity of alcohol, and mixing the solution with ether, a precipitate is obtained consisting of *phæoretin*, *aporetin*, and resinous matter. The liquid yields chrysophanic acid on concentration, while the mother-liquor contains *erythroretin*, $C_{38}H_{36}O_{14}$, which is a yellow tasteless powder readily soluble in alcohol, less freely soluble in ether and glacial acetic acid, and dissolves in alkalies with a purple color. By treating crude chrysophanic acid with cold benzene, *emodin*, $C_{15}H_{10}O_5$, is left behind; this crystallizes from hot benzene in orange-colored prisms which dissolve in alkalies with a deep-red color; it was discovered by Warren de la Rue and Müller (1857). The precipitate by ether obtained as above contains aporetin, and yields to cold alcohol *phæoretin*, $C_{32}H_{32}O_{14}$, which is yellowish-brown and soluble in alkalies with a dark red-brown color. *Aporetin* is a blackish resinous mass, sparingly soluble in alcohol, ether, benzene, and chloroform, and yields with alkalies a brown solution, and by nitric acid is oxidized to oxalic and *chrysamic* acids.

Kubly (1867) isolated from rhubarb, besides phæoretin, *chrysophan*, $C_{27}H_{30}O_{14}$ (Liebermann), which is orange-colored, bitter, insoluble in ether, soluble in alcohol, and more freely so in water, and by acids is split into sugar and chrysophanic acid; a colorless, crystallizable, neutral, and tasteless body, having the composition $C_{10}H_{12}O_4$; and *rheotannic acid*, $C_{52}H_{52}O_{28}$, which is insoluble in ether, soluble in water and alcohol, precipitates gelatin and albumen, yields with ferric salts a black-green precipitate, and when boiled with dilute acids is resolved into sugar and *rheumic acid*, $C_{40}H_{32}O_{18}$. This acid closely resembles rheotannic acid, but is sparingly soluble in cold water and yields dark-blue precipitates with ferric salts. Rhubarb contains also sugar, fat, pectinaceous matter, and starch. The ash left on incineration varies in amount; good rhubarb yields about 12 or 14 per cent., but sometimes as high as 43 per cent. has been obtained (*Pharmacographia*).

Other Rhubarbs.—Rheum rhapontieum, *Linné*, is indigenous to Asia Minor, Southern Siberia, and South-eastern Russia. It has a large conical fleshy root and cordate-ovate rather obtuse leaves on long fleshy, pleasantly acidulous petioles, the upper part of which has a shallow

channel. This species is extensively cultivated as *pie-plant* for the sake of the leaf-stalks, and the root is occasionally employed in domestic practice. The same species is also cultivated in Moravia, Hungary, and near Banbury, England, and yields the Austrian or Moravian and the English rhubarb. In some parts of Russia, Germany, and France, Rheum palmatum, *Linné*, is likewise cultivated: and experiments have also been made with Rh. undulatum, *Linné*, Rh. compactum, *Linné*, and Rh. Emodi, *Wallich*, s. Rh. australe, *Don*. The various kinds of rhubarb grown in Europe are often very handsome in appearance, though usually of a lighter color than good Chinese rhubarb, and generally of smaller dimensions. The medullary rays usually radiate pretty regularly from the centre, but in interrupted lines; the cambium-zone is more distinct, the stellate spots are entirely wanting or present only in small numbers, and the outer surface shows, after trimming, the short striæ of the brownish-red medullary rays, but white meshes are rarely seen.

FIG. 244.

European Rhubarb: transverse section.

Tests.—It has been stated above that unsightly pieces of rhubarb are occasionally rendered more attractive in appearance by turmeric; the same is the case with *powdered* rhubarb. For the detection of this sophistication W. L. Howie (1873) recommended the following test: About 5 grains of rhubarb are placed upon white blotting-paper; a few drops of chloroform are percolated through the powder, when the paper surrounding the powder will become very slightly stained from good Chinese rhubarb, while European or dark-colored Chinese rhubarb will produce a deep-yellow stain similar to turmeric. A pinch of powdered borax is now placed on the stain, and a single drop of hydrochloric acid placed upon it; if the stain was produced by rhubarb its color will not be affected, but if the rhubarb contained turmeric the color will change to a distinct red in a few seconds.

Allied Drugs.—PEREZIA ADNATA, *Gray* (Trixis Pipitzahoac, *Schaffner*, Dumerilia Alami, *De Candolle*), nat. ord. Compositæ, Mutisiaceæ. This is a plant of Central Mexico, the rhizome of which is used as a laxative. It is described by Th. Greenish (1884) as 8–10 Cm. (3 to 4 inches) long, 2 Mm. ($\frac{1}{12}$ inch) thick, longitudinally wrinkled, brown, bitter, and rather persistently pungent; it has a thick central pith, surrounded by about eight short fibro-vascular bundles, on the outside of which, in the thickish bark, are contained a number of cells forming a circle and containing a yellow crystalline substance; stone-cells of a somewhat stellate appearance are scattered in the parenchyma. The yellow principle, *pipitzahoic acid*, $C_{15}H_{10}O_3$, was examined by C. M. Weld (1855); it crystallizes in golden-colored glossy scales or plates; hence it has been called *vegetable gold*; it is nearly insoluble in cold water, dissolves readily in alcohol and ether, melts near 100° C., sublimes when heated with care, and acquires an intense purple color with alkalies and alkaline earths. The same compound was obtained by Charles Mohr (1884) from the root of Perezia Wrightii and P. nana, *Gray*, of South-western Texas—from the latter in smaller quantity; it separates from the decoction in needles. The acid acts as a drastic purgative in doses of 0.25–0.50 Gm. (4 to 8 grains), and imparts a greenish color to urine.

RHINACANTHUS COMMUNIS, *Nees* (nat. ord. Acanthaceæ). This shrub is indigenous to India and China. The woody root and leaves have been used in ringworm and other cutaneous diseases. The root contains in intercellular spaces of the bark a quinone-like body, which Liborius (1881) called *rhinacanthin*, $C_{14}H_{18}O_4$, which forms with alkalies intensely red compounds, and these are decomposed by benzin, dissolving the rhinacanthin with a yellow color.

Action and Uses.—Rhubarb acts as a purgative on horses and dogs as well as on man, and in all cases its coloring and purgative principles are absorbed into the blood, since it tinges the urine and milk and renders the latter purgative. It also sometimes stains the perspiration yellow. The color which it gives the fæces probably led to its being regarded as a cholagogue, but the experiments of Rutherford led him to conclude that it is really so independently of its purgative action. Provost and Binet class it with medicines whose action on the biliary secretion is inconstant, although they commonly slightly increase it (*Therap. Gaz.* xii. 610). Its purgative and astringent properties have been ascribed to cathartinic (?) and rheo-tannic (?) acids, respectively. After large doses a moderate purgative action is followed by quiescence of the bowels; but a very small quantity taken daily in mass and allowed to dissolve in the mouth will maintain them in a free condition for some time, and that without at all impairing the digestion. The purgative operation of rhubarb has been manifested when it was applied to ulcers or moistened and rubbed upon the skin.

The gentle action of rhubarb renders it one of the best remedies for *hæmorrhoids* connected with constipation. Its tonic or astringent influence, superadded to its laxative

operation, constitutes it one of the best remedies for *diarrhœa* due to cold or to the presence of irritating ingesta in the bowels; and for this purpose roasted rhubarb is thought to be peculiarly efficient. It is prepared by roasting fragments of rhubarb like coffee. The diarrhœa to which children are liable in summer is often cured by this medicine, especially when associated with magnesia. Rhubarb laxatives in small doses have been recommended for *thread-worms*. At one time rhubarb was believed to be a valuable remedy for *dysentery*, but in this disease, which presents so many types and varieties, it is difficult to determine in what particular form of it the medicine is most efficient. We believe that it is so in the first stages of simple dysentery when associated with mild salines, in the decline of the bilious form with a tendency to protracted diarrhœa, and as an occasional purgative in chronic dysentery prolonged by scybala in the bowels.

Externally, powdered rhubarb has been recommended as a stimulant and astringent application to old, indolent, and irritable *ulcers*. Opium, calomel, and other substances may be mixed with it.

The *dose* of rhubarb as a purgative is about Gm. 1.30 (gr. xx); as a gentle aperient and tonic, Gm. 0.30 (gr. v). Associated with calomel, its action is prompt and efficient. With magnesia it is very appropriate when the secretions of the stomach and bowels are unduly acid. The simple rhubarb pill, which contains soap, is very eligible as a mild laxative for habitual or occasional use. The numerous official preparations of this drug are commented upon in their proper places.

Rhinacanthus communis has been employed in Japan and also in Europe, for chronic *diseases of the skin*, as a topical remedy (Strumpf, *Handbuch*, ii. 361; *Philada. Med. Times*, xiv. 393).

RHŒADOS PETALA, *Br.*—Red-poppy Petals.

Flores rhœados.—Corn poppy, Corn rose, E.; *Coquelicot*, F. Cod; *Pavot rouge*, Fr.; *Klatschrose, Klapperrose*, G.; *Amapola*, Sp.

The fresh petals of Papaver Rhœas, *Linné*. Bentley and Trimen, *Med. Plants*, 19.

Nat. Ord.—Papaveraceæ.

Origin.—The red poppy is an herbaceous annual growing in fields among cereals throughout the greater part of Europe, in Northern Africa, and in Asia eastward to India. It is about 60 Cm. (2 feet) high, is covered with spreading hairs, has deeply pinnatifid leaves with the segments lanceolate and cut-toothed; it has showy red flowers, and produces short, smooth, obovate capsules which are truncate above and contain numerous minute blackish seeds.

Description.—The petals are roundish in outline, 5 Cm. (2 inches) and more in width, one pair always broader than the other pair, deep scarlet-red, after drying of a dull purple, very thin, with a short claw and a black spot near the base. Their odor in the fresh state is heavy and somewhat narcotic, and is dissipated in drying; their taste is mucilaginous and slightly bitter.

Papaver dubium, *Linné*, which is sometimes met with spontaneously in the United States, is appressed-hairy and has a club-shaped capsule and roundish-oblong, red petals, which agree in sensible properties with the preceding, but are generally smaller.

Constituents.—Red-poppy petals have been frequently examined, and it has been asserted by some that they contain small quantities of morphine, paramorphine, and narcotine, which alkaloids, however, could not be detected by other investigators. According to Hesse (1865), they contain *rhœadine* (see p. 1172). Leo Meier (1846) found in the petals gum, starch, albumen, fat, and wax, and two deliquescent coloring principles—*rhœadic acid*, which is dark-red, soluble in alcohol and water, but insoluble in ether, and yields brown compounds with alkalies; and *papaveric acid*, which is bright-red, soluble in dilute alcohol and water, and forms violet compounds with the alkalies. Hesse found the milk-juice of the plant to become deep-red with ferric chloride; it probably contains meconic acid.

Uses.—The dried petals of the red or corn poppy are used in the preparation of syrup of red poppy.

RHUS GLABRA, *U. S.*—Sumach.

Pennsylvania or upland sumach, E.; *Sumac*, Fr.; *Sumach*, G.; *Zumaque*, Sp.

The fruit of Rhus glabra, *Linné*.

Nat. Ord.—Terebinthaceæ, Anacardieæ.

Origin.—The smooth sumach is a shrub or suffruticose plant growing in rocky and barren soil in North America. It attains a height of about 3.6 M. (12 feet). The stem has a large pith and a thin circular layer of white wood, which is covered with a thin brown-gray *bark* having small scattered warts on the outer surface, the inner tangential layers of a green and the inner surface of a brown color. The *leaves* are imparipinnate, with from twenty-one to thirty-one lance-oblong, pointed, and serrate, on the under side whitish, leaflets. The small greenish *flowers* grow in dense ovoid terminal panicles, and appear in June; the fruit ripens in September.

Description.—The fruit is drupaceous, subglobular, less than 3 Mm. ($\frac{1}{8}$ inch) in diameter; is densely covered with bright purplish-red hairs, and encloses a roundish oblong smooth putamen. It is inodorous and has a strong and pleasant acidulous taste. The leaves and bark, which have also been employed medicinally, have an astringent and bitter taste.

Constituents.—Trommsdorff (1834) found in the fruit of the European sumach tannin, coloring matter, potassium malate, and much calcium malate. Similar results were obtained by W. B. Rogers (1835) with the fruit of Rhus glabra and copallina. The seeds contain fixed oil. The astringent taste of European sumach-leaves was ascertained by Chevreul to be due to tannic and gallic acids, and Stenhouse (1862) corroborated this result by converting the tannin into gallic acid. He attributes the variation in the amount of tannin to the fact that the European sumach-leaves are collected also from Rhus Cotinus, *Linné*. Bowman (1869) estimated the tannin in Rhus glabra by means of gelatin, and found in the bark 8.75 and 14.55 per cent., and in the fruit 1.9 per cent.

Allied Species.—Rhus copallina, *Linné*, *Dwarf sumach*. It is from .9–2.1 M. (3 to 7 feet) high, and has downy branches and the petioles wing-margined between the lanceolate entire leaflets.

Rhus typhina, *Linné*, *Staghorn sumach*. It is 6–9 M. (20 to 30 feet) high, velvety-hairy, and has leaves with from seventeen to thirty-one oblong-lanceolate, pointed, and sharply serrate or cut-toothed leaflets.

Rhus aromatica, *Aiton*, *Sweet sumach*. It is about 1.5 M. (5 feet) high, has petiolate aromatic leaves, with three sessile rhombic-ovate cut-toothed leaves, and produces yellowish flowers in ament-like spikes. The root-bark is about 2 Mm. ($\frac{1}{12}$ inch) thick, covered with a fissured and warty brown cork (underneath which the bark is orange-red), and is whitish or pale-brownish in color. It is brittle, breaks with a short granular fracture, yields an ochre-colored powder, and has a slight pleasant odor and an astringent, aromatic, and bitterish taste. The bark contains scattered oil-cells, and has a somewhat checkered appearance from the tangential arrangement of the bast-layer and the radiating delicate medullary rays. H. W. Harper (1881) found it to contain volatile oil, several resins, fat, tannin, gum, etc., and to yield 13.8 per cent. of ash. A *tincture* has been used made with alcohol, and representing in the pint 4 troyounces of the bark. The *fluid extract* is prepared with alcohol in the same manner as fluid extract of ginger.

Rhus Coriaria, *Linné*, *European sumach*. It grows near the Mediterranean, and has elliptic, coarsely serrate, woolly leaflets. From fifteen to twenty million pounds of this sumach are annually imported. The red hispid fruit is medicinally used.

All the above species have red, hairy, acidulous fruits and astringent leaves, and, with the exception of the last, are indigenous to North America.

Action and Uses.—Sumach-berries, containing both an acid and an astringent principle, may be used in infusion Gm. 32 to Gm. 500 (℥j to Oj) as a gargle in *catarrhal* and other mild forms of *pharyngitis*, for which it forms a very agreeable and efficient remedy. Even in the decline of graver forms of this affection it is deserving of attention. The same is true of its use in *aphthæ* and other forms of sore mouth, including that produced by mercury. An infusion or decoction of the leaves or of the inner bark of the root is simply astringent, but may be applied to the same purposes, as well as for dressing wounds and ulcers. The glandular excrescences on the leaves are powerfully astringent.

Rhus aromatica, or sweet sumach, is reported to have such an action on the pelvic organs as to be useful in *hæmaturia*, *enuresis*, and *leucorrhœa*. In a case of so-called hysterical incontinence of urine it almost immediately caused a suspension of the infirmity when given as a fluid extract in doses of from 10 to 30 drops several times a day (*Centralbl. f. Therapie*, i. 207). Willeford extolled its virtues in enuresis, but did not state in what forms of the affection it excels (*Med. Record*, xxviii. 96); Unna recommended it in the nocturnal enuresis of children, but did not find its effects were usually permanent (*Therap. Gaz.*, xi. 360); and Burnevich (*ibid.*, xii., 477) used a tincture of the plant in many cases of senile and infantile incontinence of urine with good effect, prescribing it in doses of from 10–30 drops a day. (Compare Eloy, *Therap. Gaz.*, xiii. 485.)

RHUS TOXICODENDRON, *U. S.*—Rhus Toxicodendron.

Folia toxicodendri.—Poison oak, E.; *Sumach vénéneux*, Fr.; *Giftsumach*, G.; *Zumaque venenoso*, Sp.

The leaves of Rhus Toxicodendron, *Linné*.

Nat. Ord.—Terebinthaceæ.

Origin.—The poison oak is indigenous to Canada and the greater portion of the United States westward to the Rocky Mountains. It attains a height of about 1 M. (40 inches), and has an erect stem, or, if growing in close proximity to trees or walls, it becomes a climber, supporting itself by adventitious roots, and ascends to the height of 9–12 M. (30 or 40 feet). This climbing shrub, Rhus radicans, *Linné*, is now regarded merely as a variety of the erect form, but is popularly distinguished as *poison ivy*. Both forms, when wounded, emit a milky juice which turns black on exposure; they have the small pale greenish pentamerous flowers in axillary paniculate racemes, and produce small dry drupaceous fruits of a whitish color. The juice may be employed as an indelible ink, but is soluble in ether. The leaves are employed, and should be collected from May to July, while the shrub is in bloom. The plant has been introduced into Europe, and has become naturalized there.

Description.—The leaves are on petioles 10–12 Cm. (4 or 5 inches) long, and are trifoliate, with the terminal leaflet prominently stalked, ovate or oval, acuminate, and with a wedge-shaped base. The lateral leaflets are nearly sessile, 10–13 Cm. (4 or 5 inches) long, pointed, rounded at the base, and obliquely ovate in shape, the lower half being broadest. The leaflets are either entire or variously notched, coarsely toothed or lobed, smooth above, somewhat downy beneath, or sometimes downy on both sides, and after drying thin and papery; they are inodorous, and have a somewhat astringent, saline, and acrid taste. The leaves are said to have been confounded with those of Ptelea trifoliata, *Linné* (see p. 1321), which are thicker, pale-green, and have three sessile leaflets.

Constituents.—Khittel (1858) found in the leaves of poison oak tannin, producing a green-black precipitate with ferric salts, fixed oil, wax, mucilage, and other principles commonly found in plants. He believed the poisonous properties to be due to a volatile alkaloid. But we found (1865) the exhalations of this plant to have an acid reaction, and the leaves to contain notable quantities of ammonia, but no other alkaloid or only minute traces of such a compound. The poisonous *toxicodendric acid* is volatile, has a strongly acid reaction, neutralizes bases completely, and yields with an excess of lead oxide a soluble salt having a strong alkaline reaction. The aqueous solution of the acid produces with lead acetates heavy white precipitates, yields with silver nitrate, on boiling, a black precipitate of silver oxide, and separates metallic gold from a warm solution of gold chloride. Its neutral salts produce with mercurous salts a white precipitate, changing to black when heated. Potassium permanganate is readily reduced both by the acid and its salts. Toxicodendric acid resembles both formic and acetic acid in some of its reactions, and, according to the unpublished researches of H. P. Pettigrew (1883), who verified the above observations, the neutral solutions of its salts yield also a red color with ferric salts. Applied to the skin either in solution or in the state of vapor, the acid produces vesicular eruption.

Pharmaceutical Preparations.—The expressed juice of the fresh leaves preserved by alcohol probably possesses all the virtues of the drug.

Tinctura toxicodendri. The bruised fresh leaves are macerated for ten days with an equal weight of alcohol, and the liquid expressed and filtered.

Allied Plants.—Rhus diversiloba, *Torrey et Gray* (Rh. lobata, *Hooker*), is a straggling or climbing shrub of the Pacific coast of North America, and has the leaves with three or five more or less deeply lobed or pinnatifid leaflets.

Rhus venenata, *De Candolle* (Rh. Vernix, *Linné*). This species grows in swampy localities in Canada and the United States, and is known as the *poison sumach*, *poison dogwood*, and *poison elder*. It is a shrub 3.6 to 5.4 M. (12 to 18 feet) high, and has very glabrous leaves, with about eleven oval or obovate-oblong, abruptly pointed, and entire leaflets. The fruit is yellowish.

Rhus pumila *Michaux*, is a procumbent shrub of Western South Carolina, and has pubescent pinnate leaves, with about eleven oval or oblong, coarsely-toothed, and somewhat acuminate leaflets. The fruit is red and softly hairy.

Rhus Metopium, *Linné*. The *coral sumach*, *bum-wood* or *mountain-machineel*, grows in Southern Florida and the West Indian islands. It is about 9 M. (30 feet) high, and has leaves with five long-stalked ovate entire and smooth leaflets. The wood contains much tannin; the fruit is about 1 Cm. ($\frac{2}{5}$ inch) long, red and acrid.

All the species named are poisonous, and their properties are probably due to the same principle.

Action and Uses.—Poison oak was well known to the aborigines, and early described by travellers in North America, both as a poison and as a medicine. The volatile acid emanations of the living plant produce an eczematous eruption upon the skin, and it is alleged that a dog exposed to them died with a general swelling of the body. Herbivorous animals devour its leaves with impunity, but dogs are poisoned by its juice, losing their power of muscular co-ordination and strength, and dying with dilated pupils, without coma or convulsions. On man it acts externally as an irritant, some persons being much more susceptible than others to its influence. Even air impregnated with the exhalations of the leaves is sufficient to produce an eczematous inflammation of the skin. This is characterized by violent itching, redness, and swelling, followed by heat, pain, fever, and vesication, which, upon the face and genitals particularly, may be attended with extreme tumefaction. These symptoms begin between a few hours and several days after the application of the poison, and are usually at their height on the fourth or fifth day, after which desquamation commences. But sometimes they continue active for a longer time. The juice of the plant applied to the skin will, in the course of forty-eight hours, produce a blister which is soon surrounded with vesicles, and later a similar eruption may take place upon distant parts of the body without the primary blisters having been ruptured. The eruption is attended with severe burning and itching. Usually, however, the more distant irritation is due to the discharge from the primary one being conveyed elsewhere by the hands. Japanese lacquer, which is prepared from the juice of this plant, exhales a vapor that produces the characteristic eruption (Prentiss, *Therap. Gaz.*, xiii. 447). But there are some cases of poisoning by this plant, taken internally, which seem to be attended with a vesicular eruption of the skin (*Med. Record*, xxx. 601; *Therap. Gaz.*, xiii. 448). A case is reported of a woman who used the leaves of the plant instead of paper after defecation, and who suffered, besides the general affection of the skin, from symptoms of inflammation of the rectum (*Phila. Med. Times*, xii. 636). Internally, it gives rise to a species of intoxication, with vertigo, confusion of the senses, dilatation of the pupils, a sense of constriction of the temples, chilliness, nausea, thirst, a slow, small, and irregular pulse, diaphoresis, and diuresis, debility, faintness, trembling, and convulsions. Two children who between them had eaten a pint of the berries became drowsy and stupid, and then delirious and convulsed.

Various remedies have been employed to palliate the inflammation caused by poison oak. If the inflammation is early seen, it should be washed with warm water and soap or sodium bicarbonate. Alum-curd is appropriate at all stages of the process. Before the blisters have fully formed or have discharged their contents lead-water is useful, but a weak solution of ammonia or a strong one of sodium carbonate or sulphite, or the solution of chlorinated soda, is perhaps still more so. Cosmoline allays the itching and burning. When the blisters are mature or have been ruptured, a solution of iron perchloride or persulphate or of zinc sulphate, or simply lime-water, carefully applied to the vesicated skin, will arrest the progress of the inflammation. Grindelia squarrosa has also been used for this purpose. These articles are more or less palliative, but no one of them is strictly curative. Of the great number used, the following may be mentioned besides those already named: Hamamelis, stramonium, lobelia, sassafras-bark, elder-bark, boneset, gelsemium, dulcamara, serpentaria, spice-bush; oak-bark, tannin, zinc, bismuth, lead, alum; potassium chlorate, carbolic acid, oxalic axid, copper sulphate, black-wash, bromine. It is evident that these agents are divisible into protective, astringent, and stimulant, and that each group is most applicable to a special stage or grade of the affection.

The inflammation of the skin which poison oak excites led to its being employed substitutively in chronic *cutaneous affections*, but there is no proof of its efficiency, as there is in *sciatica*, for which it has been used. It has been alleged to be efficacious in the treatment of *paraplegia* from concussion of the spinal marrow, and other affections of this organ without lesion of tissue; it is said to occasion no inconvenience, and to strengthen rather than enfeeble digestion. Sometimes a slight degree of strangury is observed. It has also been used to cure *incontinence of urine* depending upon atony of the bladder. In the early part of this century this plant was extensively employed in the treatment of *paralytic* affections, but it fell into complete disuse (Richter, *Ausführ. Arzneim.*, ii. 805; Stillé, *Therapeutics*, 4th ed. ii. 795). Some recent reports of its efficiency were published by Aulde (*Med. News*, liv. 446; *Therap. Gaz.*, xiii. 676), but as the dose employed represented only half a drop of the official tincture, the statements can hardly be regarded as conclusive. A recent writer (who incorrectly states that "it is official (*sic*) in the German Pharmacopœia") reiterates the above statements of its utility in

nervous, rheumatic, cutaneous, and urinary disorders (*Med. News*, lxiii. 390). It is, however, pronounced by Husemann (*Arzneimittellehre*, 3d ed. p. 440) an obsolete medicine; and Dr. H. C. Wood, who tested the alleged efficacy of the drug in various forms of *rheumatism*, found that it gave no definite good result (*Therap. Gaz.*, xiv. 95). One physician found it useful in spinal anæmia if associated with nux vomica, and that it reduces the temperature if administered with gelsemium; which may very readily be credited—much more readily than that it is "a laxative, diaphoretic, diuretic, and particularly a stimulant of the nervous system," which is asserted by the same authority (*Detroit Lancet*, Jan. 1880). The *dose* of the powdered leaves, which should be gradually increased, is Gm. 0.30–4 (gr. v to gr. lx). On the whole, the medicinal virtues of this plant are too uncertain to inspire any confidence.

ROBINIA.—Locust Tree.

False acacia, E.; *Robinier*, Fr.; *Falsche Akazie*, G.

Robinia Pseudacacia, *Linné*.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Description.—The common locust tree is indigenous to the southern part of the United States, but is commonly cultivated and naturalized farther north and in Europe. It is thorny when young, attains a height of 18 to 24 M. (60 or 80 feet), but is smaller in northern localities, and has a durable white or reddish wood and a brownish or gray, smooth, and internally yellowish bark. Its leaves are imparipinnate, the leaflets in from eight to twelve pairs, oval, obtuse, and smooth, and the fragrant whitish flowers in long slender racemes. The legume is about 8 Cm. (3 inches) long, linear, flat, margined on the inner side, and contains about six blackish-brown small seeds. The root and inner bark have a sweetish taste.

Constituents.—The root was examined by H. Reinsch (1845), who found it to contain much albumen, tannin, sugar, starch, and other common vegetable principles. His *robinic acid* is believed by Hlasiwetz (1852) to be *asparagin*, of which he obtained 2½ ounces from 30 pounds of the root. Power and Cambier (1890) isolated from the bark *choline*, a globulin, and an albumose. The latter is tasteless, soluble in water, coagulated and rendered inert by heat. It is precipitated by potassium-bismuth iodide, and by tannin, and from its acidulated solutions by potassium ferrocyanide. It is an emetic and purgative. According to Zwenger and Dronke (1861), the flowers contain a yellow glucoside, *robinin*, which, on being boiled with acids, is resolved into sugar and *quercetin*, and which is also contained in the bark and wood.

Action and Uses.—The bark of the root of Robinia is said to be tonic, and in large doses purgative and emetic, and a syrup prepared from the flowers is related to have produced acro-narcotic effects in children. Gendron mentions that certain boys who had chewed some of the bark and swallowed the juice were affected not only with vomiting, but with coma and slight convulsions (Griffith, *Med. Botany*). Gelcich reports two cases of poisoning in the same manner. The symptoms were burning in the throat and stomach, stupor, dilated pupils, staggering, muscular spasms, and drawing of the knees upward. In one of the cases, a child three years old, there were extreme pallor, livid lips, sunken eyes, and absence of pulse. Recovery in both cases took place after the use of diffusible and mechanical stimulants (*Philada. Med. Times*, Apr. 24, 1880). No definite information concerning its medicinal virtues is accessible.

ROSÆ CANINÆ FRUCTUS, *Br.*—Hips.

Cynosbata, *Fructus cynosbati.*—*Fruit of the dog rose*, E.; *Gratte-cul*, Fr.; *Cynorrhodon*, Fr. Cod.; *Hagebutte*, *Hainbutte*, G.; *Cinosbato*, *Escaraniujo*, *Una de gato*, Sp.

The ripe fruit of the dog rose, Rosa canina, *Linné*, and other indigenous allied species. Bentley and Trimen, *Med. Plants*, 103.

Nat. Ord.—Rosaceæ, Roseæ.

Origin.—The *dog rose* is a spiny European shrub, from 1.2–2.4 M. (4 to 8 feet) high, and resembles the roses indigenous to this country, but differs from them in the shape of the calyx and in the absence of glandular hairs on the peduncle and calyx.

Description.—Hips are not the fruit, but the enlarged calyx-tubes, of the rose. They are about 25 Mm. (1 inch) in length, ovate, contracted above, of a bright-red color, shining, internally stiff-haired, and enclose a number of ovate, hairy, brownish, bony akenes. Hips are at first tough and crowned with the five-cleft deciduous calyx-

lobes; later in autumn they are naked above, softer, and more fleshy. They are inodorous and have a sweet acidulous and somewhat astringent taste. For medicinal use the hard akenes are removed and the fleshy calyx-tube alone is employed. The corresponding part of Rosa carolina, *Linné*, and R. lucida, *Ehrhart* (Meehan, *Native Flowers*, i. 169; ii. 133), is depressed globular, the former somewhat hairy, and has properties similar to those of the first.

Constituents.—Scheele already noticed malic and citric acid in the pulp. Biltz (1824) obtained 7.78 per cent. of malic and 2.95 per cent. of citric acid; also 30.6 per cent. of sugar, 25 per cent. of gum, and small quantities of tannin, resin, wax, malates, citrates, and other salts.

Action and Uses.—Hips are described as slightly refrigerant and astringent, but they are used in medicine only to prepare the confection of hips.

ROSA CENTIFOLIA, *U. S.*—Pale Rose.

Rosæ centifoliæ petala, Br.; *Flores rosæ*, P. G.; *Flores rosarum incarnatarum.—Cabbage rose-petals, Hundred-leaved rose*, E.; *Rose à cent feuilles, Rose pâle*, Fr. Cod.; *Centifolienrose, Roseublätter*, G.; *Rosa pallida, Rosa de Castilla*, Sp.

The petals of Rosa centifolia, *Linné*. Bentley and Trimen, *Med. Plants*, 105.

Nat. Ord.—Rosaceæ, Roseæ.

Origin.—This well-known shrub, which is by some botanists regarded as a cultivated variety of the red rose, is probably indigenous to Western Asia, and is cultivated in innumerable varieties in all countries. Its branches are covered with numerous nearly straight spines; the petioles and peduncles are nearly unarmed, but more or less clothed with glandular bristles, and the leaves have five, or sometimes seven, ovate or elliptic-oval serrate glandular and beneath soft-hairy leaflets. The flowers are collected and deprived of the calyx and ovaries, the petals alone being employed.

Description.—The petals are roundish-obovate, retuse at the apex or almost obcordate, of a pink color, a delicious rose odor, and of a sweetish, somewhat bitter, and slightly astringent taste. In drying they become brownish and less fragrant.

Constituents.—The odor of rose-petals is due to a minute quantity of volatile oil (see page 1147). Enz (1867) determined the other constituents to be tannin, giving a green reaction with ferric salts, fat, resin, sugar, mucilage, a bitter principle, malates, tannates, and phosphates, and a coloring matter which is easily altered, and, from the investigations of Fremy, Cloez, Filhol, and others, seems to be identical with that of the red rose and of many other red-colored flowers.

Pharmaceutical Uses.—Rose-petals are employed chiefly in the distillation of rose-water, and are for this purpose often preserved by being packed into suitable vessels with one-half or their own weight of common salt. It is stated that in some laboratories the entire rose-flowers are used in the distillation of rose-water, and furnish a good product.

Action and Uses.—Pale rose-leaves are seldom used medicinally except in the form of the official rose-water. The nervous symptoms and occasionally the coryza ascribed to fresh roses are apt to be produced by other odorous flowers.

ROSA GALLICA, *U. S.*—Red Rose.

Rosæ gallicæ petala, Br.; *Flores rosarum rubrarum.—Red-rose petals*, E.; *Rose rouge, Rose de Provins*, Fr. Cod.; *Essigrose, Sammtrose, Zuckerrose*, G.; *Rosa roja, R. rubra*, Sp.

The petals of Rosa gallica, *Linné*. Bentley and Trimen, *Med. Plants*, 104.

Nat. Ord.—Rosaceæ. Roseæ.

Origin.—The red rose is a bushy shrub 60–90 Cm. (2 or 3 feet) high, which grows wild in Southern Europe and the Levant and is cultivated in gardens in numerous varieties. It is armed with bristly prickles and with a few curved spines, and has slightly heart-shaped and thicker leaflets than the preceding species. The flowers are collected while still in bud, and the petals cut off near the base and rapidly dried.

Description.—As seen in commerce, red rose is in small cones consisting of the numerous densely-imbricated petals, which, when unfolded, are roundish, retuse at the apex, and at the base narrowed into a short yellow claw, the greater portion of which has been trimmed off; the centre of the cone is hollow or it contains some of the stamens. The color is deep purplish-red, velvety in aspect; the odor is roseate and the taste bit-

terish, slightly acid, and astringent. Red rose should be preserved in a dry place and excluded from the light.

Constituents.—The chemical constituents of red rose are very similar to, if not identical with, those of pale rose, but the astringent principle is more predominating. Filhol (1863) denied the existence of tannin in red-rose petals; by extracting them with ether two fats and *quercitrin* were obtained, to which the dark-green reaction with ferric salts is due; alcohol afterward took up a little gallic acid and nearly 20 per cent. (?) of invert-sugar. Rochleder (1867), however, ascribed the reaction with iron to *quercetic* and a little gallic acid. The coloring principle of red rose was isolated by H. Lenier (1877) by exhausting the petals with ether, and afterward with alcohol; the tincture was precipitated by lead acetate, and this precipitate decomposed by an insufficient quantity of sulphuric acid in the presence of alcohol. The coloring matter becomes deep-red, with a bright-green fluorescence, by alkalies; it decomposes carbonates, yields with alkalies crystallizable compounds, and is precipitated by salts of alkaline earths and metals, the lead salt having the composition $Pb_2C_{21}H_{29}O_{30}$.

Action and Uses.—Red-rose leaves were anciently used in infusion as a cooling and astringent remedy for *inflamed* uterine and other *hæmorrhages*, and as an application to *aphthæ* and other *ulcers* affecting the mouth, ears, anus, etc., and the fresh bruised leaves were applied to inflamed *eyes*, etc.

A compound infusion of rose, containing sugar and diluted sulphuric acid (*U. S. P.* 1870), is employed as a coloring and flavoring ingredient of mixtures, and as an excipient and solvent for magnesium sulphate and for quinine sulphate, whose taste it partially covers. It forms an agreeable gargle for inflamed and ulcerated states of the *mouth* and *fauces*, and may be used to moderate profuse *sweats*. Its virtues are largely due to the sulphuric acid it contains. *Dose*, from Gm. 64–128 (f℥ij–iv).

ROSMARINUS, *U. S.*—Rosemary.

Folia rosmarini, s: roris marini, Folia anthos.—Romarin, Fr. Cod.; *Rosmarin*, G.; *Romero*, Sp.

The leaves of Rosmarinus officinalis, *Linné*. Bentley and Trimen, *Med. Plants*, 207.

Nat. Ord.—Labiatæ, Monardeæ.

Fig. 245.

Rosmarinus officinalis, *Linné*: branch and flower.

Origin.—Rosemary is a native of the basin of the Mediterranean, and is often cultivated in gardens. It is shrubby, .9–1.2 M. (3 or 4 feet) high, much branched, evergreen, and has few-flowered axillary clusters of rather large pale-blue flowers.

Description.—Rosemary-leaves are about 25 Mm. (1 inch) long, leathery, linear, entire, sessile, obtuse at both ends, dark-green above, densely woolly and dotted with oil-glands beneath, and revolute on the margin. In drying the margin becomes more strongly revolute, the leaf narrower and rigid, and the midrib prominent on the lower side. Rosemary has a peculiar aromatic somewhat camphoraceous odor and a pungently aromatic taste.

Constituents.—The principal constituent is the volatile oil (see page 1148). A little tannin, resin, and bitter principle are likewise present.

Pharmaceutical Uses.—The leaves are employed in the preparation of fumigating powders and the distillation of the volatile oil.

Action and Uses.—By the ancients rosemary was esteemed for its emmenagogue, galactagogue, and diuretic virtues, and more recently it was regarded as diaphoretic and carminative, and as useful in various functional *nervous disorders*. In Europe it is sometimes still employed for similar purposes. An infusion prepared with Gm. 4–8 in Gm. 500 (gr. lx–cxx in Oj) may be prescribed in tablespoonful doses. Fomentations, made with the plant steeped in hot water or alcohol, and ointments prepared with it, are used for the relief of local pains.

RUBUS, *U. S.*—Blackberry.

Ronce sauvage, Ronce noir, Fr. Cod.; *Brombeeren*, G.; *Zarzamora*, Sp.

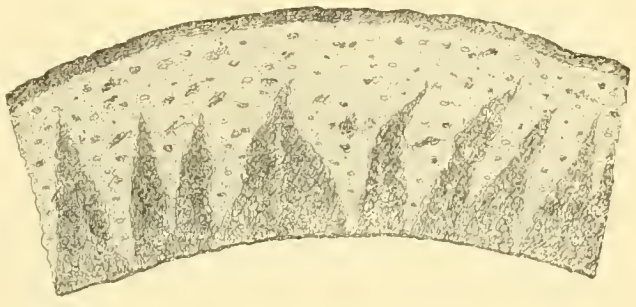
The bark of the root of Rubus villosus, *Aiton*, Rubus Canadensis, *Linné*, and of Rubus trivialis, *Michaux*. Bentley and Trimen, *Med. Plants*, 100.

Nat. Ord.—Rosaceæ, Dryadeæ.

Origin.—These species are common shrubby North American plants with trifoliate or quinate leaves. R. Canadensis is the *dewberry*, and has a trailing slightly prickly stem and nearly smooth ovate-lanceolate, sharply serrate leaflets. R. villosus is the common *American blackberry*, has an upright or reclining stem armed with stout recurved prickles, and is glandular and hairy on the branchlets and the lower surface of the leaflets, and ripens its fruit later than the first species. R. trivialis is the dewberry or bush-blackberry of the Southern United States, growing as far north as Maryland; it is armed with bristles and recurved prickles, and has coriaceous, evergreen, nearly smooth leaflets.

Description.—The roots of these species are considerably branched, vary in size from the thickness of a goosequill or less to the diameter of 25 Mm. (1 inch) or more, and contain a large whitish, tough, ligneous meditullium. The bark is quite thin, blackish or in the dewberry blackish-gray, externally, internally dark-brown, and the inner surface pale-brownish and smooth, tough, breaks with some difficulty, shows in the bast-wedges a tangential arrangement of the tissue, is nearly inodorous, and has a strongly astringent and somewhat bitter taste. The thinnest roots are frequently not deprived of the white, tasteless, and inert wood. The leaves of most species of this genus have an astringent and somewhat bitter taste; those of R. fruticosus, *Linné*, are medicinally employed in Europe.

Fig. 246.



Rubus villosus: transverse section through bark, magnified 15 diameters.

Constituents.—Blackberry-bark contains tannin, of which C. F. Kramer (1882) obtained 10.2 per cent.; its other constituents have not been investigated.

Action and Uses.—Blackberry-root and dewberry-root possess astringent and probably tonic virtues, and are much used in *summer complaint* and *infantile diarrhœa*. They are best administered in a decoction made with water or with milk, Gm. 32 in Gm. 750, reduced to Gm. 500 (℥j in Oiss, reduced to Oj).

The roots and leaves of several species of Rubus were anciently employed internally as diuretics and externally as dressings for wounds and ulcers. In Russia an infusion of the leaves of R. chamœmorus has long been used as a remedy for debility of the *bladder* (Strumpf, *Handbuch*, i. 288). In recent times Popoff and others have confirmed the efficiency of this treatment (*Lancet*, Mar. 6, 1866), and obtained from the plant an acid which, combined with alkalies, showed a diuretic action whether given internally or subcutaneously (*Lond. Med. Record*, June 15, 1886). Troitsky employed an infusion of the leaves successfully in *dropsy* (*Centralbl. f. d. g. Therap.*, v. 540).

RUBUS IDÆUS, *U. S.*—Raspberry.

Framboise, Fr. Cod.; *Himbeeren*, G.; *Frambuesa*, *Sanguesa*, Sp.

The fruit of Rubus Idæus, *Linné*.

Nat. Ord.—Rosaceæ, Dryadeæ.

Origin.—This shrub attains a height of about 1.8 M. (6 feet), is indigenous to the greater portion of Europe and to Northern Asia as far east as Japan, and is frequently cultivated. Areschong (1872) regards it as being derived from Rubus strigosus, *Michaux*, which is common in North America and Japan. The young shoots are glaucous, more or less bristly-spinous, and have imparipinnate leaves with one to three pairs of sessile, ovate, serrate, and whitish-downy leaflets. The flowers have five white petals, about as long as the calyx-lobes.

Description.—The fruit is hemispherical or subconical, and consists of about twenty or thirty small red velvety-hairy drupes, which are laterally coalesced and separate in a collective mass from the dry conical receptacle. Raspberries, which are used in the fresh state only, contain a bright-red juice and have an agreeable fruity odor and a pleasant acidulous taste.

The fruit of the North American Rubus occidentalis, *Linné*, or *thimbleberry*, closely resembles the preceding, but is of a purplish-black color and has a dark-red juice.

Constituents.—Raspberries contain 4.5 to 8.7 per cent. of insoluble matter, .4 to .8 per cent. of ash, and 7 to 8.5 per cent. of organic constituents, about one-half of which is

sugar, one-fourth is malic and citric acids, and the remainder consists of proteids, pectin, etc. The odor is due to a volatile oil consisting of compound ethers, and when distilled with water the distillate separates a white flocculent stearopten.

Allied Fruits.—Blackberries.—Dewberries, *E.*; Mures des haies, Baies de ronce, *Fr.*; Brombeeren, *G.*; *Zarzamoras*, Sp.—The fruit of Rubus villosus, *Aiton*, of North America, R. fruticosus, *Linné*, of Europe, and allied species, has a fleshy receptacle, which remains united with the coalesced drupes, is of a black or blackish color, and contains a blackish-purple juice resembling in composition the juice of raspberries, but of a less delicate odor.

Uses.—The sole use of this fruit in medicine is to prepare an agreeable syrup.

RUMEX, *U. S.*—Rumex.

Radix rumicis s. lapathi.—Yellow dock, E.; *Patience*, Fr. Cod.; *Grindwurz, Mengelwurz*, G.; *Lapato*, Sp.

The root of Rumex crispus, *Linné*, and of other species of Rumex.

Nat. Ord.—Polygonaceæ.

Origin.—The *curled dock* is a European perennial, and has been extensively naturalized in North America and in other countries. It grows in waste places and in cultivated ground, and is distinguished from allied species by the wavy curled margins of its lanceolate leaves, and by the roundish-cordate, slightly denticulate, and grain-bearing valves of the fruit. The root is collected in autumn.

Description.—The root is 20–30 Cm. (8 to 13 inches) long, 6–18 Mm. ($\frac{1}{4}$ to $\frac{3}{4}$ inch) or more thick, many-headed, fusiform, annulate above, somewhat branched and sparsely beset with fibres; after drying deeply wrinkled longitudinally, externally of a brown or reddish-brown color, inodorous, and of a bitter and astringent taste. The root breaks with a short irregular fracture, and upon transverse section shows a rather thick bark nearly one-sixth the diameter of the root, a dark-colored cambium-line, and a fleshy meditullium, containing porous wood-wedges, separated by narrow medullary rays. The color of the inner tissue is white or whitish, after drying dingy brown-yellow, with yellowish or brownish-red striæ. The roots of Rumex obtusifolius, *Linné*, and R. sanguineus, *Linné*, both indigenous to Europe and naturalized in North America, are indiscriminately collected with the preceding and resemble it.

Constituents.—The chemical composition of yellow dock is nearly identical with that of rhubarb, except in the relative proportion of the constituents, the astringency predominating. The *rumicin* and *lapathin* of earlier investigators were proven by Tann (1858) to be identical with chrysophanic acid.

Action and Uses.—Yellow or curled dock is astringent, slightly tonic, and also laxative, and in its operation has been compared to rhubarb and also sarsaparilla. It has been chiefly used in chronic *cutaneous diseases*, particularly of a scrofulous nature. Some species of Rumex have been famous for the cure of *intermittent fevers*, for which purpose they were given in a hot decoction, to the production of sweating. Others have been regarded as eminently depurative, and used in chronic *hepatic congestion* and *dyspepsia* with lateritious urinary deposits and a tendency to *gout*. Externally, yellow dock has been applied to the treatment of various *skin diseases*, *glandular swellings*, and *scabies*. For the last an ointment is employed, made by boiling the root in vinegar until the fibre is softened; the latter is then reduced to a pulp and mixed with sulphur and lard. It is pretty certain that the sulphur is the efficient ingredient of this ointment. The fresh leaf when bruised is a popular antidote to the eruption caused by the stinging *nettle*. The root, softened by boiling, may be used as a stimulant and resolvent cataplasm. The decoction is made by boiling 2 ounces of the fresh root or 1 ounce of the dry root, bruised, Gm. 64 or 32 in Gm. 500 (a pint) of water. Of this 2 fluidounces may be taken at a dose.

R. sanguineus and *R. aquaticus* are astringent, especially the seeds: *R. alpinus* is compared to rhubarb for its bitterness and astringency; *R. acutus* has been much used in pulp as a dressing for cancerous and other foul *ulcers*; *R. acetatus* is employed like sorrel for culinary purposes.

RUTA.—Rue.

Rue, Fr. Cod.; *Raute, Gartenraute*, G.; *Ruda*, Sp.

The leaves of Ruta graveolens, *Linné*. Bentley and Trimen, *Med. Plants*, 44.

Nat. Ord.—Rutaceæ, Ruteæ.

Description.—Rue is an herbaceous or suffruticose perennial 60–90 Cm. (2 or 3 feet) high, which grows wild throughout Southern Europe and is frequently cultivated in gardens. The leaves are alternate, on long petioles, thrice or twice pinnate, or the upper ones pinnatifid, the lower ones 7–10 Cm. (3 to 4 inches) long, triangular-ovate in outline, subcoriaceous, grayish-green, finely pellucid-punctate and smooth; the final divisions obovate-oblong or spatulate, sparingly crenate, obtuse or rounded above, the terminal division larger and spatulate wedge-shaped. The plant has yellowish flowers in terminal corymbs, and four- or five-lobed capsules containing numerous ovoid-angular blackish seeds. The leaves have a peculiar, strongly balsamic odor and possess an aromatic, bitter, and acrid taste.

Constituents.—The most important constituent of rue is its volatile oil (see page 1149). Machl found free malic acid. Weiss (1842) isolated the yellow coloring matter, *rutin*, $C_{25}H_{28}O_{15}$, and obtained it in needle-shaped crystals. Bornträger (1844) ascertained it to possess acid properties, and named it *rutinic acid*. Hlasiwetz (1855) observed that it splits into sugar and quercetin, and regarded it as identical with *quercitrin;* but Zwenger and Dronke found the unfermentable *rutin-sugar* to differ from isodulcit and to have the composition $C_{12}H_{18}O_9$. P. Foerster (1882) obtained between 44.5 and 46.5 per cent. of quercetin. In preparing rutin it is with difficulty purified from resinous matter and a compound resembling coumarin.

Allied Drug.—Evodia rutæcarpa, *Bentham* (Zanthoxyleæ), is a handsome Japanese shrub about 2.4 M. (8 feet) high. The thin, cylindrical, downy stalks and the unripe fruit are used; the latter are of the size of a small pea, five-grooved in the upper half, red-brown, glandular-pitted, and of a rutaceous odor and pungent taste. The drug is employed as a purgative and emmenagogue.

Action and Uses.—Rue is an active irritant, as numerous cases of poisoning by it attest. In one example a man who had been gathering rue suffered from an inflammation of the skin of the forearms with abundant vesicles, which healed very slowly. Three cases are reported by Hélie, in which rue was used to produce abortion. In the first a decoction of the sliced root, in the second a decoction of the leaves, and in the third the expressed juice of the leaves, was taken. In one of the cases the effects were violent gastric pain, vomiting or efforts to vomit, with the rejection of a little blood. In all there were great prostration, confusion of mind, cloudy vision, feebleness and slowness of pulse, coldness of the extremities, and twitching of the limbs. All the patients, who were in the fourth or fifth month of pregnancy, aborted and recovered. In another case a woman had several times caused herself to abort by using an infusion of rue. The symptoms produced were pain in the back, bearing down, frequent micturition, continuing for several days and often attended with headache, when a "show" took place, followed by pains and abortion about ten days from the beginning of the administration. Three doses of the oil of rue taken within an hour by a healthy adult produced uneasiness in the stomach, oppression and confusion of the brain, aching in the loins, an urgent desire to urinate, a strong smell of rue in the urine, flushes of heat, unsteadiness of gait, a tendency to sleep, and increased frequency and diminished tension of the pulse. On the other hand, when an infusion of the dried leaves was employed the pulse fell from 80 to 69 in three hours (Van de Warker, *Criminal Abortion*, 1872).

Capparis, the pickled flower-buds, were once regarded as possessed of medicinal virtues, but are now employed only as a condiment for fatty meats. (See also page 304.)

Reseda was formerly considered diaphoretic and alexipharmic, and employed as an antidote to snake-bites and as a vermifuge. For the latter purpose it is still used in Russia.

Rue was held in high esteem from the time of Hippocrates. It was employed to cure amenorrhœa, promote the lochia, and cause abortion. It was believed that in women it stimulated sexual desire, but that in men it diminished the seminal secretion and the tendency to venery; that it was carminative and tonic, and useful internally and externally to relieve colic; and that it destroyed intestinal worms and cured intermittent fever. It was thought, in due proportion, to strengthen, but in excess to weaken, the sight, and was prescribed as an antidote to poisoning by aconite, mushrooms, etc. Externally, it was known to cause a pustular eruption upon the hands of persons employed to gather it, and was used to destroy fleas.

Rue is a powerful antispasmodic, and was formerly administered in enemata for preventing or shortening *hysterical* attacks. Its stimulant action upon the uterus is shown in the unimpregnated as well as the pregnant state of the organ, but especially in the cure of *amenorrhœa* due to non-inflammatory causes. In cases arising from congestion

of the uterus rue has sometimes occasioned profuse hæmorrhage and severe pain. It should, therefore, be cautiously used in *dysmenorrhœa*. In Chili it is said to be applied to the umbilicus and to the soles of the feet to produce an emmenagogue effect. The essential oil is the most convenient form for its administration. Rue has been used instead of savin in uterine *hæmorrhage* after abortion and when it depends upon general debility. A decoction of the fresh leaves of rue has been employed as an injection to destroy *ascarides* of the rectum, and internally to remove *lumbricoid worms*. Externally, compresses saturated with a strong decoction of the plant, and applied to the chest, have been used with advantage in *chronic bronchitis*. A similar decoction has been found very efficient in destroying *body lice*, in various *scaly eruptions*, and in *glandular* engorgements.

The decoction and infusion of rue should be made from the fresh plant, but as this is not always to be procured, the oil may be substituted for it in the dose of from 1 to 5 drops. An infusion may be prepared with about Gm. 16 in Gm. 500 (℥ss in Oj) of water.

SABADILLA, *Br.*—Cevadilla.

Cévadille, Fr. Cod.; *Sabadillsamen*, *Läusekörner*, G.; *Cebadilla*, Sp.

The seeds of Schœnocaulon (Veratrum, *Schlechtendal*) officinale, *Gray*, Asagræa (Helonias, *Don*) officinalis, *Lindley*, Sabadilla officinarum, *Brandt*. Bentley and Trimen, *Med. Plants*, 287.

Nat. Ord.—Melanthaceæ.

Origin.—The cevadilla is a bulbous plant with long, linear, grass-like radical leaves and a slender scape, bearing a narrow spike-like raceme about 30–45 Cm. (12 or 18 inches) long, of greenish-yellow flowers, of which the lower ones only are fertile. It is indigenous to the eastern section of Mexico, also to Guatemala and Venezuela. The plant growing in the latter country differs in some respects from the Mexican cevadilla, but no difference is observed in the seeds. The seeds alone are usually exported from Venezuela, and the ripe capsules from Mexico.

Description.—The fruit consists of three slightly-spreading, brownish, papery follicles which are about 12 Mm. (½ inch) long, and are either empty or contain from two to six seeds each. These are from 5–8 Mm. (⅕ to ⅓ inch) long, narrow oblong or lance-linear, one side usually flattened and angular, the lower end rounded and the apex attenuate and rather beaked; the testa is rugosely wrinkled, somewhat shining, of a brownish-black color, and encloses a whitish oily albumen and at the base a small linear embryo. The seeds are inodorous and have a bitter and persistently acrid taste; the powder is sternutatory.

Fig. 247.

Asagræa officinalis, *Lindley*: fruit, nat. size; seed and longitudinal section magnified

Constituents.—Pelletier and Caventou's analysis (1820) proved the presence of fat, wax, mucilage, and *veratrine*, combined with an acid which was at first supposed to be gallic acid, but was shown by Pfaff to be a different compound: the fat is a mixture of liquid and solid fat, and contains a volatile fatty acid, *sabadillic* or *cevadic acid*, which has an odor similar to that of butyric acid, melts at 20° C. (68° F.) and at a higher heat sublimes in white pearly needles. *Veratrine* was discovered by Meissner (1819). (For recent investigations on the alkaloids of sabadilla see Veratrina.)

Veratric acid, $C_9H_{10}O_4$, was discovered by Merck (1839); it crystallizes in needles or prisms which are soluble in alcohol and hot water, but insoluble in ether; is fusible and sublimable, and yields with the alkalies crystallizable salts which are soluble in alcohol and water.

Cevadilla yields about ½ per cent. of veratrine and about $\frac{1}{60}$ per cent. of veratric acid. The composition of the capsular integuments has not been ascertained. The seeds are used in pharmacy only for preparing veratrine.

Action and Uses.—The medicinal virtues of cevadilla are due to the veratrine it contains, and will be found more particularly described in connection with that alkaloid. The seeds are poisonous to dogs and cats, causing vomiting and convulsions. Two children drank of a decoction of cevadilla (?), and presented the following symptoms: vomiting, insensibility, pallor, a small sharp pulse, heat of head and cool extremity, and spasms of the face and limbs; deglutition was impossible, the pupils were dilated, and the eyes projecting and oscillating. Both patients recovered (*Prager Viertcljahrs.*, lxxi. 117).

It was formerly employed to destroy *body lice* and other *vermin*, but sometimes, when applied to the sore head, it has occasioned alarming symptoms. The tincture has been found a very efficient remedy for *scabies*. The powder has been used for the same purpose, mixed with oil and brandy, and applied after the patient has taken a prolonged warm bath. Cevadilla has also been prescribed as a *vermifuge* for tænia and rectal ascarides, and for various nervous affections. It is seldom given internally, but the dose of the seeds is stated to be from Gm. 0.10–0.20 (gr. ij–iv).

SABBATIA.—Sabbatia.

American centaury, E.; *Centaurée américaine*, Fr.; *Sabbatie*, G.

The herb of Sabbatia (Chironia, *Linné*) angularis, *Pursh*.

Nat. Ord.—Gentianeæ, Chironieæ.

Description.—The American centaury is a smooth biennial herb growing in dry fields and on hillsides throughout the Middle and Southern United States. Its stem is about 60 Cm. (2 feet) high, quadrangular, winged, and much branched above; the leaves are about 25 Mm. (1 inch) long, oblong-ovate, five-nerved, entire, acute, and at the base clasping; the flowers are in terminal corymbose panicles, have a five- or six-parted calyx with lance-linear lobes, a wheel-shaped pale or purplish-red corolla, about 38 Mm. (1½ inches) wide, five or six finally recurved stamens, and produce an oblong-ovate, mucronate, many-seeded capsule. It blooms in July, and should then be collected. The herb is without odor, but has a persistent and purely bitter taste.

Constituents.—The plant contains the principles commonly found in herbs, but appears to be free from tannin, or nearly so: the bitter principle has not been obtained in a pure state. Méhu (1868) isolated *erythrocentaurin*, $C_{27}H_{24}O_8$, by agitating the syrupy alcoholic extract of European centaury with ether; it crystallizes readily, is inodorous, tasteless, neutral, readily soluble in carbon disulphide, benzene, and oils, and dissolves in 1600 parts of cold water, 48 parts of alcohol, 13 of chloroform, and 245 parts of ether; light colors it red, but on recrystallization it is again obtained colorless. The yield is only $\frac{1}{30}$ per cent. Méhu obtained (1870) the same principle also from Erythræa chilensis, *Persoon*, and J. F. Huneker (1871) from American centaury.

Pharmaceutical Preparation.—Extractum centaurii, Extract of centaury. It is made by digesting European centaury with hot water and evaporating the infusion.

Allied Herbs.—Sabbatia Elliottii, *Steudel*, is known in Florida as *quinine-flower*. The stem is 25–50 Cm. (10 to 20 inches) high, terete and diffusely branched; the leaves are sessile, 6–12 Mm. (¼ to ½ inch) long, obovate or oblanceolate, and the upper ones linear; the calyx-lobes are almost filiform and about one-fourth the length of the rose-colored corolla. The plant is inodorous and has a persistent, purely bitter taste. The solution of the alcoholic extract in acidulated water gives with potassio-mercuric iodide a slight precipitate (T. F. Beckert, 1877).

Several other species of Sabbatia, having white, rose-colored, or purplish flowers, are indigenous to the United States, particularly in the Southern States, and appear to possess similar properties.

Erythræa (Gentiana, *Linné*) centaurium, *Persoon*: Herba centaurii, *P. G.*—European centaury, *E.*: Petite centaurée, *Fr.*; Tausendguldenkraut, *G.*; Centaura menor, *Sp.*—This species closely resembles American centaury, but has oval or obovate-oblong, obtuse, three- or five-nerved, nearly sessile leaves, and the parts of the flowers in fives. It is only 25–30 Cm. (10 or 12 inches) high, and grows spontaneously in a few places in this country.

Erythræa chilensis, *Persoon*, E. stricta, *Schiede*, E. jorullensis, *Kunth*, and perhaps other species of Mexico and South America, are called *canchalagua*, and used as bitter tonics.

Pleurogyne rotata, *Grisebach* (Swertieæ), is a very bitter plant of Japan and Western North America, with linear-lanceolate leaves and pale-pinkish flowers, having the throat of the corolla bearded and the sessile stigmas prolonged on the valves of the ovary.

Action and Uses.—American centaury is a simple bitter, without special virtues. Its cold infusion is useful in debilitated states of the stomach, and its hot infusions as a diaphoretic in muscular *rheumatism*, *sore throat*, and febrile attacks generally. The infusion may be made with Gm. 32 to Gm. 500 (an ounce of the plant to a pint) of boiling water, and given hot in the *dose* of Gm. 124–190 (f℥iv–vj), or cold in the *dose* of Gm. 64 (f℥ij).

SABINA, *U. S.*—Savin (Savine).

Sabinæ cacumina, Br.; *Summitates* (*Herba*) *sabinæ*, P. G.—*Savin-tops*, E.; *Sabine*, Fr. Cod.; *Sadebaumspitzen*, *Sevenkraut*, G.; *Sabina*, Sp.

The tops of Juniperus Sabina, *Linné*, s. Sabina officinalis, *Garcke*. Bentley and Trimen, *Med. Plants*, 254.

Nat. Ord.—Coniferæ.

Origin.—Savin is a small evergreen procumbent or erect shrub which grows on rocky banks from Maine to Wisconsin, near the Great Lakes and farther northward. It is distributed throughout a great portion of Europe and eastward to the Caspian Sea and Southern Siberia. Besides in size, it is distinguished from red cedar, which it closely resembles, by the larger fruit, which is nodding on the recurved peduncle-like branchlet. The young branchlets are collected for medicinal use.

Fig. 248.

Branch of Savin.

Description.—As met with in commerce, savin is in small and thin subquadrangular pieces, consisting of slender twigs, which are densely covered with minute, scale-like, imbricate leaves, arranged alternately in opposite pairs. The leaves are rhomboid-lanceolate, rather obtuse, and closely appressed, and on the back have a shallow groove containing a gland, which is mostly oblong in shape. Older leaves are more pointed and more or less spreading. Savin has a persistent somewhat terebinthinate odor, which is stronger after bruising the branchlets; the taste is nauseous, resinous, and bitter. The drug is frequently mixed with some fruits which are about 5 Mm. ($\frac{1}{5}$ inch) in diameter, globular, but more or less shrivelled, blackish-blue or brownish, contain usually two seeds, and have a similar but stronger odor and taste than the branchlets.

Constituents.—Gardes (1837) found savin to contain tannin, resin, volatile oil (page 1150), extractive, chlorophyll, etc. The fresh fruit yields 10 per cent. of volatile oil.

Allied Plants.—Juniperus virginiana, *Linné.* Red cedar, *E.*: Cèdre de Virginie, *Fr.*: Virginische Ceder, Rothe Ceder, *G.*—The branchlets resemble savine, are about 25 Mm. (1 inch) long, and of a quadrangular appearance from their four rows of scale-like leaves, which are ovate-lanceolate, obtuse, or rather acute, appressed, and imbricated. They have a longitudinal furrow on the back, which gradually deepens toward the base, where there is contained a circular or oblong gland. They have a not unpleasantly terebinthinate odor and an aromatic, bitterish, and somewhat acrid taste. Red cedar was analyzed by W. J. Jenks (1842), who found it to contain volatile oil, resin, fat, tannin, and other common constituents of plants. *Oil of red cedar*, distilled from the wood, was examined by Walter (1842). On exposing it to cold, expressing the coagulated mass, and recrystallizing the solid portion from alcohol, *cedrene camphor*, $C_{15}H_{26}O$ (Gerhardt), was obtained, which has an aromatic odor and a slight taste. The liquid portion, after rectification and distillation over potassium, is *cedrene*, $C_{15}H_{24}$ (Gerhardt), which is colorless, of specific gravity 0.98, boils at 237° C. (458.6° F.), and has an aromatic odor differing from that of the camphor, and an aromatic afterward pepper-like taste.

Medical History.—In ancient times the virtues of savin were clearly recognized. Its stimulant action caused it to be employed for the treatment of ulcers and carbuncles and as a remedy for alopecia; it was also used with honey for the removal of freckles; and it was well known that, internally, it was apt to cause bloody urine, and, when taken by pregnant females, miscarriage.

Action and Uses.—On man the action of savin itself is chiefly illustrated by cases in which it was taken for the purpose of producing abortion. Thus, an infusion caused incessant vomiting, abortion, excruciating pain, rupture of the gall-bladder, and death. Many cases are recorded of the fatal consequences of its use in large doses.

Savin has been used with unquestionable advantage in cases of *amenorrhœa* and *dysmenorrhœa* depending on a want of vigor in the uterine apparatus, and also for the cure of *menorrhagia* due to a like condition. Several trustworthy physicians declare that in such cases of uterine hæmorrhage 1 grain of powdered savin, repeated three times a day and continued for weeks together, will overcome the tendency to the uterine loss. Under like conditions *sterility* and *chlorosis* have been cured by this medicine. For amenorrhœa it has been recommended to administer a pill composed of rue, savin, and ergot, of each 1 grain, and aloes $\frac{1}{2}$ grain, three times a day at first, and gradually increasing the dose (Courty). Savin had once a repute, not entirely undeserved, for its virtues in *chronic gout* and *rheumatism*, for which it was employed in infusion or in decoction, both internally and in a lotion for the affected joints. Savin has no doubt been found efficient as a *vermifuge*, but other anthelmintics are to be preferred as being less dangerous. In pregnancy, and wherever there is a tendency to congestion in any important organ, savin is contraindicated. Savin, in cerate, is used to excite or to prolong the secretion produced by *blisters*. Its powder, slightly moistened, is one of the most efficient remedies

for *venereal warts*. It may be applied alone or mixed with burnt alum or with subacetate of copper. It is also used, either in powder or in solution, to wither *polypi*, and may be applied with advantage to *condylomata*, and, as in ancient times, to stimulate indolent and unhealthy *ulcers*.

Fresh is much more active than dried savin. It may be administered in powder in the *dose* of Gm. 0.30–0.40 (gr. v–vj), repeated several times a day. It is most conveniently given in syrup or honey.

SACCHARINUM.—Saccharin.

Glusidum, Br. Add.—*Gluside*, *Glucosimide*, *Anhydro-orthosulphamine benzoic acid*, *Benzoic sulphinide*, *Benzoyl-sulphonic-imide*.

Formula $C_6H_4COSO_2NH$. Molecular weight 168.65.

Preparation.—Toluene is treated with concentrated sulphuric acid at 100° C. (212° F.), whereby toluene sulphonic acids (ortho- and para-) are formed, which are first converted into calcium salts, and then, by means of sodium carbonate, into sodium salts. From these a mixture of ortho- and para-toluenesulphochlorides is obtained by action of phosphorus pentachloride; upon strongly cooling the mixture the para- modification crystallizes out, and is thus separated. Orthotoluene-sulphamide is formed from the other isomeric chloride by means of dry ammonia gas. This sulphamide is next oxidized with potassium permanganate, converting it into potassium orthosulphaminebenzoate, the solution of which is freed from precipitated manganese dioxide and decomposed by means of an acid; instead of separating as free orthosulphamine-benzoic acid, the latter splits up into its anhydride and water. It is this orthosulphamine-benzoic anhydride which is known as saccharin or gluside.

Properties and Tests.—Saccharin or gluside occurs as a light, minutely crystalline powder, having an intensely sweet taste in dilute solution. When heated it fuses, and then sublimes with partial decomposition. It is slightly soluble in cold water (1 : 400) at 15° C. (59° F.), forming a feebly acid solution; it is more soluble in boiling water, alcohol (1 : 30), or glycerin, and freely soluble in ether, dilute ammonia, or solution of sodium bicarbonate, with evolution of carbon dioxide. "The latter solution, when warmed and made neutral and evaporated to dryness, yields soluble gluside or saccharin, 100 parts of gluside yielding nearly 113 parts of neutral soluble gluside. Neither gluside nor the soluble gluside is blackened by strong sulphuric acid, even when the mixture is warmed for a short time."—*Br. Add.* Commercial saccharin seems to be far from a pure or simple substance; as much as 50 per cent. of impurities have been discovered, consisting of the parasulphamine-benzoic acid and of acid potassium orthosulphobenzoate (Remsen; Burton; Dohme). The substance may readily be tested by treating with ether, which dissolves out the benzoic sulphinide and leaves undissolved all foreign matter.

Allied Compounds.—Dulcin, Sucrol, Paraphenetol carbamide, $C_6H_4.OC_2H_5NH.CONH_2$.—Another synthetic sweet compound obtained when ammonia is allowed to act on a body produced by the reaction between 1 molecule of carbonyl chloride in benzene or toluene solution and 2 molecules of paraphenetidin. Dulcin occurs in colorless needles, melting at 160° C. (320° F.), and is said to be free from any injurious action upon the human organism.

Pharmaceutical Uses.—In pharmacy saccharin has been employed to disguise the bitter taste of alkaloids and bitter principles in various elixirs, etc.

Liquor saccharini, N. F., Solution of saccharin. Dissolve 512 grains of saccharin and 240 grains of sodium bicarbonate in 10 fluidounces of water; filter the solution, add 4 fluidounces of alcohol, and pass enough water through the filter to make 16 fluidounces. Each fluidrachm represents 4 grains of saccharin.

Action and Uses.—Saccharin is excreted rapidly, unchanged, and almost entirely with the urine, and does not affect the nutrition or the functions of respiration, circulation, and urination, nor does it appear in any of the secretions proper. It may, however, disorder the gastric digestion. Paul found a solution of it, 1 : 500, retarded the action of pepsin on egg-albumen and of diastase upon starch. This direct interference with the assimilation of food caused the French government to prohibit its use as a dietetic substitute for sugar. The soda compound of saccharin does not exert this influence, or does so very slightly; nor does saccharin itself when its dose is kept within proper bounds. Pittschek and Zerner (*Centralbl. f. Ther.*, vii. 231) used the soda compound for several weeks for themselves and for their patients as a sweetener for both food and drink, without it in the least disturbing digestion. It appears to arrest the development of the microbes of putrefaction and suppuration and those habitually found in the

mouth. For this purpose the pure is superior to the combined acid; of it, practically, a mixture of 2 parts of sodium bicarbonate and 3 parts of saccharin is an efficient antiseptic. Aducco and Masso found its control of acetous and ammoniacal fermentation less perfect than that of salicylic, and about the same as that of boric, acid (*Therap. Gaz.*, xi. 55). Saccharin may be useful wherever cane- or milk-sugar is objectionable, as in flatulent *dyspepsia*, in *obesity*, and in saccharine *diabetes*. In the last it is a convenient substitute for sugar. Its sweetening power is said to be nearly three hundred times greater than that of cane-sugar, and hence it should be prescribed in the smallest doses as a condiment that will fulfil its purpose as a sweetener, not only lest it should impair digestion, but also because it might beget aversion. This quality has been utilized to conceal the taste of many medicines, including quinine, tincture of chloride of iron, antipyrine, guaiacum, cod-liver oil, copaiba, etc. From ½ a grain to 1½ grains will sweeten a cup of tea or coffee. In *fevers* it does not control, nor, on the other hand, does it aggravate, any symptom. It does not mitigate articular *rheumatism*. Fourrier considered an alcoholic solution of it (1 : 50) a very useful application to *thrush* following measles (*Annuaire de Thérap.*, 1889, p. 163). The alcohol alone might have answered as well. Some have denied its utility in cases of disease of the *urinary organs* with alkaline or purulent urine, but the direct testimony in its favor appears conclusive. Among others may be cited that of Little (*Dublin Jour. Med. Sci.*, June, 1888, p. 493), and of A. H. Smith (*Med. Record*, xxxvi. 541), who both employed it in cases of phosphatic and ammoniacal urine connected with prostatic disease, paralysis of the bladder, etc. In cases of *dilatation of the stomach* with fermentation of the gastric contents it has been found useful, especially when associated with washing out of the organ. It has been used advantageously in similar disorders of the *intestines*, and has also been applied to purulent disease of the *middle ear*. The dose of saccharin is Gm. 0.06–0.20 (gr. j–iij). It may be given in wafers or capsules and repeated from three to six times a day. But it is preferably associated with sodium bicarbonate; *e. g.* ℞. Saccharin, gr. 45; Dry sodium bicarbonate, gr. xxx; Mannite, ʒiiss.—S. Make 100 pastilles, of which 1 will sweeten a cup of coffee. ℞. Glycerin 1 lb.; Saccharin ʒj. S. Heat to solution. 2 teaspoonfuls will sweeten fʒviij of lemonade or ʒiij of cranberries (*Med. News*, lii. 251). Dr. McNaughton Jones has recommended in diabetes a biscuit containing Gm. 11.5 (ʒiij) of gluten flour, Gm. 2.75 (45 gr.) of butter, Gm. 8.5 (ʒij) of eggs, and Gm. 0.01625 (2½ gr.) of saccharin.

SACCHARUM, *U. S., P. G.*—Sugar.

Saccharum purificatum, Br.—*Refined sugar*, *Cane-sugar*, E.; *Sucre*, *Sucre de canne*, Fr.; *Zucker*, *Rohrzucker*, G.; *Azúcar*, *Azúcar de caña*, Sp.

The refined sugar obtained from Saccharum officinarum, *Linné*, and from various species or varieties of Sorghum (nat. ord. Gramineæ); also from one or more varieties of Beta vulgaris, *Linné* (nat. ord. Chenopodiaceæ).

Formula $C_{12}H_{22}O_{11}$. Molecular weight 341.2.

Origin.—The sugar-cane appears to have been indigenous to India and other parts of Southern and Eastern Asia, and has been cultivated from time immemorial. At present it is not known in the wild state, but it is raised in most tropical and subtropical countries, and in many of them for the production of sugar. It is a perennial, and produces a stem which is from 2.4–3.6 M. (8 to 12 feet) high, 2–5 Cm. (1 to 2 inches) thick, cylindrical, jointed, and, with the exception of the flowering tops, which are hollow, filled with a juicy pith. The leaves are 1.2–1.5 M. (4 to 5 feet) long, 5 Cm. (2 inches) wide, and linear; and the flowering panicles large, pyramidal, and with spreading branches. Several varieties are known, differing chiefly in the color and hairiness of the stem. Saccharum chinense, *Roxburgh*, having a slender erect panicle, is probably a distinct species, and the one principally cultivated in China.

Cane-sugar is present in a large number of grasses, particularly in those having a rather thick stem, such as Sorghum saccharatum, *Persoon*, s. Holcus saccharatus, *Linné*, Zea Mays, *Linné*, and others. From the thorough researches of H. Leplay, published in 1882, it appears that in maize the sugar is produced in the leaves and transferred to the stem, where it gradually accumulates, and when the fruit begins to develop it is conveyed to the grain, where it is converted into starch, the sugar at the same time disappearing from the leaves and diminishing very materially in the stem. It is also present in the juice of different species of maple, birch, palm, and other trees, and in many fleshy roots, prominent among which is a cultivated variety of Beta vulgaris, *Linné*, or *sugar-beet*, which is largely employed in Europe in preparing sugar.

Preparation.—Recently-collected sugar-cane yields by crushing and expressing about 80 per cent. of juice, which contains from 78 to 84 per cent. of water, 16 to 21 per cent. of sugar, 0.3 to 0.4 per cent. of mucilaginous, resinous, fatty, and albuminous matters, and nearly the same amount of salts. The juice is a grayish, turbid, sweet liquid, which is clarified by heating, a little lime being at the same time added for the purpose of neutralizing free acid; it is then concentrated by rapid evaporation in open pans, transferred to coolers, where it is frequently stirred, and afterward into casks perforated at the bottom and arranged in such a manner that the liquid portion may drain off and be collected in suitable tanks. The granular solid product thus obtained constitutes the *raw* or *muscovado sugar* of commerce; the liquid portion is known as *treacle* or *molasses*. Raw sugar is refined by dissolving it in water, the solution is heated with blood, the impurities are skimmed off, and the liquid is filtered through recently-burned granular animal charcoal. The clear and colorless filtrate is concentrated in a vacuum-pan, and when of sufficient density run off into conical moulds, the narrow orifice of which is closed by a plug. It solidifies as a dense crystalline mass, which is drained by the removal of the plug, and freed from the remaining colored mother-liquor by percolating through it a concentrated solution of pure sugar, after which it is dried and sent into commerce as *refined* or *loaf sugar*. By concentrating the mother-liquors they are made to yield more sugar of an inferior grade, until finally a thick syrupy liquid is obtained, which refuses to crystallize, and is known as *sugar-house molasses*, and in England as treacle.

The method of obtaining sugar from the sugar-beet is very similar to that described, but is attended with greater difficulties, owing to the presence of larger quantities of proteids and other foreign constituents. Sugar-beets contain about 12 per cent. and yield about 9 per cent. of cane-sugar.

Properties.—Refined sugar is seen in commerce broken into small pieces or lumps, which are hard and have a granular crystalline texture and a pure white color. Somewhat inferior kinds of sugar are softer, and those having a yellowish tint are often artificially improved in appearance by adding, while crystallizing, a minute quantity of blue pigment, like ultramarine, with the view of neutralizing the objectionable tint and making the sugar appear whiter; such sugar will yield a yellowish solution with water, and on standing will gradually separate the pigment. Perfectly white sugar, known in commerce as *double refined*, is the only kind that should be used in pharmaceutical preparations. Sugar may be obtained in large transparent rhombic prisms, known as *rock candy*, *saccharum candidum*, which does not differ from lump sugar except that this is in crystalline masses from disturbed crystallization. Sugar has the specific gravity 1.58 (Kopp), is permanent in the air, neutral, without odor, has a very sweet taste, and dissolves at ordinary temperatures in one-half its weight of water, yielding a dense, sweet, and colorless liquid known as syrup; saturated at 15° C. (59° F.), such a solution contains 66 per cent. of sugar, and this has the density 1.345082 (Michel and Kraft). At the boiling-point sugar dissolves in water almost in all proportions (in 0.2 parts, *U. S.*; 0.212 parts, Flourens). It requires for solution about 80 parts of boiling absolute alcohol, 28 parts of boiling official alcohol, and about 4 parts of boiling alcohol spec. grav. .830, these solutions depositing most of the sugar on cooling. The solubility is greater in weak alcohol, both cold and hot. At 15° C. (59° F.) 1 part of sugar dissolves in 2 parts of 50 per cent. alcohol, in 7.7 parts of 75 per cent. alcohol, in 14.7 parts of 80 per cent. alcohol, in 31.6 parts of 85 per cent. alcohol, in 175 parts of 92 per cent. alcohol, and in 228 parts of methylic alcohol of the same strength (Casamajor). Sugar dissolves also in glycerin, the solubility being increased on dilution with water, but it is insoluble in ether, chloroform, carbon disulphide, and in hydrocarbons. It combines with sodium chloride, yielding deliquescent crystals which contain 14.9 per cent. of that salt. Definite compounds have likewise been obtained with several other salts and with alkalies and alkaline earths. (See Syrupus Calcis.) When triturated in the dark it becomes luminous. Its solution deviates polarized light to the right—a behavior which is of great practical importance for the estimation of sugar in aqueous liquids and for distinguishing different kinds of sugar, which have a different rotary power.

When sugar is heated to 160° C. (320° F.) it melts without losing in weight, and congeals on cooling to a transparent amorphous yellowish mass known as *barley sugar*, *saccharum hordeatum*, which becomes gradually opaque on the surface from the formation of minute crystals. If sugar is kept in the melted state between 160° and 170° C. (320° and 338° F.) for a short time, it is converted into a deliquescent mixture of *glucose* and *levulosan*; $C_{12}H_{22}O_{11}$ yields $C_6H_{12}O_6 + C_6H_{10}O_5$; the latter is not fermentable until after it has been boiled with water or dilute acids. When heated to between 180° and 200° C.

(356° and 392° F.) sugar turns brown, evolves a peculiar odor, and is converted into *caramel*, $C_{12}H_{18}O_9$, parting at the same time with $2H_2O$; the pure product of this composition, *caramelan*, was obtained colorless by Gélis (1862). Caramel may be prepared in the same manner from inferior qualities of sugar, from molasses, and from glucose, and the conversion is hastened in the presence of small quanties of alkalies; the addition of a little ammonium carbonate, which is again volatilized by the heat, is of service, for the reason stated. Subjected to dry distillation, sugar yields aldehyde acetone, acetic acid, tarry products, and carbon dioxide, carbonic oxide, and marsh gas. According to Lassaigne, iodine heated with a solution of sugar is converted into hydriodic acid. Under the influence of ferments, as well as of dilute acids, cane-sugar is converted into *invert-sugar*, which is a mixture of *dextrose* or grape-sugar and *levulose* or fruit-sugar, and is directly fermentable. This inversion of sugar takes place slowly on boiling with water, but cold aqueous solutions keep unaltered for a long time, provided that the access of ferments suspended in the air be prevented. Under the same condition, according to the investigations of Kreusler, Lemoine, and others, light does not exert the inverting effect reported by Raoul (1871). Nitric acid inverts cane-sugar readily, and when heated with it produces saccharic, racemic, tartaric, and oxalic acids.

Tests.—The purity of cane-sugar is ascertained by the physical properties described above, and by its complete solubility in water and alcohol. The absence of glucose or of a similar sugar is ascertained by some of the reactions given below. "Aqueous and alcoholic solutions of sugar should have no effect on litmus-paper. The solution in 20 parts of distilled water should be scarcely rendered turbid by silver nitrate or barium nitrate (chloride and sulphate)."—*P. G.* "Both the aqueous and the alcoholic solution of sugar should be clear and transparent. When kept in large, well-closed, and completely filled bottles, they should not deposit a sediment on prolonged standing (absence of insoluble salts, ultramarine, Prussian blue, etc.). If 1 Gm. of sugar be dissolved in 10 Cc. of boiling water, the solution mixed with 4 or 5 drops of silver nitrate test-solution, then about 2 Cc. of ammonia-water added, and the liquid quickly brought to a boil, not more than a slight coloration, but no black precipitate, should appear in the liquid after standing at rest for five minutes (absence of grape-sugar and of more than a slight amount of inverted sugar)."—*U. S.*

Other Sugars.—Glucose, Grape-Sugar, Dextrose, or Starch-Sugar, $C_6H_{12}O_6$; molecular weight 179.58. Hydrated, $C_6H_{12}O_6.H_2O$; mol. weight 197.54. Carbohydrates having a sweet taste are frequently met with in plants and among the products of decomposition of those organic compounds forming the large class of *glucosides*. The sugar yielded by the latter is frequently, though not always, identical with the sugar met with in grapes and other fruits and with that produced from starch. This is now very largely made for uses in the arts by boiling 100 parts of starch, 400 parts of water, and 4 or 5 parts of sulphuric acid until starch can no longer be detected in the liquid, the transformation being hastened by heating under pressure; the free acid is then neutralized with chalk, the filtrate clarified and decolorized, if necessary, by treating it with clay and animal charcoal, and, finally, concentrated, preferably in a vacuum-pan. The grape-sugar or glucose of commerce is prepared in this manner. Liquid glucose contains from 34 to 43 per cent. of dextrose, from 0 to 19 per cent. of maltose, from 30 to 45 per cent. of dextrin, and from 14 to 23 per cent. of water. Solid grape-sugar is usually in a white or whitish, irregularly granular powder or mass; from alcohol it may be obtained in compact, nodular groups of needles. A. Behr (1882) has shown that the cooling concentrated solution of glucose, on the addition of crystals or powdered crystals of that compound, will give a large crop of prisms of anhydrous glucose. It rotates polarized light to the right, though less than cane-sugar, reduces the so-called noble metals, and acquires a dark color when heated with solutions of alkalies. It is less sweet than cane-sugar, is directly fermentable, undergoes by heat alterations analogous to those of cane-sugar, is insoluble in ether, dissolves in about 50 parts of alcohol, and requires little more than 1 part of cold water for solution; but after it has been rendered amorphous by heat it dissolves in water in nearly all proportions. Nitric acid oxidizes it to saccharic, tartaric, racemic, and oxalic acids. *Saccharic acid*, $H_2C_6H_8O_8$, is amorphous, deliquescent, freely soluble in water and alcohol, and yields mostly crystallizable salts.

Levulose, Chylariose, or Fruit-Sugar, $C_6H_{12}O_6$; mol. weight 179.58. It frequently accompanies grape-sugar in fruits, also in honey: in some plants it is associated with cane-sugar. It is usually a colorless, uncrystallizable syrup, has nearly the same sweetness as cane-sugar, and turns the plane of polarized light to the left. It may be obtained in fine silky needles which are insoluble in absolute alcohol and ether, but dissolve readily in aqueous liquids. Levulose is produced from inulin by treatment with dilute acids; with nascent hydrogen it yields mannit. Among the products of oxidation by nitric acid are succinic, acetic, and oxalic acids.

Inosit, Phaseo-mannit, $C_6H_{12}O_6.2H_2O$; mol. weight 215.50. It is present in the juice of some meats, in the green fruit of many Leguminosæ, in asparagus, and in other plants. It is very sweet, crystallizes readily fron water and alcohol, is insoluble in ether, does not undergo alcoholic fermentation, and yields with nitric acid explosive compounds and oxalic acid.

Sugar Tests.—*Moore's Test.* A solution of cane-sugar, heated with 3 or 4 per cent. of potassa for a minute or two, remains colorless; glucose and milk-sugar are colored brown.

Trommer's Test. A solution of cane-sugar, mixed with a little copper sulphate and an excess of potassa or soda, retains its blue color on boiling, but turns bright-red in the presence of glucose or milk-sugar, red cuprous oxide being deposited. Glucose and most allied sugars effect the same reduction, though more slowly, in the cold.

Fehling's test is a modification of the preceding, and may be used for the quantitative determination of glucose. The test liquid is prepared by dissolving 34.64 Gm. of crystallized sulphate of copper in water, adding 200 Gm. of Rochelle salt, and 600 or 700 Gm. of soda solution spec. grav. 1.20, and diluting the whole to 1 liter (Schorlemmer). 10 Cc. of this solution are reduced by 0.5 Gm. of grape-sugar.—Boedecker introduced Rochelle salt in place of potassium tartrate, which was used by Fehling. The test is usually made with a solution containing about 1 per cent. of glucose; weaker solutions reduce a somewhat smaller amount of the test liquid.

Pettenkofer's Test. Bile in the presence of sugar (of other carbohydrates and of proteids) acquires a blood-red color with concentrated sulphuric or phosphoric acid.

Boettger's Test. A little bismuth subnitrate boiled with solution of glucose, rendered alkaline by sodium carbonate, acquires a gray or black color; pure cane-sugar produces no alteration.

O. Schmidt's Test. Lead acetate, added to a saccharine liquid, is precipitated white by excess of ammonia; on heating the mixture it remains unchanged if cane-sugar or milk-sugar is present, but turns orange-red with glucose.

Sachsse's Test. 18 Gm. mercuric iodide, 25 Gm. potassium iodide, and 80 Gm. caustic potassa are dissolved in distilled water sufficient to make 1 liter. 40 Cc. of this solution heated to boiling are decomposed by 1.1342 Gm. of glucose, so that a drop of liquid is not rendered black by ammonium sulphydrate,

Naumenê's Test. On heating a solution of glucose with a few drops of solution of silver nitrate the liquid acquires a brown color.

Tollen's Test. An ammoniacal solution of silver nitrate containing caustic soda is reduced by glucose, with the production of a metallic mirror.

Gawalowski's Test. A solution of sugar heated with neutral ammonium molybdate to 100° C. (212° F.) becomes blue in the presence of glucose.

Many other tests have been proposed; the above are quite available and give good results. Tannin and similar compounds which are likely to interfere are previously removed, either by solvents or precipitants.

Uses.—Sugar is of comparatively little value for its independent effects, but few substances are more useful as an associate of other medicines, whether to preserve them from oxidation and decomposition, to conceal or improve their taste, or to give them special pharmaceutical forms.

In solution sugar is almost exclusively lenitive, but in powder it is stimulant. Finely powdered, it hastens the detachment of *diphtherial* false membranes and corrects their fetor. It is universally employed to diminish dryness of the mouth and fauces, to allay irritation, and to mitigate *cough* and *hoarseness*. Sugar dissolved in water is said to have a diuretic effect. When injected into the veins of animals it is said to be powerfully diuretic (Richet and M. Martin, *Med. Record*, xxi. 394). It certainly, when moderately used, promotes digestion and allays nervous excitement. For these purposes sweetened water (*eau sucrée*) is universally employed in France and Southern Europe. Formerly a strong solution of sugar was much used as an antidote to *corrosive poisons*. It enters into all the drinks, mucilaginous, farinaceous, and gelatinous, employed in febrile diseases. Finely-powdered loaf-sugar will sometimes relieve the *hiccough* which in nursing infants is apt to arise from over-feeding. Eaten freely, it is said to arrest the development of *alcoholic intoxication*, perhaps by retarding gastric absorption. A strong solution of sugar injected into the rectum has been used successfully to destroy *ascarides* of that part. In powder it is very efficient as a remedy for *aphthæ* of the mouth, in repressing the exuberant and stimulating the indolent granulations of *ulcers*, in removing opacities of the *cornea*, and in curing granular *eyelids*. Sugar has been claimed by Fischer to be an efficient antiseptic dressing for *wounds* (*Centralbl. f. Ther.*, iii. 453; Danhauser, *ibid.*, vii. 553). Windelschmidt states that for small wounds sugar is equal to iodoform as a dressing (*Med. News*, xliii. 462). In *chronic laryngitis*, when inhaled by a sudden aspiration from a tube extending to the root of the tongue, it may be used with advantage alone or mixed with other powders. In the same manner it may be employed as a snuff in chronic *ozæna*. The fumes from burnt sugar destroy *offensive effluvia*, and are conveniently disengaged by sprinkling sugar upon burning coals or on a hot shovel. The culinary and medicinal uses of beet-sugar are the same as those of cane-sugar, but in sweetness it is inferior. *Glucose* is more or less diuretic (Meilach, *Bull. de Therap.*, cxviii. 24).

SACCHARUM LACTIS, *U. S., Br., P. G.*—Sugar of Milk.

Lactose, Milk-sugar, E.; *Sucre de lait, Lactine*, Fr.; *Milchzucker*, G.; *Azúcar de leche*, Sp.

A peculiar crystalline sugar obtained from the whey of cow's milk by evaporation and purified by recrystallization..

Formula $C_{12}H_{22}O_{11}.H_2O$. Molecular weight 359.16.

Preparation.—Milk-sugar is one of the constituents of the milk of mammals, and appears to be present in larger proportion in the milk of herbivorous animals than in that of the Carnivoræ. To obtain it the butter and casein are first removed, the whey (see p. 917) is concentrated, and the liquid permitted to crystallize in large tanks, the crystallization being facilitated by the introduction of thin sticks or cords; the impure crystals are once or twice recrystallized from water. It is chiefly prepared in Switzerland. Milk-sugar was prepared by Bertoletti in 1619, and was introduced into medicine by Testi in 1698.

Properties.—Sugar of milk is usually met with in commerce in cylindrical pieces composed of numerous crystals aggregated around an axis of stick or cord. It crystallizes in hard white or translucent four-sided prisms, is permanent in the air, yields a white sandy powder, is neutral, inodorous, and has a slightly sweet taste. It dissolves in 6 parts (7 parts, *P. G.*) of water at 15° C. (59° F.), and in 1 part (Guérin-Varry), or, according to other observers, in 2½ parts, of boiling water, and is insoluble in ether, alcohol, chloroform, and hydrocarbons. Its aqueous solution rotates the plane of polarized light to the right, is rendered yellow or brown on being heated with solutions of alkalies or alkali carbonates, reduces in the cold, or more rapidly on heating, alkaline liquids containing salts of copper, bismuth, mercury, or silver, and produces a bright metallic mirror with ammoniacal solution of silver. When heated to 130° C. (266° F.) milk-sugar parts with its water of crystallization without fusion, and leaves a white mass which again absorbs water, at a higher heat becomes yellow, and melts at 203.5° C. (398° F.) (Lieben); but above 170° C. (338° F.) it is converted into *lacto-caramel*, $C_6H_{10}O_5$, and afterward into products similar to those obtained on the dry distillation of cane-sugar and glucose. Milk-sugar does not readily undergo vinous fermentation until after it has been boiled with diluted sulphuric acid, which converts it into *galactose*, $C_6H_{12}O_6$, and glucose. In the presence of casein it is converted into *lactic acid* (see page 69), alcohol being formed at the same time, but in small quantity only if the free acid is neutralized as fast as it is produced. By boiling with dilute nitric acid it is converted into mucic, saccharic, tartaric, racemic, and finally into oxalic, acid. Its hardness renders it serviceable for reducing other substances to a fine powder.

Tests.—If 1 Gm. of sugar of milk be sprinkled upon 5 Cc. of sulphuric acid contained in a flat-bottomed capsule, the acid should acquire at most a greenish or reddish, but no brown or brownish-black, color within half an hour (absence of cane-sugar)."—*U. S., P. G.* It is important that in applying this test heat be avoided, since milk-sugar is rendered dark-brown by concentrated sulphuric acid at the heat of the water-bath. "On adding 0.2 Gm. of milk-sugar to a boiling mixture of 4 Gm. of solution of basic lead acetate and 2 Gm. of ammonia-water, a white precipitate free from a red tint should be produced (absence of glucose)."—*P. G.*

Action and Uses.—Sugar of milk is far less sweet than cane- or beet-sugar, and is thought to be less apt to ferment in the stomach and bowels. It is chiefly used as a vehicle for small doses of pulverulent medicines. It is said that added largely to warm skimmed milk it may be used as a laxative (*Bull. de Therap.*, cii. 182). It has been used advantageously in many cases of cardiac dropsy by Sée, when given to the extent of 3 ounces a day dissolved in 2 quarts of water (*Bull. de Therap.*, cxviii. 26). These results were not confirmed by Niesel (*Cent. f. Ther.*, viii. 223), but were so by Meilach and by Zawadski (*ibid.*, pp. 287 and 288).

SALEP, *Fr. Cod.*—Salep.

Tubera (Radix) salep, P. G.—*Salep*, Fr., G., Sp.

The tubers of different species of Orchis and allied genera.

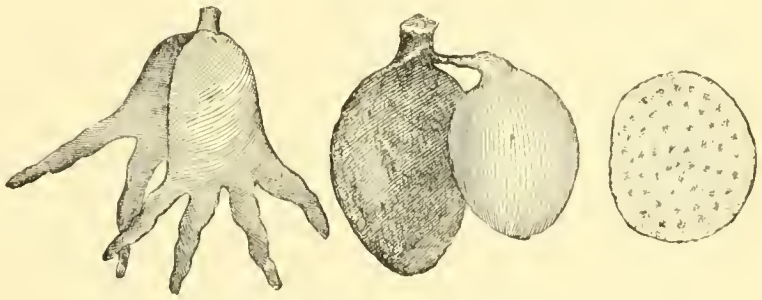
Nat. Ord.—Orchidaceæ, Ophrydeæ.

Origin and Preparation.—The plants belonging to the genus Orchis are small herbs, usually with a stem between 15 and 45 Cm. (6 and 18 inches) high, with showy, mostly pink, red, or purple-colored ringent flowers, having the lip turned downward and

bearing a nectariferous spur underneath, and with parallel-veined sheathing leaves, those of the stem often reduced to bracts. The subterraneous portion usually consists of two fleshy tubers, the smaller of which originates from the axil of a radical leaf and produces the flowering stem during the following year. These tubers furnish the salep. They are collected, scalded in water, and rapidly dried, and thereby lose their white opaque appearance, as well as their unpleasant odor and bitter taste. Salep was formerly procured in Persia and other Oriental countries from the tubers of Eulophia campestris, E. herbacea, *Lindley*, and several allied species. At the present time it is prepared in various parts of Southern and Central Europe. The German Pharmacopœia admits only unbranched tubers, such as are furnished by Orchis mascula, *Linné*, O. Morio, *Linné*, O. ustulata, *Linné*, Anacamptis pyramidalis, *Richard*, Platanthera (Habenaria, *R. Brown*) bifolia, *Reichenbach*, and other species.

Description.—Oriental salep is 25–40 Mm. (1–1⅗ inches) long, and usually dark-colored; European salep is always smaller. Salep is globular, pyriform, ovate, or oblong in shape, somewhat flattened or wrinkled, with a scar of the terminal bud at the apex, of a pale brownish-yellow color, somewhat translucent, of a horny texture, hard, inodorous, and of an insipid, very mucilaginous taste. It is generally kept in the form of powder which has a yellowish color. The tissue consists of thin-walled parenchyma filled with starch, the granules of which are more or less ruptured from scalding, and of large, nearly globular cells containing mucilage. The scattered fibro-vascular bundles are small and thin, and few cells contain raphides.

Fig. 249.



Salep: tubers and transverse section.

The tissue of palmately-divided tubers is similar, but the mucilage-cells are generally much smaller and more or less elongated. Such tubers are derived from Orchis latifolia, *Linné*, O. maculata, *Linné*, O. sambucina, *Linné*, Gymnadænia conopsea, *R. Brown*, and other species, and were formerly known in European pharmacy as *radix palmæ Christi*. They are rather flat, below divided into two to five branches, and less mucilaginous, but otherwise resemble the former kind.

Constituents.—Raspail found the old tuber collected in autumn to be free from starch, while the young tuber contained then large quantities of it. Dragendorff (1865) obtained from 100 parts of salep starch 27.3, mucilaginous constituents 48.1, sugar 1.2, proteids 4.9, and cellulose 2.4, parts; the mucilage is not extracted by cold water. Salep yields 2.1 per cent. of ash.

Adulterations and Substitutions.—The scalded tuber of colchicum resembles salep in appearance, but has a broad groove on one side and a sweetish afterward bitter and acrid taste. An adulteration of powdered salep with starch is best detected by the microscope, which reveals the shape of the foreign starch-granules; owing to the manner of its preparation, salep has its starch converted into a pasty mass. 1 part of powdered salep should yield, with 50 parts of boiling water, a jelly which after cooling is rather stiff, and with 100 parts a thick turbid mucilage; this has an insipid taste and is rendered blue by iodine.

Mucilago salep, *P. G.*, is prepared by shaking in a vial 1 part of powdered salep with 10 parts of cold water until it is uniformly diffused, when 90 parts of boiling water are added and the whole well agitated.

Action and Uses.—Salep was, even in ancient times, regarded as very nutritious, and as a demulcent it was used in medicine. It tends to confine rather than relax the bowels, and hence is a very useful article of diet for infants and children affected with *diarrhœa* or *summer complaint*, and for adults suffering from tuberculous and other forms of chronic diarrhœa. The mucilage may be prepared as above, or by first macerating powdered salep in cold water, and gradually adding boiling water, with stirring, in the proportion of 5 grains of salep to the ounce. Instead of water, milk or some animal broth may be used. Salep jelly may be made as follows: Rub 60 grains of powdered salep with water in a mortar until it has swollen to four times its original bulk; then add gradually, and with constant stirring, 16 ounces of boiling water, and boil down to 8 ounces.

SALICINUM, *U. S., Br.*—Salicin.

Salicine, Fr.; *Salicin*, G.

A neutral principle obtained from several species of Salix and Populus.

Nat. Ord.—Salicaceæ.

Formula $C_{13}H_{18}O_7$. Molecular weight 285.33.

Origin.—Salicin exists in the bark of most species of Salix and Populus, and to a small extent also in the leaves and pistillate flowers. According to Herberger, it is best prepared from the bark of young wood, which contains it in relatively larger proportion than the trunk bark, and associated with smaller quantities of other compounds, which interfere with its isolation. It may also be prepared from populin by boiling it with lime-water or with solution of barium hydroxide. Salicin was discovered by Leroux (1830); in the same year Braconnot obtained from it saligenin and saliretin, without, however, recognizing their relations to salicin; these and the glucoside nature of the latter were first established by Piria (1838, 1845). Herberger obtained 3 to 4 per cent. of salicin from the bark of Salix pentandra and S. Helix; but the results of different investigators with various species are very variable, which may in part be due to the kind of bark examined. This principle was prepared synthetically by A. Michael in 1879.

Preparation.—A decoction of willow-bark is deprived of tannin and coloring matter by digesting it with levigated litharge (Duflos) or by precipitating with basic lead acetate (Peschier); in the latter case the free acid is afterward neutralized with calcium carbonate. The filtrate on concentration yields crystals which require purification by recrystallization. The tannin may also be removed by milk of lime, and the salicin taken up by alcohol from the filtrate concentrated to a soft extract.

Properties.—Salicin crystallizes in colorless plates or flat rhombic prisms, but is usually seen in white glossy scales or needles. It remains unaltered in the air, has a neutral reaction to test-paper, is inodorous, and possesses a persistently bitter taste. It is soluble in 28 parts of water at 15° C. (59° F.) and in 30 parts of alcohol. It dissolves in 0.7 part of boiling water and in 2 parts of boiling alcohol (*U. S.*), is soluble in amylic alcohol, creosote, and without alteration in acetic acid; dissolves more freely in alkaline liquids than in water, but is insoluble in ether, chloroform, benzene, and petroleum benzin. Its ammoniacal solution is not colored on exposure (difference from phlorizin), and its aqueous solution is not precipitated by tannin or the various reagents for alkaloids. Salicin melts at 198° C. (388.4° F.) to a colorless liquid, which on cooling congeals crystalline; at a higher heat it becomes brown, at about 260° C. (500° F.) gives off acid vapors having the odor of salicylous acid and of caramel, and at a red heat is completely decomposed, without leaving any residue.

Cold sulphuric acid dissolves salicin with a bright-red color; after the absorption of water from the air—but not after the addition of water or after being neutralized by an alkali—deposits a red powder (*rutilin*) which after washing is yellowish-red, after drying blackish-brown, insoluble in water, alcohol, and glacial acetic acid, and is colored violet-red by alkalies (Braconnot). On warming salicin with somewhat diluted sulphuric acid and potassium dichromate, oil of meadowsweet (Spiræa ulmaria (Rosaceæ), or *salicylous acid* or *salicyl-aldehyde*, $C_7H_6O_2$, is given off, recognizable by its peculiar fragrance. Salicin is a glucoside, and when digested with emulsin or saliva, or heated to 80° C. (128° F.) with dilute sulphuric acid, assimilates 1 molecule of water, and is split into glucose and *salicylic alcohol* or *saligenin*, $C_7H_8O_2$, which crystallizes in pearly tables, is easily soluble in hot water, alcohol, and ether, melts at 82° C. (179.6° F.), and sublimes at 100° C. (212° F.). Saligenin is characterized by yielding in solution a deep-blue color with ferric chloride, and when boiled with dilute acids by being converted into a resinous body, *salirétin*, $C_{14}H_{14}O_3$, while oxidizing agents convert it into salicylous and salicylic acids. Cold nitric acid of specific gravity 1.16 oxidizes salicin, with the production of *helicin*, $C_{13}H_{16}O_7$, which crystallizes in white needles, and is by ferments and dilute acids resolved into sugar and salicylic aldehyde. If nitric acid of spec. grav. 1.09 is employed, salicin yields *helicoidin*, $C_{26}H_{34}O_{14}$, which may be regarded as a compound of salicin and helicin. These interesting reactions have been chiefly investigated by Piria (1837, etc.).

Tests.—"On heating a small portion of salicin in a test-tube until it turns brown, then adding a few Cc. of water, and afterward a drop of solution of ferric chloride, a violet color will appear."—*U. S.* The behavior of salicin to ammonia distinguishes it readily from phlorizin, and its solubility in cold nitric acid from those alkaloids which

acquire with this reagent a characteristic color. To test for poisonous alkaloids, which may possibly be present, Hager recommends agitating 0.2 Gm. of salicin with 4 Cc. of water and 1 Cc. of potassa solution, when a clear solution should be obtained. "The aqueous solution of salicin should not be precipitated by tannic or picric acid, nor by mercuric potassium iodide (absence of, and difference from, alkaloids)."—*U. S.*

Action and Uses.—The experiments of Ringer and Bury with salicin upon healthy children appear to show that it has no influence upon the temperature, and that under full medicinal doses a dusky flush suffuses the face on slight excitement, while the expression becomes dull and heavy. Less constant symptoms are deafness, noises in the ears, frontal headache, trembling of the hands, and quickened breathing. Very large doses occasion severe headache, marked muscular weakness, tremor, and irritability. Tingling may be felt in the extremities, and the voice becomes husky; the breathing is hurried, but there is no dyspnœa; large doses often repeated raise the pulse-rate to 140 and render the beats feeble. Other observers have noted an intermittent or a slower pulse among the physiological effects of this medicine, while the greater number declare that in healthy persons and in medicinal doses it does not affect the pulse at all. Such has certainly been the case after doses of 40, and even 75, grains, which produced buzzing in the ears and a state of semi-intoxication. Like sodium salicylate, salicin has sometimes produced hæmorrhage apparently due to dissolution of the blood (Shaw, *Lancet*, Jan. 1889, p. 114). In some cases it has caused vomiting and purging, and its continued use has occasioned gastric catarrh. A similar dissidence exists in regard to its influence upon the temperature in health. The singular opinion has been expressed that it is only sedative to the calorific function when it acts as a diuretic. On the whole, we repeat, there is no reason to believe that in healthy persons it reduces the temperature. Salicin appears to render the sweat alkaline or neutral even in rheumatic patients with acid urine, but the evidence of this operation is not conclusive. To its promotion of urinary elimination must be attributed its alleged action in removing yellowness of the skin in jaundice.

Salicin has been used, and indeed was first used, in the inflammatory affections in which it has since been customary to employ salicylic acid and its compounds. In the report of one physician (Riess), who vaunted the antiphlogistic virtues of this substance, the mortality from *pneumonia* is stated to have been 11 out of 35 cases—a result which is the reverse of encouraging. The experience of Dr. Greenhow in treating *rheumatic* fever with salicin was, on the whole, not so satisfactory as to encourage him in continuing to employ it (*Trans. Clin. Soc.*, xiii. 261), and the advocacy of it by Dr Maclagan has not established its efficiency. Conway vaunted its topical application in severe cases of *diphtheria*, but his success has not been matched (*Practitioner*, xxviii. 61). Many have reported salicin to be a valuable substitute for quinine, but these reports are counterbalanced by others, which appear to show that it was quite powerless in periodical fevers. In neither case was the natural tendency to cure of these affections sufficiently considered. In the absence of quinine, salicin may be employed in mild cases of *intermittent fever*. Salicin has been found efficient in preventing the development of acute *coryza* when given in doses of from Gm. 1.30–2 (20 to 30 grains), and also in mitigating the symptoms of *hay fever*. Turner and also Maclagan allege that it both prevents and cures *influenza*. It has been thought to moderate the pain of *lumbago*. In *neuralgia* of a periodical type, and not amenable to quinine, it is said to have been very efficient in doses of from 20 to 40 grains, given every hour for three or four hours. Even *diabetic patients* are alleged to have gotten well under the influence of this medicine!

Salicin, although not very soluble, may be given in water in the *dose* of Gm. 0.60–2.60 (gr. x–xl). It is better to give the smaller dose and repeat it frequently than to prescribe a full dose at once. It may be administered in powdered liquorice extract.

SALIX.—Salix; Willow.

Saule blanc, Fr. Cod.; *Weidenrinde*, G.; *Sauce, Sauz*, Sp.

The bark of Salix alba, *Linné*. Bentley and Trimen, *Med. Plants*, 234.

Nat. Ord.—Salicaceæ.

Origin.—The willows form a large genus, which is mostly confined to the northern temperate zone, and with some species extends into the Arctic regions. They are either trees or shrubs with flexible branches, and have alternate, short-petioled, and mostly more or less lanceolate, entire, or finely serrate leaves, with small or conspicuous stipules. The flowers are diœcious, in cylindrical catkins, each bract being one-flowered, and have at the

base one or two glands, but no other floral envelopes. The fruit is a one-celled and two-valved capsule, and contains numerous minute seeds which are furnished with a silky down. Most of the species are exceedingly variable in some of their characters, and all grow in moist localities, along streams, etc. The species recognized by the Pharmacopœia of 1880 is common in Europe, and is frequently cultivated, and has been to some extent naturalized, in North America. It grows to the height of 18–24 M. (60 or 80 feet), and belongs to the group of *crack willows*, which are characterized by having their branches brittle at the base. Salix fragilis, *Linné*, resembles this species. Salix purpurea, *Linné*, is mostly shrubby, with olive-green, brownish, or purplish bark, and has the branches not brittle at the base. A large number of hybrids have been observed between the different species. The bark is collected from the branches in spring, when it is easily removed from the wood.

Fig. 250.

Willow-bark: transverse section, magnified 15 diameters.

Description.—Willow-bark is met with in fragments or quills. It varies in thickness between 1–2 Mm. ($\frac{1}{25}$ and $\frac{1}{12}$ inch), is externally smooth or little wrinkled, varies in color between gray, brownish, and brown-yellow, is shining, when young has a somewhat metallic lustre, and is furnished with some roundish, small, suberous warts. The inner surface is smooth, pale-brownish, or cinnamon-colored. The bark may be readily torn in a longitudinal direction, but breaks transversely with some difficulty. Under the thin corky layer it has a green color, and the inner bast-layer is striate by very fine medullary rays, is arranged in tangential rows, and may be separated in thin shreds. The dry bark is nearly inodorous and has a bitter and astringent taste. Willow-bark collected from old wood is usually deprived of the more or less fissured corky layer, and consists of the pale-brownish liber, which breaks with a tough, splintery fracture, and is less bitter than the branch-bark. The parenchyma of the primary bark contains scattered groups of crystals; the bast-layer is formed of tangentially-arranged bast-fibres, which are accompanied by crystal-cells and alternate with thin layers of parenchyma; the numerous narrow mostly one-rowed medullary rays impart to the bast a finely-checkered appearance.

Constituents.—Salicin, the important medicinal constituent of willow-bark, has been described above. The other constituents are wax, fat, gum, and tannin. The crack willows appear to contain more tannin, and the purple willows more salicin. According to Johanson (1875), the tannin of willow-bark is a glucoside, and gives with ferric salts a blue-black precipitate, the liquid becoming purplish-red on the addition of soda. Johanson also showed the presence of a kind of sugar having a slightly sweet taste and reducing alkaline copper solution with difficulty, and of the glucoside *benzohelicin*, $C_{20}H_{20}O_8$, which was prepared by Piria (1851) by dissolving populin in cold nitric acid; it yields with sulphuric acid a yellow solution which, on the addition of water, becomes colorless and gives off the odor of salicylous acid.

The bark and leaves of different species of Populus contain, in addition to salicin, *populin* or *benzoyl-salicin*, $C_{20}H_{22}O_8$, which crystallizes in white needles of a sweet and somewhat acrid taste, and yields, under the influence of dilute acids, benzoic acid and decomposition-products of salicin.

Action and Uses.—Willow-bark was anciently employed in medicine as an astringent. Like simple bitters, it appears to increase the appetite and improve the digestion, but if its use is long continued it confines the bowels. It has been used in cases of *dyspepsia* and of general *debility* and to lessen excessive discharges from mucous membranes. It has had some repute as a *vermifuge*, and its powder has been applied as a dressing for unhealthy and gangrenous *ulcers*. Before being introduced into medicine willow-bark had been a popular domestic febrifuge. It was first recommended for the treatment of *intermittent fever* by Stone of London in 1763, and was reported to be efficient by many others down to the discovery of salicin in 1825. A fluid extract of *S. nigra* is credited by Paine with allaying *sexual erethism* (*Report of Texas Med. Soc.*, 1885). His statement is corroborated by Fenwick and by Hutchison in England (*Med. Record*, xxxii. 487, 517), and partially by Oliver (*Lancet*, May 5, 1888).

Powdered willow-bark may be given in *doses* of Gm. 1.30–4 (gr. xx–lx) three times a day as a tonic; as an antiperiodic at least Gm. 32 (℥j) must be taken during an intermission. A decoction or infusion may be made with Gm. 32 (an ounce) of the bruised bark to 500 Cc. (a pint) of water.

SALOL, *U. S.*—Salol.

Salolum, P. G.; *Phenyl salicylate*, E.; *Salicylate de phenol*, Fr.; *Salicylsäure-phenyl-æther*, *Phenylsalicylat*, *Salol*, G.

Formula $C_6H_4(OH)CO_2C_6H_5 = C_6H_5C_7H_5O_3$. Molecular weight 213.49.

Salol was first produced by Nencki in 1883, and introduced into medicine by Sahli in 1886.

Preparation.—When dehydrating agents are made to act upon a mixture of phenol and salicylic acid, phenyl salicylate is formed and water eliminated. For this purpose a mixture of sodium-phenol and sodium salicylate in molecular proportions may either be treated for some time with phosphorus oxychloride or a slow current of phosgene gas (carbonyl chloride) may be passed into a warmed mixture of the two salts: in the first case the secondary or by-products consist of sodium chloride and metaphosphate, and in the second case of sodium chloride and carbon dioxide. These are removed by washing the mass repeatedly with water, and recrystallizing the residuary salol from alcohol.

A later process, which has been patented, consists in heating pure or even crude salicylic acid in a flask with a long narrow neck in a bath to 220°–230° C. (428°–446° F.); air is excluded by keeping the flask filled with carbon dioxide, and the length of the neck permits only vapors of water and carbon dioxide to escape. The theory underlying the reaction is the conversion of the salicylic acid into its anhydride, and the subsequent decomposition of this into phenylsalicylate and carbon dioxide, according to the equations: $2C_6H_4(OH)CO_2H = (C_6H_4CO_2H)_2O + H_2O$; — $(C_6H_4CO_2H)_2O = C_6H_4(OH)CO_2C_6H_5 + CO_2$.

Properties.—Salol occurs as a white crystalline powder, of slightly aromatic odor and taste, and melting at 42° C. (107.6° F.). It is sparingly soluble in water, but soluble in 10 parts of alcohol or 0.3 part of ether. Also soluble in chloroform. Heated on platinum-foil, it burns with a sooty flame, without leaving a residue. Bromine-water added to an alcoholic solution of salol causes a white precipitate of monobromsalol. When heated with caustic soda solution salol is decomposed into sodium-phenol and salicylate; the further addition of hydrochloric acid precipitates salicylic acid and develops the odor of phenol.

Tests.—Salol should not redden moistened blue litmus-paper (absence of free acid). Shaken with 50 parts of water, a filtrate is obtained which should not be colored violet by dilute ferric chloride solution (absence of uncombined phenol and salicylic acid), nor by solutions of barium nitrate or silver nitrate (absence of sulphates and chlorides).

Derivative and Allied Compounds.—Salophen. Acetylpara-amidophenolsalicylate, $C_6H_4(OH)CO_2.C_6H_4NH.COCH_3$. This compound was introduced in 1891 as a substitute for salol, from which it differs chiefly in yielding harmless acetylpara-amidophenol, instead of toxic phenol, when decomposed in the human organism. It is prepared by a complicated process, the first step being the preparation of paranitrophenol salicylate in a manner similar to the production of salol; then converting this into para-amidophenol salicylate by means of reducing agents, and finally, by the action of acetic acid, into acetylpara-amidophenol salicylate or salophen, which is purified by crystallization from benzene or alcohol. It occurs as minute white scales containing 50.9 per cent. of salicylic acid, is of neutral reaction, and is free from odor and taste. Salophen melts at 187°–188° C. (368.6°–370.4° F.). It is insoluble in cold, but somewhat soluble in hot water, and is readily taken up by alcohol, ether, and solution of the alkalies. When salophen is heated with sulphuric acid and alcohol, the odor of acetic ether is developed. Salophen should not be confounded with "*saliphen*," the name given to salicyl-phenetidin, a compound of salicylic acid and phenetidin introduced in 1890, and having the formula $C_6H_4OC_2H_5NHC_6H_4(OH)CO$.

Salicylamide. $C_6H_4(OH)CONH_2$. This compound is produced by the action of dry ammonia gas on methyl salicylate in the form of oil of wintergreen. It is a colorless or slightly yellowish-white crystalline powder, melting at 138° C. (280.4° F.), and soluble in alcohol and ether; it requires about 250 parts of cold water for solution. Salicylamide is quite tasteless, but produces a gritty feeling between the teeth; treated with caustic soda, it is converted into sodium salicylate and ammonia.

Salol-camphor, Camphol, is a colorless or pale-yellow oily liquid, obtained by mixing 3 parts of salol with 2 parts of camphor, and heating gradually to complete fusion; it should be preserved in yellow hermetically sealed bottles, as it readily decomposes when exposed to light and air.

Diiodosalol. Phenyldiiodosalicylate. $C_6H_2I_2(OH)CO_2C_6H_5$. A tasteless and odorless crystalline powder, obtained as a condensation-product of phenol with diiodosalicylic acid; it fuses at 133° C. (271.4° F.).

Cresalol. Cresol salicylate, $C_6H_4(OH)CO_2C_6H_4CH_3$. This is a crystalline compound analogous to betol and salol. It is obtained by the interaction of cresol and salicylic acid in the form

of sodium salts in the presence of phosphorus oxychloride: three varieties are formed, depending on the sodium salt (ortho-, meta-, or para-) used. All are insoluble in water, but soluble in alcohol and ether. Meta- and paracresol salicylate have been used internally in place of salol; the former melts at 74° C. (165.2° F.) the latter at 40° C. (104° F.).

Action and Uses.—Most observers state that, unlike salicylic acid, salol does not, even in large doses, cause ringing in the ears, and Lombard refers to one case in which no functional disorder was produced by Gm. 8 (120 gr.). It is, however, unquestionable that, like salicylic acid, it may occasion tinnitus, irregular heart-beat, and, less frequently, sweating. Herrlich states that in *typhoid fever* it sometimes causes nausea, vomiting, and persistent loss of appetite, and even rigors, followed by fever. In a case of chronic rheumatism it brought on dysury and vesical tenesmus, with dark urine (*Archives gén.*, Nov. 1887, p. 616). Two drachms of it have caused death with signs of carbolic-acid poisoning (Hesselbach). In another case a dose of Gm. 1 (gr. xv.) caused a like catastrophe (*Lancet*, May 23, 1891). There can be no doubt that the poisonous action of the compound is due to the carbolic acid it contains. Herpetic eruptions and urticaria have occurred among its occasional effects (*Med. Record*, xxxiii. 244; *Centralbl. f. Med.*, vi. 298).

This preparation has been used chiefly for the cure of acute articular *rheumatism*, in which Nencki and Sahli found it as efficient as sodium salicylate when given in doses of 30 gr. three or four times a day. They also used it in the chronic form and in muscular rheumatism (*Med. News*, xlviii. 707). Others have furnished less favorable reports, of whom Rosenberg states that relapses were more frequent than after the use of salicylic acid; and others, like Herrlich, noted that it did not lessen the tendency to complications and relapses. In these views Kleefeld concurs, and the general drift of opinion is expressed by Bielschowsky—viz. that the medicine has the same mode of action in acute articular rheumatism as salicylic acid, antipyrine, and antifebrin, with a less tendency to produce unpleasant symptoms (*Centralb. f. Ther.*, v. pp. 243–246), but is less efficient than salicylic acid in controlling pain, for which these several preparations are useful, and decidedly less so than sodium salicylate (*Bull. de Thérap.*, cxiii. 197). Aufrecht, however, holds that in *chronic* articular rheumatism salol is sometimes preferable to salicylic acid when the latter fails or is no longer tolerated (*Centralb. f. Ther.*, vi. 78). Demme did not find the medicine satisfactory in rheumatism occurring in children (*ibid.*, vi. 298), nor did Bradford regard it as equal to sodium salicylate for adults (*Boston Med. and Surg. Jour.*, July, 1888, p. 67). On the whole, little doubt can be entertained that the value of the compound in rheumatism depends upon the salicylic acid it contains—a view which explains the fact that only relatively large doses of it are efficient.

The anodyne virtues of the medicine have also been made useful in relieving the *lancinating pains* which attend sclerosis of the spinal cord and other forms of *neuralgia*, as Lombard, Montagne, and Chéron testify. As an antipyretic it was found useless by Lombard in pneumonia, phthisis, measles, mumps, scarlet fever, erysipelas, intermittent fever, etc.; and in this also its analogy with salicylic acid is notable. Capart claims that it aborts *tonsillitis* (*Therap. Gaz.*, xiii. 701). The influence of the carbolic-acid element in salol is shown by the utility of the compound as an application to various *ulcers* of the mouth and throat, in *ozæna*, *diphtheria*, *otorrhœa*, *gonorrhœa*, *vesical catarrh*, etc., and as a substitute for iodoform in surgical dressings. It is, however, difficult of application in these cases, owing to its slight solubility. As a wash a dessert-spoonful of a 6 per cent. solution of the compound in alcohol, added to a tumbler of water, was employed. Like carbolic acid, it is useful in *fermentative dyspepsia*. Saalfeld claimed that a 5–8 per cent. ointment of salol with vaseline is efficient in *sycosis* and *impetigo contagiosa* (*Med. News*, liv. 18), and Graetzer recommended a powder of starch containing 4–6 per cent. of salol as a useful application to *ulcers* of the legs, gangrenous sores, etc. (*Therap. Monatsh.*, iii. 536). In *cystitis* with ammoniacal and turbid urine by the daily use of 30–40 gr. of salol the urine is cleared up and can be passed without difficulty (Arnold, Demme, Dreyfous). This effect is chiefly due to the carbolic acid of the compound, which with the salicylic acid is eliminated by the kidneys. It is unnecessary to do more than mention the employment of salol in diabetes, typhoid fever, cholera infantum, etc., in none of which is there proof of its utility.

Salol may be given to the extent of Gm. 1.30–2 (gr. xx–xxx) a day in divided doses, but it has been prescribed in much larger quantities, such as from Gm. 2–3 (gr. xxx–xlv) a day (Lombard). According to the Extra Pharmacopœia (Br.), the dose is Gm. 0.67–1.30 (gr. x–xxx). It may be administered in capsules or in emulsion, or simply suspended in milk.

Salicylamide, proposed as a substitute for salicylic acid as being tasteless, more soluble, prompter in its action in smaller doses, and of greater analgesic properties, was given in doses of Gm. 0.195–0.325 (gr. iij–v) several times a day. It has not yet justified its claims (Squibb).

Salipyrine, it is claimed, is not apt to produce unfavorable symptoms, except, perhaps, a transient erythema, but in full doses it certainly occasions sweating and disorders of the stomach. It is antipyretic and analgesic, and has been employed chiefly in *typhoid fever* and acute articular *rheumatism*. Like its congeners, it palliates pain in the latter disease, but does not shorten the duration or prevent the complications of either affection. It is anodyne in *neuralgia*. In fact, its action is that of its constituents. The doses used have been, in acute febrile affections, Gm. 2, followed after one or two hours by doses of Gm. 1 at hourly intervals for four hours.

Salophen is reported to be one of the most speedy and efficient remedies in *acute articular rheumatism*. Fröhlich regards it as "preferable to sodium salicylate and salol, because it is not hygroscopic, is tasteless, and can be used for a long time without any ill effects." This judgment is confirmed by Guttmann, Gerhardo, and others. It is also said to relieve habitual *headaches*, *hemicrania*, and trigeminal and other *neuralgiæ*. It may be given in doses of Gm. 1 (gr. xv) every two hours up to Gm. 6 (gr. xc) in twenty-four hours.

Cresalol—or rather the several compounds so called—is antiseptic and free from disagreeable odor. It is said to correct and restrain offensive discharges from wounds, etc., and has been given internally for a similar purpose.

SALVIA, *U. S.*—Salvia; Sage.

Folia (*Herba*) *salviæ*, P. A., P. G.; *Sauge officinale*, Fr. Cod.; *Salbei*, G.; *Salvia*, Sp.

The leaves of Salvia officinalis, *Linné*. Bentley and Trimen, *Med. Plants*, 206.

Nat. Ord.—Labiatæ, Monardeæ.

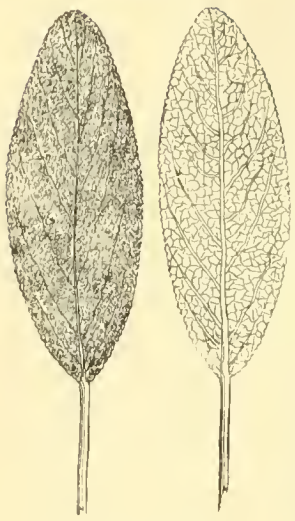
Origin and Description.—Sage is a suffruticose perennial indigenous to Southern Europe and extensively cultivated in England, France, and Germany and in gardens in the United States (*garden sage*). The stem is about 60 Cm. (2 feet) high, woody at the base, much branched, quadrangular, and whitish pubescent above. The leaves are opposite, petiolate, 5–8 Cm. (2 or 3 inches) long, thickish, ovate- or lance-oblong, obtuse or subacute, finely crenulate on the margin, wrinkled, grayish-green, and beneath soft hairy. The lower leaves are sometimes auricular or rounded, more frequently narrowed, at the base, the upper ones smaller and nearly sessile. The flowers are in three-flowered cymes in the axils of the upper leaves or bracts, have a tubular, bell-shaped, bilabiate, brownish, pubescent calyx, with mucronate divisions, and a violet-blue, bilabiate corolla, with a short tube, a depressed, helmet-shaped upper lip, three-lobed, spreading lower lip, and two stamens. All parts of the plant are more or less glandular and have a peculiar strong, aromatic odor, and a warm, bitterish, and somewhat astringent taste.

Fig. 251.

Salvia officinalis, *Linné*.

Constituents.—The most important constituent is volatile oil, of which the fresh herb yields ⅛ to ¼ per cent., and when recently dried about three times this quantity. *Oil of sage* is of a greenish or yellowish color, has the density 0.86 to 0.93, commences to boil at 130° C. (266° F.), and is very freely soluble in 80 per cent. alcohol. P. Muir (1876) found the portion boiling between 156° and 158° C. (312.8° and 316.4° F.) to be a terpene, $C_{10}H_{16}$, which yielded cymene under the influence of sulphuric acid and terephtalic acid when treated with sulphuric acid and potassium dichromate. The portion having the boiling-point 10° C. (18° F.) higher yielded identical products, and in the neighborhood of 200° C. (392° F.) an oxygenated portion was obtained, which Muir designated *salviol*, $C_{10}H_{18}O$, and at 260° C. (500° F.) a hydrocarbon of the formula $C_{18}H_{24}$. The stearopten of the oil melts at 187° C. (368.6° F.), and closely resembles ordinary camphor. The other constituents of sage are of no medicinal importance, and are those commonly found in plants; Hirsch did not succeed in obtaining tannin.

Fig. 252.



Sage-leaf: upper and lower surface.

Pharmaceutical Preparations.—Aqua salviæ, Sage-water. Distil 10 parts of water from 1 part of sage-leaves.—*P. G.* 1872.

Infusum salviæ. Sage ½ troyounce, boiling water a pint.—*U. S.* 1870.

Allied Species.—Most species of Salvia are aromatic and bitter. Salvia pratensis, *Linné*, and S. Sclera, *Linné*, are used in Southern Europe; S. lyrata, *Linné*, is common in North America, but only slightly aromatic.

Salvia polystachya, *Ortega* (Salvia Chian, *La Llave*). The fruit of this Mexican species is used under the name of *chia-seed*. It is about 2 Mm. ($\frac{1}{12}$ inch) long, about 1.2 Mm. ($\frac{1}{20}$ inch) broad, flattish-globular, gray marbled with brown, glossy, internally white and oily. The testa is covered with a transparent epithelium containing much insipid mucilage, which, according to Hiland Flowers (1882), is coagulated by ferric chloride; the white embryo contains a pale-yellow drying oil. According to Profs. Gray and Rothrock, the fruit of Salvia Columbariæ, *Bentham*, which is indigenous to New Mexico and westward, is likewise known as chia-seed. The fruit of Salvia verticillata, S. verbenaca, S. Horminum, *Linné*, and other species, are also mucilaginous.

Action and Uses.—Sage is an ancient medicine. From the time of Hippocrates, when it was reputed to be desiccant and astringent, it was used in chronic pulmonary complaints and uterine derangements and as a dressing for wounds and sores. Later on, it was regarded as emmenagogue, and used to arrest hæmoptysis and as a gargle for sore throat.

Sage is stimulant, tonic, and astringent. Pidoux states that, having caught cold during the month of July, an infusion of half an ounce of sage caused him to sweat copiously for several hours. Such effects are likely to be produced by a hot infusion of any stimulant herb. It is certain that a cold infusion of sage has in all ages been employed to moderate excessive sweats depending upon debility alone. An infusion in red wine is to be preferred for this purpose. It is less serviceable in the colliquative *sweats* of phthisis accompanied by hectic fever, yet even in them it adds to the power of aromatic sulphuric acid when used as a vehicle for the latter. A strong infusion of sage has been employed successfully to hasten the drying up of the *milk* at weaning-time. Sage tea or an infusion of sage in red wine is a popular and efficient remedy for aphthous and other *ulcers* of the mouth and for all forms of *sore throat;* it is best applied as a wash or gargle when sweetened with honey. Its power is increased by the addition of vinegar, alum, borax, or potassium chlorate. Externally, similar applications are of great value in healing *ulcers* and the raw surfaces occurring in *intertrigo*, etc. Chronic *nasal catarrh* has been benefited by injections of sage tea (D. H. Agnew). The aromatic wine of the French Codex, which is so largely used for the treatment of *chancres* and other ulcers, contains sage. Sage is much used as a seasoning for gross and fat meats, such as pork and goose. It is seldom prescribed internally, unless in an infusion, which is no longer official.

Dr. Henry M. Stillé, who has long practised in Mexico and Texas, informs us that a decoction of *chia-seeds* is applied cold in external inflammations—*e. g.* of the eye. It is also given internally, sweetened with sugar, in febrile affections, sore throat, etc. The Mexicans describe it as "cooling."

SAMBUCUS, *U. S.*—Sambucus; Elder.

Sambuci flores, Br., P. G.; *Sureau*, Fr.; *Flieder, Hollunder*, G.; *Saúco, Sahuco*, Sp.

The flowers of Sambucus canadensis, *Linné* (S. nigra, *Linné, Br., P. G.*). Bentley and Trimen, *Med. Plants*, 137, 138.

Nat. Ord.—Caprifoliaceæ.

Origin.—The American elder is suffruticose, attaining a height of 2.4–3 M. (8 or 10 feet), and grows in moist thickets and on the banks of streams throughout a great portion of North America. It has opposite mostly smooth *leaves*, with from seven to eleven short-stalked, oblong, pointed, serrate leaflets, the lower pair of which is frequently three-parted, and juicy, purplish-black, drupaceous *fruits*, containing three one-seeded hard nutlets and having an acidulous and sweetish taste. The bark, leaves, and fruit are sometimes medicinally employed, besides the flowers.

Description.—Elder-flowers are in large, level-topped cymes, which terminate the small branches and are five-branched below and forked above. The marginal flowers are occasionally radiate; all have a superior calyx, with five minute teeth, a wheel-shaped, cream-colored, or whitish corolla, with a short tube and a spreading five-lobed limb, and five stamens which are inserted between the obtuse corolla-lobes. The flowers appear in June, and have in their fresh state a peculiar rather disagreeable odor, which becomes more pleasant and sweetish on drying. They are collected when in full bloom, and rapidly dried to prevent them from turning black; the corollas fall off very readily, and are separated from the stalks by shaking. Well-dried elder-flowers are of a pale brownish-yellow color, and have a slight peculiar odor and a sweetish, mucilaginous, and bitterish taste. The constituents of this drug appear to be closely allied to those of the European elder.

SAMBUCUS NIGRA, *Linné*, extends throughout the greater portion of Europe, Southern Siberia, and Northern Africa. It is a shrub or small tree, has the leaflets ovate-oblong and acute, and the flowers in smaller compound cymes than the preceding; otherwise the two species resemble each other very closely.

Constituents.—European elder-flowers contain as their most important principle a volatile oil which, according to the investigations of Eliason, Pagenstecher, and others, is yellowish and limpid, but mostly of a butyraceous consistence, of a strong odor and of a warm, bitterish, afterward cooling taste. The recently-dried flowers yield only $\frac{1}{3}$ to $\frac{1}{2}$ per cent. of it if the distilled water is extracted with ether. The remaining constituents of the flowers are acrid resin, a little tannin, mucilage, albumen, and other common vegetable principles; among the salts are potassium and calcium malates. Scheele found in the berries mucilage, sugar, and malic acid, and Kraemer (1846) obtained from the bark *viburnic acid*, which is identical with *valerianic acid*. C. G. Traub (1881) ascertained that the bark of American elder contains likewise valerianic acid, and in addition resin, tannin, sugar, etc. J. B. Metzger (1881) found in the berries sugar, gum, tannin, fat, etc.

Allied Species.—SAMBUCUS EBULUS, *Linné*. All parts of this European species have a strong, disagreeable color and a bitterish, somewhat acrid taste. At present the four-seeded fruit, which resembles elder-berries, but has a more agreeable taste, is occasionally employed. The plant is known as dwarf-elder, *E.;* yèble or hièble, *Fr. Cod.;* Attich, *G.;* and yezgo, *Sp.*

Pharmaceutical Preparations.—SUCCUS SAMBUCI INSPISSATUS.—Extract of elder-berries, *E.;* Rob de sureau, *Fr.;* Fliedermus, *G.*—Bruise fresh elder-berries, after twenty-four hours express the juice, allow to settle, decant, strain, and evaporate the clear liquid to the consistence of a soft extract.—*F. Cod.* It has a sweet acidulous taste and dissolves in water with a brown-red color.

Action and Uses.—Elder-berries (S. nigra) are cooling, aperient, and diuretic, and when their juice is fermented it forms a wine which is much used in England as a domestic cordial. The flowers are said to be poisonous to peacocks and the berries to hens (Strumpf). According to Cazin, cattle refuse to eat the leaves, caterpillars avoid them, and hence the shrubs are planted around the beds of kitchen-gardens; the flowers are used to preserve clothing from moths.

The ancients considered elder-bark and leaves as purgative and diuretic, and several centuries ago the leaves, bark, and seeds were much used in dropsy, and the flowers for fomentations, as they continue to be at the present time. From the flowers a water is distilled which is employed as a perfume, and an ointment is prepared with them for the treatment of *burns* and *excoriations*. An ointment made with the inner bark has been used in *tinea capitis*, as a dressing for *blisters* and various excoriations and sores, and in *erysipelas*, as well as for moderating the pain of *hæmorrhoids*, and in poultices as an application to *gangrenous* tissues, glandular engorgements, etc. For most of these purposes an infusion of the flowers is employed. Porcher states (*Resources of the Southern Fields, etc.*, p. 448) that "a decoction made by pouring boiling water over the leaves, flowers, or berries of the elder is recommended as a wash for wounds to prevent injury from flies. An ointment is used for the same purpose." In the same work elder is said to have been employed in an ointment—which, however, contained sulphur—in the treatment of *scabies*. Dr. T. A. Smith of Crêve Cœur, Mo., informs us that a strong decoction of sambucus is employed in his neighborhood to expel *maggots* from parts not readily accessible, particularly the nostrils; and adds that a decoction made with the green leaves and shoots of the elder succeeded perfectly in driving away these creatures from the wounds made in cutting off lambs' tails when every other application had failed. It acted very promptly and was entirely unirritating. The young leaf-buds are said to be a drastic cathartic, but

the fresh inner bark is more efficacious. The juice of the root of S. nigra has been found to act as a hydragogue cathartic in the dose of Gm. 32–64 (℥j–ij), taken fasting. This dose excites copious salivation, followed by vomiting without excessive straining; later, watery stools occur, and continue for eight or ten hours. In this country similar effects have followed the use of the native elder-bark (S. canadensis) infused in hard cider. The expressed juice of the root of the official plant may be given in the *dose* of Gm. 64 (f℥ij) every two hours until its specific operation begins. A decoction is made by boiling an ounce of the inner bark in 2 pints of water until reduced to Gm. 32 in Gm. 1000 to Gm. 500 (a pint); of this Gm. 128 (4 fluidounces) may be given at a dose.

SANGUINARIA, *U. S.*—Sanguinaria.

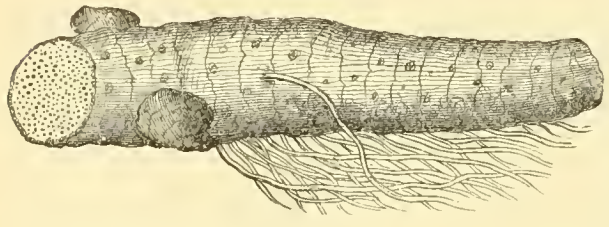
Bloodroot, Puccoon, Tetterwort, Indian paint, E.; *Sanguinaire*, Fr.; *Blutwurzel*, G.

The rhizome of Sanguinaria canadensis, *Linné*. Bentley and Trimen, *Med. Plants*, 20. *Nat. Ord.*—Papaveraceæ, Eupapavereæ.

Origin.—Bloodroot is a native of Canada and the United States, where it grows in open woods on a rich soil. In early spring the rhizome sends up one or two leaves and a slender scape about 10–15 Cm. (4 or 6 inches) high, bearing a single large white flower. The leaves do not attain their full size until after the petals have been shed in April or May, and are then about 75 Mm. (3 inches) long and 10–12 Cm. (4 or 5 inches) wide, heart-shaped at the base, reniform in outline, palmately seven- or nine-veined, and divided into the same number of obtuse lobes; the upper surface is of a light-green, the lower surface glaucous, whitish, and the veins often reddish. The calyx consists of two fugacious sepals, and the corolla of about eight oblong and obtuse petals; the stamens are in several rows, and the fruit, which ripens in June, is an oblong two-valved capsule tapering at each end and containing numerous roundish seeds with a strongly crested raphe. All parts of the plant contain a bright orange-red juice, but only the rhizome is employed.

Description.—The rhizome is 5–10 Cm. (2 to 4 inches) long and about 1 Cm. (⅖ inch) thick, horizontal, slightly branched, cylindrical, and faintly annulate by leaf-scars. In the fresh state it is fleshy, and emits, when wounded, a dark-red juice; after drying it is reddish-brown externally, longitudinally wrinkled, and breaks with a short fracture of a slight waxy appearance. Transverse section shows a thin bark, which is in width about one-twelfth the diameter of the rhizome, a very fine cambium-line, and a white mealy inner portion, in which the circle of about eighteen small fibro-vascular bundles is not readily distinguished, and which contains a large number of small red resin-cells; the interior tissue is not unfrequently of a nearly uniform brownish-red color, due probably to the manner in which the drug was dried. The thin rootlets are mainly on the lower side, and in commercial bloodroot are mostly broken off, short remnants or scars only remaining; they have a bark about equal in thickness to the ligneous cord and contain scattered red resin-cells. Bloodroot yields a pale grayish-red irritating powder, and has a slight heavy odor and a persistent bitter and acrid taste.

Fig. 253.



Bloodroot.

Constituents.—Dr. Dana (1828) obtained from bloodroot the alkaloid *sanguinarine*, which Probst considered identical with the alkaloid chelerythrine discovered by him (1830) in celandine (see page 445). The identity of the two was conclusively proven by Shiel (1855). Riegel (1845), and afterward Gibb (1860), isolated a second alkaloid, which they named *porphyroxine*, from its supposed identity with a constituent of opium formerly known by that name. It was obtained by exhausting the rhizome with dilute acetic acid, precipitating the sanguinarine with ammonia, neutralizing the filtrate with acetic acid, and precipitating with tannin; on decomposing the precipitate with either lime or potassa and exhausting with ether, white, tasteless crystals are stated to be obtained, which yield with acids bitter and neutral salts. In 1856, E. S. Wayne announced the discovery of a third alkaloid, named *puccine* by Gibb. It was said to remain dissolved in ether after precipitating the ethereal solution of crude sanguinarine with sulphuric acid. L. C. Hopp (1875) proved it to be sanguinarine held in solution as sulphate by a trace of resin; he also found *sanguinarinic acid* of Newbold (1866) to be a mixture of impure citric and malic acids.

Sanguinarine, $C_{19}H_{17}NO_4$, is obtained from the syrupy alcoholic extract of sanguinaria by digesting it with dilute hydrochloric acid, filtering from the resin, precipitating by ammonia, dissolving the crude alkaloid in ether, and passing hydrochloric acid gas into the solution, when sanguinarine hydrochlorate is precipitated. The pure alkaloid is in white verrucose or needle-shaped crystals, which are sternutatory, freely soluble in ether and alcohol, and yield with acids bright-red salts having a bitter and persistently acrid taste, like the alcoholic solution of the alkaloid. The second alkaloid observed by Riegel was obtained by F. W. Carpenter (1879) as a yellow mass which acquired with strong sulphuric acid a deep-purple color, intensified on the addition of potassium dichromate, the reaction resembling that produced by these two reagents with strychnine. F. L. Slocum crystallized the same alkaloid from ether in colorless, slightly bitter needles of an alkaline reaction, and in this pure state yielding with sulphuric acid a deep-purple color, which, however, was not permanent, and changed with chromate to yellow. It exists in minute quantity only, and is not precipitated by ammonia. Slocum examined also the red resinous matter which is separated by alcohol into two portions, both of which, when fused with potassa, yielded protocatechuic acid. C. W. Dodd (1882) found in 100 parts of air-dry bloodroot 10.9 moisture, 7.9 ash, 2.7 benzene extract, 19.9 alcohol, extract 16.2 water extract, 7.2 starch, and 1.11 sanguinarine.

Pharmaceutical Preparations.—Acetum sanguinariæ, *U. S.* 1880.—Take of Bloodroot, in No. 30 powder, 10 parts (1 oz. av.); Diluted Acetic Acid sufficient to moisten the powder with 5 parts (½ oz. av.) of the acid. Pack into a conical glass percolator, and gradually pour upon it diluted acetic acid until 100 parts (10 oz. av.) are obtained.

Action and Uses.—In non-nauseating doses it increases the appetite and improves digestion. In man, sanguinarine, in doses of from ⅛ to ¼ grain continued for several days, occasions nausea and sometimes vomiting, and a manifest reduction of the pulse-rate. 1 grain in solution, repeated at intervals of ten minutes, may excite vomiting after the third dose.

The physiological action of sanguinaria bears no relation to its medicinal uses. In all cases in which the former is developed the depressing operation of the medicine is distressing and unsafe. Its value is only demonstrated, if at all, by its long-continued use in moderate doses, so as to produce its so-called deobstruent or alterative effects. These are supposed to be exhibited when it is used in the treatment of *atonic dyspepsia*, with "torpor of the liver," but in such cases the cure is probably due, in some degree, to the simultaneous regulation of the diet, etc. and abstinence from active medication. Possibly in protracted muscular *rheumatism* the medicine may deserve a trial. It has been used in *bronchitis*, *croup*, and *asthma*, and has seemed to be most useful when the spasmodic element predominated. Hence its utility in *spasmodic croup*—i. e. *spasmodic laryngitis*.

Powdered bloodroot has been employed as a *sternutatory* and as a stimulant for indolent and unhealthy *ulcers*. The latter effect probably led to its being used by quacks in the treatment of *cancer*. The fresh juice of the root is said to cure *warts*, and an infusion or decoction of the root has been applied to chronic *scaly* and *pustular eruptions*.

The *dose* of sanguinaria as an emetic is Gm. 0.60–4 (gr. x–lx). An infusion made with the bruised root Gm. 32 in Gm. 250 (℥j in Oss) of boiling water may be given in tablespoonful doses at short intervals. The official preparation represents the medicine fully.

Acetum sanguinariæ (*Pharm.* 1880).—Whatever utility this preparation may have displayed as a gargle in *scarlatinous sore throat* was probably due to its menstruum. It would be folly to employ it as an emetic when other and more certain emetics are at hand; and there is nothing to show that as an expectorant, which it is reputed to be, its beneficent action outweighs its harsh operation and its depressing action on the heart and nervous system. Its dose as an emetic is stated to be Gm. 12–16 (f℥iij–iv), and as an alterative and expectorant, from Gm. 1–2 (gtt. xv–xxx).

SANGUIS.—Blood.

Sang, Fr.; *Blut*, G.; *Sangre*, Sp.

Description and Composition.—Blood is an animal fluid which passes to all organs through the circulation. In the inferior animals it is of a white color, while in the vertebrated animals it is red, and the red color is brighter in blood taken from the arteries than in that contained in the veins. Blood is not a simple solution of different compounds, but it is a kind of emulsion containing chiefly blood-corpuscles in suspension.

According to Lehmann, 1000 parts of corpuscles contain 688 water, 16.75 hæmatin, 282.22 globulin, 2.31 fat, 2.60 extractive matter, and 8.12 mineral constituents, among which potassium salts predominate. The red color of blood-corpuscles is due to *hæmoglobin*, which under some conditions may be obtained in well-defined crystals, as was shown by B. Reichardt (1847); acids and alkalies decompose it into the red coloring matter hæmatin, which contains iron and may likewise be crystallized, and into the albuminoid compound globulin. 1000 parts of the liquid portion of blood contain 902.90 parts of water, 4.05 fibrin, 78.84 albumen, 1.72 fat, 3.92 extractive matter, and 8.55 mineral constituents, among which sodium chloride predominates. The saline constituents both of the corpuscles and liquid are, besides iron, calcium and magnesium phosphates, and potassium and sodium chlorides, phosphates, and sulphates. The composition of blood varies, however, in different animals, and in the same animal if taken from different vessels. When left to itself, blood coagulates, forming a *clot*, *cruor*, which separates from the liquid portion, called *serum*. The clot consists of the fibrin, which has become insoluble, and of the corpuscles, while the serum is chiefly a solution of albumen and salts. According to Boussingault, the red color of the blood of the higher animals is not due to iron, since the white blood of mollusks contains about the same amount of iron, varying in different animals between about 0.04 and 0.06 part in 1000.

Bullock's blood has been used in the fresh state, and, according to W. C. Bakes (1872), also evaporated to an extract (*extractum sanguinis*), and, if subsequently powdered, under the name of *pulvis sanguinis*.

Action and Uses.—We shall not in this place discuss the nutritive qualities of blood, but only recall the fact that, in spite of the wise Mosaic law against eating blood, it is more or less used as food in several countries. We remember to have observed many years ago in the Roman market cakes of coagulated blood sold openly as food. They disagreeably recalled the basins of human blood we had then but recently seen shed in hospital practice.

In 1873, Mr. Vacher, an English health-officer, having learned that the serum of the blood of sheep and oxen was regarded by the journeymen in certain slaughter-houses as "a remedy of great value for the treatment of scrofulous children, and as little less than a specific in cases of seat- and tape-worms," undertook some experiments with it which confirmed him in his impression of its efficacy. When employed in the Birkenhead Borough Hospital it was found "most successful in cases of thread-worms, and less so in those of Ascaris lumbricoides; it failed almost entirely in tænia." It would seem unnecessary to introduce a new remedy for these entozoa when so many efficient anthelmintics are already available, especially when the proposed medicine is difficult to obtain in a fresh and sound condition and is of doubtful value. Defibrinated blood, dried and powdered, has been used with advantage in various conditions of *debility* depending upon exhausting discharges, *anæmia*, *dyspepsia*, chronic diseases, etc., especially in infants and children (Guernder, *Therap. Gaz.*, viii. 49; Dujardin-Beaumetz, *Bull. et Mém. Soc. de Thérap.*, 1885, p. 125; Stewart, *Proc. Phila. Co. Med. Soc.*, xi. 115). Even in its liquid state such blood has been given internally with alleged success in *chlorosis* by Bloukvajeff (*Centralbl. f. Therap.*, vi. 734). It is claimed by Dr. Andrew H. Smith (*Amer. Jour. of Med. Sci.*, July, 1879, p. 242) that an enema of defibrinated blood is almost wholly absorbed; that it confines rather than irritates the bowels, as a rule; and that "in favorable cases it quickens nutrition more than other remedies." Sansom (*Lancet*, Feb. 16, 1881) reports favorably of the method, stating that in urgent cases 2 or 3 ounces of the liquid should be injected into the rectum every two or three hours, and that in chronic cases, in which it supplements gastric alimentation, from 2 to 6 ounces should be administered twice a day. Moller has confirmed this experience by his own in several cases of extreme debility and anæmia. In one instance the weight of the patient and the proportion of red elements in the blood largely increased under the treatment (*Archives gén.*, Dec. 1882, p. 731). Before the administration the intestine should be washed out with tepid water slightly salted, and it is recommended that 10 or 15 grains of chloral hydrate should be added to every enema. Defibrinated blood has been injected into the peritoneal cavity, and also hypodermically, in cases of extreme exhaustion (Bareggi, *Medical Record*, xxiv. 239). According to Benczór (*Amer. Jour. of Med. Sci.*, July, 1885), it may be injected subcutaneously without occasioning pain or inflammation, and it promptly increases the quantity of hæmoglobin in the blood. This method has been employed by Ziemssen (*Centralbl. f. Therap.*, iii. 159), Westphalen (*ibid.*, vii. 279), Silbermann (*Archives gén.*, Oct. 1885, p. 496), and others in anæmia from hæmorrhage and other discharges, and from leukæmia and pernicious anæmia, as well as from chronic diseases of various sorts.

In favorable cases an immediate revival follows the operation, the skin and mucous membranes become less pale, there is greater activity of body and mind, the sleep and appetite improve, and the proportion of red corpuscles in the blood is increased. The primary influence of the operation gradually declines, but leaves a certain permanent gain of strength. Infusion is performed with a glass syringe holding about Cc. 25 (ʒvj), and provided with a canula larger than belongs to the ordinary hypodermic instrument. It should be thoroughly disinfected, as well as the hands of the operator, and after the operation the injected liquid should be diffused by appropriate pressure on the skin.

Hæmogallol and Hæmol, the former a preparation of blood with pyrogallol, and the latter of blood with zinc, have been recommended in anæmia and chlorosis, but there is no evidence of their advantages over the ordinary forms of animal food.

SANICULA.—Sanicle.

Sanicle, Fr.; *Sanikel*, G.; *Sanicula*, Sp.

Nat. Ord.—Umbelliferæ, Saniculeæ.

Description.—The genus Sanicula is composed of perennial herbs with palmately divided and coarsely serrate radical leaves and irregular or compound umbels, having polygamous, rather capitate flowers, and few-leaved involucres and involucels. The fruit is nearly globular, and has the mericarps closely united, without prominent ribs, covered with hooked prickles, and containing five oil-tubes.

San. marilandica, *Linné*, has the radical and stem-leaves five- or seven-parted and the divisions rather narrow; the staminate flowers are numerous and on slender pedicels (the variety *canadensis* has few and short-pedicelled sterile flowers) and the perfect flowers have elongated and recurved styles. The blackish root and the leaves are nearly inodorous, and have a somewhat bitter and persistent acrid taste. These American plants are in some localities known as *black snakeroot* and *pool-root*.

Constituents.—C. J. Houck (1884) obtained from the air-dry root 8 per cent. of ash, volatile oil, resinous matter, tannin, and other common constituents. The ethereal extract is very aromatic and has a burning, acrid taste.

Allied Plants.—Sanicula europæa, *Linné*, is official as *sanicle*, Fr. Cod. The root is several-headed, branched, and dark-brown. The radical leaves are palmately five-parted, and the obovate wedge-shaped segments again three-lobed. The stem-leaves are few in number and small. The perfect flowers are sessile and the staminate flowers on very short stalks.

Astrantia major, *Linné*, is a European plant, the root of which is known as *black sanicle*, and is occasionally used as *radix imperatoriæ nigræ*. It consists of an oblique annulated rhizome about 10 Cm. (4 inches) long and 6 Mm. (¼ inch) thick, externally brown-black, internally whitish, and of fragile, shrivelled rootlets having a similar color; it resembles the roots of the preceding plants.

Action and Uses.—Nothing appears to have been recently added to the often-repeated statements respecting the American species, that the aborigines of this country used sanicle in syphilis and diseases of the lungs, and that some physicians affirmed its virtues in chorea and intermittent fever. S. europæa has an acrid, astringent, and somewhat bitter taste, and is popularly employed in Germany and France as a remedy for profuse *hæmorrhages* from the lungs, bowels, uterus, or urinary organs, and for the cure of *diarrhœa*, *dysentery*, and *leucorrhœa*, and externally as an application to *wounds*, *bruises*, etc. The fresh juice of the plant is prescribed in doses of Gm. 16 (ʒss) or more, and a vinous infusion of it is also given internally.

SANTALUM RUBRUM, *U. S.*—Red Saunders.

Pterocarpi lignum, Br.; *Lignum santalinum rubrum.—Red sandal-wood*, E.; *Santal rouge*, Fr. Cod.; *Rothes Sandelholz*, G.; *Sandalo rojo*, Sp.

The wood of Pterocarpus santalinus, *Linné filius*. Bentley and Trimen, *Med. Plants*, 82.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—This species is a small or medium-sized tree, with a trunk of 30 Cm. (1 foot) or more in diameter. The leaves are pinnately trifoliate, with orbicular ovate emarginate leaflets. The flowers are small, yellow, and in lax racemes. The pod is roundish, sickle-shaped, winged, and contains one or two seeds. It grows wild only in the Madras Presidency, but is cultivated in Southern India.

Description.—Red sandal-wood is met with in commerce in hard and heavy billets, which are deprived of the light-colored sap-wood, are externally of a dark-brown or reddish-brown color, and split irregularly and coarsely splintery in a longitudinal direction.

If cut transversely, it is of a somewhat variegated appearance, the circles being alternately rather broad and dark brown-red and narrow and lighter colored. The medullary rays appear as delicate red radiating lines. In the shops the wood is usually found in chips or in a coarse and irregular powder of a brown-red color, nearly inodorous and having a scarcely perceptible astringent taste. A red resinous mass exudes from the wood on heating it. Red saunders is distinguished from other red-colored woods by the characters given, and by means of water, which is not colored by it; it imparts a deep-red color to alcohol, and this tincture acquires a dark-violet color on the addition of ferric chloride.

Constituents.—The coloring principle of red saunders is *santalic acid* or *santalin*, $C_{15}H_{14}O_5$, which may be obtained, according to Leo Meier (1849), by precipitating the tincture with lead acetate, washing the precipitate with hot alcohol, and decomposing it with hydrogen sulphide in the presence of alcohol. Santalic acid forms microscopic needles of a beautiful red color, is inodorous and tasteless, melts at 104° C. (219.2° F.), is insoluble in water, but dissolves in concentrated sulphuric acid with a deep-red, in alkalies with a violet, in alcohol with a blood-red, and in ether with a yellow, color; it is soluble in the volatile oils of cinnamon, cloves, bergamot, and bitter almond, but is insoluble in most other volatile and fixed oils. The coloring matter, as obtained by Franchimont (1879), was amorphous, had the composition $C_{17}H_{16}O_6$, and yielded resorcin and acetic acid when fused with potassa. L. Meier (1849) obtained several other compounds, which appear to be decomposition-products. Weidel (1870) obtained 0.5 per cent. of colorless and inodorous scaly crystals of *santal*, $C_8H_6O_3$, which resemble benzoic acid in appearance, but are tasteless; they are insoluble in water, carbon disulphide, chloroform, and benzene, sparingly soluble in alcohol, ether, ammonia, and alkali carbonates, but freely soluble in potassa and soda, these solutions turning yellow, red, and green. The alcoholic solution becomes red with ferric chloride. Cazeneuve's *pterocarpin*, $C_{17}H_{16}O_5$ (1875), is likewise colorless and crystalline, but is soluble in ether, chloroform, and carbon disulphide. Red saunders is free from gallic acid, but appears to contain a minute quantity of tannic acid, which has not been further examined.

Uses.—Red sandal-wood has no medicinal virtues, and is used only as a coloring agent.

SANTONICA, *U. S., Br.*—Santonica.

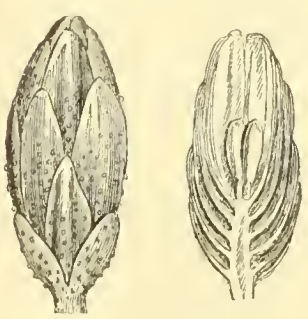
Flores cinæ, P. G.; *Semen cinæ*, *s. contra*, *s. sanctum*, *s. santonici.*—*Levant wormseed*, E.; *Semen-contra*, *Barbotine*, *Semencine*, Fr. Cod.; *Wurmsamen*, *Zittwersamen*, G.; *Yantónica*, Sp.

The unexpanded flowers of Artemisia pauciflora, *Weber*. Bentley and Trimen, *Med. Plants*, 157.

Nat. Ord.—Compositæ, Senecionideæ.

Origin.—Levant wormseed is obtained from Asia, and appears to be mainly if not exclusively collected in the northern part of Turkestan, and to be sent to the great fair at Nishnei-Novgorod, and thence to St. Petersburg and Western Europe. Berg characterized the plant botanically from the commercial drug, Artemisia Cina, *Berg*, and Willkomm (1872) described under the same name a plant brought from Turkestan; but the flower-heads of this plant do not entirely resemble the wormseed of trade, in that they have fewer scales (*Pharmacographia*). Flückiger and Hanbury consider the drug to be obtained from the plant mentioned above, which is identical with A. Lercheana, *Karel et Kiril*, A. maritima, var. pauciflora, *Ledebour*, and A. pauciflora, *Weber*. The typical form of A. maritima, *Linné*, grows in salt marshes in Western Europe, extends under various forms eastward to Western Asia, and has tomentose flower-heads with about eighteen scales.

Fig. 254.



Santonica: head and longitudinal section, magnified 10 diameters.

Description.—Levant wormseed consists of unexpanded flower-heads, which are about 2–3 Mm. ($\frac{1}{12}$ to $\frac{1}{8}$ inch) long and 1 Mm. ($\frac{1}{25}$ inch) wide, oblong-ovoid in shape, obtuse at both ends, smooth, somewhat shining, and of a grayish-green color, changing to brownish-green on exposure to light. The involucre is densely imbricate, and consists of twelve to eighteen keeled scales, of which the lower ones are smallest and ovate in shape, and the oblong upper ones have a scarious margin and are dotted with numerous minute yellowish glands. The florets are four or five in number,

but undeveloped and minute. The drug has a strong peculiar odor and a bitter camphoraceous and disagreeable taste, and frequently contains fragments of the thin peduncles and of linear leaves.

Constituents.—Levant wormseed has been frequently examined, and found to contain as active principles about 1½ or 2 per cent. of a crystalline body, *santonin* (see below), and 1 or 2 per cent., of volatile oil; also resin and various other less important constituents. *Oil of Levant wormseed* is pale-yellow, limpid, has the density 0.92, commences to boil at about 170° C. (338° F.), is readily soluble in ether and alcohol, and, according to Völkel, is a mixture of various oxygenated compounds, of which Hirzel (1854) distinguished *cinæbene*, *cinæbene camphor*, and others. Kraut (1862) found it to consist mainly of *cinæol*, which was found also in Ol. Cajuputi (cajuputtol) and Ol. eucalypti (eucalyptol) and Ol. rosmarini. (For description see EUCALYPTOL.)

Pharmaceutical Uses.—Levant wormseed is the source of santonin.

EXTRACTUM CINÆ. Exhaust the powdered drug with ether or with a mixture of equal parts of ether and alcohol (*P. G.* 1872), and evaporate the tincture until the ether has been completely dissipated, *F. Cod.* (or to the consistence of a soft extract, *P. G.*). The yield is about 20 or 25 per cent. The extract is of a green or green-brown color, and on keeping becomes granular, depositing crystals of santonin. It should be well agitated before dispensing it.

Allied Drugs.—The unexpanded flower-heads of a species of Artemisia, supposed by some to be derived from A. ramosa, *Smith*, have sometimes entered commerce from North-western Africa, and are known as *Barbary wormseed*. This consists of roundish-ovate flower-heads having a grayish-brown color, covered with a whitish down, and mixed with numerous fragments of pedunceles and of leaves; the outer scales are roundish and the inner ones ovate. Another variety has occasionally been observed in Europe and described as *Indian wormseed*. It is only about one-half the size of the official drug, and is hairy and of a more yellowish color. We have repeatedly observed American wormseed to be sold in place of santonica, to which it bears no resemblance (see page 446).

Action and Uses.—This medicine was well known to the ancients, but was introduced anew into Europe by the Crusaders, and has ever since been employed as an anthelmintic (Guermonprez, *Bull. de Thérap.*, cii. 89). After the discovery and isolation of santonin, the proximate principle which the "seeds" depend upon for their virtues, they became less used than formerly. They were then held to be stomachic in small doses, general stimulants of the circulatory and nervous systems in larger doses, and in still larger quantities were found to produce gastric oppression, nausea, vomiting, and diarrhœa. Sometimes they gave rise to symptoms of cerebral congestion.

Santonica is used almost exclusively as a vermicide for lumbricoid *worms* and *ascarides* of the rectum, but occasionally for *tape-worm* also. For the last it is of little efficacy; for the other parasites it is one of the best remedies, and, according to Guermonprez, far superior to santonin, not only on account of its vermicide qualities, but because it is less apt to produce discolored vision. It is administered in coarse powder with honey, molasses, or some analogous liquid, to which jalap may be added for its purgative effect. The *dose* is 0.60–4 (gr. x–lx) three times a day.

SANTONINUM, *U. S., Br., P. G.*—SANTONIN.

Santonine, Fr.; *Santonin*, G.; *Santonina*, Sp.

Formula $C_{15}H_{18}O_3$. Molecular weight 245.43.

Preparation.—Santonin was discovered in 1830 simultaneously by Kabler and by Alms, and since that time has been frequently examined by chemists. The process given by the British Pharmacopœia has been elaborated by the researches of Calloud, Cerutti, Mialhe, and others. The santonin is extracted by boiling 16 parts of bruised santonica with 5 parts of lime and sufficient water, and, after straining, repeating the operation with 2 parts of lime. In the process of Trommsdorff (1834) diluted alcohol is used in the place of water, and digesting instead of boiling. The lime and santonin forms a compound soluble in water and alcohol, and on concentrating the liquors an aqueous solution of calcium santonin remains, contaminated with coloring and extractive matter and with resin held in solution by lime. The calcium compounds are decomposed by either acetic or hydrochloric acid, which form freely soluble calcium salts, and liberate the santonin together with resin and other compounds. The impure santonin thus obtained may be freed from some of its impurities by washing it with dilute ammonia, or, without being thus treated, may be purified by recrystallization from hot alcohol, a little charcoal being

used to remove coloring matter; the resin will remain dissolved in the alcohol. The yield is 1½ to nearly 2 per cent.

Properties.—Santonin crystallizes in flat, rhombic prisms, which are colorless, of a pearly lustre, and of a slightly bitter taste, which is gradually developed, but the solutions of santonin are persistently bitter. When heated to about 170° C. (338° F.) it melts to a colorless liquid, which, on being slowly cooled, becomes again crystalline, but when rapidly cooled usually remains amorphous and gum-like until after it has been moistened with alcohol, ether, or acetic acid, or has been heated again to a little over 40° C. (104° F.). When carefully heated in small quantities to a little above its melting-point, it sublimes without decomposition in white needles; but if larger quantities of it are heated, dense yellowish, irritating vapors are formed, condensing to a resinous mass; decomposition takes place, and at a higher heat santonin burns in the air with a sooty flame and without leaving any fixed residue. Santonin dissolves in about 5000 parts of, and is therefore nearly insoluble in cold water, and requires 250 parts of boiling water and 40 parts, *U. S.* (44 parts, *P. G.*), of cold alcohol for solution. Trommsdorff found santonin to be dissolved at 17.5° C. (63.5° F.) in 43 parts, and at 80° C. (176° F.) in 2.7 parts, of alcohol spec. grav. 0.848, while at the same temperatures 280 and 10 parts of an alcohol having the density 0.928 were necessary. Santonin dissolves in 72 parts (140 parts, *U. S.*) of cold and 42 parts of boiling ether (Trommsdorff), and in 4.35 parts (4 parts, *U. S.*, *P. G.*) of chloroform (Schlimpert); these solutions have a neutral reaction. It is likewise soluble in strong acetic acid, in volatile oils, and in warm olive oil. Santonin should be kept excluded from the light or in amber-colored bottles. Air has no effect upon it, but in the sunlight it acquires a yellow color, and, according to Sestini (1864, 1865), is converted into *photo-santonic acid*, $C_{23}H_{34}O_6$, which is more freely soluble in simple solvents, has a bitter taste, when pure is colorless and inodorous, and melts near 65° C. (149° F.). The coloring matter produced at the same time is of a resinous nature. Santonin yields with sulphuric acid a colorless solution, and is precipitated without alteration by water; but the color of the solution changes to yellow, red, and dark-brown, and then gives with water red or brown resinous precipitates (Trommsdorff). Santonin is transiently colored red by hot alkalies and alkaline earths. "With alcoholic solution of potassa it yields a scarlet-red liquid, which gradually becomes colorless."—*U. S.* "On boiling 5 parts of santonin and 4 parts of sodium carbonate with 60 parts of alcohol and 20 parts of water the liquid has alternately a red and yellow color."—*P. G.* After the solutions in alkalies or alkaline earths have become colorless, they yield insoluble precipitates with the salts of most heavy metals. According to Hesse (1874), these compounds are true salts, and on liberating from them the *santonic acid* it may be obtained from the hot aqueous solution in white rhombic crystals, which do not turn yellow in the light, are sparingly soluble in cold water, but are readily soluble in alcohol, ether, chloroform, and glacial acetic acid, and have the composition $C_{15}H_{20}O_4$. The official santonin is therefore *santonic anhydride*.

Impurities.—Santonin has been sometimes adulterated with *boric acid*, which imparts to the flame of alcohol a green color, and on being heated upon platinum-foil is left behind as a glass-like mass, the solution of which turns turmeric-paper brown. *Strychnine* has been mistaken for santonin; it is readily detected by the bluish-purple color produced by sulphuric acid and a little potassium dichromate. *Picric acid*, which has been mistaken for santonin colored yellow by light, is very bitter, and may be recognized by the behavior described on page 86.

Tests.—"Its solution in cold, concentrated sulphuric acid is at first colorless (absence of easily carbonizable, organic substances), but after some time turns yellow, then red, and finally brown. If water be added immediately after it is dissolved without color in sulphuric acid, it is completely precipitated, and the supernatant liquid should not have a bitter taste, nor should it be altered upon the addition of potassium dichromate test-solution (absence of brucine or strychnine), or of mercuric potassium iodide test-solution (absence of alkaloids in general)."—*U. S.* "After boiling for some time 1 part of santonin with 100 parts of water and 5 parts of diluted sulphuric acid, the filtered liquid should not have a bitter taste, and on the addition of a few drops of solution of potassium dichromate should not give a precipitate (of yellow crystalline strychnine chromate)."—*P. G.*

Pharmaceutical Preparation.—Trochisci santonini. *Br.*, *P. G.* The santonin lozenges (*U. S.* 1890) weigh about 18 grains and contain ½ grain of santonin and 17 grains of sugar; those of the French Codex are colored by carmine, and contain 0.01 Gm. (⅙ grain); while those of the P. G. (which does not give a formula) are to contain 0.025 Gm. (⅖ grain), and those of the Br. P. 1 grain (total weight 17 grains).

Action and Uses.—The most remarkable effect of medicinal doses of santonin is that the whole field of vision appears yellow or yellowish-green; if the dose is large, it may be purplish or even red. The effect seems to be due to changed conditions of the retina or of the brain, and not, as was formerly supposed, to a staining of the humors of the eye. When given in large doses, as 5 grains or more, santonin imparts to the urine a deep-saffron color and stains the linen as bilious urine does. (For the distinction between urine colored by santonin and that stained by rhubarb see Munk, *Virchow's Archiv*, lxxii. 136, and between the urine colored by santonin and that colored by chrysophanic acid, see *Amer. Jour. Phar.*, lix. 21). At the same time it operates strongly as a diuretic. When the urine grows alkaline by putrefaction or is made so by the addition of an alkali, the saffron tint is replaced by a violet or purplish color. In doses of 3 grains santonin may occasion nausea and vomiting, with abdominal pain, thirst, giddiness, and diarrhœa. (Compare Labbé, *Practitioner*, xxii. 284.) Within three hours after taking a 5-grain dose of santonin a man presented "a general morbilloid eruption and an intense punctiform rash on the mucous membrane of the mouth and throat" (*Practitioner*, xlii. 127). Decidedly poisonous effects sometimes arise from doses which are quite insignificant in comparison with those which some experimenters have taken without serious inconvenience. For example, a child six months old was rendered amaurotic for two months by a dose of 5 grains of santonin. In another case 2 grains, given to a child two years old, occasioned convulsions, injection and heat of the face and head, twitching of the eyeballs, dilatation of the pupils, foaming at the mouth, clenching of the teeth, stertorous breathing, and jerking of the arms. On the morrow recovery was complete. In a third case a healthy child of two years swallowed two santonin troches at six o'clock in the morning. No result appeared until four in the afternoon, when suddenly the muscles of the left side of the face began to twitch and the pupils to dilate. Then clonic convulsions affected the left side, beginning at the fingers, and these were followed by muscular rigidity of the same side. After a quarter of an hour the spasms subsided, but in the course of an hour were renewed, the voice meanwhile becoming quite extinct. The spasms were at intervals repeated for several days, during which the respiratory act grew very feeble and artificial respiration was resorted to (Becker. Compare Husemann and Hilger, *Die Pflanzenstoffe*, 2te Aufl., S. 1518; also *Centralbl. f. Ther.*, viii. 245, 638). A child of five years took 5 grains of santonin. She immediately complained of pain in the stomach; in a minute or two convulsions came on, with insensibility. There was neither vomiting nor purging. Death took place in thirty-five minutes. Post-mortem, the stomach was inflamed in patches, and the duodenum throughout. The right heart was contracted and contained no blood; the left contained about 1 ounce of black fluid blood (Kilner, *St. Thomas's Hospital Reports*, N. S., x. 247, where the tests for santonin are discussed). In other cases it is not the nervous but the digestive apparatus that is chiefly affected, and violent vomiting and purging, followed by collapse, produces an attack like one of cholera morbus. In all the urine has the characteristic color. Although recovery generally takes place after these grave symptoms, they occasionally terminate in death. These illustrations suffice to prove the necessity of caution in the administration of santonin. (For other cases see *Therap. Gaz.*, viii. 555; xi. 210, 427, 497; *Centralbl. f. Ther.*, iii. 532.)

The chief practical value of santonin consists in its power of destroying *lumbricoid worms*, and in a less degree rectal *ascarides*. A single dose of about 2 grains has sufficed to cause the expulsion of one hundred and sixty-six of the former species. It should be prescribed in doses not larger at first than Gm. 0.06 (gr. j) for adults and Gm. 0.016 (gr. ¼) for children, and ought to be taken at night, both because its action upon the parasites is less interfered with by food at that time, and because the yellow vision which it may occasion will not then be a source of so much annoyance. Early on the following day a dose of castor oil or of some other purgative should be given. As santonin in substance is almost devoid of taste and smell, it may be prescribed with powdered sugar or in jelly. Pastilles or troches of santonin made with chocolate are much used and are very efficient. Lewin recommends that it be administered in oil, which prevents its absorption by the patient, but increases its action as a vermicide (*Practitioner*, xxxi. 65). On similar grounds *calcium santonate* has been recommended. Guermonprez (*Bull. de Thérap.*, cii. 89) has maintained that santonin is not, like santonica, a direct vermicide—that it, on the contrary, excites lumbricoid worms to violent action, which, if they are mature, may occasion various reflex phenomena, etc.; and he therefore advises that it should always be associated with a purgative. That it possesses a special stimulant action in addition is shown by the advantage following its use in

various diseases in which it appears to improve digestion and assimilation. Among these may be mentioned imperfect and painful menstruation and the attendant debility (Whitehead, *Lancet*, Sept. 6, 1885). It has also been employed with alleged advantage in the treatment of *whooping cough*, as a diuretic in cases of *renal colic*, and for subacute and chronic inflammation of the *choroid* and *retina*, especially of an atrophic character. But in none of these affections has its utility been fully demonstrated. Internal and external stimulants, heat, cold, and artificial respiration, have all been employed in *poisoning by santonin*, but of these the last is the only one of positive value. Evacuants should be used to remove any of the drug remaining in the alimentary canal, and inhalations of ether to control the spasms.

SAPO, *U. S., Br., P. G.*—Soap.

Savon, Fr.; *Seife*, G.

Preparation.—Soaps may be obtained by combining fatty acids (see page 1094) with alkalies, but they are generally prepared by boiling fats with a solution of caustic soda or potassa, when the fatty acids unite with the alkali, the soap remaining dissolved in the water, together with the glycerin which is liberated from the fat. The lye used in this operation is employed in a rather diluted state, is gradually added, and an excess of it is mostly used, since the saponification is thereby much facilitated, and the free alkali may be readily removed from the soap. The decomposition of the fats being effected by the gradual conversion of tripalmitin, etc. into di- and monopalmitin before saponification is completed, the boiling must be continued until the mixture becomes transparent and rather tenacious. The soap is separated from the lye by adding common salt to the liquid, soap being insoluble in the solutions of most salts of potassium and sodium. If potassa has been used for saponification, the sodium chloride serves also the purpose of converting the potassa soap into soda soap. When the soap has separated from the liquor and sufficiently solidified, it is transferred into wooden frames until it is stiff enough to be cut into bars, which are exposed to the air in a warm place until they become hard and dry.

Properties and Composition.—Soaps are salts of the fat acids, and if soluble have an alkaline reaction and taste. Commonly, the term "soap" is restricted to such of these salts as contain potassa or soda as the base and are soluble in water. The compounds with earthy and metallic bases are chemically analogous to these *soluble soaps*, but, being insoluble in water, are often distinguished as *insoluble soaps*. Of this latter kind two are recognized by the pharmacopœias—namely, lead plaster (p. 605) and lime liniment (p. 940). Other insoluble soaps are extensively employed for rendering fabrics *waterproof*, and are produced by impregnating such fabrics first with aluminum acetate or soluble salts of calcium or barium, and afterward steeping them in a solution of soap. The consistence of soap depends in part on the nature of the fat and in part on the alkali. Drying oils yield softer soaps than non-drying oils, and of the latter those containing much olein furnish soaps which are less hard, but more freely soluble in water and alcohol, than those rich in palmitic or stearic acid. Soda soaps are invariably harder than potassa soaps, which are mostly deliquescent, and therefore remain soft; dry potassium palmitate readily absorbs from the air about 50 per cent., and the oleate about 160 per cent., of moisture, while the corresponding sodium compounds absorb only 8 and 12 per cent. Soaps have mostly a white color when pure; the color and the marbled appearance of many soaps are due either to accidental impurities or to coloring matter contained in the oil, or they are produced by the intentional addition of coloring matters or of metallic salts, like sulphate of iron, in which case the result is due to the presence of an iron soap. Good soluble soaps have a slight fatty but not a rancid odor, or they have the fragrance of the fat (palm oil, etc.) from which they have been made.

The well-known detergent properties of soap depend upon its decomposition by a large quantity of water into acid and basic salts, of which the latter contain about 50 per cent. more alkali than the former, and act as solvents of fats and other matters; in this respect their action is similar to, but milder than, that of caustic alkali. So-called *hard water* is unsuited for washing on account of calcium or magnesium salts which are contained in solution, and which form insoluble soaps by double decomposition.

Examination and Valuation.—Soaps frequently contain a large amount of water—in some kinds 40 or even 50 per cent. From 12 to 15 per cent. of water is usually regarded as admissible for good air-dry Castile soap. The water is determined from a weighed quantity of the soap reduced to thin shavings, which are exsiccated at a

temperature between 100° and 110° C. (212° and 230° F.). On treating the powdered soap with benzin or benzene or with ether, any unsaponified fat present will be dissolved, and on the evaporation of the solvent may be weighed; rosin oils and tar oils sometimes incorporated with soap are extracted by the same solvents. By incinerating another portion of the soap the soda may be determined from the residue, and should be about 10 or 11 per cent. for the exsiccated soap; if this quantity is exceeded, free alkali is most likely present. The dry soap is then dissolved in strong alcohol, in which sodium and potassium carbonate are insoluble, and, after separation from the alcoholic solution, may be estimated by titration with normal oxalic acid. On passing carbon dioxide into the alcoholic liquid, the caustic alkali will be precipitated as carbonate, and may be estimated as before. The solution may now be mixed with water, and again titrated with an acid for estimating the combined alkali. By decomposing a solution of soap with hydrochloric acid, washing, and collecting the fat acid, its weight may be ascertained, and should be near 90 per cent. of the dried soap. The melting- and congealing-points of these mixtures will usually give some indication of the nature of the fat used for preparing the soap. The acid liquid may be employed for the determination of glycerin if present: it is concentrated by evaporation and dried, care being taken to prevent charring: on exhausting the saline residue with absolute alcohol the glycerin will be dissolved, and on evaporating this solution at about 60° C. (140° F.), it will be left behind. Adulterations with starch, chalk, clay, and similar compounds are ascertained by their insolubility in hot water or alcohol. Common soaps are sometimes mixed with resin soap (an alkaline solution of rosin being incorporated) or with alkali silicate. There is usually no difficulty in recognizing the presence of rosin, but we know of no method for accurately determining its amount. F. S. Gladding (1882) recommends decomposing the solution of soap in alcoholic ether by powdered silver nitrate; the silver resin compound remains in solution, is decomposed by hydrochloric acid, the solution evaporated, and the resin weighed. Sodium silicate is insoluble in alcohol, and the amount of silica present may be determined in the usual way by dissolving this residue in water, acidulating with hydrochloric acid, evaporating to dryness, and dissolving the salts in acidulated water. Free alkali cannot be recognized by litmus-paper, since soap solutions possess an alkaline reaction; but if powdered soap is mixed with calomel, and the mixture is moistened with distilled water, it will acquire a gray or blackish color in proportion to the amount of free alkali present; its solution in distilled water gives with corrosive sublimate a white precipitate, which is yellowish or brownish-red in the presence of alkali or alkali carbonate.

Tests.—"On placing a small weighed portion of soap, together with about 10 Cc. of alcohol, in a tared beaker containing sand, evaporating the resulting solution of the soap to dryness, and drying the residue at 110° C. (230° F.), the loss of weight should not exceed 36 per cent. (absence of an undue amount of water). On dissolving 20 Gm. of soap in alcohol, with the aid of heat, transferring the undissolved residue, if any, to a filter, and washing it thoroughly with boiling alcohol, it should, after drying, weigh not more than 0.6 Gm. (limit of sodium carbonate, etc.); and at least 0.4 Gm. of this should be soluble in water (limit of silica and other accidental impurities). The aqueous (alcoholic, *P. G.*) solution of soap should remain unaffected on the addition of solution of hydrogen sulphide or ammonium sulphide test-solution."—*U. S.* Some of the compounds of metals with fat acids are somewhat soluble in alcohol, but they are insoluble in water; the test given, therefore, has reference to the mixture or turbid solution in water, which should not be colored brown or black. Sodium stearate and palmitate being sparingly soluble in cold alcohol, an adulteration of olive-oil soap with such prepared from animal fat is detected by the latter separating in the form of a jelly on the cooling of the alcoholic liquid. "A 4 per cent. alcoholic solution should not gelatinize on cooling (absence of animal fats). If a solution of 5 Gm. of soap in 50 Cc. of water be mixed with 3 Cc. of decinormal oxalic-acid test-solution, the subsequent addition of a few drops of phenolphtalein test-solution should produce no pink or red tint (limit of alkalinity)."—*U. S.*

Medicinal Soaps.—Sapo, *U. S.*; Sapo durus, *Br.*; Sapo oleaceus, s. hispanicus, s. venetus.—Soap, Hard soap, Castile soap, *E.*; Savon blanc de Marseille, Savon d'Espagne, *Fr.*; Oelseife, Spanische Seife, *G.*—It is prepared from olive oil and soda, and should be white or grayish-white, free from rancid odor, hard, and should not become moist on exposure; it should be completely soluble in alcohol and water, should not impart an oily stain to paper, and on incineration should yield an ash which is not deliquescent. *Mottled Castile soap* is a similar soap, which is more or less colored by the addition of an iron salt; internally it is white, mottled with black, changing to red-brown on exposure.

Sapo medicatus, *F. Cod.*, is a soda soap prepared from expressed almond oil, and agrees in its principal characters with the preceding. The soap recognized under the same name by the P. G. is a soda soap made with equal weights of olive oil and lard; it is required to be free from alkali, and may be used in the preparation of opodeldoc.

Sapo animalis, *Br.;* Sapo domesticus.—Curd soap, *E.;* Savon animal, *Fr.;* Hausseife, *G.*—It is made with soda and a purified animal fat consisting principally of stearin. It resembles the preceding; its solution in boiling alcohol, after cooling, forms a translucent jelly-like mass, which constitutes the basis of opodeldoc.

Sapo mollis, *U. S.*, *Br.;* Sapo kalinus, *P. G.;* Sapo viridis, *U. S.* 1880.—Soft soap, Green soap, *E.;* Savon vert, *Fr.;* Kaliseife, Grüne Seife, *G.*—"Linseed Oil 400 Gm.; Potassa 90 Gm.; Alcohol 40 Cc.; Water a sufficient quantity. Heat the linseed oil in a deep, capacious vessel, on a water-bath or steam-bath, to a temperature of about 60° C. (140° F.). Dissolve the potassa in 450 Cc. of water, mix with this the alcohol, and gradually add the mixture, under constant stirring, to the oil, continuing the heat until a small portion of the mixture is found to be soluble in boiling water without the separation of oily drops. Then allow the mixture to cool and transfer it to suitable vessels. The potassa used in this process should be of the full strength directed by the Pharmacopœia (90 per cent.). Potassa of any other strength, however, may be used, if a proportionately larger or smaller quantity be taken, the proper amount for the above formula being ascertained by dividing 8100 by the percentage of absolute potassa (potassium hydroxide) contained therein."—*U. S.*

The process of the Germ. Pharm. is almost identical with the foregoing. Soft soap is directed to be made from olive oil (*Br.*). Commercial soft soap (Sapo kalinus venalis, *P. G.*) is frequently made of fish oil, rancid fats, etc., has generally a nauseous odor, and varies in color from yellow or green to black, pigments being sometimes incorporated. Prepared by the above formula, it is a brownish-yellow, transparent, soft, unctuous mass, of a slight but not repulsive odor, free from granular admixtures. It is stated to be "soluble in about 5 parts of hot water to a nearly clear liquid; also in 2 parts of hot alcohol, without leaving more than 3 per cent. of insoluble residue" (*U. S.*), (yellowish-green, and to not impart an oily stain to paper, *Br.*); it has an alkaline reaction, and when incinerated leaves a very deliquescent ash of potassium carbonate. It should contain not over 40 per cent. of moisture, but, being very hygroscopic, generally contains more. The granules frequently seen in the commercial article are sodium stearate, which separates from the jelly-like mass; sometimes starch, earthy carbonates, or similar compounds are added to produce this appearance.

Action and Uses.—Soap acts upon quadrupeds (horses and dogs) internally very much as it does upon man—*i. e.* as mildly laxative and as weakly antacid through its alkaline constituent. But it is hardly ever used alone for these purposes, but rather to dissolve the resinous medicines along with which it is given, and thereby to quicken and strengthen their action. Pareira states that he knew of an idiot who had frequently eaten large lumps of soap without any ill effects, and that he had heard of a pound of it being swallowed for a wager.

Besides the use of soap as a *laxative*, it has been given internally as a solvent for uric acid. Along with calcined egg-shells (lime) and aromatic bitters it formed a once-famous cure for *gravel:* probably in this case it acted by giving up its acid to the lime and liberating the soda, which then tended to neutralize the free uric acid in the system. Soap is one of the best antidotes for *acid poisons*, because it is always to be promptly obtained, and does not itself act as an irritant. It should be given freely in the form of soapsuds. As a local remedy for external injuries by acids or by phosphorus soapsuds are efficient if promptly used.

As an external remedy soap acts by modifying the condition of the skin; it combines with the fat of the excretions, and removes them when they have grown acid or fetid, and, with them, the dirt accumulated from without; it softens the epidermis and removes its outer layers, and thus exposes the integument to the vivifying influence of the air; by all of which agencies a healthier condition of it is secured. If the soap be too strongly alkaline or too little diluted with water, or applied with too active friction, it may induce painful irritation of the skin. This is particularly the case when there is added to the soap proper some article intended to exert a specific action, as sulphur, tar, etc. But in general the curative agent is used separately after the skin has been brought to a proper condition by warm water and soap. These remarks are particularly applicable to the treatment of *scabies*, *prurigo*, *psoriasis*, *acne*, and *eczema*. For this purpose soft soap is greatly to be preferred. In Germany, where the treatment of itch with soft soap

originated, it is now nearly abandoned, not only on account of the offensive smell and irritant properties of the preparation (green soap), but because the speedier and more agreeable cure by balsam of Peru and storax has superseded it. The stimulant action of soft soap is also resorted to in the treatment of *ichthyosis* and of *lupus*. The semi-liquid or liquid soaps have been much used as discutients of acute and chronic *glandular* swellings, whether of a simple or specific nature, and in serous effusions into *joints* (Senator, *Med. Record*, xxii. 711). A soft soap made with olive oil and pure solution of potassa is devoid of the offensive smell of ordinary soft soap, and is to be preferred when patients are delicate or fastidious, as in the case of ladies and children. It can be scented with an essential oil or dissolved in Cologne-water. The ancient treatment of *boils* by soap continues to be used. In general, yellow soap, mixed with sugar and spread on leather or muslin, is applied to the part. So far from irritating it and causing greater pain, this remedy, when promptly resorted to, lessens the pain materially and hastens suppuration.

Under the name of "Mollin" a soft soap has been proposed which is supposed to promote the cutaneous absorption of mercury, iodine, chrysarobin, iodoform, etc. when applied by friction (*Centralbl. f. d. g. Therapie*, iv. 520; v. 275).

SAPONARIA.—Soaproot, Soapwort.

Saponaire officinale, Fr. Cod.; *Savonnière*, Fr.; *Seifenwurzel*, G.; *Saponaria*, Sp.

The root of Saponaria officinalis, *Linné*.

Nat. Ord.—Caryophyllaceæ, Silenæ.

Origin.—Soapwort is a perennial herb growing throughout the greater part of Europe on the banks of streams and on roadsides. It is sometimes met with in cultivation in gardens, and has been naturalized in North America. The stem is about 50 Cm. (20 inches) high; the leaves are opposite, mostly sessile, ovate, oblong or nearly lanceolate, three-nerved, entire, and nearly smooth. The large, pale rose-colored flowers are in corymbed clusters, have a cylindrical five-toothed calyx and five petals, with a two-cleft appendage at the top of the long claw. The herb flowers from June to August.

Description.—The root is collected in the spring or autumn without the creeping runners, is 25–38 Cm. (10 to 15 inches) long, cylindrical, about 3–6 Mm. ($\frac{1}{8}$ or $\frac{1}{4}$ inch) thick, gradually tapering below, somewhat branched, longitudinally wrinkled, and of a red-brown color externally. It breaks with a short fracture, and is internally white, with a rather thick bark and a soft yellowish, and in the centre whitish, wood, which has no medullary rays and is surrounded by a fine dark-colored cambium-line. The root is inodorous, and has a sweetish and bitter afterward persistently acrid taste.

Constituents.—Soaproot contains *saponin*, and is free from starch. Bucholz (1811) found also resin, mucilage, and other common principles. Osborne (1827) obtained from the root collected before flowering white, fusible, very bitter needles soluble in water, alcohol, and ether; but the nature of these has not been ascertained. Schiaparelli (1883) obtained saponin as a white, amorphous, inodorous powder, sternutatory and of a disagreeable taste, insoluble in ether, benzene, and chloroform, of the composition $C_{32}H_{54}O_{18}$, and by dilute acids split into glucose and *saponetin*, $C_{40}H_{66}O_{15}$. Saponin from quillaja-bark was found by Stütz to have the composition $C_{19}H_{30}O_{10}$. (See also Quillaja.)

Allied Drugs.—Levant soaproot is obtained from Gypsophila Struthium, *Linné*, of Northern Africa and Southern Europe, and is about 30 Cm. (12 inches) long, 5 Cm. (2 inches) thick, transversely and longitudinally wrinkled, pale-brownish externally, internally white, with a rather hard wood and numerous medullary rays. In sensible properties and in composition it resembles the preceding.

Soap-berries are the fruit of Sapindus Saponaria, *Linné* (nat. ord. Sapindaceæ), a medium-sized tree of tropical America. They are the size of a cherry, globular or somewhat ovate, orange-colored, and contain a parchment-like endocarp enclosing two or three black seeds; the fleshy sarcocarp contains saponin and formic and tartaric acids. The fruit of the East Indian Sap. laurifolius, *Vahl*, is red-brown or blackish, and has similar constituents and properties. The seeds yield about 30 per cent. of a butyraceous fat.

Buda (Spergularia, *Persoon*, Arenaria, *Linné*) rubra, *Dumortier* (Alsineæ), grows in dry sandy soil near the sea-coast in Europe, Africa, and North America. It has a prostrate stem, opposite-linear, gray-green leaves, lanceolate-cleft stipules, small pink flowers, and three-valved, many-seeded capsules; odor and taste slight. Vigier (1881) obtained from the plant a stearopten and some odorous resin; the decoction is stated to have an alkaline reaction. The commercial drug, as used in France, consisted of a number of allied species.

Action and Uses.—Saponaria has long enjoyed the reputation of being diaphoretic

and diuretic, and alterative in that it cured chronic *diseases of the skin* and *bronchia*, *rheumatism*, *gout*, *syphilis*, and *periodical fevers*, or the *visceral engorgements* following them. It has been compared with sarsaparilla and with senega. To this list Blumenstadt (1888) adds a direct emmenagogue virtue, all the more valuable because it is free from dangerous qualities (*Therap. Gaz.*, xii. 705). It is administered in a decoction made with Gm. 32 in Gm. 500 (℥j in Oj) of water. That this plant possesses active powers is evident from the large proportion it contains of saponin, whose peculiar virtues are treated of elsewhere. (See SENEGA).

SARCOCOLLA.—SARCOCOLLA.

Sarcocolle, Fr.; *Fleischleimgummi*, *Fischleimgummi*, G.

An exudation of Penæa Sarcocolla, *Linné*, and P. mucronata, *Linné*.
Nat. Ord.—Penæaceæ.

Origin and Description.—The plants named are small branching shrubs, with small, opposite, entire, coriaceous leaves, and clusters of yellow flowers surrounded by a purplish-red leafy involucre. The shrubs are indigenous to Central and Southern Africa, and exude a juice which after hardening constitutes sarcocolla. Dymock (1879), however, noticed that the sarcocolla which comes in considerable quantities to Bombay from the Persian port of Bushire is always mixed with fragments of a thorny stem and with short, slender, and cottony pods containing a single gray-brown vetch-like seed; he believes that the gum is obtained from one of the desert Leguminosæ, probably a species of Astragalus. It is in small, roundish, somewhat spongy, and friable grains, which are sometimes agglutinated to larger masses, often mixed with fine hairs, and have a yellowish, reddish, or brownish color. Sarcocolla is inodorous, has an insipid, sweetish, afterward somewhat acrid and bitter taste, resembling that of liquorice-root; is soluble in water, almost completely soluble in alcohol, except the impurities, and when heated burns and gives off the odor of burning sugar.

Constituents.—On treating sarcocolla with ether, Pelletier (1834) separated a resin; the undissolved residue yielded to alcohol *sarcocollin*, and left gummy matter behind. Sarcocollin is uncrystallizable, soluble in alcohol and water, possesses a bitter-sweet taste, and when oxidized with nitric acid yields oxalic acid. Its composition is said to be $C_{13}H_{23}O_6$.

Action and Uses.—The name of this substance, which means a "joiner" or "healer of the flesh," it has borne since an early period in the history of medicine. It was held in great repute for agglutinating *wounds* and curing *defluxions of the eyes*, and was applied to *joints* affected with chronic inflammation. It was reputed to be a *depilatory*, was used with honey to check *otorrhœa*, and was applied with nitre as a discutient of *scrofulous glands*.

SARRACENIA.—PITCHER-PLANT.

Side-saddle plant, *Huntsman's cup*, *Water cup*, E.; *Sarracenie*, Fr., G.

Sarracenia purpurea, *Linné*.
Nat. Ord.—Sarraceniaceæ.

Description.—This plant grows in boggy places from Canada southward. The *rhizome* is oblique, conical, about 25 Mm. (1 inch) or more long, of a reddish-brown color externally and brownish-white internally, has numerous, thin, nearly simple, toughish rootlets attached, breaks with a short fracture, and does not acquire a blue color with solution of iodine. It is inodorous, and has a bitter and somewhat astringent taste. The *leaves* are radical, 15–20 Cm. (6 or 8 inches) long, pitcher-shaped, most inflated near the middle, curved, broadly winged, with an erect, roundish, heart-shaped hood, and have a bitterish taste. The *flower* is nodding, globose, and deep purple, and has fiddle-shaped petals.

Constituents.—The plant was analyzed by Björklund and Dragendorff (1863), who found, besides the usual constituents of herbs, *acrylic acid*, which is volatile, and about ⅛ per cent. of a *volatile base* having an odor resembling that of coniine. Stan. Martin (1865) announced the presence of a bitter alkaloid, *sarracenine*, the sulphate of which is crystallizable; and Hêtet found two alkaloids, one of which had the properties of veratrine. E. Schmidt (1872) isolated a yellow coloring matter, *sarracenic acid*, which yields with alumina a yellow lake.

Allied Plants.—Sar. flava, *Linné*, Trumpet-leaf. The *rhizome* is similar to the preceding, but larger. The *leaves* are about 60 Cm. (2 feet) long, tubular, gradually enlarged to the open throat, and have a very narrow wing and a roundish mucronate hood, which is narrowed toward the base. The flower is yellow. The plant grows in the Southern United States.

Sar. variolaris, *Michaux*, grows from South Carolina to Florida, and has elongated leaves mottled with white on the back, with a linear wing, and with the lamina inflected over the throat of the tube. The flower is yellow.

Action and Uses.—S. flava and S. variolaris possess stimulant and tonic virtues, for which they enjoy a high reputation in South Carolina, where they are used in the treatment of *dyspepsia* and its associated ailments. Sarracenia is said to have been employed in gout and rheumatism, and Hêtet has claimed that it contains an alkali identical with veratrine (*Bull. de Thérap.*, xcvi. 178). A hasty and immature observation at one time ascribed to S. variolaris the virtues of a specific remedy for small-pox—a notion which, it is almost superfluous to say, was not confirmed by experience, but which, like other errors, it required some time and labor to destroy. The plant is probably slightly tonic, anodyne, and astringent.

SARSAPARILLA, *U. S.*—Sarsaparilla.

Sarsæ radix, Br.; *Radix sarsaparillæ*, P. G.—*Salsepareille*, Fr. Cod.; *Sassaparilla*, G.; *Zarzaparilla*, Sp.

The root of Smilax officinalis, *Kunth*, Sm. medica, *Schlechtendal et Chamisso*, and of other species of Smilax. Bentley and Trimen, *Med. Plants*, 289, 290.

Nat. Ord.—Smilaceæ.

Origin.—Sarsaparilla is obtained from different species of Smilax growing in swampy forests of Mexico and as far south as the northern portion of Brazil. These are woody climbers, and often attain a great height. Smilax Sarsaparilla, *Linné*, is indigenous to the United States, and grows chiefly in the Southern States; it is in part at least Smilax glauca, *Walter*, but does not afford any sarsaparilla; its subterraneous portion is a long, cylindrical, creeping rhizome with prominent nodes and a few small rootlets, and bears no resemblance to the commercial drug. The only sarsaparilla-yielding species which are tolerably well known are the following:

Smilax officinalis. It is indigenous to New Granada and other parts of Northern South America, and has a quadrangular stem and large cordately-ovate or oblong, five- or seven-nerved leaves; it furnishes Jamaica sarsaparilla.

Smilax medica. It has a zigzag stem and much smaller leaves, which are frequently auriculate, with broad and obtuse basal lobes. It is indigenous to Mexico, and affords the Mexican sarsaparilla.

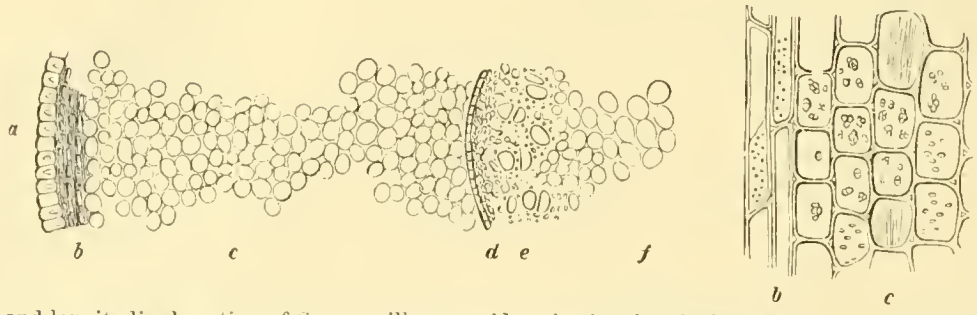
Smilax syphilitica, *Kunth*, Smilax or Nata, *Hooker filius*, S. scabriuscula, *Kunth*, S. cordato-ovata, *Richard*, S. papyracea, *Poiret*, S. Purhampuy, *Ruiz*, and others are imperfectly known, or, at all events, it is uncertain whether they are sources of some variety of the drug.

Collection.—No satisfactory account has been given of the manner in which the different varieties are collected and prepared for the market. According to Rich. Spruce, in the valley of the Amazon the roots are about 2.7 M. (9 feet) long, spread horizontally, and are collected after several stems have been produced, younger plants having so few roots as not to be worth grubbing up. The earth is scraped away from the roots by hand, aided by a pointed stick, and the roots of other plants interfering are cut through with a knife. When at length laid bare, the sarsaparilla-roots are cut off near the crown, a few slender ones being allowed to remain to aid the plant in renewing its growth, and the stems are cut down to near the ground. The yield of a plant of four years' growth is about 16 pounds, and of older plants from two to four times that quantity (*Pharmacographia*).

Description.—As met with in commerce, sarsaparilla consists either of the horizontal roots alone or in part also of the short knotty rhizome, to which, in some sorts, portions of the overground stems are sometimes attached. The roots are long, cylindrical, tapering toward both extremities, and beset with thin branching fibres called the *beard*, or nearly free from fibres. They are more or less deeply furrowed in a longitudinal direction, and have mostly a gray or blackish-gray color externally from adhering earth, and after this has been washed off are of a bright brownish- or reddish-yellow color, and particularly in the folds are often clothed with short simple hairs. When cut transversely several distinct zones are observed, which, under the microscope, have the following

appearance: The epidermis is formed of one layer of cells, some of which are prolonged into hairs; then follows the outer endoderm, a subcuticular layer composed of two or

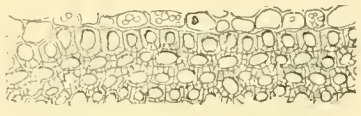
Fig. 255.



Transverse and longitudinal section of Sarsaparilla: *a*, epidermis; *b*, subcuticular tissue; *c*, parenchyma; *d*, nucleus-sheath; *e*, woody zone; *f*, central parenchyma.

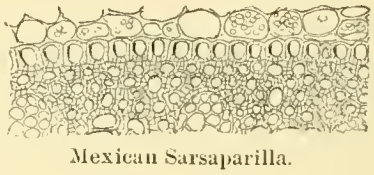
three or more rows of axially-elongated cells with their walls thickened from secondary deposits, and a layer of parenchyma, called the *bark*, and containing starch or an amorph-

Fig. 256.



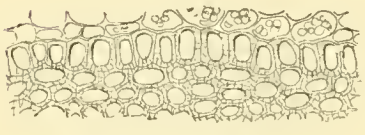
Honduras Sarsaparilla.

Fig. 257.



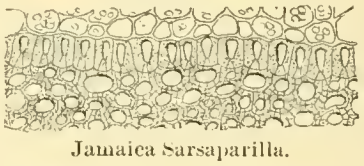
Mexican Sarsaparilla.

Fig. 258.



Rio Negro Sarsaparilla.

Fig. 259.

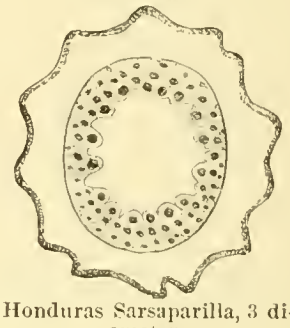


Jamaica Sarsaparilla.

Sections through nucleus-sheath, showing above one row of cells of bark-parenchyma, and beneath it several rows of cells of the woody zone; magnified 80 diameters.

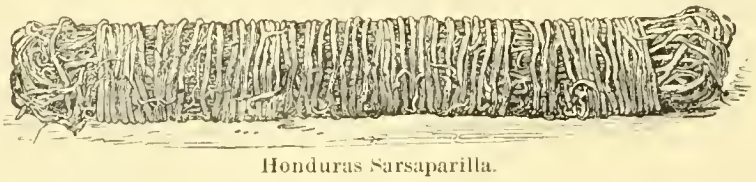
ous mass, and some cells filled with bundles of needle-shaped crystals consisting of oxalate of calcium. Underneath the bark is the nucleus-sheath, also called bundle-sheath and inner endoderm, consisting of a single row of cells with thickened walls, resembling those of the subcuticular tissue, and varying in shape and in the secondary deposits in the differ-

Fig. 261.



Honduras Sarsaparilla, 3 diameters.

Fig. 260.



Honduras Sarsaparilla.

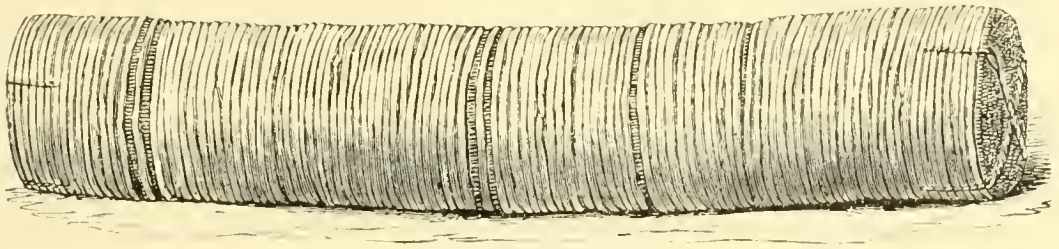
ent varieties; to this adheres the *woody zone*, varying in width in the different kinds, and chiefly composed of fibro-vascular bundles. The central layer, usually called the *pith*, consists of parenchyma-cells similar to those outside the nucleus-sheath, and occasionally contains a few scattered wood-bundles. Schleiden, and afterward Berg, proposed a classification of the sarsaparillas mainly from the character of the nucleus-sheath, and more recently a similar view was taken by Ferd. Otten (1876). The cells of the nucleus-sheath are nearly uniformly thickened on all sides, and have an almost quadrangular appearance in Honduras sarsaparilla; they are somewhat elongated in a radial direction in Brazilian sarsaparilla, and toward the outside are rather less thickened than on the inner and lateral cell-walls. Mexican sarsaparilla has the cells of the nucleus-sheath of a somewhat wedge-shaped appearance, the layers of the cells-walls being thick-

est in the inner half. Jamaica sarsaparilla has the incrustation of the sheath-cells thickest upon the inner and lateral walls—frequently so as to assume a wedge-shaped appearance; another kind has the cells radially elongated, but not wedge-shaped, and the cell-walls nearly uniformly thickened on all sides. There are, however, frequently modifications or intermediate forms of these characters observed. The cells of the subcuticular layer have their cell-walls considerably thickened, particularly the outer ones.

Sarsaparilla is nearly inodorous, except in infusion and decoction; it has at first a slight taste, but leaves an acrid impression in the fauces, by the intensity of which the quality of the root may be approximately judged.

Commercial Varieties.—The sarsaparillas may be conveniently distinguished as *mealy* and *non-mealy;* the former are amylaceous in the interior, but usually contain in some portions of the parenchyma-tissue amorphous masses of altered starch, and they are usually marked externally by rather uniform and shallow wrinkles. The non-mealy varieties are rather horny, and not farinaceous when broken transversely, contain but little granular starch, and are usually characterized by deep longitudinal and irregular folds. The sarsaparillas from Honduras and Mexico, which are mostly met with in the United States, are representatives of the two classes.

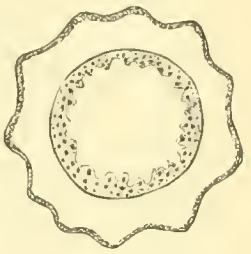
Fig. 262.



Rio Negro or Para Sarsaparilla.

Mealy Sarsaparillas.—Honduras Sarsaparilla. This is exported from Belize and other ports on the Bay of Honduras, and comes in bundles 2 or 3 feet (60 to 90 Cm.) long, consisting of the folded roots, in the interior containing some hard woody rhizomes and often short fragments of the stem, and tied with roots of the same kind. The roots have some fibres attached, and have the cortical layer somewhat thicker than the woody zone, and of about the same width or thinner than the pith. It is the kind recognized by the German Pharmacopœia.

Fig. 263.

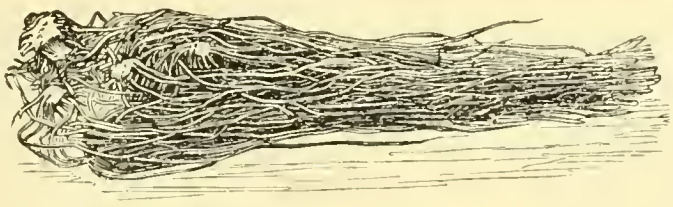


Rio Negro Sarsaparilla, 3 diameters.

Rio Negro Sarsaparilla, also called *Para*, *Brazilian*, and *Lisbon Sarsaparilla*. This is exported from Para, and comes in long cylindrical rolls tied together by a smooth stem, and with both ends cut off evenly. It is free from rhizomes and stems, and contains but few root-fibres, but the interior of the bundle is frequently packed with roots of inferior quality. The bark and pith are nearly of the same width, but the ligneous zone is only one-third or one-fourth that thickness.

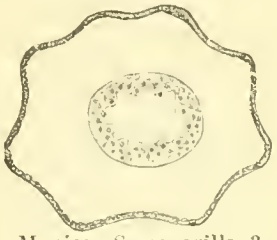
Non-mealy Sarsaparillas.—Mexican Sarsaparilla, also called *Vera Cruz* and *Tampico Sarsaparilla*. The roots are folded back, so as to cover the knotty rhizomes and portions of the stem, which are often 6 inches (15 Cm.) in length. The roots have but few rootlets attached, and are deeply and irregularly wrinkled. The pith is of about the same width as the woody zone or a little thicker, but the bark is sometimes twice this thickness, at least in the projecting ridges or after soaking in water. It is probably obtained from Smilax medica.

Fig. 264.



Mexican Sarsaparilla.

Fig. 265.

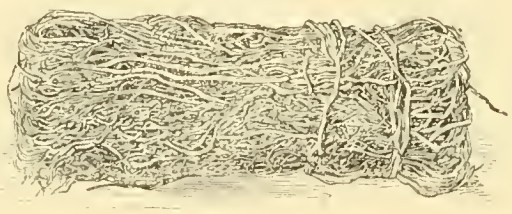


Mexican Sarsaparilla, 3 diameters.

Jamaica Sarsaparilla. This is also known as *bearded sarsaparilla*, from the numerous root-fibres attached to it. It comes in bundles similar to, but usually shorter than, those of Honduras sarsaparilla, and less neatly tied. The rhizomes are generally

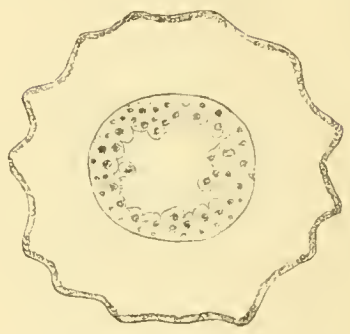
absent. The layers of pith and bark are nearly of the same width, but the woody zone is narrower, being about one-half the width of the pith. It varies in mealiness, often in different parts of the same root, and is also distinguished from the other varieties by its reddish-brown color. It does not grow wild in Jamaica,

Fig. 266.



Jamaica Sarsaparilla.

Fig. 267.



Jamaica Sarsaparilla, 4 diam.

but is obtained from Costa Rica, and a similar drug, agreeing in all essential qualities with this, is sometimes exported from Venezuela and known as *Caracas sarsaparilla*. It is supposed to be derived from Smilax officinalis, which is cultivated to a limited extent in Jamaica, but there furnishes a more mealy root. Jamaica sarsaparilla is the only kind recognized by the British Pharmacopœia.

Other varieties of sarsaparilla have been described by European writers, but are rarely, if ever, met with in commerce in this country.

Constituents.—Sarsaparilla was analyzed by Pallotta (1824), Folchi, Thubeuf (1831), Batka (1834), Poggiale (1835), and others, and the acrid principle has at different times received the designations *smilacin*, *pariglin*, *parillin*, *salseparin*, etc. Pallotta precipitated the decoction with milk of lime, decomposed the precipitate with carbonic acid, and, after drying, exhausted it with alcohol. Thubeuf exhausted the root with boiling alcohol, concentrated the tincture, treated the residue with charcoal, and recrystallized from hot alcohol; 10 pounds of the root yielded 3 ounces of smilacin. Lamatsch (1857) precipitated the concentrated alcoholic decoction with water, washed the precipitate with ether, and purified it by treating its alcoholic solution with animal charcoal; Flückiger (1877) recrystallized this precipitate from alcohol; the yield was 0.19 per cent. In its purest state parillin has been obtained as colorless needles, which are sparingly soluble in cold water and diluted alcohol, but more freely soluble in hot water (20 parts, Flückiger) and hot alcohol; it is also soluble in alkalies and dilute acids, and nearly insoluble in ether and chloroform. Its aqueous solution foams in a manner similar to that of a solution of saponin, and on boiling reduces in a slight degree an alkaline solution of copper, but more abundantly after it has been boiled with dilute sulphuric acid, when sugar and *parigenin*, which is insoluble in water, are formed. Parillin is precipitated by lead acetate and subacetate and by tannin, dissolves in sulphuric acid with a yellow afterward cherry-red color, and with warm diluted sulphuric acid turns greenish, red, and brown; it appears to be closely related to sapogenin, but its exact composition has not been determined. The other constituents of sarsaparilla are a trace of essential oil, resin, pectin, albumen, and other common principles. Otten obtained also between 2 and 3 per cent. of *saponin*, and determined the starch in the non-mealy varieties to vary between 3 and 13.8 per cent., while the mealy varieties contained sometimes as high as 15 per cent., and in rare cases as low as 10, or even 6.25, per cent. of starch.

Valuation.—Marquis (1875) estimated the amount of (impure) parillin by digesting the root with 30 per cent. alcohol, evaporating to an extract, washing this with cold water, and exhausting with boiling alcohol, on the evaporation of which a yellowish mass was left, which was weighed as parillin. After modifying the process, Otten obtained similar results, tending to show that Honduras and Para sarsaparilla yield less parillin than the Vera Cruz and Jamaica varieties.

Allied Drugs.—Smilax China, *Linné*. This is a climbing shrub of Eastern and South-eastern Asia. Its irregular, tuberous rhizomes, together with those of several other species, are used in Europe as Rhizoma (Radix) Chinæ.—China-root, *E.*; Squine, Racine de Chine, *Fr.*; China-wurzel, *G.*—They vary in length from 10–25 Cm. (4 to about 10 inches), and in thickness from 2–5 Cm. (1 to 2 inches), are more or less covered with short obtuse branches, are reddish-brown and somewhat wrinkled externally, and internally brownish-white, with numerous brown resin-spots, somewhat horny or mealy, hard, and dense. China-root is inodorous and has an insipid, faintly bitter, and somewhat acrid taste. Smilax Pseudo-china, *Linné*, and Sm. tamnoides, *Linné*, which are natives of the United States, yield similar tuberous rhizomes, which are usually lighter in color and weight. The root of Sm. aspera, *Linné*, of Southern Europe, has been employed there in place of sarsaparilla.

The Mexican Pharmacopœia recognizes as *raiz de China de Mexico* a large conical or somewhat spindle-shaped root, which is 45 Cm. (18 inches) long, 15–18 Cm. (6 or 7 inches) in diameter, reddish-brown, internally lighter, fleshy, with numerous irregular wood-bundles, inodorous when dry, and of an astringent and somewhat bitter taste. It is erroneously referred to Smilax rotundifolia, *Linné*, which is indigenous to the United States and has a creeping rhizome with prominent nodes.

Carex arenaria, *Linné*.—Sand sedge, German sarsaparilla, *E.*; Laiche, *Fr.*; Sandriedgras, Rothe Quecke, *G.* (nat. ord. Cyperaceæ).—It is indigenous to Europe, and grows frequently in sandy soil and near the coast of Germany. The rhizome (Rhizoma caricis) is creeping, several feet long, about 2.5 Mm. ($\frac{1}{10}$ inch) thick, subcylindrical, gray-brown, wrinkled, and on the nodes beset with rootlets and with fringed sheaths. Internally, it shows a woody zone composed of three irregular circles of fibro-vascular bundles enclosing soft white cellular tissue, and surrounded by a cortical layer having a circle of large prominent air-passages. The dried rhizome has little odor and a mealy, sweetish, afterward bitter and acrid taste. It is employed like sarsaparilla.

History.—The Spaniards first brought sarsaparilla to Europe about the middle of the sixteenth century from Peru, St. Domingo, and Brazil. It was then believed to be a specific for constitutional syphilis, and especially for the rheumatoid and ulcerative symptoms of that disease. It had, however, quite fallen into neglect when a belief in its virtues was for a time revived at the end of the eighteenth century; but it again gradually lost vogue as a remedy for syphilis, and was more largely used by nostrum-venders than by physicians.

Action and Uses.—The operation of the active principle of this root (smilacin, parillin) is by no means a negative one. According to Pallotta, in doses of 6 grains it occasions malaise and slowness of the pulse; 8 grains produce nausea and constriction of the throat; 10 grains, general debility and diaphoresis; 13 grains, moderate vomiting of a bitter liquid, with irritation and constriction of the throat, faintness, and general exhaustion. These effects have been ascribed to a different principle from either of the above, but which has not been isolated. It is certain, however, that they may be caused by some derivative of sarsaparilla, however named, and that they have also been produced by large doses of the drug itself. In medicinal doses neither sarsaparilla nor its usual preparations occasion any such phenomena. Their effects are manifested during a state of disease, rather than in health, and consist of an improved condition of the digestive and nutritive functions and the gradual subsidence of the morbid derangement.

Although sarsaparilla has been recommended in chronic *gout*, *rheumatism*, and *skin diseases*, yet the only disease for the cure of which special virtues have been claimed for it is constitutional *syphilis*, and the most eminent authorities upon this subject have generally agreed that its efficacy depends upon the patient having been previously subjected to a mercurial treatment. It is certain that with the disuse of mercury to produce salivation, and the dire consequences of the saturation of the system with that mineral, the use of sarsaparilla grew less and less frequent, so that it at last came to be prescribed, not so much from a belief in its utility as to gratify the popular faith in its virtues. Some have gone so far as to declare that the various decoctions of sarsaparilla are curative solely by means of the water which they contain—a judgment which, in view of the powers manifested by its active principles, seems to be exaggerated, if not erroneous. It is the more difficult to determine the value of sarsaparilla in the treatment of syphilis because it is nearly always associated with other active medicines, as with guaiacum and mezereon in the compound decoction, and with the former of these drugs in the compound syrup of sarsaparilla. Of the official preparations, the first is the only one that is worthy of being used. It is customary to associate with it potassium iodide, which is commonly curative without the sarsaparilla. Nevertheless, there are cases of constitutional syphilis which make no progress or grow worse under treatment by mercury or by iodine, and which are restored to health by the decoction of sarsaparilla (*e. g.* two cases by Carter, *Practitioner*, xxvi. 357).

Zittmann's decoction for the cure of syphilis is one of the most celebrated and efficient preparations of sarsaparilla. (See Decoctum Sarsaparillæ Compositum.) Of the virtues of this preparation we have the authority of Erasmus Wilson for saying that in extreme and very obstinate cases of the ulcerating forms of syphilis which have resisted both mercury and iodine, and particularly in those most difficult of all cases where the disease has got possession of the tongue and the mucous membrane of the mouth, it may often be had recourse to with great success.

Carex arenaria was at one time regarded as possessing all the virtues of sarsaparilla, and particularly as promoting the cutaneous and renal secretions. It was used in

the treatment of *rheumatism*, *gout*, *pulmonary* and *cutaneous diseases*, and *syphilis*. The root was used in decoction, and in its stead C. intermedia and C. hirta were often employed.

ARENARIA RUBRA is a popular remedy in Algiers for *gravel* and various affections of the urino-genital organs and in some forms of dropsy (*Therap. Gaz.*, viii. 382). It is said to be entirely innocuous. It probably owes its diuretic qualities to the large proportion it contains of sodium and potassium salts. It is best given in a decoction prepared with an ounce of the plant in a pint of water, reduced one-fifth and sweetened. *Dose*, a tablespoonful six or seven times a day (*Bull. de Thérap.*, xcv. 287; xcvii. 69, 94).

SASSAFRAS, *U. S.*—SASSAFRAS.

SASSAFRAS MEDULLA, *U. S.*—SASSAFRAS-PITH.

The bark of the root (the root, *Br.*, *P. G.*) and the pith of Sassafras variifolium (*Salisbury*), *O. Kuntz.* Bentley and Trimen, *Med. Plants*, 220.

Nat. Ord.—Lauraceæ, Litseaceæ.

Origin.—Sassafras became known in Europe toward the close of the sixteenth century. The plant is indigenous to North America from Canada southward to the Gulf of Mexico and westward to Texas; remains shrubby in the North, but attains a height of 12–15 M. (40 or 50 feet) in the Southern States. The trunk has a rough furrowed gray bark, but the young branches are of a brown color. The wood is white or reddish, light, but very strong and durable. The leaves are alternate, petiolate 7–15 Cm. (3 or 6 inches) long, bright-green and smooth above, downy beneath, especially when young; broadly ovate in shape and entire, or some of them two- or three-lobed—all, however, with a wedge-shaped base. The greenish-yellow flowers appear before the leaves in March and April or May, are diœcious, grow in downy racemes, and have linear bracts at the base and a deeply six-lobed perianth. The male flowers have nine stamens in three rows, and the female flowers six short imperfect stamens. The fruit is a dark-blue, oval or ovoid, one-seeded drupe, supported in the permanent base of the perianth and on the thickened clavate reddish peduncle. The flowers have an agreeable though not a strong odor; the bark of the branches is aromatic, but differs in flavor from that of the root; the leaves contain a considerable quantity of mucilage.

Description.—The following parts are recognized by the pharmacopœias:

1. SASSAFRAS, *U. S.*; CORTEX SASSAFRAS.—Sassafras-bark, *E.*; Écorce de sassafras, *Fr.*; Sassafrasrinde, *G.*; Corteza de sasafras, *Sp.*—Only the root-bark is employed. It is deprived of the dark-gray, inert, corky layer, is whitish in the fresh state, and is seen in commerce in irregular flattish or curved pieces, usually 5–10 Cm. (2 to 4 inches) in length and width. It is of a bright rust-brown color, on the inner surface finely striate and glistening, rather soft and fragile, breaks with a short corky fracture, and on transverse section is radially striate. It has a strong fragrant odor and a sweetish, aromatic, somewhat astringent taste.

2. SASSAFRAS RADIX, *Br.*; Lignum sassafras, *P. G.*—Sassafras-root, *E.*; Sassafras, (Bois), *Fr. Cod.*; Sassafrasholz, Fenchelholz, *G.*; Leño de sasafras, *Sp.*—The root is medicinally employed in Europe, but not in the United States. It comes in crooked and branching pieces with or without the bark attached, varying in size, and in color between yellowish-white and a pale-brownish or reddish. The wood is rather spongy, porous, light, composed of numerous annual layers and marked by numerous medullary rays; it has the odor and taste of the bark, but in a milder degree. The German name *Fenchelholz* (fennel-wood) has reference to the fancied resemblance of its odor to that of fennel.

3. SASSAFRAS MEDULLA, *U. S.*, Sassafras-pith. It is obtained from the branches, and is met with in slender, cylindrical, very light pieces, frequently curved or coiled, white, inodorous, and of an insipid, mucilaginous taste. When macerated in water it forms a ropy but non-tenacious mucilaginous liquid, which is not precipitated by alcohol.

Constituents.—Sassafras-bark was examined by Reinsch (1845), who obtained from it volatile oil (page 1152), tannin, sassafrid, starch, resin, waxy matter, mucilage, and coloring matter. On treating the bark, previously exhausted by ether, with alcohol, evaporating the alcohol, and macerating the extract with water, *tannin* is dissolved, yielding with ferric salts bluish-green precipitates, and *sassafrid* remains behind as a light reddish-brown, inodorous, and nearly tasteless powder, which is nearly insoluble in ether, and separates from its hot concentrated alcoholic solution in yellowish-brown crystalline gran-

ules. Its solutions are colored red by alkalies, and precipitated carmine-red by alkaline earths, dark greenish-brown by ferric salts, and whitish by lead acetate. It is doubtless an oxidation-product of tannin. Pectin could not be found. The bark contains about 6 per cent. of tannin and over 9 per cent. of sassafrid. According to Procter (1866), fresh sassafras-bark contains no sassafrid, but this is formed from the tannin on exposure to air. The woody portion of the root contains the same constituents, but in smaller proportion. The principal constituent of sassafras-pith is *mucilage*.

Allied Plant.—Umbellularia (Oreodaphne, *Nees*, Tetranthera, *Wight et Arnott*) californica, *Nuttall*. California bay-laurel or spice-tree. This evergreen tree is indigenous near the Pacific coast of North America, and in Oregon attains a height of 24 M. (80 feet) or more, but in California is of smaller size. The brownish, close-grained wood is much esteemed for cabinet-work. The leaves are alternate, lanceolate, entire, pinnately veined, reticulate, and pellucid punctate. They yield about 4 per cent. of a yellowish volatile oil having the spec. grav. 0.936, an odor resembling nutmeg and cardamom, and a warm camphoraceous taste. The oil was examined by J. P. Heamy (1875) and J. M. Stillman (1880), and appears to contain a hydrocarbon and a terpene-hydrate, $C_{20}H_{32}.H_2O$, boiling below 190° C. (374° F.), and *oreodaphnol* (umbellol, Stillman), $C_8H_{12}O$, boiling above 210° C. (410° F.). The seeds contain a fat which melts near 32° C. (89° F.), and, according to Stillman (1882), contains crystalline *umbellulic acid*, $C_{11}H_{22}O_2$, distilling near 272° C. (522° F.) without decomposition.

Action and Uses.—Sassafras-bark is believed to be somewhat stimulant, quickening the pulse slightly, promoting digestion, and increasing the secretions of the skin and kidneys. It was formerly used in the treatment of chronic *syphilis* and diseases of the *skin*, and is one of the medicines which are popularly supposed to purify the blood. Emmenagogue virtues have been attributed to it (*Med. News*, xlviii. 46). Its real virtues, if any, are undetermined. It may be given *ad libitum* in an infusion made with from Gm. 16–32 in Gm. 250 (½ ounce to an ounce of the bark and ½ pint) of hot water. It is said that an infusion of sassafras-bark is "almost a specific for the rash produced by poison oak." It should be taken internally and applied topically (Hinton).

Sassafras-pith is used to form a mucilage with cold water. It is demulcent, and at the same time a very mild local stimulant. An infusion of it may be used internally as a drink in *dysentery*, in inflammations of the *throat*, *air-passages*, and *stomach*, and in febrile affections generally. It forms an agreeable and efficient collyrium in cases of acute *conjunctivitis*, and serves as a vehicle for more active remedies.

California laurel is alleged to be stimulant and anodyne, and is said to be used with advantage in various *diarrhœal* affections, *neuralgia*, *headache*, etc. (*Therap. Gaz.*, viii. 161).

SAURURUS.—Lizard's Tail.

Saururus cernuus, *Linné*.

Nat. Ord.—Saururaceæ.

Description.—This is a common North American perennial, inhabiting swampy localities. Its stem is about 60 Cm. (2 feet) high and rather weak. The leaves are alternate, petiolate, about 10 Cm. (4 inches) long, heart-shaped, entire, pointed, convergingly ribbed, slightly hairy, and underneath pale-green. The flowers are in a slender, crowded, terminal, spike-like raceme which is about 10 Cm. (4 inches) long, are destitute of any floral envelope, contain six hypogynous stamens and three or four ovaries united at the base, and produce a somewhat fleshy, berry-like fruit. The entire plant has an aromatic but rather unpleasant odor and a somewhat acrid taste.

Constituents.—The plant has not been analyzed.

Allied Plant.—Anemopsis californica, *Hooker*. It is a small perennial, indigenous to California and Mexico, where it is known as *yerba mansa*. The leaves are mostly radical, smooth, and have sheathing petioles; the root is whitish and fleshy; all parts of the plant, when broken, have a pungent peppery taste. Prof. Lloyd (1880) obtained from a pound of the root 6 drachms of a yellowish volatile oil, which becomes red and thick with sulphuric acid, is slowly colored blue, violet purple, and brown by hydrochloric acid, and acquires a blue color with nitro-muriatic acid. Alcohol deprives the root of its sensible properties, and when evaporated leaves an oil which is heavier than water, and from which carbon disulphide precipitates a brown granular substance having an astringent and peppery taste and being soluble in dilute alcohol and in glycerin.

Action and Uses.—The root of saururus is used in poultices as an application to *abscesses* and other painful swellings, and a decoction of it is sometimes employed in *strangury* and other irritations of the urinary passages and bowels. It is also directed in a strong infusion, of which several ounces should be continuously given at short intervals when the symptoms are urgent.

SCAMMONIÆ RADIX, *Br.*—Scammony-root.

Racine de scammonée, Fr.; *Scammoniawurzel*, G.

SCAMMONIUM, *U. S., Br.*—Scammony.

Scammonée d'Alep, Fr.; *Scammonium*, G.; *Escamonéa*, Sp.

The root and the resinous exudation from the root of Convolvulus Scammonia, *Linné*. Bentley and Trimen, *Med. Plants*, 187.

Nat. Ord.—Convolvulaceæ.

Origin.—The scammony-plant is an herbaceous, twining perennial growing in Syria, Asia Minor, and Greece; it has alternate, triangular-cordate, very acute leaves, large, funnel-shaped, pale-yellowish flowers, and ovate-globose capsules containing four angular seeds.

Description.—1. Scammony-root. It is .5–1 M. (20 to 40 inches) in length, after drying about 5 Cm. (2 inches) thick in the upper part, cylindrical, somewhat tapering below, more or less twisted, with several short stem-fragments at the crown, longitudinally wrinkled, of a grayish- or yellowish-brown color externally and grayish or brownish-white within. The root is hard, has but a slight odor, and a sweetish afterward acrid taste, and upon transverse section shows a thin bark about one-eighth or one-sixth the diameter of the root, and, like the parenchyma of the meditullium, containing numerous resin-dots, the concrete latex of the milk-vessels; the wood consists of a number of separate groups of wood-bundles varying in thickness, irregularly arranged, and separated from one another by parenchyma of variable thickness.

2. Scammonium. This is collected by laying the upper portion of the root bare, cutting the top off in an oblique direction, and collecting the milk-juice in shells, the contents of which are mixed together with the juice scraped from the root and dried. Scammony is met with in commerce in irregular angular pieces or circular cakes of a greenish dark ash-gray or dark-brown nearly black color, of a peculiar sour and somewhat cheese-like odor, and of a slight but distinctly acrid taste; it breaks readily with an angular or splintery fracture, and exhibits in the interior small fissures and cavities and a resinous lustre. When triturated with water it yields a greenish emulsion; its powder has a gray or greenish-gray color. It yields to alcohol or ether not less than 75 (*U. S.*), and sometimes as much as 95, per cent. of its weight, and when the solvent has been evaporated and the resinous residue dissolved in warm solution of potassa, no precipitate is produced on the addition of an acid. The portion left undissolved by alcohol or ether is of a gray color, and is not colored blue by iodine.

The best quality of scammony is known in commerce as *virgin scammony*. Of late years scammony is usually sold in the market, at least at wholesale, by the amount of resin it contains—a commendable custom which we believe has been introduced in this country through the efforts of Dr. E. R. Squibb.

Adulterations.—A distinction has been sometimes made between *Aleppo* and *Smyrna* scammony, the former being regarded as the pure article, but we have seen in commerce scammony sold as one or the other kind which was very impure. The adulterations usually consist of farinaceous substances, chalk, and earthy material, which can easily be recognized by their insolubility in ether. Scammony thus adulterated is frequently smooth externally, dense, heavy, and effervesces when thrown into dilute hydrochloric acid, or its decoction with water yields a blue color on the addition of iodine. M. Conroy (1883) reported an adulteration consisting of the resin prepared from scammony-root, which is recognized by its distinctive persistent leathery odor.

Montpellier scammony, employed to a limited extent in France, was claimed to be the milk-juice of Cynanchum monspeliacum, *Linné*. The commercial article was found by Laval (1861) to contain from 10 to 21 per cent. of resinous matter, 50 to 59 of starch, and 11 to 18 of earthy substances.

In place of scammony-root, we have seen a thin farinaceous root offered, which resembled turpeth-root (page 903), but was not identical with it.

Constituents.—Scammony-root is stated to be richest in resin immediately before the flowering period. Good roots will yield about 5 per cent. of resin. Hager found 10 per cent. of resin, 3 per cent. of tannin, and 15 per cent. of sugar and extractive; starch is likewise present. According to the British Pharmacopœia, scammony should contain between 80 and 90 per cent. of resin. The pure resin has been named *scammonin*: its composition, derivatives, and relation to allied resins have been described on pages 903 and 1369.

History.—Scammony, or at least the concrete juice of a Convolvulus, was well known to the Greek, Latin, and Arabian medical writers, who agree in ascribing to it active irritant and purgative qualities. It was used externally in the treatment of cutaneous diseases and in a tampon to provoke abortion. As a purgative they describe its harsh, painful, and exhausting action and its cholagogue qualities, and mention that it may produce cold sweats, syncope, and even death. To guard against its violent operation they advised that it be associated with certain gums, oils, mucilage, etc.

Action and Uses.—No other purgative is so uncertain as scammony, partly in consequence of its adulteration with inert substances, and partly from its slight solubility in the gastro-intestinal contents when these are acid. According to Rutherford and Vignal, it is a cholagogue of feeble power. It is singular that while in some experiments upon animals it occasioned active, exhausting, and even fatal purgation, yet in others it inflamed the bowels and killed the animals without purging at all. The actions of jalapin and convolvulin or scammonin are said to be identical. Careful experiments show that scammonin is a less active cathartic than scammony itself, unless finely divided by trituration. It appears also that in the case of both very slightly greater effects are obtained by a large increase of the dose—a result doubtless due to the imperfect solubility of the medicine. This is said to be increased by the presence of bile. That its active principle is absorbed appears from the following case: A healthy woman, nursing a healthy child two months old, took a dose of scammony to relieve herself of constipation; she suffered no purgation or any other symptoms attributable to the medicine, but her child was presently seized with violent cholera morbus, which rapidly ended in collapse and death (*Bull. de Thérap.*, lxxv. 554).

Scammony is hardly ever used alone at the present day, although, on account of its tastelessness, it has been recommended as a purgative for children. Even in the cases to which it has been thought peculiarly applicable as a hydragogue, colocynth, jalap, and even gamboge, are to be preferred, and the same may be said in regard to its association with calomel as a cholagogue purgative. The compound powder of scammony is possibly preferable to scammony or to jalap alone when a powerful derivative action from the brain is desired.

The *dose* of ordinary scammony is Gm. 0.60–1.30 (gr. x–xx), and of pure scammony or of its resin Gm. 0.30–1 (gr. v–xv). It may be given powdered in a wafer, but is inactive in the pilular form. It is also administered in emulsion with milk, almond milk, mucilage,or other demulcent sweetened.

SCILLA, *U. S., Br.*—Squill; Squills.

Bulbus scillæ, P. G.—*Scille*, Fr. Cod.; *Squille*, Fr.; *Meerzwiebel*, G.; *Escila, Cebolla albarrana*, Sp.

The bulb of Urginea Scilla, *Steinheil*, s. Scilla (Urginea, *Baker*) maritima, *Linné*.

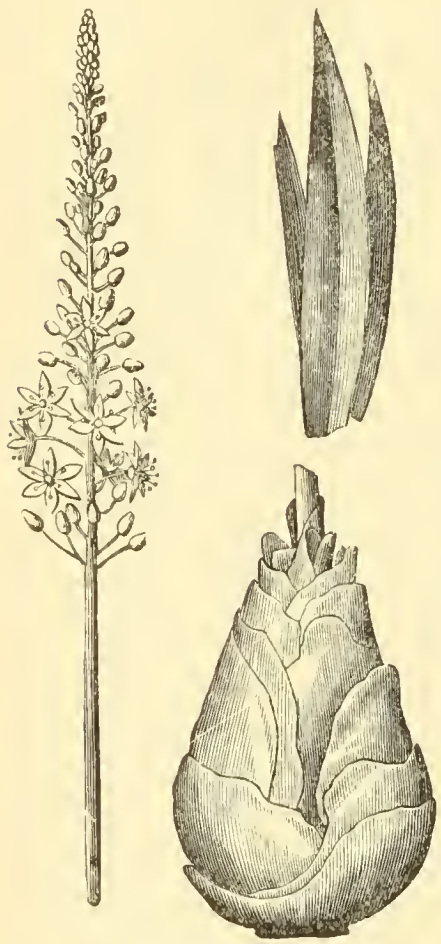
Nat. Ord.—Liliaceæ.

Origin.—The squill is indigenous to the basin of the Mediterranean from Syria westward to the coast of the Atlantic. It grows in sandy and sunny places near the seashore, but is likewise found inland to some extent and in hilly localities. Two varieties are known, which differ only in the color of their bulb-scales, being of a reddish tint in the one and whitish in the other variety. The leaves make their appearance during the flowering period, and are broad-lanceolate, 30–50 Cm. (12 to 20 inches) long, channelled, finally recurved and spreading. The scape attains a height of .9–1.2 M. (3 or 4 feet), and is terminated by a long raceme of whitish green-nerved flowers with six stamens inserted on the base of the sepals. Along the Mediterranean the bulb is frequently employed in the fresh state, but in the United States it is now usually seen in dry segments.

Description.—The bulb of squill is broadly ovate or somewhat pear-shaped, and is from 7–15 Cm. (3 to 6 inches) long, and of the same thickness at its lower portion, weighing sometimes over 4 pounds. It consists of a large number of fleshy scales, which are either whitish or reddish, and are covered by dry reddish-brown and scarious scales. The bulb is collected while leafless, about the month of August, freed from the inert outer and small, insipid central scales and from the dense stem portion and rootlets, and then cut transversely into segments, which are dried in the sun. Thus prepared, it is found in the market, and consists of narrow slices 3–6 Mm. ($\frac{1}{8}$ to $\frac{1}{4}$ inch) wide and 2–5 Cm. (1 or 2 inches) long, somewhat translucent, yellowish-white or reddish, brittle and pulverizable when dry, but very hygroscopic, and therefore often flexible. Squill

is scentless, and even in the fresh state is but slightly odorous; it has a mucilaginous afterward bitter and acrid taste. When dried and powdered it is easily converted into a solid hard mass from the absorption of moisture. In damp weather squill loses on drying from 10 to 14 per cent. of its weight. On handling squill it is apt to cause irritation of the skin, due to the sharp-pointed raphides of calcium oxalate.

Fig. 268.



Scilla maritima, *Linnê.*

Constituents.—Squill has been frequently the subject of chemical investigation, but even at the present time the medicinally important principles of this drug are not satisfactorily known. Two such principles are usually distinguished: one, having a bitter taste, is called *scillitin;* the other, being acrid, has received the name *skulein.* Wittstein (1850) observed that the expressed juice of fresh squill yields with alcohol a precipitate consisting mainly of gum and amounting to 28 per cent. of the dry drug; the filtrate was freed from alcohol by evaporation, fermented with yeast, and, after the sugar had been thus destroyed, yielded with lead acetate a slight precipitate. After removing the lead from the filtrate by hydrogen sulphide the resulting extract had a bitter and acrid taste, the latter of which was removed by agitation with lead hydroxide, but not by baryta. The earlier investigations were less successful. Vogel's and Tilloy's *scillitin* was amorphous and neutral; both regarded the acrid principle as being volatile. Landerer and Marais (1857) obtained compounds which they regarded as alkaloids. But Tilloy (1854) proved the non-existence of such a body in squill, and announced then that squill does not contain any volatile acrid principle: the compound producing irritation of the skin was by him believed to be crystallized calcium citrate. Labourdais (1849) obtained the bitter principle, after precipitating the infusion of squill with lead acetate, by treating it with animal charcoal, and exhausting this with hot alcohol; and Bley obtained it once by this process in flexible needles. The presence of crystals in squill was recognized long ago, but these were generally considered to be either calcium tartrate, carbonate, or citrate until Scroff (1864) proved them to be very fine and sharp-pointed needles of *calcium oxalate.* Scroff is likewise convinced of the existence of a non-volatile acrid besides the bitter principle, and of the greater efficacy of the red-colored variety of the drug. The bitter principle forms a compound with tannic acid (*Pharmacographia*). Jarmersted (1879) isolated from this precipitate the glucoside *scillein*, which is white or yellowish, dissolves in strong hydrochloric acid with a red color, and is decomposed by dilute acids into glucose and a resin. E. Merck (1879) obtained three not quite pure principles, the last two of which are poisonous—namely, *scillin* (crystalline, pale-yellow, sparingly soluble in water, more freely soluble in alcohol and hot ether, colored by sulphuric acid red-brown, by nitric acid yellow, and on heating green); *scillipicrin* (amorphous, whitish, hygroscopic, and bitter); and *scillitoxin* (amorphous, cinnamon-brown, insoluble in water and ether, soluble in alcohol, colored red and brown by sulphuric acid and orange-red and green by nitric acid). Schmiedeberg (1879) isolated the gummy matter by precipitating the infusion with basic lead acetate, and afterward with lime; on decomposing the last precipitate with carbonic and oxalic acids *sinistrin*, $C_6H_{10}O_5$, is obtained; this is colorless, amorphous, levogyrate, and is readily converted into levulose and another fermentable but inactive sugar. *Scillin* of Riche and Rémont (1880) is probably identical with sinistrin.

History.—Squill was used by the Greeks and their medical followers in Rome, Arabia, and Europe. Its preparations with honey and vinegar were anciently employed in dropsical affections, and the latter were extolled in the treatment of spongy and ulcerated gums, ulcerated throat, and debility of the digestive organs.

Action and Uses.—The juice of the fresh plant acts upon the skin as a rubefacient, and has also occasioned diuresis. Even the powder of the dried corm applied to

the denuded cutis has had the same effect in dropsy. Its local action is irritating, which is ascribed to the large proportion it contains of lime oxalate (?). Internally, the effects of a very large dose of squill are violent vomiting, purging, and colic, dysury or bloody urine, rapid breathing, a cold skin, coma, and general convulsions. It has even destroyed life. In small or medicinal doses it usually exerts a diuretic action, tends to relax the bowels, and reduces the frequency and increases the tension of the pulse. The characteristic effects are most distinctly produced by the powder or the wine of squill. But fatal poisoning has been attributed to the syrup in the cases of two children. The symptoms were pains in the legs, lividity of the face, and hurried respiration. The heart was found to have stopped in systole (*Ther. Gaz.*, x. 788). The continued use of squill impairs the appetite and digestion.

Although there is nothing in the results of scientific investigation even to suggest that squill acts upon the bronchial mucous membrane, the much more direct and conclusive evidence of clinical experience leaves no doubt of its great value in *bronchitis*, whether of an acute form, when the sputa are tenacious and scanty, or of a chronic type occurring without complication or associated with obstructive disease of the heart and pulmonary emphysema. It is of daily use as an expectorant in the treatment of *spasmodic croup*, but in the form of compound syrup of squill, which owes its efficacy chiefly to the antimony it contains.

As a diuretic squill is universally employed in *dropsy*. Even when the effusion is owing to some organic and incurable lesion it may often be temporarily evacuated by squill. The experimental researches into its mode of action in dropsy have tended to confirm what was long ago established by clinical experience, that it is most useful in the passive forms of the disease, when the pulse is weak and the heart feeble or obstructed, and when there is neither fever nor an irritable condition of the kidneys present. Undoubtedly, it is oftener useful in cardiac than in renal, splenic, or hepatic dropsy. As already mentioned, it seems probable that its action is very analogous to that of digitalis. Within certain limits this is true, but is not the whole truth. The diuretic action of neither medicine is due exclusively to its sensible sedative action on the heart. Squill is not so apt as digitalis to cause sudden and alarming depression. The best mode of using these medicines in dropsy is to combine them in the same prescription in pilular form, or as tinctures with compound spirit of juniper or with a solution of potassium acetate in water. When the stomach is intolerant of the medicine, it may be administered by rubbing its tincture with that of digitalis into the skin, or applying compresses saturated with these liquids to the abdomen and covering them with impermeable cloth. Scillipicrin dissolved in water may be administered hypodermically. It is apt, however, to cause some local irritation. In one case 4 tablespoonfuls a day of a 2 per cent. solution of scillipicrin were given without effect. For subcutaneous injection a 10 per cent. solution has been preferred (Fronmüller). Powdered squill, with or without digitalis, may also be applied endermically. In the *hydrocele* of young subjects a cure has been effected by applications of vinegar of squill. Powdered squill has been used to remove *warts*.

The *dose* of squill in substance is Gm. 0.06–0.20 (gr. j–iij) three times a day in pilular form. It may gradually be increased to Gm. 0.66 (gr. x) a day. As a general rule, if it disturbs the stomach the dose should be reduced. An infusion is sometimes employed, which is made with from Gm. 2–4 (30–60 grains) in Gm. 250 (½ pint) of hot water, of which from Gm. 8–16 (2 to 4 fluidrachms) may be given at a dose.

SCOPARIUS, *U. S.*—Scoparius.

Scoparii cacumina, Br.; *Herba scoparii.—Broom*, *Irish broom*, E.; *Genêt à balais*, Fr.; *Besenginster*, *Pfriemenkraut*, G.

The tops of Cytisus Scoparius (*Linné*), *Link*, Sarothamnus Scoparius, *Koch*, Sar. vulgaris, *Wimmer*, Genista scoparia, *Lamarck*. Bentley and Trimen, *Med. Plants*, 70.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—Broom is a shrub about .9–1.8 M. (3 to 6 feet) high, and grows in Western Siberia and throughout the greater portion of Europe, but is more abundant in the western part of that continent and in Great Britain. It is sometimes cultivated in our gardens, and is occasionally met with wild in some of the Middle and Southern States. It prefers a sandy soil, and flowers in May and June. The shrub has long, wand-like branches, small trifoliate leaves with obovate or elliptic-lanceolate sessile leaflets, and produces an abundance of large golden-yellow papilionaceous flowers, and a flat dark-brown legume, which is white-hairy on the edges, and contains about twelve olive-colored, oblong,

and, below, truncate seeds. The flower-buds are in some places used like capers, and the branches as a substitute for hops.

Description.—The green twigs constitute the portion generally employed. They are long, thin, and flexible, pentangular, winged, but not spiny, smooth, except the extremities, which are pubescent, and are usually free from leaves and flowers. In the fresh state they have a peculiar odor, but are nearly inodorous after drying; their taste is bitter and disagreeable. The *flowers* have been occasionally employed; on drying they usually become brown and their honey-like odor is almost entirely lost; their taste is nauseous and bitter.

Constituents.—The analyses by Cadet de Gassicourt (1824) and Reinsch (1846) failed to isolate any important principle. Stenhouse (1851) obtained two interesting principles, scoparin and sparteine. *Scoparin*, $C_{21}H_{22}O_{10}$, is prepared from the concentrated decoction of broom-tops, which gelatinizes on standing; the jelly-like mass is expressed and purified by repeated solution in hot water, and finally in hot alcohol. Scoparin is amorphous and brittle or in small crystals, has a pale-yellow color, yields with lead acetates green-yellow precipitates, and furnishes picric acid when treated with nitric acid; it is inodorous and tasteless. On fusing it with potassa, phloroglucin and protocatechuic acid are produced (Hlasiwetz). *Sparteine*, $C_{15}H_{26}N_2$, is best obtained, according to Mills (1861), by exhausting broom with acidulated water and distilling the concentrated liquid with soda. In its pure state it is a colorless, transparent, oily liquid, which becomes brown on exposure, has a slight aniline-like odor, a very bitter taste, a strongly alkaline reaction, boils at 288° C. (550° F.), and yields amorphous and crystallizable salts. The alkaloid is but slightly soluble in water and alcohol. 150 pounds of the plant yielded 22 Cc. of sparteine. The air-dry plant yields about 5.6 per cent. of ash.

Allied Species.—Spartium junceum, *Linné*, (Spartianthus, *Link*, Genista, *Lamarck*), Spanish broom. This evergreen European shrub resembles the preceding, but has obtuse-lanceolate, at the base wedge-shaped, and on the lower side soft-hairy leaves, and nearly reniform seeds. The branches, leaves, and seeds have a bitter taste, and are stated to possess diuretic, purgative, and emetic properties.

Action and Uses.—An old woman, who drank of a decoction of the tops and seeds of broom, sweated and vomited profusely, had indistinct vision, and staggered. These symptoms continued for twenty-four hours (*Lancet*, Oct. 1884, p. 668). *Sparteine* is a sedative of the spinal reflex centres, and in a less degree of the circulatory system, and it even acts upon some of the lower animals in some measure as a narcotic (Fick). A drop of sparteine introduced by Schroff into a rabbit's mouth occasioned spasms of the muscles of the spine and limbs and paralysis of the latter, slowing of the respiration and heart, and death in six minutes. On dissection the intestine responded but feebly to stimulation, the heart, except the auricles, not at all, and the venous system was gorged with blood. The phenomena noted by Fick were somnolence, a staggering gait, at first extreme frequency of the pulse and respiration, and subsequently great dyspnœa and slowing and feebleness of the heart, and finally death in convulsion, with dilated pupils. Its effects have caused it to be compared with coniine. Leech states that he took 5 grains of it without any unpleasant effect (*Practitioner*, xxxix. 373), and Prior observed secondary effects in one case only, and after a dose of Gm. 2 (30 grains). They consisted of arhythmical heart-action, nausea, giddiness, and a sense of weight in the limbs (*Edinb. Med. Jour.*, xxxiii. 567). In health it does not seem to be diuretic (Masius, *Times and Gaz.*, xi. 403).

Broom is applicable to all forms of *chronic dropsy* as one of the most efficient of hydragogues, acting both by the bowels and the kidneys. It is best given in a decoction prepared by boiling Gm. 16 (℥ss) of the tops in Gm. 250 (½ pint) of water in a covered vessel for ten minutes. This quantity may be taken in divided doses in twenty-four hours, or the officinal decoction (British Pharmacopœia) may be used instead. A compound decoction, which is still more efficient, may be prepared by boiling broom tops and dandelion, of each Gm. 16 (½ ounce) in Gm. 750 (1½ pints) of water to Gm. 500 (1 pint), and near the close of the process adding Gm. 16 (½ ounce) of juniper-berries. When cold the decoction should be strained. Gm. 36–64 (1 or 2 fluidounces) may be given at a dose.

Sparteine may be employed in all cases adapted to the use of digitalis or digitaline—*i. e.* when impaired power of the heart and a diminished secretion of urine coincide. But, although it is inferior in power to digitalis, it is a convenient and safe substitute where the latter is not tolerated, and also to sustain the action when it may seem imprudent to prolong the use of digitalis (Stoessel, *Centralbl. f. d. g. Ther.*, v. 163; Gluzinski, *Therap. Gaz.*, xi. 263). It results from Sée's observations (1885) that sparteine augments the

action of the heart and arteries, and is more prompt and persistent than digitalis in producing these effects, as well as in reducing to order arhythmical heart movements. But, unlike digitalis, it renders the pulse more frequent. Sée held it to be indicated in all cases of irregular action of the heart due either to weakness of the heart-muscle or to valvular disease, as well as to cases of abnormal slowness of the organ produced by its functional exhaustion (*Comptes rendus de l'Acad. des Sciences*). The action on the pulse attributed by him to sparteine is, however, the opposite of that observed by Clarke, at least in cases where the pulse is abnormally rapid. The latter states that the arterial tension is raised, the skin is flushed and warm, and the pulse-rate is gradually lowered until it reaches or approaches the normal. The departures from this rule seemed to be exceptional (*Am. Jour. Med. Sci.*, Oct. 1887, p. 363. Compare Griffe, Pick, Legris, *Therap. Gaz.*, xii. 108). In the treatment of cases connected with obstructive heart-disease Clarke found that small doses were preferable to large; the former—*e. g.* Gm. 0.004–0.005 (gr. $\frac{1}{16}$–$\frac{1}{12}$) produced a maximum effect in regulating the pulse, quieting palpitation and violent cardiac pulsation. Larger doses, Gm. 0.06–0.12 (gr. j–ij), augmented the force of the heart-beats and the arterial tension, and sometimes even caused distress. In exceptional cases to these effects were added tightness of the chest and sharp pains about the heart, and a great subsidence of the pulse-rate below the normal. Nausea occurred in a few cases, and paresis of the lower limbs seems to have followed its use (Bruen, *University Med. Mag.*, i. 223). Of the special forms of disease in which sparteine gives relief Clarke states—1, that in *mitral regurgitation* the results were very striking; 2, in *mitral stenosis* the benefits were less and less prolonged; 3, in *aortic regurgitation* with greatly enlarged and excited heart small doses were useful; 4, in "*asthma*" the influence was good, but very tardy; 5, in *palpitation* without organic disease of the heart the relief was immediate; and, 6, in *Grave's disease* it occasioned great improvement. When *dropsy* is associated with any of these anatomical conditions, it is benefited by sparteine, but the medicine has no effect on renal or abdominal dropsy depending on hepatic or splenic disease. When given internally in doses of Gm. 0.004–0.016 (gr. $\frac{1}{16}$–$\frac{1}{4}$), its influence is felt within thirty or forty-five minutes, and lasts four or five hours, and when taken regularly for several days or weeks its effect usually continues four, or even six, days after its administration has been suspended. The stimulant action of sparteine on the heart has been used by Ball and Jennings to sustain that organ during the treatment of the *opium habit*. Sometimes nitro-glycerin has been associated with it in such cases (*Practitioner*, xxxviii. 459; xxxix. 132).

The dose of sparteine recommended by Sée was about Gm. 0.12 (gr. ij) a day; by Prior, Gm. 0.01–0.02 (gr. $\frac{1}{6}$–$\frac{1}{3}$) several times a day; by Nothnagel and by Voigt, Gm. 0.001–0.004 (gr. $\frac{1}{64}$–$\frac{1}{16}$); by Legris, Gm. 0.05–0.25 (gr. $\frac{1}{4}$–iv) a day; Houde, Gm. 0.02–0.10 (gr. $\frac{1}{3}$–$1\frac{1}{2}$) in five daily doses; and Clarke recommends Gm. 0.004 (gr. $\frac{1}{16}$) every four hours, which, he says, may be increased gradually to Gm. 0.80 (gr. xij) in twenty-four hours without occasioning any toxic symptoms.

Ulexine, the alkaloid of Ulex europæus, appears to be nearly identical in its action with sparteine and cytisine, rendering the movements of the heart slower and more vigorous and contracting the arteries, as digitalis does, and so occasioning diuresis, which, however, is much more transient than that due to foxglove. In poisonous doses these alkaloids produce cardiac paralysis. Milk given by cattle which have eaten ulex has poisoned a child fed upon it. Kobert, from whom these statements are derived, suggests as a proper dose of ulexine nitrate Gm. 0.003–0.005 ($\frac{1}{20}$–$\frac{1}{12}$), to be given subcutaneously (*Therap. Gaz.*, xiv. 475).

SCROPHULARIA.—Figwort; Scrofula-plant.

Scrofulaire, Fr. Cod.; *Kropfwurz, Knotenwurz*, G.; *Escrofularia*, Sp.

Scrophularia nodosa, *Linné.*

Nat. Ord.—Scrophulariaceæ.

Origin and Description.—Figwort is a perennial herb growing in damp places in Europe and North America. The American plant is usually taller, growing to the height of 1.2–1.5 M. (4 or 5 feet), and has an obtusely angled stem, but otherwise agrees closely with the European plant; it was formerly regarded as a distinct species, Scrophularia marilandica, *Linné.* The plant has a horizontal branching fleshy *rhizome*, to which numerous oblong or oval tubers of the thickness of a thumb are attached. The *leaves* are opposite, petiolate, ovate-oblong, rounded or heart-shaped at the base, and cut-serrate on the margin. The flowers are in a terminal loose panicle, have a greenish-

brown, tubular-globose, five-lobed corolla with four stamens, and produce a two-celled many-seeded capsule. The fresh plant, bruised, has an unpleasant odor and a nauseous, bitter, and acrid taste; on drying it loses about 75 per cent. in weight and becomes nearly inodorous.

Constituents.—The fresh flowering plant was analyzed by Walz (1853), who found in the aqueous distillate *acetic* and *propionic acids* and a stearopten, *scrophularosmin*. On treating the decoction with lead acetate and subacetate, tannic, tartaric, citric, and malic acids, pectin, and coloring matter were precipitated, and the filtrate, after freeing it from lead, yielded with tannin a precipitate containing *scrophularin*. This principle crystallizes in scales, has a bitter taste, and is soluble in water and alcohol. Scrophularia aquatica, *Linné*, contains the same principle, and in addition thereto a resinous body, *scrophulacrin*, which is soluble in ether.

Action and Uses.—S. nodosa and S. aquatica appear to possess analogous qualities. The generic name of the plant seems to have been gained through a popular belief that it was useful in *scrofula*. It was employed in the glandular form of the disease, and also in *cutaneous affections* originating in the strumous diathesis. It was an ingredient of an ointment much used in the treatment of *itch*. It was also applied to *hæmorrhoids* and *anal ulcers* and as a dressing for unhealthy *wounds* and *sores* generally. The fresh juice, and also a decoction of the leaves or root, were used, the latter being made with Gm. 16 to Gm. 500 (℥ss in Oj) of water.

SCUTELLARIA, *U. S.*—Skullcap.

Hoodwort, Madweed, E.; *Scutellaire*, Fr.; *Helmkraut, Schildkraut*, G.

Scutellaria lateriflora, *Linné*.

Nat. Ord.—Labiatæ, Stachydeæ.

Description.—This species, in some places known as *mad-dog skullcap*, is a common North American perennial herb, growing in swampy and wet places. Its stem is about 60 Cm. (2 feet) high, quadrangular, smooth, and much-branched. The leaves are opposite, petiolate, about 5 Cm. (2 inches) long, oval-lanceolate, pointed, coarsely serrate, rounded at the base, thin, and smooth. The flowers are small in slender axillary leafy racemes, with a minute filiform bract at the base of each pedicle, and with a pale-blue or purplish bilabiate corolla. The calyx is divided into two entire lips, the upper with a helmet-like appendage on the back. The herb flowers in July, and should then be collected; its loss on drying amounts to from 75 to 80 per cent. It has a slight odor and bitterish taste. Its constituents have not been ascertained.

Allied Species.—The following and probably other indigenous species of Scutellaria possess a more decidedly bitter taste, and are occasionally employed:

Scut. integrifolia, *Linné*. It is 30 to 45 Cm. (12 to 18 inches) high, minutely hairy all over, has lance-oblong or linear-oblong, mostly entire, short petiolate leaves, and terminal racemes of blue flowers, which are about 25 Mm. (1 inch) long.

Scut. pilosa, *Linné*. It is 30 to 60 Cm. (1 or 2 feet) high, covered with spreading hairs, has rhombic- or oblong-ovate, crenate, petiolate leaves in distant pairs, and short terminal racemes of rather large purplish-blue flowers.

Scut. galericulata, *Linné*. It is somewhat downy, has short-stalked, lance-ovate, crenately serrate leaves, which are rounded or heart-shaped at the base, and bear in the axils of the upper leaves rather large blue flowers, which are turned to one side. This species is indigenous to Europe, Northern Asia, and the northern section of North America.

Brunella (Prunella) vulgaris, *Linné*.—Heal-all, Self-heal, *E.*; Pâquerette, *Fr.*; Braunelle, Braunheil, *G.*—This is a perennial herb, common in fields, grassy places, and in woods in North America, Asia, and Europe. Its ascending stem is about 30 Cm. (12 inches) long; the leaves are about 38 Mm. (1½ inches) long, petiolate, oblong-ovate, entire or somewhat toothed, and more or less hairy. The flowers are purplish-blue and form a dense leafy-bracted spike. The herb is nearly inodorous, and has a bitterish and somewhat astringent taste.

Constituents.—These plants contain principles similar to those found in other plants of the same order. Cadet de Gassicourt (1824) obtained from the official species a little volatile oil, fat, tannin, a trace of bitter principle, sugar, etc.

Action and Uses.—Skullcap has been employed in extract, fluid extract, and infusion, and has had some repute in *intermittent fever* and as a nervine—that is, in diseases presenting a depressed and disordered condition of the nervous functions. It has even been recommended in *epilepsy* when continuously given in a decoction made with Gm. 64 to Gm. 250 (℥ij in ℥viij) of water. It is one of several stimulants occasionally useful in nocturnal *incontinence of urine*. There is no evidence of its virtues which entitles it to a place among official drugs.

SEDUM.—Stonecrop; Mossy Stonecrop.

Joubarbe âcre, Poivre des murailles, Fr.; *Mauerpfeffer, Steinkraut*, G.; *Siempreviva menor*, Sp.

Sedum acre, *Linné.*

Nat. Ord.—Crassulaceæ.

Description.—This little moss-like spreading plant is indigenous to Europe, where it grows in dry fields and on old walls; it is cultivated in gardens and runs wild in some places in North America. Its leaves are 3–6 Mm. (⅛ to ¼ inch) long, alternate, nearly imbricate, in about six spirally turned rows, ovate, thick, convex on the back, punctate, and smooth. The flowers are on one side of the branched inflorescence, forming scropoid cymes, and have four or five yellow petals, the same number of pistils, and twice that number of stamens. The plant is inodorous and has a mucilaginous and acrid taste.

Constituents.—Mossy stonecrop contains much mucilage and malates (Vauquelin), also rutin (Mylius); its acrid principle has not been isolated.

Allied Species.—Sedum dendroideum, *Mocino*, is used in Mexico like the preceding. Sedum Telephium, *Linné.*—Live-for-ever, Garden opine, *E.*; Joubarbe des vignes, Grassette, *Fr.*; Grosse Fetthenne, *G.*—It is indigenous to Europe, and in the United States has escaped from cultivation. It has an ascending stem, purplish or greenish flowers, and oval or ovate, obtuse and toothed sessile leaves, which are 5–8 Cm. (2 or 3 inches) long, and are either alternate, opposite, or in whorls of three.

Sempervivum tectorum, *Linné.*—Houseleek, *E.*; Grande joubarbe, *Fr.*; Dachwurz, *G.*; Siempreviva major, *Sp.*—It is indigenous to the Alps, but now grows spontaneously throughout Europe on roofs and old walls, and, with several allied species, is cultivated in North America. It has numerous fleshy rosulate radical leaves, which are 2–5 Cm. (1 to 2 inches) long, obovate in shape, of a green color, and on the margin stiff-hairy, and of a brownish or reddish color. The flowers are rose-colored and purplish. The leaves have an acidulous taste and contain malates.

Penthorum sedoides, *Linné* (Ditch stonecrop), is not fleshy, has a stem about 40 Cm. (16 inches) high, lanceolate-serrate leaves, and terminal spike-like secund racemes of greenish or yellowish flowers having a five-beaked ovary. The plant is common in wet places in North America, and is used in nasal catarrh.

Action and Uses.—In man the expressed juice, in large doses, acts as an acrid emetic and purgative, and is capable of blistering the skin. Sedum was formerly in common use as a remedy for *scrofula*, and was administered internally in decoction and applied to the ulcerated skin, etc. Its emeto-cathartic action was employed in the treatment of *intermittent fever*, and also in *dropsy* and *epilepsy*, with a certain degree of success, but the plant appears to have been found more really useful when it was applied bruised or its expressed juice was used as an application to scrofulous, cancerous, and other *ulcers*, as a resolvent to enlarged lymphatic *glands*, and as a dressing for chronic *diseases of the skin*. The juice has also been used to remove *warts* and *corns*. A concentrated decoction of stonecrop in beer, administered to *diphtheritic* patients, is said to soften the membranes and cause their expulsion with vomiting (*Therap. Gaz.*, ix. 264). This mode of using it is accused of causing inordinate vomiting and pulmonary congestion, and instead of it the fluid extract may be applied at intervals of three minutes for half an hour by means of a brush, either pure or in the following mixture: ℞. Fluid ext. of sedum f℥j; oil of turpentine, lactic acid, of each f℥ij. The application tends to produce vomiting, or it may be provoked mechanically while the softened and detached membrane is expelled (*ibid.*, p. 449). The dried plant was prescribed internally in powder in the *dose* of Gm. 0.8–1 (gr. xij–xv), or a decoction was made with a handful of it in a pint of beer. The juice was given in doses of Gm. 8–12 (f℥ij–℥iij), or, as others state, of from Gm. 0.5–2 (gr. viij–xxx), in wine. Externally, the bruised fresh plant was generally preferred.

Houseleek has been described as refrigerant, astringent, antispasmodic, and detergent. Its expressed juice was once prized in *dysentery* and in *hysterical* disorders, and externally as a dressing for *ulcers* and chronic *skin diseases*, *hæmorrhoids*, etc. It is still used to soften *corns* and *warts*. Identical virtues have been ascribed to S. telephium.

S. latifolium is related to be used by the Cree Indians as a tea, and they apply the fresh-chewed leaves to wounds, etc. (*Therap. Gaz.*, viii. 398).

SELINUM.—Marsh-Parsley.

Radix olsnitii.—Sélin (Persil) des marais, Fr.; *Sumpfsilge, Elsenich*, G.

The root of Selinum (Thysselinum, *Hoffmann*, Peucedanum, *Moench*) palustre, *Linné*.
Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—This is a perennial plant indigenous to Europe, and growing in swampy and moist localities. It is about 1.2 M. (4 feet) high, has twice or thrice pinnately divided and cleft leaves with linear-lanceolate lobes, large and lax compound umbels of white flowers, and oval-oblong brown fruits.

Description.—The root is about 15 Cm. (6 inches) long, in the upper part nearly 25 Mm. (1 inch) thick, one- or several-headed, annulate above, with deep longitudinal wrinkles, grayish-brown, and with scattered whitish suberous warts. The bark is thick, spongy, and brown, and contains a circle of rather large laticiferous vessels; the meditullium is soft and often radially cleft. The root has a strong, disagreeable, somewhat terebinthinate odor and a pungent and acrid taste.

Constituents.—The chemical constituents are analogous to those of other umbelliferous roots—volatile oil, mucilage, sugar, etc. Peschier's *selinic acid* has not been further investigated.

Allied Plants. (See Heracleum, p. 812), Imperatoria (p. 864), and Levisticum (p. 935).

Action and Uses.—The juice of this plant is said to be irritating, and even caustic, in its action. Many years ago it was found to be a popular remedy for *epilepsy* in the Russian province of Courland. It afterward attracted a good deal of attention in Paris, and received for a time greater credit than it deserved. It was exhibited in powder in the *dose* of Gm. 2–4 (gr. xxx–lx), several times a day. The medicine is no longer employed in epilepsy.

SENEGA, *U. S.*—Senega.

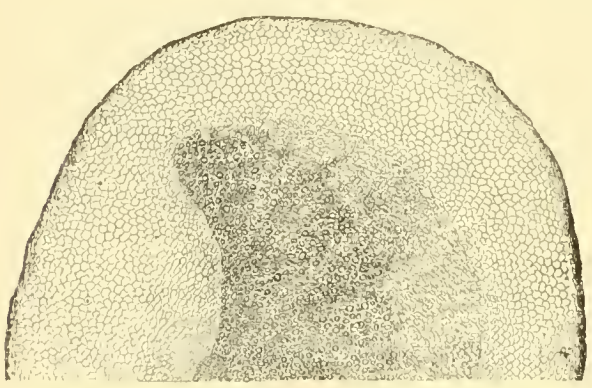
Senegæ radix, Br.; *Radix senegæ*, P. G.—*Seneka-root, Senega snakeroot*, E.; *Polygale de Virginie*, Fr. Cod; *Senegawurzel*, G.; *Polygala de Virginie*, Sp.

The root of Polygala Senega, *Linné*.
Nat. Ord.—Polygalaceæ.

Origin.—Senega is a native of North America from Canada southward to South Carolina and westward to Wisconsin. It has numerous slender stems about 30 Cm. (1 foot) high from each root. The leaves are alternate, sessile, lanceolate or oblong-lanceolate, rough on the margin, otherwise smooth, and narrowed to both ends. The flowers are nearly sessile, in slender terminal spikes, and have five sepals, of which the two lateral ones are round, petaloid, and rose-colored; the three petals are whitish. Senega flowers in May and June, and ripens its small two-celled and two-seeded capsule in July. The root is collected in autumn, mainly in the Southern and Western States.

Description.—Senega-root has a head or crown which is 12–25 Mm. (½ or 1 inch) in diameter, very knotty from the numerous thin remnants of stems, and is below contracted into the root, having a diameter

Fig. 269.



Senega-root; section showing one-sided growth of wood and inner bark, magnified 18 diameters.

Fig. 270.

Transverse sections of Senega-root.

of 4–6 Mm. (⅛ or ¼ inch). The root is 10–15 Cm. (4 or 6 inches) long, and divided into

several branches nearly uniform in thickness, which are tapering below, usually spreading, more or less tortuous, fleshy and cylindrical when fresh, but after drying twisted and furnished with a projecting ridge or keel, which runs around the root in about one spiral turn from near the base to the tip. Opposite the keel are sometimes seen irregular annulations; otherwise the root is longitudinally wrinkled. Externally, it varies in color between yellowish-gray and brownish-yellow, and is whitish internally. When cut transversely it presents a porous, yellowish radially striate ligneous portion and a thick white bark. The wood is circular near the crown, and surrrounded by bark nearly uniform in thickness. At some distance from the head the wood presents a more or less irregular appearance, being rounded on one side and only partially developed on the opposite side. The bark is seen to consist of two layers, the inner one of which is found chiefly on the rounded side of the wood, and projects more or less conically into the keel, which is therefore formed by the one-sided development of the inner bark. On soaking the root in water the outer bark swells to a greater extent than the inner layer, and the root becomes again nearly cylindrical. Senega-root has a slight odor when dry, but the liquid preparations of it have a characteristic rather nauseous odor; the taste is sweetish, and afterward persistently acrid. The root is brittle and breaks with a short fracture.

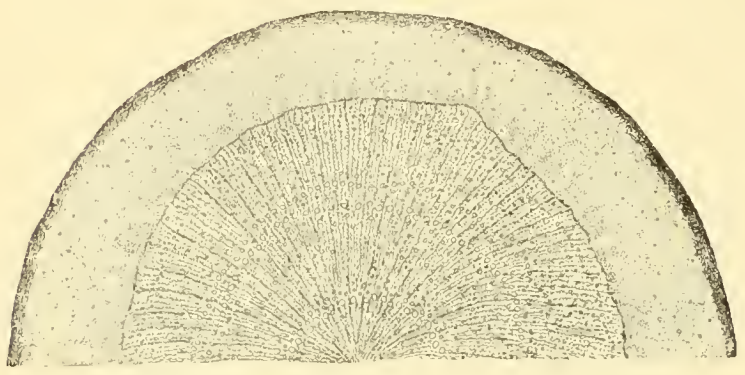
Senega-root of the above description is collected in Virginia and westward to Arkansas and Missouri, and is sometimes designated as "Southern senega." Since about 1870 senega of much larger dimensions has frequently been seen in the market; the head is often 5–8 Cm. (2 or 3 inches), and the top portion of the root sometimes 2 Cm. ($\frac{4}{5}$ inch) thick; the root is less contorted, more fleshy, and the branches show the keel often rather indistinctly. Prof. Lloyd (1881) has shown that this "Northern senega" is derived from a variety of Polygala senega growing in Minnesota and Wisconsin; from the lattter state we have also roots agreeing in every respect with Southern senega.

Constituents.—The acrid taste of senega-root is due to *senegin* (Gehlen, 1804), *polygalin*, or *polygalic acid* (Peschier, 1821). Quevenne (1836) prepared it in a nearly pure condition, and Procter (1859) obtained $5\frac{1}{2}$ per cent. of it by exhausting the root with 60 per cent. alcohol, concentrating the tincture to about one-half the weight of the root, removing coloring matter by means of ether, and mixing the syrupy liquid with strong alcohol and ether, which precipitates the polygalic acid as a light fawn-colored powder, requiring to be washed with a mixture of ether and alcohol; the mother-liquor, from which Procter obtained a small quantity of crystals, seems to contain the salt of an organic acid. Precipitation with baryta gave to Christophsohn a yield of $2\frac{1}{2}$ per cent. of white amorphous senegin. *Polygalin* of Peschier is volatile, and is contained in the aqueous distillate of the root, therefore identical with the trace of volatile oil observed by Dulong (1827). Bucholz, and afterward Bolley (1854), regarded senegin as identical with *saponin;* and this view seems to be sustained by the observations of Christophsohn (1874) and Schneider (1875). But Quevenne obtained from an aqueous solution of senegin only a slight precipitate with lead acetate, which disappeared on the addition of more of the reagent; while Rochleder and Schwarz state that saponin yields with the same salt a gelatinous precipitate, which, according to Bucholz, is soluble in acetic acid. According to Braconnot and Bussy, saponin is not precipitated by lead acetate. On the other hand, polygalic acid, like saponin, is precipitated from its aqueous solution by baryta; the products of decomposition of the two bodies by acids appear to be identical; and the gelatinous mass observed by Quevenne to be produced from his polygalic acid with cold concentrated hydrochloric acid and with boiling dilute mineral acids appears to be *sapogenin*. Evidently further investigations are required to determine the chemical relations of these bodies. According to Trommsdorff (1832) and Schneider, the activity of senega resides chiefly in the cortical portion; however, the wood of the large senega described above is quite acrid, though less so than the bark. The odor of senega is partly due to methylsalicylate, as was shown by Reuter (1889).

Liquid preparations of senega are apt to become gelatinous, which property is usually ascribed to the presence of pectin compounds, but is very likely, at least in part, due to *sapogenin*, generated under the influence of acids or of other compounds; the jelly is rendered soluble again on the addition of an alkali. Flückiger (*Pharmakognosie*, 2d edit.) obtained from powdered senega by ether 8.68 per cent. of fixed oil containing free acids, and, after saponification and acidulation of the lye, yielding a distillate having the odor of acetic and valerianic acids. The *virgineic acid* of Quevenne and the bitter principle *isolusin* of Peschier have not been investigated. Other less important constituents of senega are a little resin, 7 per cent. of sugar, malic acid, etc.

Allied Roots and Substitutions.—Polygala Boykinii, *Nuttall*, a plant growing in the Southern and South-western States of North America, has a root which has been used by Dr. J. H. Gunn (1881) in place of senega, and which has the same appearance as rather small specimens of the latter, but is destitute of the keel, and has a cylindrical wood and a thinner uniform bark. We believe this to be identical with the *white* or *false senega* which was quite common in the market for several years after 1875, but appears to be no longer met with at the present time. It was said to have been collected in Southwestern Missouri. This root yielded to George Goebel (1881), by Quevenne's process, 3 per cent. of senegin, and all preparations made with it were much lighter in color than the corresponding preparations of true senega.

Fig. 271.



False Senega: transverse section, magnified 10 diameters.

Another kind of so-called white senega which we have seen was amylaceous internally, and had none of the prominent characteristics of the pharmacopœial drug.

Ginseng-root and the rhizome of Cypripedium are sometimes found among commercial senega as accidental impurities; they do not resemble senega-root, and are easily distinguished from it. The same may also be said of the roots of Ionidium Ipecacuanha (p. 895), Cynanchum Vincetoxicum, and of valerian, which have occasionally been mentioned in Europe as adulterations of senega.

Action and Uses.—Physiological investigation of the action of senega and saponin has shed no light upon their clinical applications. They are practically useless as anæsthetics and cardiac sedatives. Nor does their mode of action help to explain the recognized utility of senega in the different forms of bronchial and pulmonary disorder in which it has been found advantageous These are, first, *typhoid pneumonia*, in which, *a priori*, a stimulant and not a sedative remedy is indicated, yet it is precisely in that affection, and not in the inflammatory form of pneumonia, that senega won its reputation, and especially in the decline of the disease, when it would seem that a stimulant expectorant is called for. In like manner senega is useful in *bronchorrhœa* and in chronic *bronchitis* with profuse expectoration. Even in *croup* (spasmodic laryngitis) it is most appropriate after the inflammatory stage with spasm has passed and the affection has become a simple catarrhal laryngitis. In like manner, when it was prescribed in the treatment of *amenorrhœa*, the cases in which it seems to have done good were those of passive and not of active congestion of the uterine system. The diuretic operation of senega is too inconsiderable to constitute it a trustworthy remedy in any form of dropsy.

The *dose* of powdered senega is from Gm. 0.60–1.30 (gr. x–xx). The fluid extract is officinal.

SENNA, *U. S.*—Senna.

Folia sennæ, P. G.; *Senna Alexandrina and S. Indica*, Br.—*Senna-leaves*, E.; *Feuilles de séné*, Fr.; *Sennesblätter*, G.

The leaves of Cassia acutifolia, *Delile*, and of C. angustifolia, *Vahl*. Bentley and Trimen, *Med. Plants*, 89, 90, 91.

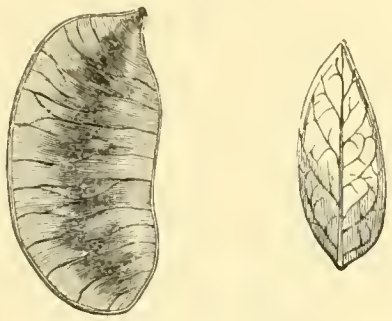
Nat. Ord.—Leguminosæ, Cæsalpineæ.

Origin.—The subgenus Senna of the genus Cassia is regarded by some botanists as a distinct genus, characterized by the absence of glands from the common petiole of the leaves, by the axillary racemose inflorescence, and by the flat, broad, papyraceous legumes, which are indehiscent, cleft on the margin at maturity, and contain near the middle the small triangular or truncately wedge-shaped seeds attached to a long funiculus. The senna-yielding species are small shrubs 60–90 Cm. (2 or 3 feet) high, have small, persistent stipules and axillary racemes of yellow flowers.

Cassia acutifolia, *Delile* (C. lanceolata, *Nectoux*, C. Senna β, *Linné*, C. orientalis, *Persoon*, C. lenitiva, *Bischoff*, Senna acutifolia, *Batka*). It is found in Upper Egypt and southward to Nubia, Sennaar, and Kordofan, and farther westward in tropical Africa. The leaflets are mostly in four or five pairs, are from 2–3 Cm. ($\frac{4}{5}$ to $1\frac{1}{5}$ inches) long, and about 1 Cm. ($\frac{2}{5}$ inch) broad, vary in shape between oval, lance-oval, and lanceolate, and

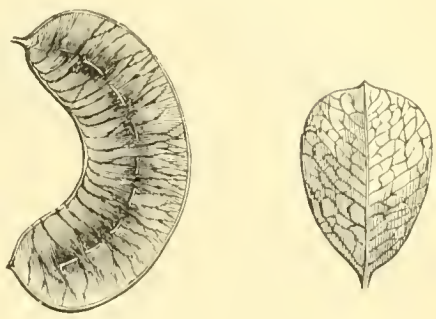
are acute or rather pointed, mucronate, on the under side somewhat hairy or nearly smooth, and are rather thick in texture. The stipules are subulate, and the fruit is broadly oblong, slightly bent, about 5 Cm. (2 inches) long, and contains about six seeds.

Fig. 272.



Cassia acutifolia, *Del.*

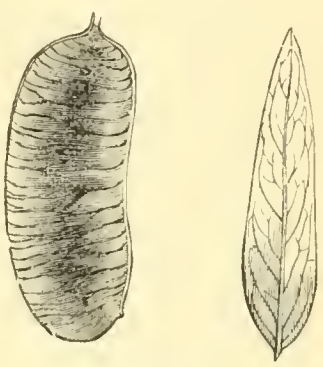
Fig. 273.



Cassia obovata, *Colladon.*

Cassia angustifolia, *Vahl* (C. elongata, *Lémaire*, C. lanceolata, *Wight et Arnott*, C. acutifolia, *Nees*, C. medica, *Forskal*, C. medicinalis, *Bischoff*, Senna officinalis, *Roxburgh*, S. angustifolia, *Batka*). It is found in South-western Arabia, along the Somali coast of Africa, and eastward in Northern India. The leaflets are in four to eight pairs, are from 25 to 50 Mm. (1 to 2 inches) long, 12–19 Mm. (½ to ¾ inch) broad, vary in shape from narrow-lanceolate to lance-ovate and oblong-ovate; are narrowed above to the mucronate apex, slightly pubescent, and beneath somewhat glaucous. The stipules are narrow, and the legumes oblong or oval, about 5 Cm. (2 inches) long, and contain about eight seeds. Batka distinguishes three varieties—namely *α dilatata* (*α* genuina, *Bischoff*), the leaflets broadest above the base and in the middle, and gradually tapering to the apex; *β arcuata* (*β* Royleana, *Bischoff*), the leaflets narrowed at the base, broadest below the middle, and more pointed and thinner than in the preceding variety; *γ genuina* (*γ* Ehrenbergii, *Bischoff*), the leaflets narrower than the preceding varieties, linear-lanceolate, and pointed. The variety *β* seems to be a form produced by cultivation at Tinnevelly in Southern India.

Fig. 274.



Cassia elongata, *Lêm.*

Cassia obovata, *Colladon* (C. Senna, *Forskal*, C. obtusa, *Wallich*, C. obtusata, *Hayne*, Senna obovata, *Batka*). It is found in Arabia and in Africa from Egypt southward, in Nubia, Abyssinia, and Southern Africa, and westward to Tripoli and Senegal. The leaflets are in four to seven pairs, obovate or oblong obovate, mucronulate, clothed with few appressed hairs or nearly smooth. The stipules are linear-lanceolate, acute and rigid, and the legume is curved, rounded at both ends, 38 Mm. (1½ inches) long, and contains about ten seeds. Batka distinguishes three varieties: *α genuina*, with the leaflets rounded or mucronulate at the apex; *β obtusata*, with the leaflets more blunt; and *γ platicarpa*, with shorter racemes and broader and less curved legumes than the preceding. C. obovata is cultivated, and has been naturalized in Jamaica. It is mentioned by the British Pharmacopœia as one of the sources of Alexandria senna, but its leaflets are now rarely met with in the drug.

Collection.—In Nubia the collection of senna appears to be carried on in the same manner now as it was at the time when Nectoux visited that country near the close of the last century. In the month of September, after the termination of the rains, the natives cut down the shrubs and dry them on the rocks in the sun, after which they are stripped. The leaves are then packed in bags made of palm-leaves and transported by camels to the Nile, and thence to Cairo and Alexandria, from which port the drug derives its name and finds its way into commerce. A second crop, which is frequently very limited, is obtained about the middle of March, when the fruit ripens.

Description.—The pharmacopœial varieties of senna are—

1. Alexandria Senna. This variety has been very variable in quality, and sometimes much broken up and mixed with leaf-stalks and fragments of the branches. Leaflets of the three species of Cassia described above have at times been observed in the commercial article, but of late years the drug consisted chiefly of the leaflets of C. acutifolia, to the exclusion of the other species. Recently, however, we have seen

samples containing again, to a limited extent, the leaflets of C. obovata, which is called by the Arabs *senna baladi* (*wild senna*), and is regarded in Egypt as much less valuable than the *senna jabeli* (*mountain-senna*), the C. acutifolia. Alexandria senna requires to be freed from argel-leaves (not by *P. G.*) and from discolored leaves, and frequently needs sifting and picking in order to separate stalks, foreign leaves, fruits, and earthy impurities (see below). Including finely-broken leaves, such impurities amount sometimes to from 40 to nearly 60 per cent. of the weight of the drug. Alexandria senna is of a pale-green color, of a thickish texture, plainly veined, finely hairy, mainly on the midrib, and possesses a somewhat tea-like odor and a mucilaginous afterward bitterish and nauseous taste. Like the other varieties of senna, the leaflets are oblique and uneven toward the base.

Fig. 275.

Tripoli Senna: leaflets and legumes.

Identical with the preceding in its botanical origin is *Tripoli senna*, which comes by caravans from the interior of Africa to Tripoli, but rarely reaches this country. It is frequently much broken up, and even discolored, but otherwise free from foreign leaves, though not from other impurities, including legumes, stalks, and earthy matters.

Fig. 276.

Solenostemma argel, *Hayne*.

2. India senna consists solely of the leaflets of C. angustifolia, but is met with of different qualities, the handsomest being—

Tinnevelly senna. It is the kind recognized by the Br. P. as Senna Indica, and consists of the carefully-dried and fully-matured leaflets of the variety arcuata, which are dull-green in color, smooth or slightly pubescent beneath, and are free from stalks, legumes, broken or discolored leaves, and other impurities. Their odor is similar to that of Alexandria senna, but the taste is more mucilaginous and less nauseous.

East India or *Bombay senna* has the same origin, but is less carefully dried, and frequently contains smaller and somewhat discolored leaflets. It is not unfrequently sold here as Tinnevelly senna.

Arabian or *Mecca senna*, also sold as *Bombay senna*, is collected and dried with still less care, and is often mixed with brown leaflets and with legumes.

Allied Drugs and Admixtures.—Cassia (Senna, *Batka*) pubescens, *R. Brown*, s. C. Schimperi, *Steudel*. The leaflets are about 25 Mm. (1 inch) long, oval or ovate, obtuse, mucronate, soft-hairy on both sides, and ciliate on the margin. They have occasionally been met with in Mecca senna.

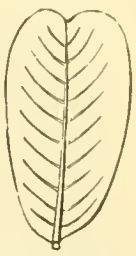
Cassia brevipes, *De Candolle*. The leaflets were sent from Central America to Great Britain in 1875; they resemble India senna, but have three veins running nearly parallel from the base to the blunt apex, and their infusion was found by Holmes to be destitute of purgative properties.

Cassia marilandica, *Linné* (*U. S.* 1870); Folia sennæ Americanæ.—Séné Américain, *Fr.*; Amerikanische Senna, *G.* Bentley and Trimen, *Med. Plants*, 88.—This perennial plant is found in low grounds and along streams from the New England States and New York south to the Carolinas and west to the Mississippi. It produces erect branching stems .9–1.5 M. (3 to 5 feet) high, and has pinnate leaves on petioles 25–50 Mm. (1 to 2 inches) long and with a nearly sessile gland near the base on the upper side, six to nine pairs of leaflets, numerous pedunculate erect racemes near the top of the branches, showy yellow or whitish flowers with dark veins, and legumes which are finally smooth, linear, compressed, often curved, and somewhat sinuate on the raised edges; the ovate oblong seeds are separated by transverse dissepiments. It flowers in August and ripens its fruit in October. It belongs to the subgenus Chamæsenna, which differs from senna mainly in the narrow glands upon the petioles and in the dehiscent legumes. The leaflets are 25 or 50 Mm. (1 to 2 inches) long, about 12 Mm. (½ inch) wide, on short foot-stalks, smooth, ovate oblong to elliptic, uneven at the base, green above and paler beneath. Collected in summer, the leaflets have an herbaceous odor, but if collected in September or the beginning of October, after the plant is out of bloom, they acquire a distinct senna odor. They are thinner in texture and larger than Alexandria senna, and lose on drying about 70 per cent. of moisture. The analyses of J. J. Martin (1835) and E. L. Perot (1855) did not throw any light upon the active principle, assuming that the leaves contain such. The usual constituents of leaves, a

minute quantity of volatile oil, some fat, resin, mucilage, etc., were found, in addition to a complex body resembling the formerly so-called cathartin of senna.

Solenostemma (Cynanchum, *Delile*) Argel, *Hayne*, s. Cyn. oleæfolium, *Neetoux* (nat. ord. Asclepiadaceæ). The leaves constitute the principal adulteration of Alexandria senna, aside from stalks and earthy admixtures. They resemble senna-leaves closely in size, shape, and color, but are readily distinguished by the indistinctness of their lateral veins and by their even base; they are also more leathery in texture, have a wrinkled surface, are grayish-green, pubescent, and of a decidedly bitter taste. They are often accompanied by the flower-buds of the same plant, by the whitish flowers, or occasionally by the slender pear-shaped fruit, which is 38 Mm. (1½ inches) long, and contains numerous hairy tufted seeds. The plant inhabits Upper Egypt, but is never collected with senna, the addition being made to supply the demand.

Fig. 277.



Tephrosia apollinea, *De C.*

The leaflets of Tephrosia (Galega, *Delile*) apollinea, *De Candolle*, a leguminous plant of Southern Europe, are said to have been sometimes noticed as an adulteration of senna; they are somewhat uneven at the base, but their shape is obovate and they are emarginate at the apex.

The leaves of Coriaria are described on page 543, and the leaflets of Colutea on page 526; they are rarely, if ever, met with now as adulterations of senna.

Globularia Alypum, *Linné* (nat. ord. Globulariaceæ). The shrub is indigenous to Southern Europe; the leaves, which are used as a substitute for senna, are nearly sessile, obovate-oblong, entire or slightly toothed, finely granular, and on the lower side bluish-green. Walz found in the leaves a peculiar tannin and an amorphous bitter principle, *globularin*, which is precipitated by tannin, is soluble in water, alcohol, ether, and chloroform, and is a glucoside. Heckel and Schlagdenhauffen (1882) found its composition to be $C_{15}H_{20}O_8$, and that of its decomposition-product, globularetin, C_9H_6O; the latter, heated with alkalies, yields cinnamic acid, which also exists in the leaves, together with mannit, wax, etc.

Constituents.—Senna-leaves have been frequently subjected to analysis, but the results are even at the present time not entirely satisfactory. Lassaigne and Feneuille's *cathartin* was found by Heerlein (1843) to be destitute of active cathartic properties. Winckler (1840) obtained the bitter principle again in an impure state; but in the same year *chrysoretin* was isolated by Bley and Diesel, and this substance was subsequently (1857) pronounced by C. Martius to be identical with *chrysophanic acid*, and to be mixed with *phæoretin* and fatty acids. Bourgoin (1871) ascertained cathartin to be free from cathartic acid, but to be a mixture of sugar, chrysophanic acid, and *chrysophanin*, which latter is white, soluble in water, insoluble in alcohol, and is not precipitated by lead acetate. Ludwig (1864) obtained an acrid and a bitter principle, both of which are absorbed by charcoal, but *sennacrol* is soluble and *sennapicrin* is insoluble in ether. From the investigations of Dragendorff and Kubly (1866) and Groves (1868) there can be no doubt that the cathartic properties of senna reside mainly, if not exclusively, in the calcium and magnesium salts of *cathartic acid*, which are insoluble in alcohol, but soluble in water, and may be obtained by precipitating a concentrated infusion of senna with an equal bulk of absolute alcohol: the liquid filtered from the precipitated mucilage and salts is mixed with more absolute alcohol as long as a precipitate is produced. This precipitate is washed with alcohol, dissolved in a little water, freed from albumen by a few drops of hydrochloric acid, the filtrate completely precipitated by the addition of more hydrochloric acid; the impure cathartic acid thus obtained is purified by dissolving in 60 per cent. alcohol and precipitating by ether. T. B. Groves (1868) takes advantage of the colloidal properties of cathartic acid, and purifies it by dissolving the crude cathartate in moderately strong hydrochloric acid and subjecting the solution to dialysis on a diaphragm of parchment-paper. Thus obtained, cathartic acid contains nitrogen and sulphur, and is a brown, and after drying a black, amorphous substance, which is insoluble in water, but dissolves in alkalies, from which solutions it is again precipitated by acids. The cathartates of the alkalies and alkaline earths are soluble in water, but insoluble in alcohol. On boiling the alcoholic solution of cathartic acid with hydrochloric acid it yields 34 per cent. of glucose and 65 of *cathartogenic acid*, which is a yellowish-brown powder insoluble in water and ether. According to Groves, the long-continued action of heat on cathartates exposed to air in watery solution decomposes them, rendering them inert; organic acids, added to the aqueous solutions of cathartates, precipitate cathartic acid, but, unlike the mineral acids, do not decompose it on boiling. Dragendorff and Kubly obtained also a dextrogyrate saccharine substance, *cathartomannit*, in verrucose crystals, and regard the yellow coloring matter as similar to, but distinct from, chrysophanic acid; it is probably the glucoside *chrysophan*. (See Rheum.) Keussler (1878) prepared from senna chrysophanic acid and inactive cathartomannit. L. Siebold (1875) found that senna-leaves treated with strong alcohol are rather less purgative

than the unextracted leaves, but he confirmed the earlier observations, that the alcoholic extract is destitute of such action, though it contains the griping principles. Diehl (1875) made similar observations.

Pharmaceutical Uses.—Species laxantes, *P. G.* Senna-leaves 16 parts, elder-flowers 10 parts, fennel and anise each 5 parts, are cut, bruised, and mixed with 4 parts of cream of tartar. A uniform mixture cannot thus be obtained, since the powdered cream of tartar separates readily; it is therefore recommended by Thanisch to moisten the unbruised fennel and anise with simple syrup, and then to mix them with the cream of tartar, which after drying will adhere. Another advantage is that the volatile oils will then not be exposed to the air.

Species laxantes St. Germain. The formula is practically identical with the preceding, except that senna-leaves, previously exhausted by alcohol, are used.

Action and Uses.—In man an infusion of senna injected into the veins has occasioned both vomiting and purging (Wibmer; Mitscherlisch); but Mr. Stockman administered, subcutaneously and by the jugular vein, large doses of cathartic acid without causing purgation (*Am. Jour. Phar.*, lvii. 261). Some persons are so susceptible to the action of senna as to be purged even by its odor or by that of its infusion. It renders the milk of a nursing woman purgative to her infant. It is very apt to create flatulence, nausea, and colic unless associated with some lenitive or aromatic substance. It produces yellow stools, and its action is not followed by constipation. It never occasions hypercatharsis. Its operation is said to be promoted by bitter medicines, such as colombo, and hence it is a valuable purgative when constipation is associated with debility of the bowels. Cathartic acid has a sour and somewhat astringent taste. It passes through the system without decomposition, and affects the milk of nursing women like senna itself. In the dose of Gm. 0.10–0.20 (1½ to 3 grains) it occasions griping and liquid yellow stools. Therapeutists of last century employed the leaf-stalks and the seed-pods of senna as milder purgatives than the leaves. The use of the pods has been recently revived by Macfarlane (*Lancet*, July, 1889, p. 164), who claims that the infusion of them is almost free from taste and smell, and, though slower in their action than the leaves, do not cause griping or flatulence. Senna-leaves treated by alcohol to exhaust them of their resinous and odorous principles, to which their griping and nauseous taste are due, retain their cathartic action in part, but to a less degree than the pods possess it (*Am. Jour. Phar.*, lxi. 581).

The uses of senna were learned from the Arabians, who employed it in various local affections, especially of the skin. Their later authorities refer to its tendency to gripe, to obviate which they recommended its association with violets, prunes, and other lenitives. Even now it is seldom given alone, but generally with some corrective of its griping qualities, as with coriander in the simple infusion, or with tamarinds, or with Epsom or Rochelle salt, manna, and fennel-seed, as in the infusion known as the "black draught." Care should be taken not to let the leaves macerate too long, nor to compress them when the liquid of the infusion is decanted, lest their acrid principle be taken up and produce griping. The *dose* of either of these infusions is Gm. 64–128 (f℥ij–iv), repeated every two or three hours until its purgative effects begin to be felt. The infusions are better purgatives than the simple tincture, for water extracts from senna a larger proportion of its purgative principle than alcohol. An excellent laxative is the compound powder of liquorice, whose active ingredient is senna, as it also is of "Tamar Indien."

American senna is identical with Alexandria senna in the mode of its operation, but a dose one-third larger of it is required. At best, it is but a poor substitute for the African drug.

SERPENTARIA, *U. S.*—Serpentaria (Virginia Snakeroot).

Serpentariæ rhizoma (*radix*), Br.—*Serpentaire* (*Vipérine*) *de Virginie*, F. Cod.; *Virginische Schlangenwurzel*, G.; *Serpentaria de Virginia*, Sp.

The rhizome and rootlets of Aristolochia (Endodeca, *Klotzsch*) Serpentaria, *Linné*, and of Aristolochia reticulata, *Nuttall*. Bentley and Trimen, *Med. Plants*, 246.

Nat. Ord.—Aristolochiaceæ.

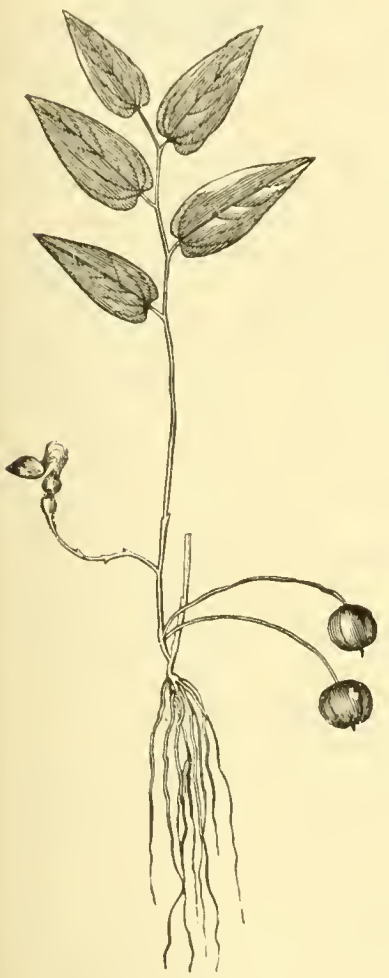
Origin.—The two plants from which Virginia snakeroot is derived are perennial herbs, with slender erect zigzag stems about 30 Cm. (12 inches) high, alternate cordate or cordately-ovate leaves, and with purple flowers, which grow on slender flexuose branches from the lower nodes, and have the tube of the perianth inflated at both ends and bent like the letter S. Arist. Serpentaria has the leaves petiolate, pointed, thin, and somewhat

pubescent, and is found in rich woodlands from Connecticut westward to the Mississippi, and southward in the middle and southern part of the United States; it is not common except near the Alleghany Mountains. The variety hastata (Aris. sagittata, *Muhlenberg*, Ar. hastata, *Nuttall*) is smaller, more slender, has narrow lance-oblong auriculate leaves, and grows in South Carolina and westward. Arist. reticulata has the leaves subsessile, obtuse, thickish, reticulate, and hirsute, and is indigenous to Louisiana and Texas.

Description.—Virginia snakeroot consists of a rhizome which is about 25 Mm. (1 inch) long, 3 Mm. ($\frac{1}{8}$ inch) thick, is bent up and down, and bears on the upper side the short approximate stem-remnants, which are flat or slightly convex above; below and on the sides are numerous thin branching rootlets, 7–15 Cm. (3 to 6 inches) long, and matted together. It is of a dull yellowish-brown color, and has an aromatic camphoraceous odor and a bitterish, aromatic, camphoraceous, and somewhat terebinthinate taste. The drug derived from Ar. reticulata is sometimes distinguished in commerce as *Red River* or *Texas snakeroot;* it closely resembles the preceding, but has a somewhat thicker rhizome and coarser, rather longer, and less interlaced rootlets. On transverse section the rhizome is seen to consist of a thin bark containing some oil-cells, and an eccentric wood with broad, slightly-curved medullary rays, and enclosing a pith which is near the upper side. The rootlets have a thick bark containing scattered oil-cells and a thin angular central ligneous cord.

Constituents.—Bucholz (1807) determined the presence in serpentaria of about $\frac{1}{2}$ per cent. of volatile oil and of resinous, extractive, and mucilaginous matters. The *volatile oil* is brownish-yellow, lighter than water, and has an odor and taste resembling those of a mixture of valerian and camphor. The *bitter principle* was obtained by Chevallier (1820) by precipitating the decoction with lead acetate, exhausting the precipitate with hot alcohol, evaporating, and treating the residue with water, which dissolves the bitter principle. Feneulle (1826) found the bitter principle in the filtrate from the precipitate occasioned in the decoction by lead acetate. It is yellow, amorphous, soluble in water and alcohol, yields precipitates with tannin and various metallic salts, and appears to resemble the bitter principle contained in the rhizome of Aristolochia Clematitis, *Linné*. A small quantity of tannin, malic acid, albumen, sugar, and other common constituents are also contained in serpentaria. According to T. S. Wiegand (1844), Red River snakeroot has the same constituents, but is more mucilaginous and yields a somewhat larger proportion of volatile oil.

Fig. 278.



Aristolochia serpentaria, *Linné.*

Impurities and Adulterations.—As found in commerce, serpentaria frequently has portions of the stem attached, sometimes with leaves and with the six-sided and six-celled capsules. Ginseng-root and the rhizomes of cypripedium and of hydrastis are occasionally met with as accidental impurities, but Milleman (1874) also observed hydrastis as an evident intentional adulteration of serpentaria. Spigelia is occasionally used for the same purpose. All these impurities and adulterations may, however, be easily identified from the characters of these drugs, as described elsewhere.

Fig. 279.

Rhizome with rootlets.

Fig. 280.

Transverse section of rhizome.

Action and Uses.—In large doses it occasions nausea, eructation, vomiting, and flatulence, but not diarrhœa; it gives rise to some fulness of the head and quickens the circulation. In certain states of the system it promotes perspiration, but experiments with it on healthy persons give no indication of its virtues in disease. They are manifested in *typhus* and *typhoid fever*, and in the *typhoid state* generally, whenever the pulse is feeble or irregular, the skin cool and clammy, the mouth fuliginous, the eyes injected and dull, and the mind delirious or stupid. When, in addition, the urine and fæces are dark and fetid, the skin covered with ecchymoses, etc., serpentaria is indicated, and with it cinchona and alcohol. Such an association of medicines exists in the compound tincture of cinchona, which from the days of Huxham, who invented it, has been an habitual remedy in these affections. In *typhoid pneumonia* serpentaria is much relied on, and also in low forms of *diphtheria*. The fluid extract is stated to be an excellent topical application for *poisoning* by *Rhus toxicodendron*.

Aristolochin (Pohl) is said to produce uræmic intoxication in warm-blooded animals.

The *dose* of serpentaria in powder is Gm. 0·60–2 (gr. x–xxx). The infusion, which is official (*Br.*), is the best simple preparation of the medicine, but the fluid extract, the tincture, and especially the compound tincture, are much more commonly employed.

SEVUM, *U. S.*—Suet; Mutton Suet.

Sevum præparatum, Br.; *Sebum ovile* (*ovillum*), P. G.—*Suif de mouton*, Fr. Cod.; *Talg*, *Hammeltalg*, G.; *Sibo de carnero*, Sp.

The internal fat of the abdomen of Ovis Aries, *Linné*, purified by melting and straining.

Class Mammalia. *Ord.* Ruminantia.

Origin.—The domesticated sheep is by zoologists considered to be a variety either of the *argali* of Siberia, Ovis Ammon, *Linné*, or of the South European *muflon*, Ovis Musimon, *Linné*. The part employed is the internal fat of the abdomen, which is cut into small pieces, melted by the aid of a moderate heat, and strained (*prepared suet*).

Properties.—Mutton suet is a white, smooth, solid, nearly inodorous fat, which on exposure to air gradually becomes rancid. It has a neutral reaction and bland taste, melts between 44° and 50° C. (111.2° and 122° F.), and congeals between 37° and 40° C. (98.6° and 104° F.), with a rise of temperature of nearly 5° C. (39° F.), fresh suet having the lower melting- and congealing-point. It dissolves in 44 parts of boiling alcohol of specific gravity 0.820, but is insoluble in cold alcohol; on warming equal parts of suet and alcohol, agitating thoroughly, and afterward cooling, the clear alcoholic liquid does not become turbid on the addition of water (absence of fat acids). According to Lecanu, suet requires over 60 parts of cold ether for solution; it is slowly soluble in 2 parts of benzin, and crystallizes again from this solution on keeping it for some time in a closed vessel.

Composition.—According to Chevreul and Heintz, mutton suet consists of 70 per cent. of *stearin* and *palmitin*, 30 per cent. of *olein*, and a trace of *hircin*; the latter is the glyceryl compound of *hircic acid*, which is a colorless oil, of a peculiar goat-like and acetous odor, has a strong acid reaction, and is freely soluble in alcohol. The olein prepared by expressing the suet is nearly colorless, has a slight odor, and dissolves in about 1½ parts of boiling absolute alcohol.

Action and Uses.—Suet, when perfectly fresh, forms a suitable dressing for blistered and other excoriated surfaces, but it is very apt to grow rancid, and is then decidedly irritant. It is used as an ingredient of various ointments, cerates, and plasters, and gives them a firmer consistence than they would derive from lard.

SINAPIS ALBA, *U. S.*—White (Yellow) Mustard.

Semen crucæ.—*Moutarde blanche*, Fr.; *Weisser Senf*, G.; *Mostaza blanco*, Sp.

The seed of Brassica (Sinapis, *Linné*, Leucosinapis, *Spach*) alba, *Hooker filius et Thompson*. Bentley and Trimen, *Med. Plants*, 23.

SINAPIS NIGRA, *U. S.*—Black Mustard.

Sinapis nigræ semina, Br.; *Semen sinapis*, P. G.—*Moutarde noire*, Fr. Cod.; *Schwarzer Senf*, G.; *Mostaza negra*, Sp.

The seed of Brassica (Sinapis, *Linné*) nigra, *Koch*, s. Brassica sinapiodes, *Roth*. Bentley and Trimen, *Med. Plants*, 22.

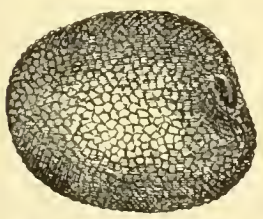
Nat. Ord.—Cruciferæ, Siliquosæ.

Origin.—Both white and black mustard have escaped from cultivation in the United States, and are sometimes found wild here. Both are indigenous to Southern Europe and Western Asia, and now grow as weeds throughout a great portion of Europe and Middle Asia, black mustard extending farther to the north, and white mustard farther eastward to China. The two plants are annuals, and have thin, branching, spindle-shaped roots, lyrate-pinnatifid lower leaves, compact and finally elongated racemes of yellow flowers, and beaked three- to six-seeded pods. *White mustard* is retrorsely hairy, has the upper leaves stalked, three-lobed and toothed, and the pods hairy, ascending, beaded by the seeds, and furnished with a prominent sword-shaped beak, containing a seed at its base. *Black mustard* is larger, .9 or 1.2 M. (3 or 4 feet) high, smooth above, has the upper leaves slightly toothed or entire, and produces smooth linear pods which are appressed to the axis and furnished with a short beak.

White and black mustard-seeds, powdered and mixed, are admitted by the British Pharmacopœia together as *sinapis*, but separately by the U. S. and French Pharmacopœias. The German Pharmacopœia recognizes black mustard-seed alone as *Semen sinapis.*

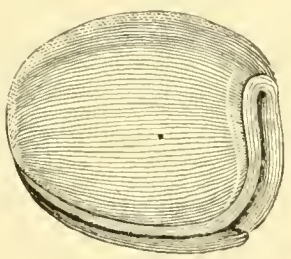
Description.—1. White Mustard-seed. The seeds are globular or nearly so, about 2 Mm. ($\frac{1}{12}$ inch) in diameter, weigh about .005 Gm., and are on one end marked with a small circular hilum and on the inner side with two shallow grooves. The testa is of a yellowish or pale grayish-brown color, very finely pitted and somewhat rough.

Fig. 281.



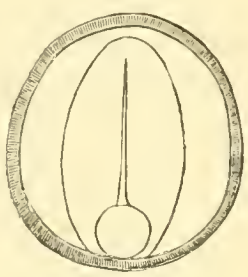
Black Mustard-seed: entire, magnified.

Fig. 282.



Embryo.

Fig. 283.



Transverse section.

The seed is inodorous, but when masticated has a pungent and acrid taste. Its internal structure is identical with that of the next.

2. Black mustard-seed resembles the preceding in shape, but has only a diameter of 1 Mm. ($\frac{1}{25}$ inch) and an average weight of .001 Gm., is blackish-brown or deep reddish-brown, has the testa covered with shallow pits, and when crushed and macerated with water acquires a strong and pungent odor.

Both seeds, after the integuments have been removed, contain an embryo having the shape of the seed, the cotyledons of which are folded along their midribs, one covering the other, while the radicle is turned back and enclosed between the folds of the inner cotyledon. This arrangement is well shown on a transeverse section of the seed, which exhibits on one side the round radicle near and between the edges of the plano-convex folds of the inner cotyledon, and these are surrounded by the concavo-convex folds of the outer cotyledon. In both seeds the embryo is yellow and very oily, and imparts to the powder of white mustard a dull pale-yellow, and to that of black mustard a yellowish-green color.

Constituents.—Both seeds are free from starch, and when crushed and subjected to pressure yield from 20 to 25 per cent. of a yellow or brownish-yellow fixed oil, which congeals between — 15° and — 17.5° C. (5° and .5° F.) to a butyraceous mass. This *fixed oil of mustard* does not readily turn rancid, has a bland taste, and consists of olein with some stearin and the glycerides of *erucic acid*, $C_{22}H_{42}O_2$, and of *behenic acid*, $C_{22}H_{44}O_2$ (p. 1154), but when expressed between heated plates from black mustard it has to some extent the pungent odor and taste of these seeds after maceration in water. The oils have the specific gravity 0.916, and give with sulphuric acid a green or blue-green afterward brown color, and with fuming nitric acid a red color. Erucic or *brassic* acid forms white shining tasteless needles which fuse at about 34° C. (93.2° F.). It was discovered by Darby (1849), who isolated also another fatty acid, *sinapoleic acid*, which, according to Städeler (1853), has the formula $C_{20}H_{38}O_2$. The two kinds of mustard-seed contain a considerable amount of mucilage in the epidermis, and various proteids, the most interesting of which is *myrosin;* and this is obtainable, according to Bussy (1839), from

the cold infusion of white mustard by concentrating it below 40° C. (104° F.) and precipitating the syrupy liquid with not too large a quantity of alcohol. Myrosin acts as a ferment upon two distinct principles, one being contained in white and the other in black mustard, and yields among their products of decomposition those compounds to which the acrid and pungent properties of both seeds are due. Myrosin is coagulated by heat and by alcohol; hence black mustard introduced into boiling water does not yield the volatile oil. Both mustard-seeds yield from 4 to 5 per cent. of ash, containing 37.4 per cent. of phosphoric acid.

The principle of white mustard yielding the acrid compound was fully investigated by H. Will (1870), and named by him *sinalbin*, $C_{30}H_{44}N_2S_2O_{16}$. It had been previously obtained in a nearly pure state, and was experimented with by Henry and Garot, Bontron, Robiquet, Winckler, Babo, and others, being described as *sinapine sulphocyanate*, *sulpho-sinapisin*, *sinapin*, and under various other names. Sinalbin is obtained from white mustard which has been deprived of its fixed oil by exhausting it with boiling alcohol, from which it crystallizes on cooling. When pure it forms small glass-like inodorous bitter prisms which are freely soluble in water, but sparingly soluble in cold alcohol, and insoluble in ether, oil of turpentine, and carbon disulphide; it is perfectly neutral, is not colored by ferric chloride, yields white precipitates with corrosive sublimate and silver nitrate, is colored yellow by traces of alkalies, and by myrosin is decomposed into sugar, acid, *sinapine sulphate*, $C_{16}H_{23}NO_5.H_2SO_4$, and *acrinyl sulphocyanate*, $C_7H_7O.NCS$. This last compound is obtainable by agitating the aqueous liquid with ether, on the evaporation of which it remains as a nearly colorless, thick, non-volatile oil, which is readily soluble in alcohol and ether, has a sweetish, afterward acrid and biting taste, and possesses epispastic properties; it is not colored red by ferric chloride until after its alcoholic solution has been heated with an alkali and again acidulated. *Sinapine* is an alkaloid which has not been isolated, since it is readily decomposed; the solution of its salts are colored yellow by alkalies, and on boiling the mixtures yield a strong base, *sinkaline* and *sinapic acid*, the barium salt of which is nearly insoluble in cold water; Van Babo and Hirschbrunn (1852) gave these two compounds the formulas $C_5H_{13}NO$ and $C_{11}H_{12}O_5$.

A principle analogous to sinalbin exists in black mustard, and was recognized by Bussy as a peculiar acid, *myronic acid*, combined with potassium. Although he observed also volatile oil of mustard among its products of decomposition by myrosin, the exact composition and behavior of *potassium myronate*, for which Will (1870) proposed the name *sinigrin*, were not ascertained until investigated by Will and Körner (1863). Sinigrin is obtained from black mustard exhausted with boiling strong alcohol by treating it with cold water, adding a little barium carbonate to the infusion, evaporating to a syrupy consistence, and boiling this residue repeatedly with 85 per cent. alcohol, on the evaporation of which sinigrin is left. The yield is .5 to .6 per cent. When pure it is in white, silky, inodorous needles, or, if crystallized from water, in short glass-like prisms, has a cooling bitter taste, dissolves in water, is insoluble in chloroform, ether, and benzene, and nearly insoluble in absolute alcohol. When treated with myrosin it is decomposed into *allyl sulphocyanate* or *volatile oil of mustard*, C_4H_5NS (see page 1154), acid potassium sulphate, $KHSO_4$, and sugar. The analogous decompositions of the peculiar principles of white and black mustard are explained by the following equations:

$$\text{Sinalbin, } C_{30}H_{44}N_2S_2O_{16} = C_8H_7NSO + C_{16}H_{25}NSO_9 + C_6H_{12}O_6.$$
$$\text{Sinigrin, } C_{10}H_{18}NS_2KO_{10} = C_4H_5NS + HKSO_4 + C_6H_{12}O_6.$$

Adulterations.—Mustard-seed is not subject to adulteration, but ground mustard is very often mixed with various farinaceous substances, and the cold decoction will then acquire a blue or greenish tint on the addition of an aqueous solution of iodine. Ground white mustard has a dull gray-yellow color, which is often rendered brighter by the addition of turmeric; it will then respond to the test for starch, and will acquire a red-brown color with solution of boric acid or of borax.

Allied Plants.—Brassica (Sinapis, *Linné*) juncea, *Hooker filius*, is extensively cultivated in Southern Russia, and constitutes the *Sarepta* or *Russian mustard*. It is likewise cultivated in Africa and India, and is exported from the latter country to Europe. The seeds closely resemble those of black mustard and yield the same products.

Br. sinapistrum, *Boissier*, s. Sinapis arvensis, *Linné*, called *charlock*, is a European annual, and a troublesome weed in some parts of the United States, and has nearly smooth, dark-brown seeds, which are smaller and less pungent than those of black mustard.

Br. campestris, *Linné*, is extensively cultivated in several varieties, the principal ones being

Br. Napus, with glaucous foliage, and Br. Rapa, with green foliage; they yield the various kinds of *turnip*, and the seeds, which are respectively 2 and 1.5 Mm. ($\frac{1}{12}$ and $\frac{1}{16}$ inch) thick, and less pungent than black mustard-seed, are used for obtaining the bland yellowish *rape-seed* and *colza oil* (Huile de navette, de colza, *Fr.*: Rüböl, Rapsöl, Kohlsaatöl, *G.*). These oils are brownish or greenish-yellow, have a somewhat acrid taste, are more bland after refining, yellow, of about the spec. grav. 0.913, congeal near —5° C. (23° F.), and are colored green-brown or brownish-yellow by sulphuric acid.

Raphanus raphanistrum, *Linné*, is a weed known as *wild radish* and *jointed charlock*. According to Pless (1846), the seeds contain also oil of mustard, but the sulphuretted volatile oil obtained from the *garden radish*, Raphanus sativus, *Linné*, appears to be different. The fixed oils expressed from these seeds closely resemble those of mustard-seeds.

Action and Uses.—Mustard-seed, taken whole in doses of a teaspoonful three or four times a day, have a laxative action upon the bowels and are discharged without perceptible change. As cases have occurred in which an accumulation of them obstructed the bowel, and as they also may possibly find their way, with fatal effect, into the vermiform appendix, they should be used cautiously and swallowed with a large quantity of water.

Powdered mustard applied to the tongue or throat causes prickling and burning. It promotes the digestion of food, but too much of it or its prolonged use enfeebles the stomach. In large quantities, a teaspoonful or more, diffused through tepid water, it acts as a prompt and efficient emetic. Care should be taken to evacuate all of the mustard swallowed.

Applied as a sinapism to the skin, it produces after several minutes an acute prickling, stinging, and burning pain, the skin grows red, and, if the application is too prolonged, is blistered. The blisters are followed by ulcers which are very difficult to heal. The rapidity and completeness of the effect depend upon the delicacy of the skin to which the sinapism is applied. Hence great caution should be observed in prescribing it for children and females. Gangrene and death have resulted from applying a mustard poultice to the swollen glands of a child's neck.

On the other hand, when the skin is naturally tough or when its vitality is impaired by collapse, chill, or low states of the system generally, sinapisms may fail to exert any influence whatever. In these several cases sinapisms made with water are referred to; those made with vinegar possess very inferior activity, and the mustard is less active in proportion as the vinegar is stronger. This fact, although now generally unknown, the ancients were well acquainted with.

The effects of a general mustard bath at 86° F. are singular. At first wandering chills are felt in the loins, back, abdomen, and limbs, followed by a feeling of decided coldness and twitching of the extremities. There is even suffering from a sense of cold. Later, and even after the skin has become red, the sensation of coldness continues until the patient leaves the water, when reaction is speedily established, with stinging and burning of the integument.

Volatile oil of mustard is a powerful irritant. A single drop of it upon the tongue causes a severe burning pain which extends to the throat, nose, and stomach. Upon the skin it acts promptly as a vesicant and caustic.

For internal purposes, and particularly where the whole seed is given, white mustard-seed is to be preferred. In *atonic dyspepsia* with *constipation* it has long been employed with advantage in the dose of a teaspoonful and in a draught of water before or after meals. It prevents flatulence, promotes digestion, and keeps the bowels regular. But, like all condiments, it loses its effect by use. An infusion of mustard has sometimes succeeded in arresting obstinate *hiccough*. It is one of the most prompt and efficient emetics which can be used in cases of *narcotic poisoning*. In the early stage of *delirium tremens* a mustard emetic will sometimes cut short the attack. In *atonic dropsy* mustard whey or an infusion of whole mustard-seed in cider is a diuretic of considerable power. Formerly a tincture or wine of mustard-seed was officinal. Mr. England has proposed to revive its use (*Amer. Jour. Phar.*, xix. 124). That the active principle of mustard is carried into the circulation is shown by the benefits accruing from the use of white mustard-seed in *chronic bronchitis*, *chronic rheumatism*, and some *cutaneous affections*. This use of the medicine has been condemned as being destitute of a rational basis, but the only rational basis for the use of a medicine is its power to cure, and that is sufficiently attested in the present case.

Externally, oil of mustard has been successfully used in the treatment of *scabies*. But one of the most usual and useful applications of mustard is in the form of poultice, plaster, or bath to produce a lively stimulation, and thereby arouse the nervous system, as in

the insensibility of *swooning* and *hysteria*, in which it acts by exciting a sense of pain, and in the *convulsions* of children, in which it stimulates the nervous system and perhaps disperses morbid accumulations of blood in the central nervous organs. In foot-baths it relieves *headache* and cerebral and other internal *congestions*, especially uterine congestion accompanied with *dysmenorrhœa*. Dr. Weber claims to have been remarkably successful in the treatment of *pneumonia* in children by means of the hot mustard bath. He placed the child in a bath-tub filled with water at a temperature of from 100° to 105° F., and had the skin rubbed thoroughly until it began to look red. This process required from seven to ten minutes, when the child was wiped dry and put into a bed previously warmed. No ill effects were observed from allowing the genitals to remain unprotected. The bath was repeated, if necessary, as often as every three hours. General baths, at a temperature of from 77° to 82° F., containing 2 or 3 ounces of mustard and applied for the space of half an hour, have been used with great advantage in allaying the violence of *insanity*. Large poultices or epithems containing mustard and sinapised hip-baths have been beneficial in analogous conditions. However it may be explained, it is certain that mustard pediluvia, and even mustard plasters employed to relieve pain, frequently induce sleep; indeed, it sometimes happens that the patient falls asleep while the plaster is "drawing," with the result of producing painful and intractable sores.

When the action of a part is morbidly diminished or that of an internal organ is morbidly increased, as in *retrocedent gout* or *rheumatism*, or where a part is too anæmic for the application of *leeches*, or where a muscle or muscles suffer partial *atrophy*, mustard poultices, etc. are sometimes beneficial.

Every form almost of local pain may be relieved in the same manner as that of subacute and chronic *articular rheumatism*, *pleurodynia*, *neuralgia*, *toothache*, *earache*, *flatulent colic*, *muscular rheumatism*, and *dysmenorrhœa*. The same is true of various abnormal discharges, such as *vomiting*, *diarrhœa*, *cholera morbus*, and *dysentery*. In epidemic *cholera* general mustard baths have frequently been found beneficial in the early stages of the disease, and occasionally in the cyanotic stage. Like other vegetable powders, mustard flour is useful in removing from the hands unpleasant *smells*.

Of white mustard-seed 1 or 2 teaspoonfuls in 3 or 4 ounces of water may be taken once a day or oftener. The *infusion* of mustard, for an emetic, is prepared by adding 1, 2, or 3 teaspoonfuls of mustard flour to a pint of warm water. Mustard *whey* is made by adding to a pint of milk mixed with a quart of water 1½ ounces of bruised mustard-seed, boiling the mixture until it is curdled, and straining off the whey. A wine-glassful may be given every hour or two. The *sinapism*, or mustard plaster, is prepared by adding cold or lukewarm water to equal quantities of mustard and wheaten or rye flour, and stirring until a thick paste is formed. This is spread upon linen or other convenient tissue and applied to the skin. It is well to interpose a piece of gauze between the plaster and the body, to prevent the former from adhering. It should remain applied from ten minutes to an hour, according to the degree of its action. The mustard *cataplasm* (*Pharm. Br.*) is an ordinary flaxseed-meal or corn-meal poultice with which ground mustard has been mixed; it is intended to maintain a gentler but more prolonged action than the sinapism. Instead of meal, a soft sponge, saturated with a mixture of mustard and water and enclosed in a thin linen or muslin cover, may be employed. "*Mustard-leaves*" should be dipped in water before being applied. Sinapised *pediluvia* are made by adding a sufficient quantity (a tablespoonful or two) of mustard flour to an ordinary foot-bath. When pediluvia are used as general stimulants, they should be as warm as they can be borne; but when employed as derivatives, especially from the head and chest, their temperature should not exceed that of the blood, or from 98° to 100° F. The *essential oil* of mustard has been prescribed internally in an emulsion in the dose of from $\frac{1}{12}$ to $\frac{1}{4}$ of a drop. It may be used externally as a rubefacient in the proportion of Gm. 1.60 to Gm. 32 (gtt. xxiv in f℥j) of alcohol, or Gm. 0.30 to Gm. 4 (gtt. v–vj in f℥j) of almond oil. Care must be taken to proportion the strength of the liniment to the delicacy of the skin. The best application for the sores produced by mustard is lime-water liniment; if the pain be severe, the part may first be covered with stramonium ointment. Later, poultices of grated raw carrots, and finally oxide-of-zinc ointment, may be employed.

SODA, *U. S., Br.*—Soda.

Soda caustica, Br.; *Natrum causticum*, *Natrium hydricum*.—*Caustic soda*, *Sodium hydroxide*, *Sodium hydrate*, E.; *Soude caustique*, Fr.; *Natron*, *Aetznatron*, G.

Formula NaOH. Molecular weight 39.96.

Soda should be kept in well-stoppered bottles made of hard glass.

Preparation.—Take of solution of soda 2 pints. Boil down rapidly in a silver or clean iron vessel until there remains a fluid of oily consistence, a drop of which, when removed on a warmed glass rod, solidifies on cooling. Pour the fluid on a clean silver or iron plate or into moulds, and as soon as it has solidified break it in pieces and preserve it in stoppered green-glass bottles.—*Br.*

The preparation of solution of soda is described on page 981. On evaporating it, sodium hydroxide is left, and this is either moulded into thin cylinders or congealed on a plate or tile. Vessels of porcelain, glass, etc. are readily corroded; soda must therefore be prepared in clean iron or silver vessels. For uses in the arts caustic soda is extensively prepared from the same raw material from which sodium carbonate and bicarbonate are made; baryta and strontia have been used in the place of lime, and various complicated processes have been applied in the manufacture. Soda was first obtained by Stahl (1702), but its preparation from the sulphate and chloride was first described by Duhamel (1736).

Properties.—Caustic soda is white (or grayish-white, *Br.*), hard, opaque, inodorous, very alkaline in reaction, strongly corrosive, and of an intensely acrid and caustic taste. It is usually seen in irregular fragments having a fibrous appearance, or in cylindrical sticks which are crystalline upon a fresh fracture. On exposure to the atmosphere it absorbs water and is liquefied, and subsequently it solidifies again and becomes efflorescent, in consequence of the absorption of carbon dioxide and the crystallization and efflorescence of sodium carbonate. According to Osann, 1 part of water dissolves at 18° C. (64.4° F.) 0.6 parts of soda, while boiling water takes up 1¼ parts; such concentrated solutions, when exposed to a temperature of — 10° C. (14° F.) or less, separate thick tabular crystals of the hydrate, $2NaOH.7H_2O$, which melt again above 6° C. (42.8° F.). Soda is also freely soluble in alcohol. The strong aqueous solution of soda dropped into test-solution of tartaric acid, so that the latter remains in excess, deposits acicular crystals of acid sodium tartrate, which are dissolved on the addition of more soda or of water. "Soluble in 1.7 parts of water at 15° C. (59° F.), and in 0.8 part of boiling water; very soluble in alcohol. When heated to about 525° C. (977° F.), soda melts to a clear, oily liquid, and at a bright red heat it is slowly volatilized unchanged. When introduced into a non-luminous flame, it imparts to it an intensely yellow color. A solution of soda, even when greatly diluted, gives an intensely alkaline reaction with litmus-paper."—*U. S.*

Tests.—Alcohol dissolves caustic soda, but leaves most of the salts behind which are likely to be present. "The aqueous solution (1 in 20) should be perfectly clear and colorless (absence of organic matter), and should yield no precipitate on the addition of platinic chloride test-solution, or sodium cobaltic nitrite test-solution, or excess of tartaric acid test-solution (absence of potassium). If 1 Gm. of soda be dissolved in 10 Cc. of water and the solution slightly supersaturated with acetic acid, 10 Cc. of the solution should not be colored or rendered turbid by the addition of an equal volume of hydrogen sulphide test-solution (absence of arsenic, copper, lead, etc.), nor by the subsequent addition of ammonia-water in slight excess (absence of iron, aluminum, etc.). The remainder of the acidulated solution should not be rendered turbid by ammonium oxalate test-solution (absence of calcium). If a solution of 1.2 Gm. of soda in 10 Cc. of water be slightly supersaturated with nitric acid, then 0.5 Cc. of decinormal silver nitrate solution added, and the precipitate, if any, removed by filtration, the clear filtrate should remain unaffected by the addition of more silver nitrate test-solution (limit of chloride). If to a solution of 2.5 Gm. of soda in 10 Cc. of water, strongly supersaturated with hydrochloric acid, 0.1 Cc. of barium chloride test-solution be added, and the precipitate, if any, removed by filtration, the clear filtrate should remain unaffected by the further addition of barium chloride test-solution (limit of sulphate). If 0.7 Gm. of soda be dissolved in 1.5 Cc. of water, and the solution added to 10 Cc. of alcohol, not more than a slight white precipitate should occur within ten minutes (limit of silicate, etc.). After boiling this alcoholic solution with 5 Cc. of calcium hydroxide test-solution and filtering, not the slightest effervescence should take place on adding the filtrate to an excess of diluted hydrochloric acid (limit of carbonate). If 0.2 Gm. of soda be dissolved in 2 Cc. of water and carefully mixed with 5 Cc. of pure sulphuric acid and 3 drops of indigo test-solution, the blue color should not be discharged (limit of nitrate). To neutralize 0.4 Gm. of soda should require not less than 9 Cc. of normal sulphuric acid (each Cc. corresponding to 10 per cent. of pure sodium hydroxide), phenolphtalein being used as indicator."—*U. S.* 40 grains of soda dissolved in water should leave scarcely any sediment,

and require for neutralization about 900 grain-measures of the volumetric solution of oxalic acid (*Br.*), indicating the presence of about 90 per cent. of NaOH. Commercial soda sometimes contains alumina, which is soluble in water, but insoluble in alcohol; on treating with excess of ammonium chloride, it will separate as a white gelatinous precipitate, which is dissolved again by excess of hydrochloric acid. Sulphide, if present, will cause the precipitate with lead salt to be more or less brown, instead of white, and cyanide will produce Prussian blue on adding to the solution a little ferrous and ferric salt and acidulating with hydrochloric acid.

Composition.—The formula of soda is NaOH. When pure it contains 22.5 per cent. H_2O and 77.5 per cent. Na_2O. Crystallized sodium hydroxides are also known containing $3\frac{1}{2}$ and $1\frac{1}{2}$ molecules of water, and respectively 30.1 and 46.3 per cent. Na_2O.

Metallic Sodium and Salts.—Sodium, s. *Natrium*, was isolated by H. Davy (1807), and is prepared on a large scale by heating in an iron retort an intimate mixture of 30 parts of exsiccated sodium carbonate, 13 parts of coal, and 5 parts of chalk: the reduction takes place at a lower temperature than is required for the isolation of potassium. Recently a process has been introduced by Castner for the manufacture of sodium, which consists in the reduction of sodium hydroxide by heating it with an intimate mixture of finely-divided iron and carbon. The mass is prepared by mixing the iron with molten pitch, allowing it to cool, breaking it into pieces, and heating to a comparatively high temperature without access of air. The reduction is said to take place at a temperature of 825°, instead of 1400°, as in the older method. The main reaction is represented by this equation: $6NaOH + FeC_2 = 2Na_2CO_3 + 6H + 2Na + Fe$ (Remsen). Sodium is silver-gray, has a strong metallic lustre, and at ordinary temperatures may be cut like wax. It melts at 95.6° C. (204.08° F.), and at a red heat volatilizes. Its density is 0.97. In contact with air it is oxidized, and therefore requires to be kept under petroleum naphtha, or should be protected by being coated with a layer of paraffin, as proposed by Wagner (1863). It unites with oxygen, forming *monoxide*, Na_2O, and *dioxide*, Na_2O_2. It was admitted in the *Br. P.* for preparing solution of sodium ethylate (page 982).

Salts of Sodium. Soda is nearly as strong a base as potassa, and yields salts which are colorless unless the acid is colored, have a neutral reaction except those with weak acids, and are not volatilized at a low red heat, and somewhat less readily than potassium salts at a higher temperature. They impart to flame an intense yellow color, which is not visible if examined through a blue glass. They are mostly readily soluble in water, and these solutions yield with hydrofluosilicic acid gelatinous precipitates, and, when neutral or alkaline, afford with potassium metantimonate white crystalline precipitates. Similar precipitates are obtained with most other metallic salts, which must therefore be removed by the proper reagents, with the exception of those of potassium, before the test for sodium is applied.

Action and Uses.—The chemical and toxical actions of soda are the same as those of potassa. (For a detailed description see Lesser, *Virchow's Archiv*, lxxxiii. 224). Caustic soda, although less deliquescent, and therefore more manageable, than caustic potassa, is not so generally employed as an escharotic. It would appear probable also that as it is more assimilable, and therefore less apt than potassa to be immediately secreted with the urine, it should be better adapted than the latter for all cases in which it is desired to render the blood and the secretions more alkaline. Moreover, sodium salts are less offensive to the taste than potassium salts, and of less poisonous qualities. But in either case the bicarbonates are preferable to the alkalies themselves. Soda is administered in the official solution and in *doses* of Gm. 0.60–1.30 (gr. x–xx).

SODII ACETAS, *U. S.*—Sodium Acetate.

Sodæ acetas, Br. 1867; *Natrium aceticum*, P. G.; *Acetas sodicus (natricus); Terra foliata tartari crystallisata.—Acetate of soda*, E.; *Acétate de soude*, Fr.; *Natriumacetat Essigsaures Natron*, G.

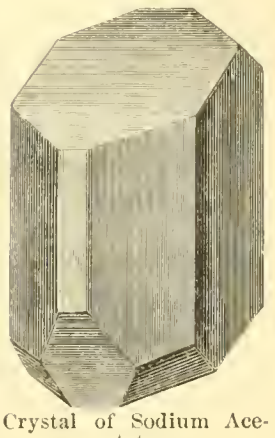
Formula $NaC_2H_3O_2.3H_2O$. Molecular weight 135.74.

Preparation.—Sodium acetate was first prepared by Duhamel (1736) and by J. F. Meyer (1767), and was made by Doerffurt (1793) from sugar of lead by decomposing it with sodium carbonate and sulphate. It may be obtained by neutralizing acetic acid or by decomposing lead acetate with sodium carbonate, in the latter case filtering from the insoluble lead carbonate and evaporating the clear liquids to crystallization. The salt is, however, manufactured on a large scale in the United States in the process for purifying acetic acid from wood-vinegar. (See p. 19.)

Properties.—This salt crystallizes in colorless, transparent, monoclinic prisms which are odorless and slightly alkaline, have a bitterish saline taste, and are somewhat efflores-

cent on exposure, falling in dry air to a white powder. "Soluble, at 15° C. (59° F.), in 1.4 parts of water and in 30 parts of alcohol; in 0.5 part of boiling water and in 2 parts of boiling alcohol. When heated to 60° C. (140° F.), the salt begins to liquefy. At 123° C. (253.4° F.), it becomes dry and anhydrous; at 300° C. (599° F.), it is decomposed with evolution of inflammable, empyreumatic vapors, leaving a black residue of sodium carbonate and carbon, which imparts to a non-luminous flame an intensely yellow color, gives an alkaline reaction with moistened litmus-paper, and effervesces with acids. The aqueous solution (1 in 20) of the salt colors litmus-paper blue, but does not redden phenolphtalein solution, unless carbonate be present. If 5 Cc. of the aqueous solution be heated with 1 Cc. of sulphuric acid and 0.5 Cc. of alcohol, acetic ether will be formed, recognizable by its odor."—*U. S.* The salt is insoluble in ether. Sulphuric acid liberates from it acetic acid, and its aqueous solution becomes deep-red with ferric salts, and on boiling yields a brown-red precipitate.

Fig. 284.



Crystal of Sodium Acetate.

Tests.—A concentrated solution of sodium acetate yields with silver nitrate a crystalline precipitate of silver acetate. Carbonate, if present, is detected by the effervescence produced by the salt when thrown into a diluted acid or on adding hydrochloric or nitric acid to its aqueous solution; the latter acidulated as indicated, when evaporated to dryness should leave a residue which is entirely soluble in water (absence of silica). "If a non-luminous flame be colored by the introduction of the salt, and viewed through a blue glass, the yellow color should entirely disappear, no red color taking its place (absence of potassium). If to 5 Cc. of the aqueous solution (1 in 20), slightly acidulated with acetic acid, an equal volume of hydrogen sulphide test-solution be added, no color or turbidity should appear, either at once (absence of arsenic, lead, zinc, etc.) or after adding ammonia-water in slight excess (absence of iron, etc.). The aqueous solution, acidulated with acetic acid, should not be rendered turbid by ammonium oxalate test-solution (absence of calcium). If a solution of 1 Gm. of the salt in 50 Cc. of water be slightly acidulated with nitric acid, then 0.5 Cc. of decinormal silver nitrate solution added, and the precipitate, if any, removed by filtration, the clear filtrate should remain unaffected by the addition of more silver nitrate solution (limit of chloride). If to a solution of 2 Gm. of the salt in 10 Cc. of water, acidulated with hydrochloric acid, 0.1 Cc. of barium chloride test-solution be added, and the precipitate, if any, removed by filtration, the clear filtrate should remain unaffected by the further addition of barium chloride test-solution (limit of sulphate). If 1.36 Gm. of sodium acetate be completely decomposed at a red heat, and the residue dissolved in water, it should require, for complete neutralization, 10 Cc. of normal sulphuric acid (corresponding to 100 per cent. of the pure salt), methyl-orange being used as indicator."—*U. S.*

Pharmaceutical Uses.—Sodium acetate is employed in preparing acetic acid, acetic ethers, and other compounds.

Action and Uses.—Sodium acetate resembles potassium acetate in its action, but is milder, less apt to derange the digestion, and more efficient as a diuretic. Its *dose* is Gm. 1–3 (gr. xv–xlv) in a large quantity of water as a diuretic. In doses of Gm. 4 (℥j) or more it is apt to be laxative.

SODII ARSENAS, *U. S.*—Sodium Arsenate.

Sodii arsenias, U. S. 1880, Br.; *Natrium arsenicicum*, *Arsenias natricus* (*sodicus*).—*Arseniate* (*arsenate*) *of soda*, E.; *Arséniate de soude*, Fr.; *Natriumarsenat*, *Arsensaures Natron*, G.

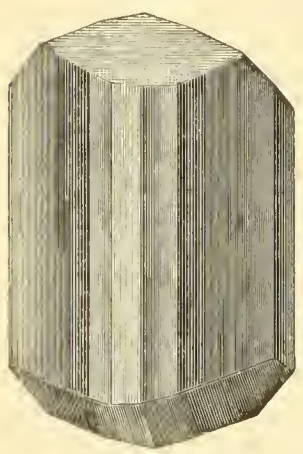
Formula $Na_2HAsO_4.7H_2O$. Molecular weight 311.46.

Preparation.—Take of Arsenous Acid 10 ounces; Sodium Nitrate 8½ ounces; Dried Sodium Carbonate 5½ ounces; Boiling Distilled Water 35 ounces. Reduce the dry ingredients separately to fine powder and mix them thoroughly in a porcelain mortar. Put the mixture into a large clay crucible and cover it with the lid. Expose to a full red heat till all effervescence has ceased and complete fusion has taken place. Pour out the fused salt on a clean flagstone, and as soon as it has solidified, and while it is still warm, put it into the boiling water, stirring diligently. When the salt has dissolved filter the solution through paper and set it aside to crystallize. Drain the crystals, and, having dried them rapidly on filtering-paper, enclose them in stoppered bottles.—*Br.*

On fusing arsenous acid in the proper proportions with sodium carbonate and nitrate, carbon dioxide, CO_2, and nitrous anhydride, N_2O_3, are given off, and the residue is converted into sodium pyroarsenate, as will be seen from the equation $As_2O_3 + 2NaNO_3 + Na_2CO_3 = Na_4As_2O_7 + N_2O_3 + CO_2$. The pyroarsenate, on being dissolved in water, is converted into orthoarsenate by combining with water; $Na_4As_2O_7 + H_2O$ yields $2Na_2HAsO_4$, and this salt crystallizes with $7H_2O$. The carbonate may be conveniently replaced by an equivalent quantity of solution of caustic soda, in which the arsenous acid may be dissolved, and the residue left on evaporation to dryness should then be oxidized by fusion with sodium nitrate; all danger of expelling arsenic by injudicious heating will then be avoided. The same salt is also obtained on oxidizing arsenous to arsenic acid by means of hot nitric acid, dissolving the dry residue in hot water, and adding sodium carbonate as long as effervescence is produced.

Properties.—Sodium arsenate crystallizes in colorless, transparent, inodorous prisms having a faint alkaline taste, and which usually contain $7H_2O$ or 40.4 per cent.; when obtained at a low temperature they contain $12H_2O$ or 53.7 per cent. The official salt is slightly deliquescent in a moist atmosphere, but in dry air it effloresces and loses $5H_2O$, the white powder which is finally left having the composition $Na_2HAsO_4.2H_2O$, and containing 16.2 per cent. of water of crystallization, which is given off near 148° C. (298.4° F.). The salt is soluble at 15° C. in 4 parts of water, is slightly soluble in cold alcohol, and is freely soluble in boiling water and in 60 parts of boiling alcohol. The aqueous solution has a slight alkaline reaction, and yields white precipitates with the soluble salts of barium, calcium, zinc, iron, and lead, and a brownish-red precipitate with silver nitrate, all these precipitates being soluble in nitric acid, and that with ferric salt turning red by heat. Hydrogen sulphide produces in the cold slowly but rapidly on being acidulated and heated, a yellow precipitate, which is completely soluble in ammonium sulphide. When heated upon charcoal before the blowpipe the salt gives off an alliaceous odor.

Fig. 285.



Crystal of Sodium Arsenate.

Tests.—"If to 2 Cc. of the aqueous solution (1 in 20) 5 Cc. of decinormal silver nitrate solution be added, and the precipitate redissolved by excess of ammonia-water no black precipitate of reduced silver should appear on boiling (absence of arsenite). If to 5 Cc. of the aqueous solution 1 Cc. of ammonium sulphide test-solution be added, no turbidity or coloration should appear (absence of lead, copper, iron, etc.)."—*U. S.* An aqueous solution of 12.4 grains anhydrous sodium arsenate, acidulated with acetic acid, requires not less than 34 grains of lead acetate for complete precipitation.—*Br.* This test is intended to show the absence of notable quantities of other salts.

Other Sodium Arsenates.—If an excess of sodium carbonate is used in the formula given above, the aqueous solution will contain *trisodic arsenate*, and yield crystals having a stronger alkaline reaction and the composition $Na_3AsO_4.12H_2O$. With an excess of arsenic acid crystals of *monosodic arsenate*, $NaH_2AsO_4.H_2O$, may be obtained.

Action and Uses.—Sodium arsenate is said to be less apt than potassium arsenate to produce the phenomena of arsenical poisoning, whether locally upon the stomach or, through the blood, in the eyelids, conjunctivæ, etc. It might be suspected that the difference, if real, would indicate that it is less efficient. The fact, however, is declared to be otherwise. This preparation is seldom used, and then in the form of the officinal solution. 1 part dissolved in 30 parts of water is made use of to saturate unglazed linen paper, from which the so-called antiasthmatic cigars are prepared. The cure of *diabetes mellitus* has been attributed in part to this preparation, but the observations of the late Dr. Flint were adverse to this claim (*Med. News*, li. 29). The *dose* of the arsenate is Gm. 0.003–0.008 (gr. $\frac{1}{20}$–$\frac{1}{8}$).

SODII BENZOAS, *U. S.*, *Br. Add.*—Sodium Benzoate.

Natrium benzoicum; Benzoas sodicus.—*Benzoate de soude*, Fr.; *Natriumbenzoat, Benzoesaures Natron*, G.

Formula $NaC_7H_5O_2.H_2O$. Molecular weight 161.67 (anhydrous $NaC_7H_5O_2 = 143.71$).

Preparation.—Add to 10 parts of benzoic acid suspended in 20 parts of hot water, gradually, 7 parts of sodium bicarbonate; after the evolution of carbon dioxide has

ceased, neutralize the liquid exactly by the addition of a little benzoic acid, or if necessary with sodium bicarbonate; filter and evaporate with frequent stirring until the residue weighs between 13½ and 14 parts. As the salt separates it creeps up on the sides of the dish, and should therefore be frequently scraped off and returned to the liquid portion. When sufficiently concentrated the mass is stirred until cold, when the remaining water will evaporate. The yield is 13¼ parts. This salt being very efflorescent, the U. S. Pharmacopœia directs it to be made anhydrous, for which purpose the above solution is evaporated to dryness, when the yield is 11⅘ parts. If prepared with acid sublimed from benzoin, the solution of the salt has a brown color and the dry salt is brownish or gray.

Properties.—Sodium benzoate is described as being a "white, amorphous powder, permanent in the air, odorless or having a faint odor of benzoin, of a sweetly-astringent taste free from bitterness, and having a neutral reaction; soluble in 1.8 parts of water and in 45 parts (24 parts, *Br.*) of alcohol at 15° C. (59° F.), in 1.3 parts of boiling water, and in 20 parts (12 parts, *Br.*) of boiling alcohol. When heated the salt melts, emits vapors having the odor of benzoic acid, then chars, and finally leaves a blackened residue of an alkaline reaction which imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass. On mixing an aqueous solution of the salt with a solution of ferric sulphate previously diluted with water, a flesh-colored precipitate is produced."—*U. S.* According to Hager, the anhydrous salt dissolves in 13.5 parts of 90 per cent. alcohol, in 4.5 parts of 60 per cent. alcohol, in 15 parts of glycerin, and is insoluble in ether, chloroform, and volatile oils; when heated, the salt becomes brown, and afterward melts near 450° C. (842° F.) to a dark-brown mass, which, ignited, burns for a short time only.

Tests.—"If 5 Cc. of diluted nitric acid be added to a solution of 1 Gm. of the salt in 10 Cc. of water, a white precipitate of benzoic acid will be produced, which, after thorough washing, should conform to the tests of purity mentioned under ACIDUM BENZOICUM. The filtrate from the foregoing precipitate should not be rendered turbid by silver nitrate test-solution (absence of chloride), nor by barium chloride test-solution (absence of sulphate). 5 Cc. of the aqueous solution (1 in 20) should not form a precipitate with 0.5 Cc. of sodium cobaltic nitrite test-solution (limit of potassium). If to 5 Cc. of the aqueous solution (1 in 20) an equal volume of hydrogen sulphide test-solution be added, no coloration or turbidity should be perceptible either before or after the addition of 1 Cc. of ammonia-water (absence of lead, iron, etc.). If 2 Gm. of sodium benzoate be ignited in a porcelain capsule until most of the carbonaceous matter is destroyed, and the residue then dissolved in 20 Cc. of water, it should require not less than 13.9 Cc. of normal sulphuric acid for complete neutralization (corresponding to at least 99.8 per cent. of the pure salt), methyl-orange being used as indicator."—*U. S.* The solution of the salt in 40 parts of water rendered alkaline by lime-water should not give a white precipitate (carbonate, tartrate). The Br. Ph. requires that 10 grains of the salt, when ignited shall leave a residue weighing about 3.68 grains, which, when dissolved in water, requires for neutralization from 69 to 70 grain-measures of the volumetric solution of oxalic acid.

Allied Salt.—POTASSII BENZOAS, Potassium benzoate, $KC_7H_5O_2.3H_2O$; mol. weight 213.62.—This salt may be prepared like sodium benzoate, 10 parts of benzoic acid requiring 8.2 parts of potassium bicarbonate, the yield being 17.5 parts of potassium benzoate of the above composition. It crystallizes with difficulty in small plates, which effloresce in air and are very soluble in water and alcohol.

Action and Uses.—Salkowski, Fleck, and Buchholtz discovered that sodium benzoate prevents the development of bacteria in putrescible liquids, and Graham Brown (*Arch. f. Pathol. und Pharm.*, viii. 151) found that diphtheritic fluids lose their contagious quality more speedily in a solution of sodium benzoate than in one of sodium salicylate or quinine muriate. Letzerich declared that in his hands no other remedy had produced such rapid and lasting effects in *diphtheria*. In patients under the age of three years he prescribed 120 grains a day; between the third and seventh year the daily dose was from 120 to 180 grains; for children more than seven years old, 150 to 240 grains, and for adults, 150 to 360 grains. Moreover, the exudation was treated with insufflations of the powdered benzoate every three hours or less frequently, according to circumstances, or in older persons gargles were used containing the salt (*Boston Med. and Surg. Jour.*, July, 1879, p. 88). In opposition to the favorable results just referred to, we find that in Vienna the salt was not successful (*Amer. Jour. of Med. Sci.*, Jan. 1880, p. 254). Various other physicians, including Klebs and Kien, reported favorably of this treat-

ment, while others, even in Germany, were unable to see its advantages, and some who at first approved afterward condemned it (*Bull. de Thérap.*, cxii. 37). It has also been employed in ordinary *tonsillitis* and *pharyngitis*, but its utility is not apparent. It is needless to refer particularly to the curative virtues attributed to it in acute rheumatism, puerperal fever, pneumonia, whooping cough, in various intestinal disorders, etc. Whatever they may have appeared to those who promoted its use, they have not prevented the medicine from quite fading out of view.

SODII BICARBONAS, *U. S., Br.*—Sodium Bicarbonate.

Sodæ bicarbonas, Br.; *Natrium bicarbonicum*, P. G.; *Natrium carbonicum acidulum*, *Bicarbonas sodicus.—Bicarbonate of soda*, *Sodium hydrocarbonate*, E.; *Bicarbonate de soude*, *Sel digestif de Vichy*, Fr.; *Natriumbicarbonat*, *Doppeltkohlensaures Natron*, G.

Formula $NaHCO_3$. Molecular weight 83.85.

Sodium bicarbonate should be kept in well-dried stoppered bottles.

Preparation.—The British Pharmacopœia of 1867 gave a formula for preparing sodium bicarbonate by saturating a mixture of 2 parts of crystallized and 3 parts of dried sodium carbonate with carbon dioxide generated from marble with hydrochloric acid; the damp salt which is formed is then shaken with half its weight of distilled water occasionally during half an hour, and the undissolved portion is dried by exposure to air.

This salt is rarely if ever prepared by the pharmacist, but is manufactured on the large scale, one of the processes being described above. Sodium bicarbonate does not contain any water of crystallization; a portion of the carbonate is therefore used in the exsiccated state, and another portion in crystals, which, if used in the proportion given above, contain more than sufficient water for the conversion of all the carbonate used into bicarbonate. This is produced according to the equation $Na_2CO_3 + CO_2 + H_2O = 2NaHCO_3$, and the excess of water removed by draining and exposure to the air. In the United States the process of Dr. E. R. Smith (1830) is employed by some manufacturers: Crystallized sodium carbonate is placed in a chamber arranged in such a manner that water may be drained off; carbon dioxide is then conducted into the chamber, and, combining with the salt, forms bicarbonate, while the water is liberated and is carried off to prevent its action as a solvent. By this arrangement the crystalline structure of the carbonate is usually not disturbed, except that the crystals lose their transparency and become opaque in proportion as the carbonate is converted into bicarbonate, and are porous and friable.

The same salt is also obtained in Solvay's process for soda: a concentrated solution of sodium chloride is mixed with ammonia, and the liquid saturated with carbon dioxide under a pressure of about two atmospheres, when sodium bicarbonate is deposited and ammonium chloride remains in solution.

It is obviously not essential that the carbon dioxide needed in this operation should be generated from marble; the same gas is largely produced in establishments where saccharine substances are undergoing fermentation, and is obtained as a waste product in many chemical operations. In some manufactories the products of combustion of the fuel used for heating steam-boilers are deprived of their impurities by washing, and subsequently utilized for saturating, at least in part, the sodium carbonate with carbon dioxide. Large quantities of this salt are manufactured in the United States, and its importation has decreased from nearly 7,000,000 pounds in 1875 to about 2,000,000 pounds annually.

Sodium bicarbonate as obtained by the above processes often contains sodium carbonate, and sometimes other impurities, from which it should be freed before it is used for medicinal purposes. A suitable process is the one given by the U. S. P. 1870, modified so as to yield a product of the purity required by the present Pharmacopœia.

Purification.—Introduce 4 pounds of commercial sodium bicarbonate gradually into a suitable conical glass percolator, cover it with a piece of wet muslin, and pour 6 pints of water upon it. When the liquid has ceased to drop or when the washings cease to give a brown-red precipitate with a solution of mercuric chloride, remove the sodium bicarbonate from the percolator, and dry it on bibulous paper or upon porous tiles in a cool place.

Sodium bicarbonate is far less readily soluble in cold distilled water than the impurities which are usually present, and in percolating water slowly through it these foreign compounds, consisting mainly of sodium carbonate and traces of sulphate and chloride, are dissolved, together with a portion of the bicarbonate. The percolate may be utilized,

after boiling for a short time, as a solution of sodium carbonate. In the presence of water, however, the salt slowly parts with a portion of its carbonic acid, and more rapidly on strong agitation and at an elevated temperature. While by this process the salt may be obtained of pharmacopœial purity as long as it is contained in the percolator, its removal from the apparatus and its exposure during drying are likely to occasion a further loss of the acid. It is therefore better to select a commercial salt which is otherwise pure, and keep it in thin layers in an atmosphere of carbon dioxide until it answers to the rigid requirements of the Pharmacopœia.

Properties.—*Sodium bicarbonate* is a white inodorous powder, has a mildly saline not unpleasant and scarcely alkaline taste, and is of a slight alkaline reaction. Permanent in dry, but slowly decomposed in moist, air. It is insoluble in alcohol and ether, and requires at 15° C. (59° F.) 11.3 parts (*U. S.*), 12 parts (*P. G.*), of water. According to Poggiale, 100 parts of water dissolve at 10° C. (50° F.) 8.88, at 20° C. (68° F.) 9.84, and at 60° C. (140° F.) 13.68, parts of sodium bicarbonate. Above that temperature the solution loses carbon dioxide, and at a boiling heat the salt is entirely converted into normal carbonate. When heated, the salt is decomposed into normal carbonate, water, and carbon dioxide, and finally, at 100° C. (212° F.), loses about 36.3 per cent. of its weight. At a bright red heat it melts. To a non-luminous flame it imparts an intensely yellow color. When freshly prepared with cold, distilled water, without shaking, the solution gives a very faint alkaline reaction with litmus-paper. The alkalinity increases by standing, agitation, or increase of temperature. Sodium bicarbonate is also soluble in glycerin without change, but in the presence of borax carbon dioxide is given off, and sodium carbonate remains behind; a mixture of sodium bicarbonate and borate is not decomposed by cold water. The salt imparts to a non-luminous flame an intense yellow color, which on being examined through a blue glass does not, or only transiently, appear red. It dissolves with brisk effervescence in diluted acids, forming solutions in which platinum chloride causes no precipitate. If the salt is treated with a small quantity of water, insufficient for solution, the liquid may react in the cold with a solution of magnesium sulphate, producing a white precipitate, and cause with a solution of corrosive sublimate a dark brown-red precipitate, both reactions being due to sodium carbonate, which may be present in small amount.

Composition.—The formula of sodium bicarbonate given above represents 36.90 per cent. Na_2O, 52.38 per cent. CO_2, and 10.72 per cent. H_2O.

Tests.—"If 1 Gm. of the salt be dissolved in 19 Cc. of water, it should yield a perfectly clear and colorless solution, leaving no residue. If 5 Cc. of the aqueous solution (1 in 20) be slightly supersaturated with hydrochloric acid, the liquid should not be colored red by a drop of ferric chloride test-solution (absence of sulphocyanate). If 1 Gm. of the salt be dissolved in 3 Cc. of acetic acid, it should yield no precipitate within an hour after being mixed with 0.5 Cc. of sodium cobaltic nitrite test-solution (limit of potassium). If 0.6 Gm. of the salt be dissolved, without agitation, in 10 Cc. of cold water, and 0.1 Cc. of normal sulphuric acid added, no red color should appear upon the addition of 2 drops of phenolphtalein test-solution (limit of normal carbonate). If 5 Cc. of the aqueous solution (1 in 20) be slightly supersaturated with hydrochloric acid, the solution should not be rendered turbid by the addition of an equal volume of hydrogen sulphide test-solution, either at once (absence of arsenic, etc.), or after the addition of ammonia-water in slight excess (absence of iron, aluminum, etc.). 5 Cc. of the aqueous solution, acidulated with acetic acid, should not be rendered turbid by 0.5 Cc. of ammonium oxalate test-solution (absence of calcium). If 1.2 Gm. of sodium bicarbonate be dissolved in 10 Cc. of diluted nitric acid, then 0.5 Cc. of decinormal silver nitrate solution added, and the precipitate, if any, removed by filtration, the clear filtrate should remain unaffected by the addition of more silver nitrate solution (limit of chloride). If 2.5 Gm. of the salt be dissolved in 11 Cc. of diluted hydrochloric acid, then 0.1 Cc. of nitric acid and 0.1 Cc. of barium chloride test-solution added, and the precipitate, if any, removed by filtration, the clear filtrate should remain unaffected by the further addition of barium chloride test-solution (limit of sulphate, sulphite, and thiosulphate). If sodium bicarbonate be heated in a test-tube, no ammoniacal vapor should be emitted. To neutralize 0.85 Gm. of sodium bicarbonate should require not less than 10 Cc. of normal sulphuric acid (corresponding to at least 98.6 per cent. of the pure salt), methyl-orange being used as indicator."—*U. S.*

Action and Uses.—Sodium bicarbonate is much less apt than the carbonate of the same base or than potassium carbonate to derange the stomach, because, it may be, that it belongs to the natural constituents of the body, and is not so promptly eliminated

with the urine. Although, when taken moderately and for a short time, no ill effects are produced, and although in many cases it is habitually used without sensible injury, it nevertheless tends to augment the acid secretions of the stomach and to perpetuate the evil it was designed to cure. It probably tends to diminish the richness (*i. e.* the corpuscular elements) of the blood, and hence to impair nutrition.

The form of *dyspepsia* in which sodium bicarbonate is peculiarly useful is that attended with acidity of the primæ viæ, and of which the chief symptoms are sour eructation and vomiting, heartburn, flatulence, and acid liquid stools. In many cases the disorder is exclusively gastric, as in acid dyspepsia. In not a few hypochondriac symptoms are superadded. But in all of them sodium bicarbonate can do no more than palliate the special symptoms due to an acid fermentation of ingesta: a radical curative treatment must be attempted by other means, of which tonic medicines and regimen are the most influential. The palliative symptomatic treatment referred to is of essential service in the case of children, in whom interference with primary digestion leads to grave and even fatal disorders. This is especially the case when their sole aliment consists of cow's milk, and the mischief can often be mitigated by adding a small portion of the bicarbonate to each portion of their food. It is essential in all cases of acid gastric dyspepsia that the bicarbonate should be taken after, and not before, meals.

In *lithiasis* a tendency to the formation of acid sand and *gravel* may be obviated by the use of this sodium salt after every meal. But it must not be overlooked that, according to competent testimony, the potassium salt is even more efficacious; and the plausible reason is assigned for the alleged fact that the latter passes off more readily than the former by the urine, and therefore tends more to maintain this fluid in a normal if not in an alkaline state. There is some reason to believe that sodium bicarbonate is capable of producing the solution of urinary concretions already formed. It is reported to be singularly efficient in *suppression of urine* from renal disease, and even in that form of Bright's disease of the kidney in which the cause of the obstruction of the renal tubules with casts is proved by their abundance in the urinary sediment.

In *saccharine diabetes* occurring in persons of an obese habit there is little doubt that the prolonged use of the salt under consideration is sometimes of marked benefit. It is less so when the patients are thin and of a nervous constitution. Such has been the result of observations at Vichy, Carlsbad, and other alkaline mineral springs renowned for their virtues in this affection. Intravenous injection of the salt has often been used to relieve *diabetic coma* (*Boston Med. and Surg. Jour.*, June, 1890, p. 623). The mineral waters just mentioned are celebrated for their utility in *gout*. They are especially so in the simple and regular forms of the disease occurring in persons of good constitution and not yet exhausted by repeated attacks or by the complications to which the gouty become subject. In the latter case the system is already impaired and unable to sustain the debilitating influence of an alkaline treatment. Under such circumstances a free use of alkaline water is apt to occasion a transference of the gout to internal organs, and sometimes it has led to a fatal termination of the disease. What has been said of gout applies in many respects to *biliary calculi*, for which alkaline mineral waters have always been used. According to some, the potash salt is preferable to the soda salt, but this notion is more than doubtful.

In *acute articular rheumatism*, and notably in those cases of it in which many joints are involved, and in which there are high fever, acid sweats, and loaded urine, sodium bicarbonate is of inestimable benefit, provided that it be given so as to maintain a neutral condition of the urine. Its efficacy is increased when the affected joints are swathed in compresses saturated with a solution of the salt. Some physicians limit the use of the alkaline treatment of rheumatism to cases in which cardiac complications exist. But if the alkaline treatment tends to save the heart, as we believe, it should be the best from the beginning, and whether anæsthetics and sedatives are used or not. In the treatment of recent *burns* a like solution has been applied with the effect of immediately relieving the pain and producing a rapid cure. This method was first proposed by Peppercorne (1844), and again recommended in 1882 (*Practitioner*, xxviii. 15.). Excellent reports of its virtues have been made by Troiski (*Med. News*, 1881, p. 679) and Koller (*Amer. Jour. Phar.*, June, 1880, p. 319). The part should be kept constantly wet with the solution. In the case of a burn of the second degree involving two-thirds of the face and both ears, and extending over the whole back of the neck down to between the shoulders, an excellent result was obtained (Rogers). A similar solution, with or without borax, is said to allay *pruritus* due to an uric-acid diathesis. In 1881, Armangué and Giné treated acute *tonsillitis* by the direct application of powdered sodium bicarbonate in the forming

stage of the disease, and claimed to have prevented its development in most instances (*Practitioner*, xxviii. 448). The same treatment was subsequently used in this country by Stuver (*Med. News*, xli. 567), Skinner (*ibid.*, xlii. 156), and Vinke (*ibid.*, xliii. 216). It has not yet been sufficiently tested, but it has at least the advantage of being harmless. A somewhat similar application has been made in contagious *ophthalmia* attended from the first with chemosis and granulations, as well as in chronic cases of granular conjunctivitis (*Times and Gaz.*, Oct. 1881, p. 516). A 1 per cent. solution of this salt has been used with alleged, but not demonstrated, success in acute *gonorrhœa* (*Bull. de Thérap.*, cxi. 515). A saturated solution has been found an efficient cure in poisoning by Rhus toxicodendron. A solution of equal parts of this salt and borax has been used to soften *diphtheritic* membranes.

Sodium bicarbonate may be prescribed in *doses* of Gm. 0.30–2 (gr. v–xxx) and upward. The largest doses are required in acute rheumatism. When the doses must be large the medicine is most conveniently administered in carbonated water.

SODII BISULPHIS, *U. S.*—Sodium Bisulphite.

Natrium bisulfurosum, *Bisulphis sodicus.*—*Bisulphite de soude*, Fr.; *Natriumbisulfit*, *Doppeltschwefligsaures Natron*, G.

Formula $NaHSO_3$. Molecular weight 103.86.

Preparation.—This salt is employed in the arts for bleaching, and was called *leucogene* by Chaudet, who recommended it for this purpose. It is also used as *antichlor* for neutralizing the excess of chlorine after bleaching fabrics or paper-pulp, and has been recommended for the preservation of fermentable liquids and articles of food. It is prepared by saturating a solution of sodium carbonate with sulphur dioxide and crystallizing in a cool place. Warm concentrated solutions treated in this manner usually separate on cooling *sodium pyrosulphite*, $Na_2S_2O_5$.

Properties.—Sodium bisulphite is in "opaque, prismatic crystals or a crystalline or granular powder, slowly oxidized and losing sulphur dioxide on exposure to air, having a faint sulphurous odor, a disagreeable sulphurous taste, and an acid reaction; soluble in 4 parts of water and in 72 parts of alcohol at 15° C. (59° F.), in 2 parts of boiling water, and in 49 parts of boiling alcohol. When strongly heated the salt decrepitates, and is converted into sulphur and sodium sulphate. A small fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass. On adding hydrochloric acid to an aqueous solution of the salt, sulphur dioxide is evolved."—*U. S.* The salt being easily affected by exposure, it is difficult to keep it unaltered, even in stoppered bottles, and to preserve for it the purity required by the tests given below. Sodium pyrosulphite resembles the pharmacopœial salt in its properties.

Tests.—"If 1.2 Gm. of sodium bisulphite be dissolved in 10 Cc. of diluted nitric acid and the solution heated sufficiently to expel gases, then 0.5 Cc. of decinormal silver nitrate solution added, and the precipitate, if any, removed by filtration, the clear filtrate should remain unaffected by the addition of more silver nitrate solution (limit of chlorine). If 2.5 Gm. of sodium bisulphite be dissolved in 11 Cc. of diluted hydrochloric acid, with the aid of sufficient heat to expel the sulphur dioxide, the solution should not be turbid (absence of thiosulphate). After adding to it 0.15 Cc. of barium chloride test-solution, and removing the precipitate, if any, by filtration, a portion of the clear filtrate should remain unaffected by the addition of more barium chloride test-solution (limit of sulphate). If to 5 Cc. of the preceding filtrate an equal volume of hydrogen sulphide test-solution be added, no turbidity or coloration should occur (absence of arsenic, etc.). If 0.26 Gm. of sodium bisulphite be dissolved in 20 Cc. of water recently boiled to expel air, and a little starch test-solution be added, at least 45 Cc. of decinormal iodine solution should be required to produce a permanent blue tint after agitation (corresponding to at least 90 per cent. of pure sodium bisulphite)."—*U. S.*

Uses.—The action and uses of the sodium bisulphite are essentially the same as those of the sulphite; it is, however, supposed to derive greater efficiency from the larger proportions of sulphurous acid in its composition. Dr. Fenn ascribes to it the power of aborting coryza and tonsillitis (*Univ. Med. Mag.*, ii. 599). *Dose*, Gm. 0.60–1 (gr. x–xxx).

SODII BORAS, *U. S.*—Sodium Borate.

Borax, Br., P. G.: *Natrium biboricum* (*pyroboricum*), *Boras sodicus.*—*Sodium tetra-* or *pyroborate*, E.; *Borax*, E., Fr., G.; *Borate de soude*, *Bauracon*, *Sel de Perse*, Fr.; *Natrium pyroborat*, G.

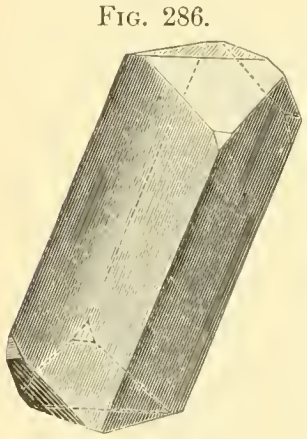
Formula $Na_2B_4O_7.10H_2O$. Molecular weight 380.92.

Origin and Preparation.—It is uncertain whether borax was known to and used by the ancients, and even in the Middle Ages it was frequently confounded with other salts. The observations of Homberg (see page 34), Geoffroy (1732), and others did not lead to correct views regarding the chemical nature of borax until Baron (1747) showed that the "sedative salt" exists in it combined with soda. Borax is found native as *tincal* in Persia, Thibet, and other localities, as a saline incrustation on the shores of certain lakes, and as a crystalline deposit at the bottom of the borax lake in California. The incrustation and the deposit are continually renewed by crystallization from the lake waters as fast as the borax is removed. Tincal requires to be washed with a solution of caustic soda for effecting the removal of fatty matter with which the crystals are covered, and on being afterward recrystallized from water yields borax. Borax is also prepared from various native borates which are found in Nevada, in certain parts of South America, Europe, and Asia, and which are known as the minerals *boracite*, *borosodocalcite*, *cryptomorphite*, etc. These consist of boric acid combined in varying proportions with sodium, calcium, and magnesium, and mixed with sulphates, chlorides, and silica, and yield borax on being treated with sodium carbonate, and after recrystallization from water.

Most of the borax is at present prepared from commercial crude boric acid, which is either boiled with a solution of soda, or, more generally, is fused together with calcined sodium carbonate; the impure Italian boric acid yields besides carbon dioxide also ammonia, which is also utilized. The fused mass is then dissolved in water, and this solution separated from the ferric hydroxide and other impurities suspended in the liquor, and evaporated sufficiently, when it is permitted to cool slowly, so that large crystals are obtained, from which the mother-liquor is rapidly withdrawn.

Properties.—Borax forms large, colorless, monoclinic prisms, which are transparent, inodorous, have a mild sweetish, cooling, and afterward alkaline taste, and in dry air effloresce superficially and become opaque. When heated it melts in its water of crystallization, and is converted into a light white spongy mass, which at a red heat fuses, and on cooling forms a transparent glass. Borax has the specific gravity 1.72, has a weak alkaline reaction, is insoluble in alcohol, but dissolves at 80° C. (176° F.) in 1 part of glycerin and at 15° C. (59° F.) in 16 parts of water. The glycerin solution imparts a green color to flame (Senier and Lowe, 1878). According to Poggiale, 100 parts of water dissolve at 10° C. (50° F.) 4.65 parts, at 20° C. (68° F.) 7.88 parts, at 30° C. (84° F.) 11.90 parts, at 40° C. (104° F.) 17.90 parts, and at 100° C. (212° F.) 201.43 parts, of crystallized borax. If a saturated solution of borax is prepared at an elevated temperature and kept at a temperature exceeding 56° C. (133° F.), sodium borate containing $5H_2O$ will crystallize in octahedral crystals which are harder than borax. A cold solution of borax absorbs considerable quantities of carbon dioxide and hydrogen sulphide, both gases being again expelled on heating and evaporating the liquid. The aqueous solution (1 in 20) colors red litmus-paper blue, and yellow turmeric-paper reddish-brown. After being acidulated with hydrochloric acid the solution colors blue litmus-paper red; yellow turmeric-paper remains unchanged at first, but on drying becomes brownish-red, and this color is temporarily changed to a bluish-black by moistening with ammonia-water. If a slight excess of sulphuric acid be added to a hot, saturated aqueous solution of the salt, shining, scaly crystals of boric acid will separate on cooling, which impart a green color to the flame of alcohol. Borax held in a non-luminous flame imparts to it an intense yellow color.

Fig. 286.



Crystal of Borax.

Composition.—The water of crystallization amounts to 47.12 per cent., Na_2O to 16.23, and B_2O_3 to 36.65 per cent. The crystallized and the anhydrous salt, $Na_2B_4O_7$, are compounds of tetra- or pyroboric acid (see p. 34).

Tests.—"With 19 Cc. of water 1 Gm. of the salt should yield a perfectly clear and

colorless solution, leaving no residue. The aqueous solution (1 in 20) should not effervesce with acids (absence of carbonate). It should not be rendered turbid by ammonium sulphide test-solution (absence of iron, aluminum, etc.), nor, after being acidulated with hydrochloric acid, by an equal volume of hydrogen sulphide test-solution (absence of arsenic, lead, etc.). When acidulated with acetic acid, the solution should not be rendered turbid by ammonium oxalate test-solution (absence of calcium). The aqueous solution (1 in 20) should not be rendered turbid by magnesia mixture (absence of phosphate). If 0.48 Gm. of the salt be dissolved in 15 Cc. of water, then 1 Cc. of diluted nitric acid and 0.2 Cc. of decinormal silver nitrate solution added, and the precipitate, if any, be removed by filtration, the clear filtrate should remain unaffected by the addition of more silver nitrate solution (limit of chloride). If 2.5 Gm. of the salt be dissolved in 50 Cc. of water, then 10 Cc. of diluted hydrochloric acid and 0.1 Cc. of barium chloride test-solution added, and the precipitate, if any, be removed by filtration, the clear filtrate should remain unaffected by the addition of more barium chloride test-solution (limit of sulphate). If 1 Gm. of the salt be dissolved in 20 Cc. of diluted sulphuric acid, by the aid of heat, and 3 drops of indigo test-solution be added, the blue color should not be discharged (absence of nitrate)."—*U. S.* Traces of chloride are always, and of sulphate occasionally, present in good commercial borax. "191 grains of borax dissolved in 10 fluidounces of distilled water require for saturation 1000 grain-measures of the volumetric solution of oxalic acid."—*Br.*

Action and Uses.—This substance is supposed to be described by Pliny under the name of chrysocolla; by the Arabians it was called tankâr (Southeimer). The former speaks of its drying and healing action upon wounds when applied as a powder—of its use in sore throat, and in collyria for removing opacities of the cornea, and in plasters for effacing scars. The latter allude to its cleansing and astringent virtues, to its application in caries of the teeth, etc., and to its use by goldsmiths as a flux for gold. A solution of borax Gm. 2 to Gm. 32 (gr. xxx to f℥j) is quite efficient in diminishing and even in removing *freckles*, *chloasma*, and those unsightly eruptions by which some women are annoyed at the menstrual periods. A drachm of borax in half an ounce of cold cream forms an excellent ointment for *chilblains*. As a lotion for *ringworm of the scalp* a solution has been recommended of 1 drachm of borax in 2 ounces of distilled vinegar. It has been thought useful in lotion or in ointment for *alopecia*. Borax has also been applied with good effect in *pityriasis versicolor* and for removing *opacities of the cornea*. It is used to heal *ill-conditioned ulcers*, and especially those of the mouth occurring in *ulcerative stomatitis*, and also to restore firmness to *spongy gums*. In the last cases particularly it should be associated with honey and myrrh. Borax is less efficient than potassium chlorate, and like it acts only as a local stimulant. It is of constant use for the cure of *aphthæ* of the mouth and fauces occurring in nursing children. In the first-named affections it should be finely powdered with white sugar and applied directly to the affected part. It is equally efficacious in *thrush*, which proceeds from the acid fermentation of the milk and occurs in the buccal cavity, about the anus, etc. Mixtures of borax with honey or with glycerin will answer the same purpose, but perhaps less efficiently. These, or the powder, or a simple watery solution, may be applied to aphthous sores of the *vulva* and *vagina*, to fissures of the *nipples*, and to similar lesions. It is sometimes advantageous to associate with the borax Peruvian balsam, benzoin, or some analogous agent to modify or strengthen its action. They may be incorporated in a mixture made with yelk of egg, oil of almonds, etc. A solution of borax is one of the best topical applications in *prurigo pudendi*, and one of the most efficient vaginal injections for *leucorrhœa*, especially when it is due to superficial ulcers of the cervix. It may also be used to relieve the symptoms of *oxyuris*.

In subacute *laryngitis*, especially as it occurs in children, a mixture of powdered borax with honey or syrup has been found serviceable by its stimulating action upon the adjacent pharyngeal mucous membrane. A like effect has been observed in *hoarseness* and in *aphonia* due to laryngeal congestion merely or to exhaustion of the larynx by an excessive use of the voice. The best mode of using it is to allow a piece of borax of the size of a pea gradually to dissolve in the mouth. The inhalation of powdered borax has been used in *phthisis* on theoretical grounds, and with the natural result.

Very few writers upon therapeutics admit that borax stimulates the uterine system, *promoting menstruation* and *labor* and checking *hæmorrhage*. The difficulty of determining the precise value of an emmenagogue medicine is notorious, and in this case, at least as much as in others, large assertion is mixed with little proof. The power attributed to borax of exciting the gravid uterus to contraction does not appear to us susceptible of

well-grounded doubt, and, while believing that it is efficacious in uterine hæmorrhage, we should find a demonstration of its value difficult. In India borax is said to be used to reduce enlargements of the *spleen* (*Med. Record*, xxxi. 549).

Dr. Gowers (*Times and Gaz.*, April, 1880, p. 447) states that in some inveterate cases of *epilepsy*, in which the bromides had no effect, he tried borax without advantage sometimes, but in a certain number of instances its value was marked. The doses were 10 or 15 grains twice or three times a day. Sometimes it occasioned gastro-intestinal disturbance, and rarely a form of dysenteric diarrhœa. According to Mairet, it is most useful in symptomatic epilepsy. A tendency, which it showed, to cause a scaly eruption has been noticed. Dr. Folsom noted that it sometimes produced itching of the skin and exfoliation of the cuticle, and Dr. Gowers observed a similar effect (*Boston Med. and Surg. Jour.*, Feb. 1886, pp. 157, 145); while Dr. Munson (*Med. News*, lv. 154) found the nutrition of the hair impaired. (Compare *Lancet*, May, 1890, p. 1061.)

The utility of borax in cases of *uric-acid gravel* is very great. Entering the urine nearly unchanged, a great part of the borax taken presents itself to the uric acid, which decomposes it, forming soluble sodium urate, which, with the freed boric acid, is discharged. Borax may be given internally in the *dose* of Gm. 0.30–2 (gr. v–xxx), in watery solution largely diluted.

Ammonium Borate has been proposed as a remedy for disorders of the *urinary secretion* attended with an excess of acid or of earthy phosphates and irritability of the bladder. It does not, however, seem to have answered these purposes, since it has completely fallen into disuse. Yet it would seem to be nearly as well fitted for them as sodium borate. The *dose* is Gm. 0.60–1.30 (gr. x–xx) in an abundant watery solution.

SODII BROMIDUM, *U. S., Br.*—Sodium Bromide.

Natrium bromatum, P. G.; *Bromuretum sodicum.—Bromure de sodium*, Fr.; *Bromnatrium*, G.

Formula NaBr. Molecular weight 102.76.

Preparation.—Sodium bromide may be prepared in a manner similar to potassium bromide (see page 1282). A solution of ferrous bromide, boiled with a solution of sodium carbonate, yields a precipitate, the filtrate from which is evaporated and crystallized.

Properties.—At a temperature of about 20° C. (68° F.) and below, colorless, transparent, oblique-rhombic prisms are obtained having the composition $NaBr.2H_2O$ (mol. weight 138.68), which when heated melt and give off the water of crystallization. But when the solution is kept at a temperature above 30° C. (86° F.), anhydrous cubes of sodium bromide are obtained, which have a saline, somewhat alkaline, and scarcely bitterish taste, and a neutral or faint alkaline reaction. The salt is usually met with in the form of a white crystalline, inodorous powder which is permanent in dry air, and is stated to be soluble in 0.5 part of boiling water, in 11 parts of boiling alcohol (*U. S.*), and at 15° C. (59° F.) in 1.2 (*U. S., P. G.*) parts of water and in 13 (*U. S.*) or 5 (*P. G.*) parts of alcohol. According to Kremers (1856), 1 part of the anhydrous salt is soluble at 0° C. (32° F.) in 1.29, at 20° C. (68° F.) in 1.13, and at 100° C. (212° F.) in 0.87, parts of water, and the saturated solution boils at 121° C. (250° F.). According to Hager, the anhydrous salt is soluble in 10 parts of 90 per cent. alcohol and in 3 parts of 60 per cent. alcohol, while the hydrated salt requires 7 parts of the former and 2.25 parts of the latter for solution. The hydrated salt melts in its water of crystallization, but the anhydrous salt requires a red heat for fusion, and then volatilizes slowly without decomposition. The salt imparts to a non-luminous flame an intense yellow color, which, when observed through a blue glass, should not appear permanently red (*P. G.*).

Tests.—The pharmacopœias give nearly identical tests for alkalinity, bromate, iodide, sulphate, and chloride, as follows: "The aqueous solution (1 in 20) should be clear and colorless, and should not be rendered turbid by sodium bitartrate test-solution, nor by sodium-cobaltic nitrite test-solution (limit of potassium), nor by ammonium oxalate test-solution (calcium), nor by barium chloride test-solution (sulphate). If the aqueous solution be slightly acidulated with hydrochloric acid, it should not be rendered turbid by the addition of an equal volume of hydrogen sulphide test-solution, either at once (absence of arsenic, lead, etc.), or after adding ammonia-water in slight excess (absence of iron, aluminum, etc.). If diluted sulphuric acid be dropped upon some of the powdered salt, no yellow color should appear at once (absence of bromate). If 5 Cc. of the aqueous solution (1 in 20) be mixed with a few drops of starch test-solution, and then 0.5 Cc. of chlorine-water added, no blue color should appear (absence of iodine). If 1

Gm. of the powdered salt be kept for twenty minutes at the temperature of 100° C. (212° F.) or slightly above it, it should not lose more than 0.03 Gm. in weight (limit of moisture). If 0.3 Gm. of the well-dried salt be dissolved in 10 Cc. of water, and 2 drops of potassium chromate test-solution be added, it should not require more than 29.8 Cc. of decinormal silver nitrate solution to produce a permanent red color (absence of more than 2.71 per cent. of chloride)."—*U. S.* When heated to a bright-red heat the salt melts, and, at a somewhat higher temperature, slowly volatilizes without decomposition. To a non-luminous flame it imparts an intensely yellow color. Its aqueous solution is neutral to litmus-paper, or at most very feebly alkaline. If a few drops of chloroform are poured into 10 Cc. of the aqueous solution (1 in 20), then 1 Cc. of chlorine-water added, and the mixture agitated, the liberated bromine will dissolve in the chloroform, imparting to it a yellow or brownish-yellow color, without a violet tint. 1 Gm. of the salt, when completely precipitated by silver nitrate, yields, if perfectly pure, 1.824 Gm. of dry silver bromide; in the presence of sodium chloride the precipitate will weigh more.

The volumetric test of the Pharmacopœia is very similar to that prescribed for the potassium salt: 0.3 Gm. of pure sodium bromide would require 29.19 Cc. of decinormal silver solution for complete precipitation, and hence each 0.222 Cc. used in excess of that quantity will show 1 per cent. of chloride. The Germ. Pharm., by allowing the use of only 29.3 Cc. of decinormal silver solution, requires sodium bromide to be 99.5 per cent. pure.

Action and Uses.—Although various theoretical considerations have been regarded as sufficient to prove sodium bromide preferable as a medicine to potassium bromide, physiological experiment and clinical observation agree in teaching that sodium bromide possesses in a less degree the characteristic sedative and hypnotic properties of potassium bromide. It has been claimed to be more eligible than the potassium salt, because it does not excite an eruption of acne nor occasion hebetude of mind or body; but the latter symptom is the very index of the efficiency of the potassium salt, at least in epilepsy; and if it fails to occur under sodium bromide, the occurrence can be taken as a proof that the latter is inoperative in cases for which the potassic bromide is appropriate. It is given in the same *doses* as potassium bromide. In point of fact, however, bromization of the nervous system is produced by the sodium salt when taken in large doses. Cutler has related (*Boston Med. and Surg. Jour.*, March, 1884, p. 248) the case of a man who took about 4 ounces of this compound in one week. Torpor, sopor, and lethargy succeeded one another; the skin was dusky and cool, the pulse and breathing slow; the urine was nearly suppressed, and reflex irritability abolished. The patient lay in a sound sleep for eighteen days. Similar cases had before been observed (Schweig, *Med. Record*, xi. 841). In one of them there were "incoherency of speech and action, hallucinations of sight and hearing, delusions of various sorts, a general aspect of imbecility, and an almost entire absence of rational conduct." Yet the patient on recovery recollected perfectly many occurrences that had taken place during his period of apparent mental darkness.

In regard to the relative value of the sodic and potassic bromides in the treatment of *epilepsy*, it would appear that the former is inferior to the latter, because it exerts less of that sedative influence on the nervous system which the mitigation of the disease requires. Dujardin-Beaumetz and Voisin entirely reject the use of the sodium salt in epilepsy, and the weightiest evidence is on the same side of the question. Nevertheless, it should be used when the other salt disagrees with the patient or is contraindicated by a state of debility. There is no doubt, as already said, that its action is less depressing, that its taste is less offensive, that it does not tend to produce an acneïform eruption, and that it is not so apt to render the breath fetid. Hence it is to be preferred in all the affections, except epilepsy as a rule, in which the bromides are indicated, and especially when the patients are young or delicate persons. Among these cases are to be reckoned nervous irritability, such as is apt to attend the *menopause;* cases of *insomnia* from fatigue and excitement of mind or body; *delirium tremens;* nervous *palpitation* from sexual indulgence, the abuse of tobacco, alcohol, etc. The practice of using the bromides to prevent *sea-sickness*, by producing a mild bromization, which became very common since 1880, is reprobated by those who have had the best opportunity of forming a correct judgment of it as merely a mode of narcotic intoxication. It is probable that frequent small doses are more efficient than larger and less frequent doses, and that the use of the medicine should be commenced before going to sea. The danger of excessive doses is shown by the following case: In 1882, Dr. F. R—— took an inordinate quantity of sodium bromide (11 oz.) for the purpose referred to, and under its influence became

insane, jumped overboard, and was drowned. As antidotes to the stupefying effects of this salt strong coffee, and also caffeine citrate, have been recommended.

Sodium lactate has also been proposed as possessing hypnotic qualities (*London Med. Record*, Dec. 15, 1879), but none were shown among seventeen patients of Kroemer, even after the very large doses of the salt had been taken. Others condemn it for its tendency to disorder the stomach and produce diarrhœa.

SODII CARBONAS, *U. S., Br.*—Sodium Carbonate.

Sodæ carbonas, Br.; *Natrium carbonicum*, P. G.; *Carbonas sodicus*, *Sal sodæ depuratus.—Pure carbonate of sodium*, E.; *Carbonate de soude*, Fr.; *Natriumcarbonat*, *Kohlensaures Natron*, G.

Formula $Na_2CO_3.10H_2O$. Molecular weight 285.45.

Origin and Preparation.—Both sodium and potassium carbonate were known at a very remote period, and by the ancients were called *nitron* and *nitrum*, which names were afterward applied to other salts (see page 1307). A distinction between the alkali carbonates was not made until after Duhamel's observation (1736) had shown table-salt to be the compound of an alkali, and until Marggraf (1759) had proved this alkali to differ from the vegetable alkali procured from the ashes of plants.

Sodium carbonate exists in a large number of mineral waters, mostly, however, as bicarbonate. It is contained in the waters of certain lakes in India, Egypt, Central Africa, Mexico, and South America, and is found in the ashes of many plants growing near the seashore, such as Salsola, Statice, Salicornia, Atriplex, Mesembryanthemum, and others. These ashes are known in commerce as *barilla*, *salicor*, etc., the former containing nearly 30 per cent., the latter about 14 per cent., of sodium carbonate. *Kelp* and *varec*, the ashes of various marine algæ, contain much less soda, and are at present not employed for obtaining this salt. Egyptian *trona*, a native sodium carbonate, contains both carbonate and sesquicarbonate. In Hungary and some other countries sodium carbonate effloresces from the earth.

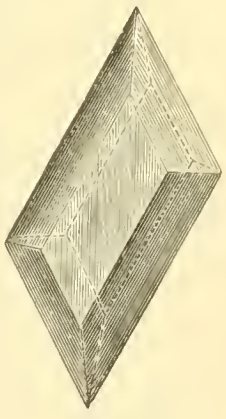
The most important sources of this salt are cryolite and sodium sulphate and chloride. *Cryolite* is a mineral found in Greenland, and consists of sodium and aluminum fluoride. When boiled with an excess of caustic lime, insoluble calcium fluoride and aluminate are obtained and caustic soda remains in solution; and when a mixture of cryolite and chalk is cautiously heated to redness, but not to fusion, calcium fluoride and sodium aluminate are produced, this last compound being soluble in water and decomposed by carbon dioxide, which precipitates aluminum hydroxide, retaining a little sodium carbonate, while pure sodium carbonate remains in solution.

The production of soda directly from sodium chloride has led to numerous investigations, and as early as 1838 it was accomplished by H. Dyar and J. Hemming; but the process, and more particularly the apparatus for the successful working of it, attained greater perfection since E. Solvay began to use it in 1865 on an extensive scale. It consists in conducting, under pressure, into a cold concentrated solution of sodium chloride, first ammonia gas and afterward carbon dioxide, when sodium bicarbonate and ammonium chloride are formed; most of the former salt is deposited, and after being heated to redness requires to be dissolved in water and crystallized in order to obtain sodium carbonate. In the first part of this process the reaction takes place between ammonium bicarbonate and sodium chloride, but the conversion of the latter salt into bicarbonate is never complete.

Sodium carbonate is obtained by *Leblanc's process* from sodium sulphate, which is mixed with chalk and coal and the mixture ignited; the mass is exhausted with water and the solution concentrated, the carbonate separating from the hot liquid being removed, while fresh portions of the solution are added until the carbonate becomes too much contaminated with foreign salts, when it is calcined with charcoal and afterward recrystallized. In the first part of this process sodium carbonate and calcium sulphate are formed by double decomposition, and the sulphate is reduced by the coal to sulphide; but the ignited mass contains also caustic soda, sodium sulphate and sulphite. The crude product obtained by evaporating the first solution to dryness is sent to market as *soda-ash*, and of this 165,502,900 pounds were imported into the United States in 1876, and in addition to this 20,074,269 pounds of soda carbonate and 32,093,691 pounds of caustic soda. The importation of soda-ash in 1883 reached 323,726,726 pounds, and in 1882, of carbonate and caustic soda, 29,842,140 and 56,878,896 pounds, respectively. Large quantities of these compounds are also manufactured here.

Properties.—As obtained in commerce, sodium carbonate is in large, colorless, oblique-rhombic crystals, or frequently in crystalline lumps, inodorous, and with a harsh alkaline taste and a decided alkaline reaction. On exposure it becomes white and friable from the loss of water of crystallization, and ultimately falls into a soft white powder; the amount of this loss depends upon the temperature, and is in ordinary dry air of 12.5° C. (54.5° F.) 31 per cent., and at about 35° C. (95° F.) 56.6 per cent.; the last molecule of water is expelled below the boiling-point of water. The salt is soluble in 1.6 parts of water at 15° C. (59° F.), in 0.09 part at 38° C. (100.4° F.), and in 0.2 part of boiling water; insoluble in alcohol and in ether; soluble in 1.02 parts of glycerin. When heated to 32.5° C. (90.5° F.), the crystals fuse in their water of crystallization. At a higher temperature, the salt continues to lose water, until at last an anhydrous residue is left, corresponding to 37 per cent. of the weight of the crystals. At a bright-red heat the anhydrous salt fuses. To a non-luminous flame it imparts an intensely yellow color. It effervesces strongly on the addition of an acid.

Fig. 287.



Crystal of Sodium Carbonate.

Sodii carbonas venalis, Natrium carbonicum crudum, *P. G.*; Sal sodæ, Soda cruda.—Sal soda, Washing soda, *E.*; Sel de soude, *Fr.*; Soda, *G.*—This is the salt generally met with in commerce. It is used for preparing the pure salt by recrystallizing from hot water until the crystals respond to the pharmacopœial tests of purity, and it is advisable to agitate the cooling solution, so as to obtain small crystals or a crystalline powder, which is readily freed from the mother-liquor by draining and washing with a little cold water. The pure salt should be kept in a well-stopped bottle in a cool place. 20 grains of it neutralize 9.7 grains of citric acid or 10½ grains of tartaric acid.

Tests.—Commercial sodium carbonate contains small but variable quantities of sulphate and chloride, and its solution in water acidulated with nitric acid therefore produces precipitates with barium chloride and with silver nitrate. Cryolite is the source of an impurity which is sometimes met with, and which consists of alumina rendered soluble in water by the soda; it is best detected by acidulating its solution in water with hydrochloric acid, heating to boiling, and then supersaturating with ammonia, when gelatinous aluminum hydroxide will be precipitated. "A 5 per cent. aqueous solution of the salt should be perfectly clear and colorless, leaving no insoluble residue. If 5 Cc. of the aqueous solution (1 in 20) be slightly supersaturated with hydrochloric acid, the liquid should not be colored red by a drop of ferric chloride test-solution (absence of sulphocyanate). If to 5 Cc. of the aqueous solution, slightly supersaturated with hydrochloric acid, an equal volume of hydrogen sulphide test-solution be added, no turbidity should be produced, either before or after the addition of ammonia-water in slight excess (absence of arsenic, lead, iron, aluminum, etc.). If 5 Cc. of the aqueous solution be slightly supersaturated with acetic acid, the addition of 0.5 Cc. of ammonium oxalate test-solution should produce no turbidity (absence of calcium). If 5 Cc. of the aqueous solution be slightly supersaturated with acetic acid, the addition of 0.5 Cc. of sodium cobaltic nitrite test-solution should not render it turbid within one hour (limit of potassium). If 1.2 Gm. of the salt be dissolved in 10 Cc. of diluted nitric acid, then 0.5 Cc. of decinormal silver nitrate solution added, and the precipitate, if any, be removed by filtration, the clear filtrate should remain unaffected by the addition of more silver nitrate test-solution (limit of chloride). If 2.5 Gm. of the salt be dissolved in 10 Cc. of diluted hydrochloric acid, then 0.1 Cc. of nitric acid and 0.1 Cc. of barium chloride test-solution added, and the precipitate, if any, be removed by filtration, the clear filtrate should remain unaffected by the further addition of barium chloride test-solution (limit of sulphate, sulphite, and thiosulphate). If the crystallized salt be heated in a test-tube, the vapor of ammonia should not be evolved."—*U. S.*

The limit of impurities allowed by the U. S. and Germ. Ph. is practically identical (1.1 per cent.), the former demanding that 1 Gm. of the anhydrous salt shall require not less than 18.7 Cc. of normal acid for complete neutralization, while the Germ. Ph. requires for 1 Gm. of crystallized (= 0.37 Gm. anhydrous) salt not less than 7 Cc. of normal acid. The Br. Ph. allows 4.3 per cent. of impurities by requiring for 14.3 Gm. of crystallized salt 96 Cc. of normal oxalic acid.

Composition.—Pure crystallized sodium carbonate contains 62.9 per cent. of water, 21.7 per cent. of Na_2O, and 15.4 per cent. of CO_2. When boiled with a little water a salt is deposited containing only 11.6 per cent. of water = $1H_2O$. Several other salts are obtainable, which crystallize with 3, 5, and $7H_2O$. Besides the sodium carbonate and

bicarbonate, another compound of intermediate composition may be obtained; this *sesquicarbonate* requires about 7 parts of water for solution, and contains nearly 22 per cent. of water.

SODII CARBONAS EXSICCATUS, *U. S.*—Dried Sodium Carbonate.

Sodii carbonas exsiccata, Br.; *Natrium carbonicum siccum*, P. G.—*Dried carbonate of soda*, E.; *Carbonate de soude sec*, Fr.; *Entwässerte Soda*, G.

Formula $Na_2CO_3 2H_2O$. Molecular weight 141.77 (anhydrous $Na_2CO_3 = 105.85$).

Preparation.—Sodium carbonate 200 Gm.; to make 100 Gm. Break the salt into small fragments, allow it to effloresce by exposure to warm air for several days, then expose it to a temperature of about 45° C. (113° F.) until it has been converted into a white powder weighing 100 parts. Pass the powder through a sieve and preserve it in well-stoppered bottles.—*U. S.*

This is also the process of the German Pharmacopœia, and was admitted so as to facilitate the dispensing of sodium carbonate. The warm air to which the crystallized salt is to be exposed in the beginning should be of a lower temperature than the melting-point (32.5° C.) of the salt, when a light and voluminous powder will be obtained. Working strictly according to the pharmacopœial directions, the salt will have the composition given above, and probably is a mixture of the mono- and terhydrated carbonate. Near and above 40° C. (104° F.) a salt of the formula $Na_2CO_3.H_2O$ is readily obtained, weighing $1\frac{3}{8}$ oz., from 4 oz. of the crystallized salt. The product of the British Pharmacopœia is denser, the salt being at first fused in its water of crystallization, and afterward rendered anhydrous.

Properties.—Dried sodium carbonate is a soft white powder which answers to the tests and reactions of the crystallized salt. It is permanent at a temperature of 30° or 35° C. (86° or 95° F.), but at low temperatures absorbs moisture. 2.65 Gm. of the anhydrous salt, if pure, require for neutralization 50 Cc. of the normal volumetric solution of oxalic acid; for the pharmacopœial salt not less than 36.5 Cc. should be necessary, showing the presence of at least 73 per cent. Na_2CO_3.

History.—Under Potassium Nitrate allusion has been made to the confusion between nitrum and natron, nitre and soda, in medical and natural history. It is probable that anciently they were not clearly distinguished from one another. It appears that originally the term *nitre* was applied to native sodium carbonate, and that the same name was afterward given to the substance procured by lixiviation from the ashes of the beech, oak, and other trees.

Soda was used by the ancients only as an external remedy for repressing fungous granulations, stimulating indolent sores, curing eruptions of the skin, lessening perspiration, whitening the teeth, and destroying vermin. It was habitually dissolved in water and applied as soap is at present, and baths of a strong solution of it were employed in the treatment of gout, tetanus, etc.

Action and Uses.—The nature of the action of sodium carbonate must be closely analogous to that of the bicarbonate, but it differs in being much more irritating. Experimental researches have shown that when from 1 to 5 drachms of this salt are daily taken by men for ten successive days the blood grows lighter in color, the proportion of its white corpuscles and water increases, while that of its other solid constituents declines and the clot exhibits a diminished firmness. Meanwhile, the strength is impaired and the skin grows pale. In excessive doses sodium carbonate is irritant and corrosive, but not so much so as potassium carbonate. Its proper *antidotes* are vinegar, lemon-juice, or a solution of tartaric acid. Subsequently cream or olive or almond oil may be administered.

In regard to the internal uses of sodium carbonate little need be said in detail. They are the same as those of the bicarbonate, but are much less frequently resorted to, on account of the greater mildness of the action of the latter salt. The carbonate is especially used now, as it was in ancient times, for the treatment of *diseases of the skin*. It is most frequently applied in a general bath, from 4 to 16 ounces of the salt being dissolved in a sufficient quantity of water at a temperature of about 80° F. Each bath should last for at least an hour. The effect of it is to redden the skin, to stimulate the affected portions to assume a more healthy action, and to remove the sebaceous and acid secretions adhering to it. If the skin is already in an irritable condition, very little of the alkali should be used, and its acrimony should be blunted by the addition of mucilage or bran to the water. Naturally, the dry eruptions (lichen, prurigo, lepra, psoriasis, pity-

riasis) are most apt to be benefited by this treatment, while pustular and vesicular affections (impetigo, eczema) are unsuited for its use, unless the solution is very weak. Lotions containing sodium carbonate are useful in many local eruptions, as those of the scalp, in herpes circinatus, lichen agrius, intertrigo, and *pruritus of the vulva*. In some cases of inveterate scaly diseases, and in a less degree in chronic papular and pustular affections, the long-continued internal use of this medicine is sometimes curative, but seldom until it has produced more or less of the cachectic phenomena above mentioned.

Sodium carbonate has also been employed in glandular *scrofula*, *whooping cough*, *congestion of the liver*, etc., but, except in the form of alkaline mineral waters, without notable advantage.

This salt is seldom administered internally, but its *dose* may be stated to be Gm. 0.30–1.30 (gr. v–xx), dissolved in water and largely diluted. From Gm. 60–250 (℥ij–viij) may be used in a general bath for diseases of the skin. A lotion for the same purpose should contain Gm. 1.30 in Gm. 32 (gr. xv–xx to the ounce) of water for scaly affections, and about half that proportion for lichenoid eruptions. A solution of the latter strength is appropriate as a wash for the mucous membrane of the female genital organs. An ointment for diseases of the skin may be made with about Gm 4 in Gm. 32 (℥j to ℥j) of lard, with the addition of 1 or 2 fluidrachms, Gm. 8 (f℥j–ij), of laudanum.

The medicinal qualities of dried sodium carbonate are identical with those of the common carbonate. It is represented to be convenient for administration in pills, but the irritant qualities of the salt render this mode of prescribing it not only ineligible, but imprudent. The *dose* of it is stated to be Gm. 0.20–0.60 (gr. iij–x).

SODII CHLORAS, *U. S.*—Sodium Chlorate.

Natrium chloricum, *Chloras sodicus*.—*Chlorate de soude*, Fr.; *Natriumchlorat*, G.

Formula $NaClO_3$. Molecular weight 106.25.

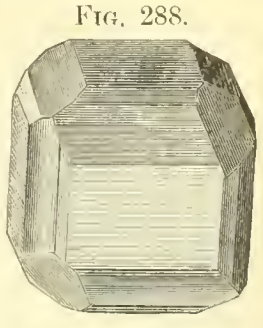
Sodium chlorate should be kept in glass-stoppered bottles, and *great caution* should be observed in handling the salt, as dangerous explosions are liable to occur when it is mixed with organic matters (cork, tannic acid, sugar, etc.), or with sulphur, antimony sulphide, phosphorus, or other easily oxidizable substances, and either heated directly or subjected to trituration or concussion.

Preparation.—This salt is most conveniently obtained, according to Wittstein, by preparing sodium bitartrate from 9 parts of crystallized sodium carbonate and 9.5 parts of tartaric acid, and adding the hot solution to one containing 8 parts of potassium chlorate. The cold liquid is filtered from the precipitated potassium bitartrate, evaporated, and crystallized. The last traces of bitartrate may be removed by recrystallization from alcohol. The yield is about 7.5 parts. The salt is also formed, like the corresponding potassium salt (see p. 1290), by passing chlorine into solution of soda and boiling; the resulting chlorate requires to be freed from chloride by repeated crystallization, involving considerable loss, owing to the ready solubility of both salts.

Hager recommends the following: Dissolve 100 parts of potassium chlorate and 60 parts of official dry sodium carbonate in 600 parts of warm water; allow to cool, add 300 parts of alcohol, set aside in a cool place for two days, decant the solution, distil off the alcohol, evaporate to crystallization, and purify by recrystallization. The yield is about 85 parts.

Properties.—Sodium chlorate crystallizes in the form of regular cubes, combined with the dodecahedron and tetrahedron. The crystals are colorless and transparent, or the salt is seen in a white crystalline powder, and is permanent in the air, inodorous, and has a cooling saline taste: it is soluble at 15° C. (59° F.) in 1.1 parts of water, and in about 100 parts of alcohol; in 0.5 part of boiling water, and in about 40 parts of boiling alcohol; also soluble in 5 parts of glycerin. When heated, the salt melts, then gives off oxygen (about 45 per cent. of its weight), and finally leaves a residue of sodium chloride readily soluble in water, and yielding, with silver nitrate test-solution, a white, curdy precipitate, insoluble in nitric acid. To a non-luminous flame it imparts an intensely yellow color. The aqueous solution is neutral to litmus-paper. When a crystal of the salt is dropped into hydrochloric acid, the liquid assumes a deep greenish-yellow color and emits the odor of chlorine.

Fig. 288.



Crystal of Sodium Chlorate.

Tests.—"A saturated aqueous solution should not be rendered turbid by sodium

bitartrate test-solution (limit of potassium). An aqueous solution of the residue left after igniting a portion of the salt, should not give an alkaline reaction with litmus-paper (absence of tartrate). The aqueous solution (1 in 20), slightly acidulated with acetic acid, should not be rendered turbid by the addition of an equal volume of hydrogen sulphide test-solution, either at once (absence of arsenic, lead, etc.), or after the addition of ammonia-water in slight excess (absence of iron, aluminum, etc.). The aqueous solution (1 in 20) should not be rendered turbid by adding to it a few drops of ammonia-water and then sodium phosphate test-solution (absence of magnesium). The solution (1 in 20), slightly acidulated with acetic acid, should not be rendered turbid by ammonium oxalate test-solution (absence of calcium); nor by barium chloride test-solution (absence of sulphate); nor should silver nitrate test-solution produce in it more than a slight opalescence (limit of chloride)."—*U. S.*

Action and Uses.—This salt is identical in the nature of its properties with potassium chlorate, but its action is very much milder. It has been but little used. The *dose* may be stated at Gm. 0.30–1.30 (gr. v–xx), but it can seldom be needed as an internal medicine. As a gargle or wash a solution of from 2 to 5 per cent. may be prescribed.

SODII CHLORIDUM, *U. S., Br.*—Sodium Chloride.

Natrium chloratum, P. G.; *Chloruretum sodicum*, *Sal commune*, *s. culinare.*—*Common salt*, *Table-salt*, *Sodium chloride*, E.; *Chlorure de sodium*, *Sel commun*, *Sel de cuisine*, Fr.; *Chlornatrium*, *Kochsalz*, G.

Formula NaCl. Molecular weight 58.37.

Origin and Preparation.—Sodium chloride is found native in extensive beds and in different geological formations, though mostly associated with clay and calcium sulphate, and constitutes *rock-salt* or *sal gem* if very pure and transparent. This is mined, mechanically freed from the adhering impurities, and sold as rock-salt or purified by recrystallization. In some places holes are dug into the rock and filled with water, which is pumped up when nearly saturated with salt and evaporated.

Most saline springs contain sodium chloride. If the salt is present in sufficiently large proportion, it is recovered by evaporation; but if present in the solution only in limited proportion, the spring water is first concentrated, in some parts of France and Germany, by pumping it up on a high scaffolding and causing it to trickle over layers of brushwood, whereby, from the largely-extended surface exposed to the air, much water is evaporated, and a brine is obtained which may be economically concentrated by artificial heat. Sometimes the brine contains also considerable proportions of gypsum and sodium sulphate, which salts are deposited from the boiling brine and raked out; when nearly free from these salts and sufficiently concentrated, the liquor is no longer mixed with fresh portions of the brine, but is maintained at an elevated temperature and the salt removed as it crystallizes. The size of the crystals, called grain of the salt, varies with the heat, and increases as the temperature falls.

Sea-water is a solution of various salts, prominent among which is sodium chloride, which is contained in the waters of the large oceans to the amount of from 2.6 to 2.9 per cent., but is much less in the large bays and seas which are surrounded by land, and sinks—for instance, in the water of the Baltic Sea—to ½ per cent. The extraction of the salt from sea-water depends upon the climate, the water being removed either by freezing or by evaporation. When frozen, sea-water yields pure ice and leaves a more concentrated saline solution. In warmer countries the concentration is effected by spontaneous evaporation in shallow pits, the brine as it concentrates being conducted into other pits, and finally into reservoirs, where the salt is deposited.

The mother-liquors which are obtained in the several processes described are solutions of various salts, usually sulphates and chlorides, in some cases also of sodium, potassium, calcium, and magnesium bromides, and they frequently yield salts or double salts of definite composition by being concentrated and exposed to either a low or an elevated temperature; they are used up in the preparation of sodium sulphate, magnesium sulphate, and bromine.

In addition to the large quantities of salt obtained in the United States, about 750,000,000 pounds of it are annually imported.

Properties.—When crystallized by spontaneous evaporation sodium chloride forms transparent cubes; but when the solution is evaporated at an elevated temperature, the crystals aggregate on the surface of the liquid in the form of white or translucent hollow

pyramids. It is very frequently kept in the form of a white, granular, crystalline powder, which is inodorous and permanent in the air, unless contaminated with magnesium chloride, when it becomes moist in a damp atmosphere. On the application of heat sodium chloride usually decrepitates, and at a red heat it melts and is slowly volatilized. It has a neutral reaction to test-paper, a density of 2.16, and a purely saline taste. It is very sparingly soluble in strong alcohol, and requires a little less than 3 parts of hot or cold water for solution. 100 parts of water dissolve at 0° C. (32° F.) 35.52 parts, at 14° C. (57.2° F.) 35.87 parts, at 25° C. (77° F.) 36.13 parts, at 60° C. (140° F.) 37.25 parts, and at 100° C. (212° F.) 39.61 parts, of sodium chloride (Poggiale). On cooling the saturated aqueous solution to below the freezing-point of water, transparent colorless prisms, $NaCl.2H_2O$, are obtained, which melt above 0° C. (32° F.) and deposit a granular powder of the anhydrous salt. Dilute aqueous solutions of sodium chloride produce at a low temperature ice which is free from the salt, and concentrated solutions deposit crystals of the salt before they freeze. A fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass; the aqueous solution, acidulated with nitric acid, yields with test-solution of silver nitrate a white precipitate soluble in ammonia.—*U. S.*

Composition.—Sodium chloride contains 60.6 per cent. of chlorine and 39.4 per cent. of sodium. Heated with sulphuric acid, hydrochloric acid is given off.

Tests.—The aqueous solution of sodium chloride should not be precipitated by sodium carbonate (absence of calcium, magnesium, etc.), barium chloride (sulphate), hydrogen sulphide or ammonium sulphide (metals). "If 2 Gm. of the salt be digested with 25 Cc. of alcohol, the cold and filtered alcoholic solution evaporated to dryness, the residue dissolved in 10 Cc. of water, a little gelatinized starch added, and subsequently chlorine-water drop by drop, no colored tint should make its appearance at the line of contact of the two liquids (absence of iodide or bromide). No turbidity should be produced in 5 Cc. of the aqueous solution (1 in 20) by the addition of 0.5 Cc. of sodium cobaltic nitrite test-solution (limit of potassium)."—*U. S.* Hager recommends for the same purpose the following simple test: Put into a dry test-tube sufficient of the powdered salt to form a layer about 25 Mm. (1 inch) thick; press it firmly with a glass rod, and add carefully twice this volume of a cold saturated solution of copper sulphate; the salt must retain its color and remain free from dark spots. (See SODII BROMIDUM.) 1 Gm. of sodium chloride, when completely precipitated by silver nitrate, should yield 2.450 Gm. of dry silver chloride. If 0.195 Gm. of well-dried sodium chloride be dissolved in 10 Cc. of water, and the solution mixed with a few drops of potassium chromate test-solution, it should require not less than 33.3 Cc. of decinormal silver nitrate solution to produce a permanent red color (corresponding to at least 99.9 per cent. of the pure salt).

Pharmaceutical Uses.—Sodium chloride is used in the preparation of chlorine, hydrochloric acid, corrosive sublimate, and calomel.

Action and Uses.—Sodium chloride is a natural constituent of the body and the chief source of its most important secretion, the gastric juice, and for this reason is an essential constituent or condiment of all solid food. Its excessive and long-continued use in food produces scurvy. Large doses of it cause vomiting and diarrhœa, and death has resulted from them.

It has been proposed to use salt for the cure of *intermittent fever*, upon the ground that it causes contraction of the spleen enlarged by the disease. From half an ounce to an ounce has been given for this purpose during the apyrexia, and usually, unless dissolved in too much water, it neither vomits nor purges. This is said to be a popular medicine in some river localities and among boatmen, who usually swallow a tablespoonful or so of salt mixed with gin. It has also been recommended to be taken after being roasted in a pan over a gentle fire (*Med. Record*, xiv. 198). There is no sufficient proof of the efficacy of the medicine. A similar remark may be applied to its use in pulmonary *phthisis*, notwithstanding certain physicians of repute have attested its benefits. This judgment does not apply to an ordinary incident of consumption, *hæmoptysis*, for which a teaspoonful of dry table-salt may be given at intervals of fifteen or twenty minutes. Nothing appears to be so successful in arresting this form of hæmorrhage, but all the ingenious hypotheses invented to explain its apparent action are chimerical. If the hæmorrhage, like most others, did not usually cease spontaneously when the patient is kept perfectly still, the action of the salt would be less ambiguous. The same remarks are more or less applicable to the use of salt to arrest *epistaxis*, in which, however, it generally fails to give any evidence of hæmostatic virtues.

In the various forms of *scrofula* affecting the glands, the skin, or the bones salt has been used internally and externally, but chiefly in the latter mode in sea-baths and the baths of various mineral springs; and doubtless these agents are often useful through their stimulant operation, without any reference to their special saline constituents, in so far as they promote tissue-change. Gargles of salt water have been used with some advantage to promote the separation of the false membranes in *diphtheria*.

As salt is essential to the digestion of food, so is it of use in certain forms of *dyspepsia*, doubtless by promoting the secretion of the gastric juice, and perhaps also by its direct solvent action upon some kinds of aliment. It is especially indicated in those forms of dyspepsia which are attended with decomposition of the food in the stomach, causing flatulence, acidity, and pain, and either diarrhœa, as in children, or constipation, as in adults. It may be best administered in the form of natural mineral waters rich in this ingredient or in carbonic acid water.

In epidemic *cholera* the injection of salt and water into the veins has frequently been followed by temporary improvement, and when duly repeated, especially at the beginning of reaction, it has hastened and secured recovery. It is also claimed that a tablespoonful of a solution of 1 ounce of salt in ½ pint of water, given by the stomach at intervals of a quarter of an hour, has repeatedly arrested the disease. If such be the fact, its explanation may probably be that the saline solution acts directly upon the cholera poison whose influence upon the gastro-intestinal mucous membrane produces the serous exhalation which constitutes the primary element of the disease. In a number of cases life has been saved from impending death from *hæmorrhage* by injecting gradually into the median vein about 2 pints of distilled or boiled water holding in solution about 90 grains of common salt and 15 grains of sodium carbonate (*Centralbl. f. Therapie*, i. 387, 389; Mikulicz, *Wiener Klinik*, July, 1884; Thon, *Boston Med. and Surg. Jour.*, Oct. 1884, p. 430; Harrington, *ibid.*, Mar., 1886, p. 197; Rook, *Jour. Am. Med. Assoc.*, vii. 367). The subcutaneous injection of saline liquids has been found efficient in like cases (*Therap. Monatsheft*, iii. 31, 477; iv. 94, 255). Salt is an ancient, and continues to be a popular remedy for intestinal *worms*, especially for lumbricoid worms. Enemas of salt water form an excellent remedy for *ascarides* of the rectum. Probably in both cases the parasites are destroyed by the salt abstracting the water from their tissues. In a similar manner, when leeches are sprinkled with salt they disgorge the blood which they had swallowed. It has been supposed that the anthelmintic virtues of helminthocorton, or Corsican moss, depend upon the saline element which saturates it.

Salt has been employed with some effect in *diabetes*, and certainly some of the mineral waters used in that disease contain it. But, given in simple watery solution, it is alleged to reduce the proportion of sugar and the amount of urine voided. In chronic *albuminuria* doses of 10 grains three times a day have been thought useful (Meminiger, *Med. News*, xlix. 263).

It is a familiar fact that salt meat, olives, and other saline articles tend to prevent *alcoholic intoxication*, and enemas of salt water have been repeatedly employed with success to rouse drunkards from their lethargy or abate their delirious pugnacity. Similar injections are in common use to relieve *congestion of the brain*, which they do more speedily than can be explained by the mere removal of fæces from the rectum. A teaspoonful of dry salt swallowed on the threatening of the *epileptic* paroxysm is a remedy that commands popular belief. Salt water is often employed as an emetic to empty the stomach gorged with food or containing *narcotic* or other *poisons*. Salt is a direct antidote to *nitrate of silver*, converting it into the comparatively innocuous chloride.

The local applications of salt are numerous. It is used to limit the action of silver nitrate applied to the *eye*, *throat*, *vagina*, etc., in an atomized solution for the treatment of subacute and chronic affections of the *pharynx* and *larynx*, and by the nasal douche in *catarrh of the nostrils* and *ozæna*. The solution used for the latter purpose should not contain more than 20 grains of salt to a pint of water. Stronger solutions are apt to be painful and to aggravate the disease. A similar solution inspired from the hands while the head is bent forward almost horizontally will often answer the purpose as well. Salt and water may also be used as a wash for *mercurial sore mouth*, as an injection in vaginal *leucorrhœa*, as a wash for indolent *ulcers*, for *pruritus vulvæ*, and for the *stings and bites of insects*. Hot salt enclosed in bags is an excellent application in *colic*, *dysmenorrhœa*, *toothache*, and *muscular rheumatism*; a solution of it in whiskey is a popular remedy for the last-named disease and for discussing *bruises*, *glandular swellings*, etc.; and, finally, a warm salt foot-bath (100° F.) is one of the best palliatives of congestive *headache*, *uterine pain*, and similar disorders. Salt-water baths (½ per cent. strong) have

been recommended as more cleansing and refreshing than those of soap and water, and a 5 per cent. strength as more agreeable and useful than soap baths in subacute *eczema*, *psoriasis*, etc. (Piffard, *Amer. Jour. Med. Sci.*, Jan. 1888, p. 95).

SODII CITRO-TARTRAS EFFERVESCENS, *Br.*—Effervescent Sodium Citro-Tartrate.

Preparation.—Take in fine powder Sodium Bicarbonate 17 ounces; Tartaric Acid 9 ounces; Citric Acid 6 ounces; and Refined Sugar 5 ounces. Mix the powders thoroughly, place them in a dish or pan of suitable form heated to between 93.3°–104.4° C. (200° to 220° F.), and when the particles of the powder begin to aggregate stir them assiduously until they assume a granular form; then by means of suitable sieves separate the granules of uniform and most convenient size, and preserve the preparation in well-closed bottles.—*Br.*

For the preparation of granular powders, see page 1254. If kept dry, this citro-tartrate is preferable to a mixture of the powdered ingredients, which soon undergoes decomposition. Thrown into water, it dissolves with brisk effervescence.

Action and Uses.—This preparation is equivalent in its action to the effervescing draught, and may be prescribed with advantage to moderate fever, promote perspiration, and diminish the acidity of the urine and other secretions. It is conveniently employed in *fevers* and *inflammations*, and especially in acute articular *rheumatism*. *Dose*, Gm. 4–8 (ʒj–ij) in several fluidounces of water.

SODII HYPOPHOSPHIS, *U. S.*, *Br.*—Sodium Hypophosphite.

Sodæ hypophosphis, Br.; *Natrium hypophosphorosum*, *Hypophosphis sodicus*.—*Hypophosphite de soude*, Fr.; *Unterphosphorigsaures Natron*, G.

Formula $NaH_2PO_2.H_2O$. Molecular weight 105.84.

Preparation.—An aqueous solution of 6 parts of calcium hypophosphite is accurately precipitated by a solution of 10 parts of crystallized sodium carbonate; insoluble calcium carbonate and soluble sodium hypophosphite are produced, and separated by filtration; on evaporating the filtrate, the latter salt is left behind, and if necessary may be freed from sodium carbonate by redissolving it in alcohol, filtering, and evaporating. Berlandt (1865) recommends its preparation with granulated phosphorus (see page 1244), of which 23½ parts are macerated in a flask at 10° C. (50° F.) with 25 parts of caustic soda and 100 parts of water; after the phosphorus has been dissolved, the liquid is mixed with four times its volume of alcohol, neutralized with sulphuric acid, filtered, and evaporated. During the evaporation decomposition with explosion has occasionally been noticed, which was caused by too high a heat; the temperature of the evaporating solution should therefore be kept below that of boiling water.

Properties.—Sodium hypophosphite is usually obtained in the form of a white granular powder, but by the slow evaporation of its alcoholic solution may be procured in pearly rectangular, tabular crystals, which, when dried over sulphuric acid and afterward heated not quite to 200° C. (392° F.), lose nearly 17 per cent. of water. At a higher heat spontaneously inflammable hydrogen phosphide is evolved, and a porous mixture of sodium pyrophosphate and metaphosphate is left. The salt is inodorous, has a peculiar bitterish (sweetish, *U. S.*) saline taste, is deliquescent in the air, though less so than potassium hypophosphite, and is easily soluble in water, and likewise in absolute alcohol, but is insoluble in ether. The U. S. P. states it to be soluble in 1 part of water and in 30 parts of alcohol at 15° C. (59° F.), in 0.12 part of boiling water, and in 1 part of boiling alcohol. A fragment of the salt imparts to a non-luminous flame an intense yellow color, not appearing more than transiently red when observed through a blue glass. On triturating or heating the salt with an oxidizing agent the mixture will explode. The aqueous solution yields with test-solution of silver nitrate a white precipitate, which rapidly turns brown and black; and when acidulated with hydrochloric acid and added to excess of test-solution of mercuric chloride, it first produces a white precipitate of calomel, and on further addition metallic mercury separates.—*U. S.* When evaporated with dilute nitric acid and finally ignited, a residue is obtained weighing 97 per cent. of the weight of the hypophosphite, and consisting of sodium metaphosphate. Like all hypophosphites, the salt is oxidized on exposure to the air to phosphite and phosphate, and must therefore be preserved in well-stoppered bottles.

Tests.—The aqueous solution of the salt should not effervesce on the addition of an

acid (absence of carbonate), and should not be precipitated nor be rendered cloudy by test-solution of ammonium oxalate (absence of calcium). After being acidulated with hydrochloric acid it should not produce a white precipitate or cloudiness with test-solution of barium chloride (sulphate). A solution of 0.5 Gm. of the salt in 1 Cc. of water should yield no precipitate upon addition of 1 Cc. of sodium bitartrate test-solution (limit of potassium). In the aqueous solution (1 in 20), acidulated with hydrochloric acid, an equal volume of hydrogen sulphide test-solution should not produce any turbidity (absence of arsenic, lead, etc.). After treating 5 Cc. of the aqueous solution (1 in 20) with 1 Cc. of nitric acid, the solution should remain clear upon addition of silver nitrate test-solution (absence of chloride). Not more than a slight cloudiness should be produced in the aqueous solution of the salt by magnesia mixture (limit of phosphate). Potassium ferrocyanide test-solution should not produce in the acidulated solution any blue color (absence of iron). If 0.1 Gm. of dry sodium hypophosphite be dissolved in 10 Cc. of water, mixed with 7.5 Cc. of sulphuric acid and 40 Cc. of decinormal potassium permanganate solution, and the mixture boiled for fifteen minutes, it should require not more than 3 Cc. of decinormal oxalic acid solution to discharge the red color, corresponding to at least 97.90 per cent. of the pure salt."—*U. S.*

Each Cc. of decinormal potassium permanganate solution is capable of oxidizing 0.002646 Gm. of crystallized sodium hypophosphite, the reaction being the same as shown under the corresponding potassium salt, and hence 37 Cc. of the permanganate solution will be required for each 0.1 Gm. of sodium hypophosphite of official purity (97.9 per cent.).

5 gr. of the salt dissolved in ½ oz. of water, and boiled for ten minutes with 11½ gr. of potassium permanganate, yield a nearly colorless filtrate.—*Br.*

Action and Uses.—Sodium hypophosphite has been administered in chronic *bronchitis* and in cases of *nervous depression* with a sense of heaviness or numbness in the limbs, in sexual *impotence*, and various other exhausted states of the nervous system, including those produced by *scrofula*, *syphilis*, and *anæmia*. This and the other alkaline and earthy phosphites and hypophosphites have also been used with alleged success in *phthisis*, but the allegations have been unsupported by the results of experience. The apparent value of the phosphatic compound in the above-named diseases is to be explained by the associated medicinal and hygienic treatment. The *dose* of sodium hypophosphite is Gm. 0.50 (gr. viij) or more given during digestion.

SODII HYPOSULPHIS, *U. S.*—Sodium Hyposulphite (Sodium Thiosulphate).

Natrium thiosulfuricum, P. G.; *Natrium subsulfurosum* (*hyposulfurosum*), *Hyposulphis sodicus.*—*Hyposulphite de soude*, *Sulfite sulfuré de soude*, Fr.; *Natriumthiosulfat*, G.

Formula $Na_2S_2O_3.5H_2O$. Molecular weight 247.64.

The Pharmacopœia has continued the official name of 1880 for this salt, but has added the synonym "Sodium Thiosulphate." We think the new revision of the Pharmacopœia offered an excellent opportunity for introducing the correct chemical name as the official name (as has been done by the Germ. Phar.), the old name being added in parenthesis with the qualification "formerly, but wrongly called." There is no longer any doubt as to the difference between hyposulphurous and thiosulphuric acids, and the chemical formula assigned to the official compound is not in conformity with the official title, which latter applies to a salt of the composition $NaHSO_2$. True hyposulphurous acid, H_2SO_2, is obtained by the action of zinc on sulphurous acid, zinc sulphite being formed and the liberated hydrogen reducing sulphurous to hyposulphurous acid, with the formation of water. The acid is a strong reducing agent, and when exposed to the air is decomposed, yielding first thiosulphuric acid, and then sulphur dioxide, sulphur, and water; it has been obtained as a deep-yellow colored liquid. True sodium hyposulphite may be prepared by treating a solution of acid sodium sulphite (bisulphite) with metallic zinc, whereby sodium hyposulphite and sulphite, together with zinc sulphite, are formed; thus, $3NaHSO_3 + Zn = NaHSO_2 + Na_2SO_3 + ZnSO_3 + H_2O$. The salt is used by dyers and calico-printers for the reduction of indigo.

Thiosulphuric acid, $H_2S_2O_3$, the acid present in the official salt, has never been obtained in a free state, but a series of stable salts (thiosulphates) has been prepared by boiling the respective sulphites in solution with sulphur; thus, $Na_2SO_3 + S = Na_2S_2O_3$; they may also be obtained by adding iodine to a mixture of sulphite and sulphide, thus, $Na_2SO_3 + Na_2S + I_2 = Na_2S_2O_3 + 2NaI$, or by the action of sulphur on alkali hydroxide,

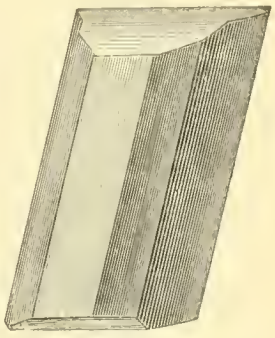
when alkali pentasulphide is simultaneously formed. The fact that thiosulphates show a great tendency to form double salts, as well as their decomposition, when heated, into sulphates and sulphides, readily distinguishes them from true hyposulphites, which latter, when heated, break up into thiosulphates and water.

Preparation.—The process proposed by Walchner is as follows: A mixture of 3 parts of exsiccated sodium carbonate and 1 part of sulphur is heated in a porcelain dish gradually to the fusing-point of sulphur, and repeatedly stirred to facilitate contact with the air. Sodium sulphide is first formed, and then oxidized to sulphite, Na_2SO_3; this salt is dissolved in a little water, and by boiling with more sulphur converted into thiosulphate; the solution is filtered from the excess of sulphur, and the nearly colorless filtrate concentrated for crystallization.

In the purification of illuminating gas prepared from coal by dry lime, the *gas-lime* contains calcium carbonate, thiosulphate, and pentasulphide, and is utilized for the manufacture of sodium thiosulphate by a process proposed by Graham. The gas-lime is exposed to the air so as to convert the sulphide into thiosulphate; $2CaS_5 + 3O_2$ yields $2CaS_2O_3 + 3S_2$. It is then treated with its weight of cold water, and the filtrate, which contains the calcium thiosulphate, is converted into the sodium salt by double decomposition with sodium carbonate, whereby insoluble calcium carbonate is produced and a solution of sodium thiosulphate obtained, which is concentrated and crystallized; $CaS_2O_3 + Na_2CO_3$ yields $CaCO_3 + Na_2S_2O_3$. The residue left in the preparation of soda, called *soda waste*, contains calcium sulphide, and is converted into sodium thiosulphate by a process nearly identical with the one just described. In decomposing calcium thiosulphate the sodium carbonate may be replaced by sodium sulphate, in which case calcium sulphate is precipitated.

Properties.—Sodium thiosulphate is in large, transparent, colorless, monoclinic prisms or plates which have the specific gravity 1.74, are neutral or faintly alkaline, are inodorous, and have a cooling, bitter, slightly alkaline, and sulphurous taste. It is permanent in the air, but over sulphuric acid it slowly parts with most of its water of crystallization (Letts, 1873), and in the atmosphere begins to effloresce at about 33° C. (91.4° F.) (Pape, 1865). When slowly heated it parts with all its water of crystallization (36.3 per cent.) at 100° C. (U. S.), but if rapidly heated not below 215° C. (419° F.), and at about 225° C. (437° F.) it is decomposed, with the separation of sulphur (Pape); at a red heat it forms a black (after cooling brown-yellow) mass of sodium sulphate and polysulphide, and a non-luminous flame is colored intensely yellow by the salt. The crystallized salt dissolves at 0° C. (32° F.) in .92 part, at 15° C. (59° F.) in .65 part, at 20° C. (68° F.) in .50 part (U. S.), and at 40° C. (122° F.) in .25 part of water, and readily forms supersaturated solutions (Kremers, 1856); it is slowly soluble in oil of turpentine, the odor of the latter being modified (Edison, 1876), but it is insoluble in alcohol, and is precipitated by the latter from its concentrated solution as an oily liquid. The aqueous solution is gradually, or in the presence of free alkali more rapidly, decomposed, sulphur being deposited, and in the presence of zinc and free acid hydrogen sulphide is formed; on acidulating the solution of the salt, thiosulphuric acid is liberated, and at once decomposed into sulphurous acid and sulphur, which forms a white precipitate (difference from sulphites).

Fig. 289.



Crystal of Sodium Thiosulphate.

Sodium thiosulphate dissolves chloride, iodide, and other compounds of silver readily, and is employed for this purpose by photographers, and such a solution may be used for silvering copper and brass. Iodine is decolorized by a solution of sodium thiosulphate, sodium iodide and tetrathionate being formed, according to the equation $2Na_2S_2O_3.5H_2O + I_2 = 2NaI + Na_2S_4O_6 + 10H_2O$. This reaction affords a convenient method for the estimation of iodine, 126.53 parts of which are decolorized by 247.64 parts of the thiosulphate. A similar reaction takes place with chlorine, and makes the salt a useful and cheap *antichlor* for the removal of chlorine retained by fabrics and other substances which have been bleached by chlorine. Sodium thiosulphate is also a solvent for the insoluble salts of lead and other metals. It affords a white precipitate in a concentrated solution of barium chloride, which is soluble in water.

Impurities.—If contaminated with sodium sulphate or carbonate, the dilute solution of sodium thiosulphate produces a white precipitate with solution of barium chloride. "A solution of the salt in 80 parts of water should not be rendered cloudy by a few drops of test-solution of barium chloride (absence of sulphate). If to 0.5 Cc. of the

aqueous solution (1 in 20) an equal volume of hydrogen sulphide test-solution be added, no coloration or turbidity should be perceptible, either before or after the addition of 1 Cc. of ammonia-water (absence of lead, iron, etc.). The aqueous solution should not be rendered turbid by the addition of ammonium oxalate test-solution (absence of calcium). The aqueous solution of the salt (1 in 20) should not be colored red by a drop of phenolphtalein test-solution (absence of caustic alkali or carbonate); nor should a drop of silver nitrate test-solution produce a brown or black precipitate in 5 Cc. of this solution (absence of sulphide). If 0.25 Gm. of sodium thiosulphate be dissolved in 10 Cc. of water and a few drops of starch test-solution added, it should require at least 9.9 Cc. of decinormal iodine solution to produce a permanent blue color (corresponding to at least 98.1 per cent. of the pure salt)."—*U. S.*

From the equation given above, explaining the reaction between sodium thiosulphate and iodine, we learn that 495.28 parts of the former will decolorize 253.06 parts of the latter, and hence each Cc. of decinormal iodine solution (containing 0.012653 Gm. of iodine) so decolorized will represent 0.024764 Gm. of crystallized sodium thiosulphate, or 9.9 Cc. are equal to 0.24525 Gm., which is 98.1 per cent. of 0.25 Gm.

Action and Uses.—Sodium thiosulphate has been largely employed for the purpose of correcting the hypothetical fermentation to which a large number of febrile and other diseases has been attributed. But the results of experience are far from confirming faith in the hypothesis. The success of the medicine—in *erysipelas*, for example—is equally great whether the administration be internal or external; in other words, its direct action is purely negative, but indirectly it saves the sick from heroic perturbative treatment and allows the disease to run its normal course toward cure. The influence of the medicine over the course and issue of *typhus* and *typhoid fevers*, the *eruptive fevers*, *yellow fever*, *diphtheria*, and *purulent infection* has been loudly proclaimed, but proofs of its efficacy are wanting. On the other hand, there is some evidence in favor of its utility in *intermittent fever;* and although the natural tendency of this disease to cure under various circumstances must be admitted, the apparently almost uniform curative influence of the hyposulphite cannot altogether be denied.

A much more tangible evidence of its value is furnished by its use in the treatment of *dyspepsia*—not that it in the least acts upon any of the vital conditions accompanying gastric disorders, but it effectually prevents fermentation in the stomach and bowels, and thereby prevents acidity and flatulence, with their accompanying distress and their ulterior mischievous effects. In like manner, this medicine may be used to destroy the products of putrefactive fermentation, whether within the body or not. It will deodorize all *putrid products*, either after their discharge or while they are still in the stomach, rectum, bladder, vagina, uterus, etc. It is a convenient and efficacious deodorizer of *cancerous* ulcers of these parts, in a solution of 1 part to 2 parts of water. Atomized solutions of this and the allied compounds may be inhaled in *gangrene of the lung*, in *fetid bronchitis*, etc. Lancereaux has reported a number of cases of the latter disease cured by this medicine, given internally to the extent of Gm. 4–5 (gr. lx–lxx) a day (*Bull de Thérap.*, ciii. 433). The dyspeptic fermentation referred to above is accompanied by the rapid development of low vegetable organisms, to which the compounds of sulphurous acid are hostile; and this mode of action has been invoked in the local treatment of *sycosis*, *favus*, *impetigo*, etc. by means of a solution of about 40 grains of the thiosulphate, or, still better, of the sodium sulphite, in Gm. 3 Gm. 32 (gr. xlv)in an ounce of water. A similar solution is useful as a lotion in *prurigo pudendi*. A saturated solution may be used in the proportion of about one-sixth to decolorize tincture of iodine, but at the expense of its caustic properties.

The *dose* of sodium thiosulphate is Gm. 1 (gr. xv) and upward in copious watery solution.

SODII IODIDUM, *U. S., Br.*—Sodium Iodide.

Natrium iodatum, P. G.—*Iodure de sodium*, Fr.; *Jodnatrium*, G.

Formula NaI. Molecular weight 149.53.

Preparation.—This salt may be obtained by processes analogous to those which afford potassium iodide (see page 1301), either from iodine and solution of caustic soda or from decomposing a solution of iodide of iron with sodium carbonate. The latter process is the more profitable one, since on the reduction of sodium iodate by charcoal a portion of the salt is converted into sodium carbonate.

Properties.—When crystallized at a temperature above 40° C. (104° F.), anhydrous

sodium iodide is obtained in cubes which are deliquescent on exposure and should therefore be kept in well-stoppered bottles. This salt melts at a dull-red heat, and when fused in contact with the air parts with a little iodine, at a higher temperature volatilizes slowly, but more readily than the chloride, and on cooling congeals to a pearly radiating crystalline mass. At ordinary temperatures the solution yields short monoclinic prisms or plates which have the composition $NaI.2H_2O$ and the molecular weight 185.45, effloresce in dry air, on exposure are deliquescent, melt at a moderate heat in the water of crystallization, and become anhydrous. The salt is usually prepared by evaporation to dryness in the form of a white crystalline powder, which is inodorous, of a saline somewhat sharp and bitterish taste, and has a neutral or faint alkaline reaction. According to the U. S. P., 1 part of the official salt dissolves at 15° C. (59° F.) in .60 part of water, and in about 3 parts of alcohol; in 0.33 part of boiling water, and in 1.4 parts of boiling alcohol. The salt is also soluble in glycerin. It differs from potassium iodide in not being precipitated from its concentrated aqueous solution by a concentrated solution of sodium bitartrate, and in imparting a yellow color to flame, which on being observed through a blue glass should not, or only transiently, appear red. On adding a little chlorine-water to the aqueous solution and agitating it with chloroform or carbon disulphide, these liquids will acquire a violet color.

Tests.—If the salt be in distinct crystals, only few monoclinic prisms (containing 2 molecules of water) should be found among the regular cubes of the anhydrous salt. On drying 1 Gm. of the salt at 100° C. (212° F.), it should not lose more than 0.05 Gm. in weight (absence of more than 5 per cent. of water). A solution of 1 Gm. of the salt in 1 Cc. of water should not yield any precipitate with 1 Cc. of sodium bitartrate test-solution (limit of potassium). The aqueous solution (1 in 20), slightly acidulated with acetic acid, should remain clear after addition of ammonium oxalate test-solution (absence of calcium), or of an equal volume of hydrogen sulphide test-solution (absence of arsenic, etc.). Addition of ammonium sulphide test-solution should not produce either a coloration or a turbidity in the aqueous solution (absence of zinc, iron, aluminum, etc.). If 1 Gm. of the salt be dissolved in water, and 0.05 Cc. (1 drop) of decinormal oxalic acid solution be added, no red color should be produced by the addition of a drop of phenolphtalein test-solution (limit of alkali). No blue color should appear in the aqueous solution, slightly acidulated with hydrochloric acid, on the addition of potassium ferrocyanide test-solution (absence of iron). If 0.5 Gm. of the salt be dissolved in 10 Cc. of freshly boiled distilled water, and the solution mixed with a few drops of starch test-solution, no blue color should appear either at once (absence of free iodine), or after addition of a drop of diluted hydrochloric acid (absence of iodate). If 5 Cc. of the aqueous solution (1 in 20) be acidulated with hydrochloric acid, and 0.5 Cc. of barium chloride test-solution be added, no immediate turbidity should appear (limit of sulphate). If 5 Cc. of the aqueous solution be gently heated with 1 drop of ferrous sulphate test-solution and 0.5 Cc. of potassium hydroxide test-solution, no blue color should appear after acidulating the mixture with hydrochloric acid (absence of cyanide). If 1 Gm. of the salt be mixed with 0.5 Gm. of iron filings and 0.5 Gm. of powdered zinc, and heated in a test-tube with 5 Cc. of sodium hydroxide test-solution, no ammoniacal vapors should be evolved (absence of nitrate or nitrite). If 0.5 Gm. of the well-dried salt be dissolved in 10 Cc. of water, and 2 drops of potassium chromate test-solution be added, it should not require more than 34.5 Cc. nor less than 33.4 Cc. of decinormal silver nitrate solution to produce a permanent red color (corresponding to at least 98 per cent. of the pure salt)."—*U. S.*

In the last-mentioned test an allowance of 1.1 Cc. is made on account of possible presence of impurities; if the salt were absolutely pure and dry, 33.4 Cc. of decinormal silver solution would practically suffice for complete precipitation of 0.5 Gm. of the same. 1 Gm. of the powdered and dried salt, when completely precipitated by silver nitrate, yields, if perfectly pure, 1.566 Gm. of dry silver iodide.

Action and Uses.—Sodium iodide contains a larger percentage of iodine, and is less apt than potassium iodide to occasion eruptions upon the skin and irritation of the respiratory and digestive mucous membranes. According to Hudson (*Lancet*, Decemb., 1883), it is better fitted than the potassium salt for all cases in which the system is already much depressed (*British Med. Jour.*, Apr. 17, 1886). But, as Laborde has shown (*Bull. de l'Academie de Méd.*, 1890, p. 303), it exerts, compared with potassium iodide, a very feeble action upon the central nervous system and the capillary blood-vessels. Richardson (*Asclepiad*, iv. 52) recommends it in *syphilis*, chronic *eczema*, and, associated with arsenic, in *lepra* and *psoriasis*. It is said to be an antiseptic and stimulant for *foul sores* with *fetor*.

SODII NITRAS, *U. S., Br.*—Sodium Nitrate.

Sodæ nitras, Br.; *Natrium nitricum*, P. G.; *Nitras (Azotas) sodicus, Nitrum cubicum.*—*Cubic nitre*, E.; *Azotate (Nitrate) de soude, Nitre cubique, Nitrate de Chili*, Fr.; *Natriumnitrat, Chilisalpeter*, G.

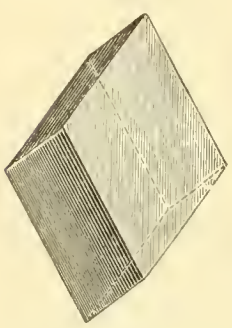
Formula $NaNO_3$. Molecular weight 84.89.

A native salt, purified by crystallization from water.

Origin and Preparation.—Sodium nitrate was first observed by Bohn (1683) on distilling a mixture of table-salt and nitric acid, and was prepared by Marggraf (1761) from calcium nitrate and sodium sulphate. In 1820 it became known through Mariano de Rivero that it exists in immense quantities in certain districts of Chili and Peru, where it is imbedded in clay and sand and more or less mixed with sulphates and chlorides of sodium, calcium, and magnesium. The stratum containing this saline mass, which is called *caleche* or *terra salitrosa*, is blasted, the salt extracted by boiling with water, and the decanted solution crystallized. In this condition sodium nitrate is brought into the market in damp crystalline masses, which are more or less colored by intermixed earth and require to be purified by recrystallization. Previous to 1879 the United States imported about 50,000,000 pounds, but 184,598,857 pounds in 1882.

Properties.—Purified sodium nitrate crystallizes in colorless, transparent rhombohedrons of the hexagonal system, which are permanent in dry air, slightly deliquescent on exposure, having a neutral reaction, and dissolve at 15° C. (59° F.), in 1.3 parts of water and in about 100 parts of alcohol, in 6.6 parts of boiling water, and in 40 parts of boiling alcohol. When heated at 312° C. (593.6° F.), the salt melts without decomposition. At a higher temperature it evolves oxygen, and is reduced to nitrite. On red-hot charcoal it deflagrates. To a non-luminous flame it imparts an intensely yellow color. The aqueous solution is neutral to litmus-paper. If the aqueous solution be mixed in a test-tube with a drop of diphenylamine test-solution, and sulphuric acid be carefully poured in, so as to form a separate layer, a deep blue color will appear at the zone of contact.

Fig. 290.



Crystal of Sodium Nitrate.

The salt is inodorous and has a cooling, saline, and somewhat bitter taste.

Tests.—The aqueous solution (5 per cent.) should remain unaffected by hydrogen sulphide and ammonium sulphide (absence of metals), also by sodium carbonate (alkaline earths), by ammonium oxalate (calcium), by a saturated solution of sodium bitartrate (potassium), by barium nitrate (sulphate), or by silver nitrate (chloride or iodide). The U. S. P. and P. G. permit the presence of a minute trace of sulphate and of chloride. "A solution of 0.5 Gm. of the salt in 1 Cc. of water should not be precipitated or rendered turbid by 1 Cc. of sodium bitartrate test-solution (limit of potassium). If the aqueous solution be mixed with a few drops each of hydrogen sulphide test-solution and of starch test-solution, and then some chlorine-water poured carefully upon the mixture, no blue color should appear at the line of contact (absence of iodate and iodide). No turbidity should be produced within five minutes in the aqueous solution, acidulated with nitric acid, on the addition of either barium chloride test-solution (limit of sulphate) or silver nitrate test-solution (limit of chloride)."—*U. S.* 1 Gm. of the salt, treated with an excess (or about 1 Cc.) of sulphuric acid and afterward heated to redness until vapors cease to be given off, yields a residue weighing .835 Gm.

Pharmaceutical Uses.—Sodium nitrate is used in preparing nitric acid and sodium arsenate.

Action and Uses.—Sodium nitrate, in moderate doses, according to experimental investigations of its action, does not directly lessen the force or frequency of the pulse, nor lower the animal temperature, nor increase the elimination of urea. In large doses, acting as a purgative, it may produce these effects. Löffler states that in such doses its action resembles that of potassium nitrate. Daily doses of from 18 to 90 grains, taken by several young men in from eight to fourteen days, occasioned pallor, emaciation, debility, unsteadiness of mind, and a decline in the pulse's force and frequency. The digestion was unimpaired, as were also the appetite and defecation. It is said that in animals very large doses also cause great debility and death, without, however, depressing the heart or lowering the temperature. Its solution dissolves false membranes. It has hence been

used with the atomizer to diminish *fibrinous exudations* in the pharynx and larynx. It is somewhat diuretic, but its chief medicinal virtue is that of a mild purgative, and it has been used with advantage in *diarrhœa* and in *dysentery*. For these purposes it may be given in daily *doses* of Gm. 32–64 (1 or 2 ounces), dissolved in a large quantity of water.

SODII NITRIS, *U. S., Br. Add.*—Sodium Nitrite.

Nitrite de soude, Fr.; *Salpetrigsaures Natron*, G.

Formula $NaNO_2$. Molecular weight 68.93.

Preparation.—When sodium nitrate is heated with charcoal, starch, or similar substances, sodium nitrite is formed, and may be recovered by lixiviation of the mass with water. A better process consists in adding to sodium nitrate, previously fused in shallow iron pans, about two and a half times its weight of lead, free from zinc and antimony (in form of thin sheets reduction takes place immediately), the lead fusing readily and being converted into yellow oxide or litharge. An excess of lead is used, and the fused mass is kept in constant agitation for about an hour; the fusion is continued for three and a half hours. After cooling the mass is lixiviated with water in large iron tanks, and when the solution has reached the specific gravity 1.342, it is treated with nitric acid sp. grav. 1.029, and then concentrated to 1.414 specific gravity, clarified by rest, and set aside in lead-lined wooden tanks to crystallize. By repeated recrystallization the salt is obtained quite pure (98 per cent. and over).

Properties.—Sodium nitrite occurs in the form of white opaque pencils or colorless, transparent, hexagonal crystals, odorless, and having a mild saline taste. When exposed to the air the salt deliquesces, and is gradually oxidized to sodium nitrate; hence it should be kept in well-stoppered bottles. It is soluble in about 1.5 parts of water at 15° C. (59° F.), and very soluble in boiling water; slightly soluble in alcohol. The aqueous solution gives an alkaline reaction with litmus-paper, and when mixed with solution of ferrous sulphate and acetic acid becomes of a dark-brown color. If the aqueous solution of the salt be mixed with some potassium iodide test-solution and a few drops of an acid added, iodine will be liberated, and nitrogen dioxide gas will escape with effervescence. When heated the salt melts, and at a red heat it is decomposed, yielding oxygen, nitrogen, nitrogen dioxide, and sodium oxide. To a non-luminous flame it imparts an intensely yellow color.

Tests.—The salt should readily form a colorless solution with water, without leaving any insoluble residue. "If 1 drop of hydrochloric acid and a few drops of starch test-solution be added to 5 Cc. of the aqueous solution, no blue coloration should appear (absence of iodide). If 5 Cc. of the aqueous solution be mixed with an equal volume of hydrogen sulphide test-solution, no coloration or precipitate should be produced (absence of lead, arsenic, copper, etc.). If 0.15 Gm. of sodium nitrite be dissolved in 5 Cc. of water, and introduced into a nitrometer, together with a solution of 1 Gm. of potassium iodide in 6 Cc. of water and 15 Cc. of normal sulphuric acid, the liberated nitrogen dioxide gas should measure not less than 50 Cc. at 15° C. (59° F.) or 51.7 Cc. at 25° C. (77° F.), corresponding to not less than 97.6 per cent. of pure salt."—*U. S.*

From the following equation, $NaNO_2 + KI + 2H_2SO_4 = NO + I + NaHSO_4 + KHSO_4 + H_2O$, we learn that 68.93 Gm. of sodium nitrite will yield 29.97 Gm. of nitric oxide; since 1 Cc. of NO gas at 25° C. (77° F.) weighs 0.0012297 Gm. and is equal to 0.0028283 Gm. of $NaNO_2$, it will require 51.7 Cc. of gas to show 97.6 per cent. of absolute $NaNO_2$ if 0.15 Gm. of the salt be used in the test. 97.6 per cent. of 0.15 = 0.1464 and 0.1464 ÷ 0.0028283 = 51.7. The Br. Ph. demands not less than 95 per cent. of absolute sodium nitrite. If 0.1 Gm. of the salt be used in the test, not less than 33.5 Cc. of NO gas should be liberated at 25° C. (77° F.).

Action and Uses.—Sodium nitrite is analogous in its action to nitro-glycerin and amyl nitrite, but it is milder and more uniform than that of either. The experiments of Barth, of Jolyet, of Regnard, of Ringer and Murrell, and of Huchard (*Bull. et Mém. de la Soc. de Thérap.*, Dec. 1883, p. 207), performed on guinea-pigs, cats, etc., showed that this nitrite, like its congeners, produces general sedation, torpor, and muscular paresis, slowing of the heart, cyanosis, asphyxia and hurried breathing, and paralysis, and that after death the heart and lungs are gorged with black or chocolate-colored blood. Gamgee and Hénocque inferred that it tends to prevent oxidation of the blood in the lungs by opposing the separation of the oxygen already combined with its constituents. Binz observed phenomena similar to those just enumerated, and, in addition, dilated pupils, salivation, vomiting, and diarrhœa (*Archiv für Path. u. Pharm.*,

xiii. 133). One or two minutes after a dose of from Gm. 0.2–0.6 (3 to 6 gr.) the pulse grew more frequent, and continued so for several hours; the face was warm and somewhat flushed; and slight fulness of the head was observed, with throbbing of the temporal arteries (Hay, Lublinski). Larger doses intensified these effects (*Practitioner*, xxx. 179). When first employed excessive doses of it were used. Ramskill and Rolfe have placed on record six cases in which it induced lividity and collapse; and Ringer and Murrell administered it to eighteen adults in 10-grain doses, and all but one "avowed that they would expect to drop down dead if they ever took another dose." Very nearly the same effects ensued in sixteen cases in which 5-grain doses were given, and even 3-grain doses of it caused unpleasant symptoms in four out of thirteen patients (*Times and Gaz.*, Nov. 1883, p. 549). In two cases were taken by mistake about Gm. 12 (℥iij) in the one, and Gm. 6 (℥iss) in the other. Vomiting and diarrhœa ensued, with faintness, cyanosis, and diuresis. Coffee was used successfully to counteract the symptoms (*Therap. Monatsh.*, iv. 52). According to Binz, it is unfit for practical use, owing to its decomposing action upon the blood (*Therap. Monatsh.*, iv. 137). Owing to ignorance of the potency of the compound, it was at first given in doses of 20 grains, but after its dangers became known the dose was reduced to 2 grains (*Times and Gaz.*, Dec. 1883, p. 636).

Hay first prescribed this medicine in a well-marked case of *angina pectoris* associated with defective aortic valves. In doses of 2 or 3 grains it relieved the patient without occasioning any characteristic physiological effects. Subsequently his observations were fully confirmed, and it was found that the medicine relieved the symptoms, pain and spasm, without a definite relation to the organic causes producing them. In general terms, it seemed to be more useful in such cases as digitalis is wont to benefit, including degeneration of the heart-muscle, certain valvular lesions, and even impaired innervation. In purely nervous *asthma* it acts most favorably, but it is also a useful palliative of *dyspnœa* due to pulmonary obstruction, at least of a transient nature. It does not appear to modify directly the bronchial secretions, but, as Fraser pointed out (*Amer. Jour. Med. Sci.*, xcv. 122), it may diminish them by lessening pulmonary congestion. In *emphysema* of the lungs its usefulness is of course limited to a palliation of the asthmatic paroxysms, so far as a nervous element is involved in them. Lublinski has commended this medicine in *hemicrania* and other forms of *headache* associated with anæmia. In 1882, Law proposed sodium nitrite for the treatment of *epilepsy*, and found it very useful in a single case (*Practitioner*, xxviii. 420). Shortly afterward Ralfe reported the results of the treatment in seventeen cases (*Med. Times and Gaz.*, Dec. 2, 1882, p. 707). The dose, according to him, should just fall short of producing its physiological effects. His conclusions were—1. That cases in which the bromides did good were not apt to be benefited by the nitrite, and *vice versâ*. 2. When the bromides begin to lose their effect or cause bromism, sodium nitrite is useful as a substitute. 3. It seemed to be especially useful in minor seizures and in convulsive attacks occurring at night. Lublinski and others have hardly corroborated these conclusions. Granville found it useful in epileptiform convulsions supposed to be of gouty origin. The *dose* of sodium nitrite should not at first exceed Gm. 0.12 (gr. ij), repeated at longer or shorter intervals and gradually increased. Fraser claims for this salt a superiority over other nitrites, because it is freely soluble and does not undergo decomposition in water. As it is liable to be decomposed by the gastric acids, he suggests its administration in an alkaline solution.

SODII PHOSPHAS, *U. S., Br.*—Sodium Phosphate.

Sodæ phosphas, Br.; *Natrium phosphoricum*, P. G.; *Phosphas sodicus* (*natricus*).—*Sodium orthophosphate*, *Disodium hydrogen phosphate*, E.; *Phosphate de soude*, Fr.; *Natriumphosphat*, *Phosphorsaures Natron*, G.

Formula $Na_2HPO_4.12H_2O$. Molecular weight 357.52.

Origin.—Sodium phosphate exists in the urine of carnivorous animals and in other animal liquids. It was probably known to the ancients, since the *chrysocolla* used for soldering (see Sodii Boras) was at least partly obtained from urine. Hellot (1735) recognized it as distinct from the ammoniacal salts of urine, and Haupt (1740) named it *sal mirabile perlatum*, because it melts before the blowpipe to an opaque pearly bead. Proust (1775) stated it to be a compound of soda, and Klaproth and Scheele (1785) proved also the presence of phosphoric acid. The salt was employed medicinally by Pearson (1787), and was usually prepared by neutralizing phosphoric acid with sodium carbonate; but at present it is exclusively prepared from bone phosphate.

Preparation.—Take of Bone-ash, in powder, 10 pounds; Sulphuric Acid 56 fluid-ounces, Distilled Water 4½ gallons or a sufficiency; Sodium Carbonate 16 pounds or a sufficiency. Place the bone-ash in a capacious earthenware or leaden vessel, pour on the sulphuric acid, and stir with a glass rod until the whole powder is thoroughly moistened. After twenty-four hours add gradually and with constant stirring a gallon of the water; digest for forty-eight hours, adding distilled water from time to time to replace what has evaporated. Add another gallon of the water, stirring diligently, digest for an hour, filter through calico, and wash what remains on the filter with successive portions of distilled water till it has almost ceased to have an acid reaction. Concentrate the filtrate to a gallon, let it rest for twenty-four hours, and filter again. Heat the filtrate to near the boiling-point, add the sodium carbonate, previously dissolved in 2 gallons of the water, till it ceases to form a precipitate and the fluid has acquired a feeble alkaline reaction. Filter through calico, evaporate the clear liquor till a film forms on the surface, and set it aside to crystallize. More crystals will be obtained by evaporating the mother-liquor, a little carbonate of soda being added if necessary to maintain its alkalinity. Dry the crystals rapidly and without heat on filtering-paper placed on porous bricks, and preserve them in bottles.—*Br.* 1867.

The inorganic matter of bones consists of tricalcium phosphate, which is decomposed by sulphuric acid, with the formation of calcium sulphate and acid phosphate, according to the equation $Ca_3(PO_4)_2 + 2H_2SO_4 = 2CaSO_4 + CaH_4(PO_4)_2$. The decomposition is known to be completed when the mixture is uniformly smooth and free from grittiness. On being treated with water the freely-soluble acid calcium phosphate enters into solution, together with a small quantity of calcium sulphate and any excess of sulphuric acid which may have been employed. On adding sodium carbonate to the solution, the calcium salt is decomposed, one-half the phosphoric acid forming insoluble calcium phosphate, while the other half unites with the sodium of the sodium carbonate, forming disodium phosphate, liberating carbon dioxide, and producing water; $CaH_4(PO_4)_2 + Na_2CO_3$ yields $CaHPO_4 + Na_2HPO_4 + CO_2 + H_2O$. The filtrate from the calcium phosphate contains the sodium salts of phosphoric, sulphuric, and carbonic acids, of which the last two should be present in small quantity only, and requires to be evaporated to crystallization. If sulphuric acid and sodium carbonate have not been used too largely in excess, the first crop or two of crystals will be pure sodium phosphate, but those subsequently obtained are usually contaminated with carbonate and sulphate, and should be purified by recrystallization from water. 100 parts of calcined bones require from 60 to 70 parts of concentrated sulphuric acid and from 100 to 110 parts of crystallized sodium carbonate, and yield between 100 and 105 parts of crystallized sodium phosphate.

Properties.—This salt crystallizes in colorless, transparent, obliquely four-sided, monoclinic prisms, which have the specific gravity 1.55, react slightly alkaline upon litmus-paper (not phenolphtalein paper), are inodorous, and have a cooling saline taste. The crystals effloresce rapidly in air, gradually losing 5 molecules of their water of crystallization (25.1 per cent.); they melt to a colorless liquid when heated to 35° C. (95° F.) (Kopp), 40° C. (104° F.) (*U. S.*, *P. G.*), and congeal on cooling to a crystalline mass. At 100° C. (212° F.), they part with all their water of crystallization, amounting to 60.3 per cent., and are converted into a white saline mass. Above 300° C. (572° F.) the basylous water is expelled and sodium pyrophosphate is left. Crystallized sodium phosphate requires for solution 5.8 parts of water at 15° C. (59° F.) and less than 1.5 parts of boiling water (*U. S.*, *P. G.*), according to Mulder (1864),

at 0°	10°	15°	30°	40°	60°	80°	99°	105° C.,
24.12	15.5	10.4	2.5	.95	.66	.625	.611	.731 parts of water.

The solution, saturated at a higher temperature, deposits near 35° C. (95° F.) transparent crystals, which contain only 47 per cent. of water of crystallization and have the formula $Na_2HPO_4.7H_2O$. Sodium phosphate is insoluble in alcohol, and imparts a yellow color to flame, which, if observed through a blue glass, is not red, or only transiently so. The aqueous solution gives with silver nitrate a yellow precipitate soluble in nitric acid and in ammonia; with test-mixture of magnesium, a white precipitate soluble in acetic acid; and with ferric chloride, a white precipitate insoluble in acetic acid. If 0.5 Cc. of the aqueous solution be mixed with 1 Cc. of ammonium molybdate test-solution, the mixture will at once assume a yellow color, and, after a few minutes, yield a yellow precipitate, the appearance of which is hastened by a gentle heat.

Tests.—" No residue should be left on dissolving the salt in water (absence of calcium, etc.). No turbidity or coloration should be produced in the aqueous solution by the

addition of a small quantity of ammonium sulphide test-solution, or of an equal volume of hydrogen sulphide test-solution after addition of a few drops of hydrochloric acid (absence of metallic impurities). If 1 Gm. of the powdered salt be shaken with 3 Cc. of stannous chloride test-solution, then a small piece of pure tin-foil added, and a gentle heat applied, no brown coloration should appear within fifteen minutes (limit of arsenic). If 0.5 Gm. of the salt be dissolved in 4 Cc. of water, and 1 Cc. of sodium bitartrate test-solution then added, the solution should remain perfectly clear (limit of potassium). No effervescence should occur on the addition of hydrochloric or nitric acid to a solution of the salt (absence of carbonate). On adding to 5 Cc. of the aqueous solution (1 in 20) 0.5 Cc. of silver nitrate test-solution, a pure yellow precipitate will be formed, which should not become dark-colored by heating (absence of thiosulphate, etc.), and which, upon addition of nitric acid, should yield a perfectly clear, or, at most, only very slightly opalescent liquid (limit of chloride). If to 5 Cc. of the aqueous solution, acidulated with hydrochloric acid, 0.5 Cc. of barium chloride test-solution be added, the solution should not be rendered more than very slightly opalescent (limit of sulphate)."—*U. S.*

Composition.—The official salt is disodic orthophosphate or disodium hydrogen phosphate, and represents, in 100 parts, 19.9 parts of P_2O_5, 17.3 parts of Na_2O, 2.5 parts of basylous H_2O, and 60.3 parts of water of crystallization.

SODII PHOSPHAS EFFERVESCENS, *Br. Add.*, Effervescent sodium phosphate.—Dry 25 ounces of crystallized sodium phosphate until it has lost 60 per cent. of its weight; powder the product, and mix with sodium bicarbonate 25 ounces, tartaric acid, in powder, 13½ ounces, and citric acid, in powder, 9 ounces. Place the mixture in a dish heated to 93.3°–104.4° C. (200°–220° F.), and when the particles of the powder begin to aggregate, stir them assiduously until they assume a granular form; by means of sieves separate the granules of uniform size, and preserve in well-closed bottles. The final product should weigh about 50 ounces.

Allied Salts.—SODII ET AMMONII PHOSPHAS, $NH_4NaHPO_4.4H_2O$ (mol. weight 208.65). This is the *microcosmic salt* of the alchemists, and was formerly prepared from urine. It is obtained by dissolving 5 parts of crystallized sodium phosphate and 2 parts of ammonium phosphate in 20 parts of hot water, adding a little ammonia until the liquid is alkaline, and crystallizing. The salt crystallizes in colorless, transparent, monoclinic prisms which are inodorous and have a cooling saline taste, and a neutral or faint alkaline reaction. It effloresces superficially on exposure, losing a little ammonia, melts readily to a colorless liquid in its water of crystallization, and at a red heat forms a colorless glass of sodium metaphosphate, which is used in blowpipe analysis.

POTASSII PHOSPHAS, *Potassium phosphate*, K_2HPO_4 (mol. weight 173.86). This may be obtained from calcined bones in precisely the same manner as sodium phosphate, only substituting in the process potassium carbonate for sodium carbonate, or by adding potassium carbonate to dilute phosphoric acid until the liquid has a slight alkaline reaction, and by evaporating. The so-called neutral potassium phosphate or dipotassium orthophosphate is with difficulty obtained in irregular crystals; usually it is a white amorphous or crystalline mass, of a saline taste, deliquescent in the air, and freely soluble in water. On the application of heat it melts, and at a red heat is converted into potassium pyrophosphate, which is likewise very deliquescent. When dissolved in water it yields with silver nitrate a yellow precipitate soluble in nitric acid, and with sodium bitartrate a white crystalline precipitate of cream of tartar. Both the mono- and tri-potassium orthophosphates crystallize more readily than the preceding salt, and are easily soluble in water.

Action and Uses.—Sodium phosphate in solution injected into the veins is almost entirely eliminated with the urine. Taken internally, it is said to diminish the discharge of sodium chloride by the kidneys and to increase the excretion of uric acid. According to Rutherford and Vignal, it is a hepatic stimulant. A special power of dissolving, or of causing the discharge of, gall-stones has been attributed to this medicine, but without convincing testimony to establish it; and Prevost and Binet declare it to be without action upon the biliary secretion (*Boston Med. and Surg. Jour.*, Nov. 1888, p. 439). It has a cooling, saline, but not disagreeable taste, and has been used upon theoretical grounds as a remedy for *scrofula*, *rachitis*, *diabetes*, etc., but without encouraging results. Luton, however, claims that it rapidly and effectually cures those cases of *scrofulous ophthalmia* which are remarkable for lachrymation, photophobia, ulceration of the cornea, and associated impetiginous eruptions. In such cases from Gm. 3–5 (40 to 70 grains) must be given daily in divided doses (*Études de Thérap.*, p. 387). It has been much recommended in the *bowel complaints* of children, for which its mild purgative action renders it well adapted when the use of purgatives of any sort is indicated. It is said, however, to be most suitable for the *diarrhœas* which are apt to occur at the period of weaning. It has been used with alleged success in correcting the acidity of the uterine and vaginal secretions, which was supposed to destroy the spermatozoa after copulation. It was employed in

injection before the act, and a course of alkaline mineral waters was at the same time prescribed (Charrier, *Bull. de Thérap.*, xcviii. 492). Its purgative *dose* for an adult is about Gm. 32 (℥j); for children affected with diarrhœa the dose should be small, from Gm. 0.20–0.60 (gr. iij–x), and may conveniently be given in milk and water.

SODII PYROPHOSPHAS, *U. S.*—Sodium Pyrophosphate.

Natrium pyrophosphoricum, *Pyrophosphas sodicus.*—*Pyrophosphate de soude*, Fr.; *Natriumpyrophosphat*, G.

Formula $Na_4P_2O_7.10H_2O$. Molecular weight 445.24.

Preparation.—10 ounces of crystallized sodium phosphate are exposed to a warm atmosphere until effloresced, and then heated to dull redness until a small portion of the mass, dissolved in water, causes with silver nitrate a white precipitate free from yellow tint. The white salt is dissolved in 5 pints of boiling water and the solution filtered if necessary and crystallized. The total yield will be 6 ounces.

When sodium phosphate is heated to a gradually increased temperature, it first undergoes fusion at about 44° C. (111.2° F.), at 100° C. (212° F.) loses all of its water of crystallization (60.31 per cent.) and finally at 300° C. (572° F.) is converted into sodium pyrophosphate, two molecules of the official phosphate yielding one molecule of anhydrous pyrophosphate, thus $2Na_2HPO_4.12H_2O = Na_4P_2O_7 + 13H_2O$.

Properties.—The salt crystallizes in colorless or whitish transparent or translucent monoclinic prisms or plates which are inodorous and have a cooling saline and feebly alkaline taste. It is permanent in cool air, slightly efflorescent in warm air. Soluble in 12 parts of water at 15° C. (59° F.), and in 1.1 parts of boiling water; insoluble in alcohol. When heated to 100° C. (212° F.), the salt loses its water of crystallization (40.34 per cent.) without previous fusion. At a higher temperature it fuses, forming a transparent liquid, which, on cooling, solidifies to a crystalline mass. To a non-luminous flame it imparts an intensely yellow color. Its aqueous solution is feebly alkaline to litmus and to phenolphtalein paper. A 5-per-cent. aqueous solution of the salt yields, with magnesia mixture, a white precipitate; with silver nitrate test-solution it yields a precipitate of a pure white color (distinction from orthophosphate), soluble in ammonia-water and in nitric acid. With ammonium molybdate test-solution no precipitate is formed within fifteen or twenty minutes, even when a gentle heat is applied (distinction from orthophosphate). On boiling the aqueous solution with free mineral acids the salt is gradually converted into orthophosphate.

Tests.—If 1 Gm. of the powdered salt be shaken with 3 Cc. of stannous chloride test-solution, then a small piece of pure tin-foil added, and a gentle heat applied, no brown coloration should appear within fifteen minutes (limit of arsenic). If 0.5 Gm. of the salt be dissolved in 6 Cc. of water, and 1 Cc. of sodium bitartrate test-solution added, the solution should remain perfectly clear (limit of potassium). "The aqueous solution of the salt should not effervesce on the addition of an acid (absence of carbonate). Acidified with hydrochloric acid, it should remain unaffected by hydrogen sulphide or ammonium sulphide (absence of metals), and when acidified with nitric acid it should not yield more than a faint opalescence with test-solution of barium nitrate (limit of sulphate) or silver nitrate (limit of chloride)."—*U. S.*

Uses.—It is said that its action and uses are the same as those of sodium phosphate, but that it should be given in doses one-third less. Its pharmaceutical uses give it its chief value.

SODII SALICYLAS, *U. S., Br.*—Sodium Salicylate.

Natrium salicylicum, P. G.—*Salicylate de soude*, Fr.; *Natriumsalicylat*, G.

Formula $NaC_7H_5O_3$. Molecular weight 159.67.

Preparation.—Sodium bicarbonate 10 parts and salicylic acid 16.5 parts are mixed in a porcelain or glass vessel, and 10 parts of pure water are gradually added: as the reaction progresses carbon dioxide is rapidly evolved, the newly-formed salt remaining in solution, which latter should have a slightly acid reaction to ensure a product free from color. If necessary, the solution may receive a slight addition of salicylic acid, as alkali salicylates in the presence of an excess of alkali absorb oxygen from the air and become colored. The solution is heated on a water-bath to expel all carbon dioxide, and then evaporated at about 60° C. (140° F.) to dryness; the residue may be recrystallized

from a solution in 120 parts of 95 per cent. alcohol if desired. Owing to the delicate reaction of salicylic acid with iron salts, all contact with metals must be avoided; moreover, the salicylic acid must be free from creosotic (homosalicylic) acid, and the alkali free from iron.

Although not a bibasic acid, salicylic acid is capable of forming two classes of salts, primary and secondary salicylates; the former are obtained when the acid is neutralized by means of alkali carbonates or bicarbonates, whereas the use of alkali hydroxides results in the formation of the secondary salts, which are less soluble and less stable.

The official sodium salicylate of the U. S., G., and Br. Pharmacopœias is the primary salt, the two first-named recognizing the anhydrous salt, while the latter admits 5.3 per cent. of water, the salt having the composition $2NaC_7H_5O_3 + H_2O$.

Properties.—Sodium salicylate is a white crystalline powder or forms small white crystalline plates, is permanent in the air, inodorous or nearly so, and has a sweetish saline and mildly alkaline taste and a feebly acid reaction. It dissolves at 15° C. (59° F.) in 0.9 (*U. S.*, *P. G.*) part of water and in 6 parts of alcohol, and is more freely soluble in boiling water and boiling alcohol; also soluble in glycerin. By heat the salt is decomposed, inflammable vapors are given off, and a carbonaceous residue of sodium carbonate is left, weighing about 33 per cent. of the salt used, and imparting to a non-luminous flame an intense yellow color, which should appear not more than transiently red when observed through a blue glass. If copper sulphate test-solution be added to the aqueous solution (1 in 20), a green color will be produced. On adding to a small portion of the salt, in a test-tube, about 1 Cc. of concentrated sulphuric acid, and then, cautiously, about 1 Cc. of methylic alcohol in drops, on heating the mixture to boiling the odor of methyl salicylate will be evolved. Ferric chloride added to the concentrated aqueous solution of the salt colors it red-brown, but a very diluted solution is colored violet. The rather concentrated aqueous solution, when strongly acidulated with hydrochloric or sulphuric acid, gives a white crystalline precipitate, which is soluble in ether and in hot water and has all the properties of salicylic acid (see p. 88).

Tests.—"The aqueous solution should be colorless, and should not effervesce on the addition of acids (absence of carbonate). Agitated with about 15 parts of concentrated sulphuric acid, the salt should not impart color to the acid within fifteen minutes (absence of foreign organic matter). If a solution of 1 Gm. of the salt in a mixture of 50 Cc. of alcohol and 25 Cc. of water be acidulated with nitric acid, the filtered solution should yield no precipitate, nor be rendered turbid on the addition of a few drops of test-solution of barium chloride (absence of sulphate) or of silver nitrate (absence of chloride)." *U. S.* The tests ordered by the P. G. are nearly identical with the above. In the last test the addition of alcohol is made for the purpose of keeping in solution the salicylic acid liberated by the nitric acid, whereby filtration is avoided. The salt should not have the odor of phenol.

Allied Salts.—Potassium salicylate, ($2KC_7H_5O_3.H_2O$) is prepared like the sodium salt, 100 parts of salicylic acid requiring 72.5 parts of potassium bicarbonate. The salt crystallizes in colorless silky needles, is permanent in dry air, and is freely soluble in water.

Sodium formate, ($NaCHO_2.H_2O$), is prepared by neutralizing formic acid with pure sodium carbonate or bicarbonate. It crystallizes in colorless rhombic plates or prisms, which are inodorous, have a saline bitter taste, melt in their water of crystallization, are deliquescent in moist air, and dissolve freely in water.

Sodium dithiosalicylate. If a mixture of equal molecular weights of sulphur chloride (bromide or iodide) and salicylic acid is heated for some time to 120°–150° C. (248°–302° F.), a lively reaction ensues, hydrogen chloride (bromide or iodide) escaping, and dithiosalicylic acid remaining in the form of a yellowish resinous mass. The residue, which is soluble in alcohol, is a mixture of two isomeric acids, designated respectively as No. 1 and No. 2. When the acid is treated with solution of sodium carbonate, the two sodium salts are formed, and may be separated by means of sodium chloride, which precipitates the No. 1 salt, while the No. 2 salt remains in solution; or the dried mixture of the two salts may be exhausted with boiling alcohol, which dissolves only the No. 2 salt. This latter salt is preferred; it occurs as a grayish-white amorphous powder, very hygroscopic and readily soluble in water, forming a brownish-black solution of alkaline reaction. Its antiseptic activity is superior to sodium salicylate, and it has been successfully employed in rheumatic fever, gonorrheic rheumatism, and similar cases. The dose is from 4–10 Gm. daily in doses of 0.5 to 1.0 Gm. Sodium dithiosalicylate No. 1 is a yellowish amorphous powder, somewhat hygroscopic and of alkaline reaction; it forms with water a clear brownish solution. The salt has been chiefly employed in veterinary practice in the form of a 5 per cent. solution.

Sodium diiodosalicylate, $NaC_6H_2I_2(OH)CO_2+2.5H_2O$. When an alcoholic solution of salicylic acid is treated with iodine and iodic acid, diiodosalicylic acid is formed by substitution of 2 atoms of iodine for 2 of hydrogen, which may be neutralized with sodium carbonate, and then

yields white laminæ or long flat, needle-shaped crystals which are soluble in 50 parts of water at 20° C. (68° F.). The salt possesses analgesic and antiseptic properties.

Sodium sulphosalicylate, $C_6H_3(OH)CO_2HSO_3Na$. This salt, obtained by neutralizing sulphosalicylic acid (see page 90) with sodium carbonate, occurs in colorless crystals, soluble in 25–30 parts of water; the aqueous solution has an acid reaction, and is not affected by barium chloride or silver nitrate. The salt has been recommended as a substitute for sodium salicylate in the treatment of articular rheumatism.

Sodio-theobromine Salicylate, Diuretin, $C_7H_7NaN_4O_2 + NaC_7H_5O_3$. This compound is obtained by mixing aqueous solutions of equal molecules of sodium theobromine and sodium salicylate and evaporating to dryness; a definite compound appears to be formed, containing theoretically 49.7 per cent. of theobromine and 38.1 per cent. of salicylic acid. Diuretin occurs as a white powder, odorless, of a saline, alkaline taste, and soluble in half its weight of warm water, the solution remaining perfect on cooling. It should be preserved in well-stoppered bottles, as it is readily affected by the air, theobromine separating by action of carbon dioxide. It has proven to be a reliable diuretic, free from poisonous properties and unpleasant after-effects. The daily dose of diuretin is 4–8 Gm. (60–120 grains) in divided portions of 1.0 Gm. (15 grains) each; it is best administered in solution with aromatic waters, and should not be dispensed in powder form, owing to liability to change upon exposure.

Action and Uses.—The great solubility of this salt, which is partly the reason of its milder action than that of potassium salicylate, renders it in many cases preferable to the latter. It is liable to act poisonously. Hampeln has reported a case in which a drachm was given daily for about six weeks, and gradually produced drowsiness, lassitude, unsteady movements, tremors, listlessness, and impaired attention, memory, and sight. On withdrawing the medicine these symptoms slowly disappeared. A similar case was reported by Mueller (*Med. Record*, xxxii. 135). Others also in which cutaneous eruptions or collapse or delirium have occurred (*Lancet*, 1890, i. 1173, 1299; *Jour. Amer. Med. Assoc.*, xviii. 594). Rutherford and Vignal declare it to be "a very powerful hepatic stimulant in the dog," but no such action has been observed in man. Its medicinal uses are the same as those of Salicylic Acid, under which the subject is fully treated. Its mode of action has been there considered, and shown to be quite inadequate to explain its broadly alleged therapeutical effects. The statement of so eminent an authority as Vulpian may be here subjoined to illustrate still further the facility with which in such matters phrases take the place of facts: "The curative effects of sodium salicylate in acute articular rheumatism are due to the action of the salt upon the anatomical elements of the joints which are primarily affected by the disease. The medicine, becoming incorporated with them, renders them insusceptible to the specific irritation from which the rheumatism proceeds. If they are not already involved, as soon as the medicine acts upon them the acute rheumatism will no longer take hold of them in the greater number of cases. If they are affected, the irritation will rapidly decline. As soon as it has ceased the articular pains will abate, and then the swelling, and soon afterward the fever also. The disease, however, is not certainly cured when these phenomena subside, ... for if the treatment is suspended they reappear; and not only so, but even while the medicine continues to be given, and several days after the joint affection has ceased, inflammation of the endocardium, the pericardium or the pleura may arise" (*Du Mode d'Action du Salicylate de Soude*, 1881). The inferences which Hood drew from an analysis of more than 2000 cases of acute articular rheumatism appear to be correct. They are substantially these: The treatment by salicylates (1) relieves pain and abates fever, but renders relapses more frequent. (2) It does not affect the frequency of the heart-complications. (3) It does not prevent hyperpyrexia. (4) Its use is followed by a longer convalescence than usual. (5) It does not modify the mortality-rate. (6) It is most efficient in conjunction with the alkaline treatment (*Lancet*, Feb. 18, 1888). This may consist of the union of the sodium bicarbonate with the salicylate in the same dose, or their administration separately and alternately. The latter has been credited with the speedy cure of *tonsillitis*, but with no better reason than may be given for the use of the bicarbonate alone. Apparently the cases in which either is efficient are those of rheumatic pharyngitis rather than of suppurative tonsillitis. In a case of *neuralgia* of the fifth nerve, of long standing and very severe, Dercum effected a cure by the persistent use of large doses of sodium salicylate (*Med. News*, l. 328). It is a palliative of the pain of *dysmenorrhœa* and the itching of *pruritus*. Burroughs states that it has been found to palliate *whooping cough* and cure *migraine* (*Med. Record*, xxxii. 528). Jaccoud has warned against the use of the medicine in *albuminuria*. In a case of *polyuria* which valerian and ergot failed to relieve the use of this medicine, in the dose of Gm. 0.50–0.60 (gr. viij–x) after meals, was followed by a return of normal urination (Randall, *Med. News*, lii. 373). The antiseptic and antacid properties of the

compound have been usefully applied to the treatment of *cholera infantum* (*Archives of Pædiatrics*, July, 1886) and of various *diarrhœas* (*Med. News*, xliii. 268). It has been credited with modifying favorably the course of *variola* and of hastening the resolution of *orchitis;* but of the correctness of these statements the evidence is slender. In rheumatic *iritis* there is more reason to accept the statements made of its efficacy, and in *biliary colic* it palliates the pain. It has the latter effect in acute *pleurisy* and *sciatica*.

The dose of sodium salicylate (as already stated under Salicylic Acid) should be about 20 grains, repeated five or six times a day in acute articular rheumatism. Smaller doses are not to be depended upon for checking the development of or arresting the disease, and such as V. Jaksch recommended (of 150–360 grains a day) are neither necessary nor safe.

Potassium Salicylate has been used as a substitute for the sodium salt in the treatment of *rheumatism*, and with alleged advantage (*Trans. Amer. Med. Assoc.*, xxxiii. 151), but confirmation of the statement is wanting.

Sodium formate has been proposed as a substitute for the salicylate in cases in which there may be danger from the renal congestion sometimes induced by the latter salt. According to Arlong (*Archives gén.*, Nov. 1879, p. 602), a 5 per cent. solution of the sodium formate gradually introduced into the blood of a dog or horse slows the heart and dilates the capillaries; in excessive doses it arrests the heart. Corresponding effects are produced on the respiration and calorification. We are not acquainted with any clinical experience with this compound.

Sodium di-iodosalicylate.—It has been claimed that in divided daily doses of Gm. 1.5–4 (gr. xx–lx) this compound is antipyretic, analgesic, and antiseptic, is a sedative of irregular action of the heart, and efficient in parasitic diseases of the skin.

Sodium di-thiosalicylate is said to be a more powerful antiseptic than the salicylate, like which it has been used in acute articular *rheumatism* without causing noises in the ears or other unpleasant effects. *Dose*, Gm. 0.2 (gr. iij) morning and evening. But May and Volt prescribed 30 to 80 grains, followed every two hours by 15-grain doses (*University Med. Mag.*, iv. 467).

SODII SANTONINAS.—Sodium Santoninate.

Natrium santoninicum, *s. santonicum.—Santonate de soude*, Fr.; *Natriumsantoninat*, G.

Formula $2NaC_{15}H_{19}O_4.7H_2O$. Molecular weight 696.50.

Preparation.—Heat on a water-bath 3½ ounces of solution of soda diluted with 1 ounce of water, add 1 ounce of santonin, digest until the latter is dissolved, filter, wash the filter with a little hot water, and set aside in a cool place to crystallize. The decanted mother-liquor, concentrated by evaporation, will yield more crystals; when these are no longer obtained colorless, the mother-liquor is acidulated with hydrochloric acid, and the santonin which separates is collected separately. The yield is about 1¼ ounces of sodium santoninate.

Lepage (1876) proposed to prepare this salt by first forming calcium santoninate, precipitating this solution by sodium carbonate, evaporating the filtrate nearly to dryness and exhausting the residue with strong alcohol to remove excess of sodium carbonate; on evaporating the solution the salt crystallizes, leaving finally a colored mother-liquor.

Properties.—The salt crystallizes from alcohol in fine felt-like needles or small white prisms, and from water in rather large colorless and transparent or translucent rhombic tables or laminæ, in which form it is usually seen. These crystals are nearly permanent in the air, a slight efflorescence being observed only after long keeping, and they are very slowly tinged yellow when kept in diffused daylight. The salt should be kept in dark amber-colored, well-stoppered vials, and not be exposed to light. The salt is inodorous and has a saline and bitter taste and a slight alkaline reaction. It is soluble in 3 parts of water and in 12 parts of alcohol at 15° C. (59° F.), and it dissolves in 0.5 parts of boiling water and in 3.4 parts of boiling alcohol. It is insoluble in ether. At 100° C. (212° F.) it parts with its water of crystallization (18 per cent.), and at a somewhat higher heat it becomes bright red, the mass having a glassy lustre after cooling and becoming colorless by water; at a red heat the salt is completely decomposed, and an alkaline residue is left which imparts an intense yellow color to flame. The aqueous solution of the salt, acidulated with hydrochloric acid, deposits santonin, which is readily soluble in chloroform, and yields with alcohol, in the presence of caustic alkali or earth, a bright-red solution, becoming gradually colorless.

Tests.—A 5 per cent. aqueous solution of the salt should not be precipitated nor be rendered turbid by test-solution of sodium carbonate (absence of alkaline earths), nor by picric or tannic acid (absence of alkaloids). The aqueous solution is not colored violet by ferric chloride (difference from salicylate).

Allied Compound.—Sodii santoninas albuminatus. Digest santonin 1 part, sodium bicarbonate 4 parts, and dry soluble albumen 2 parts with about 50 parts of water at 60° C. (140° F.) until solution has been effected; filter, evaporate at a gentle heat, and dry on glass plates (Pavesi, 1876). This compound forms brilliant white scales having a pearly lustre and a bitter alkaline taste: its solution in water is decomposed by mineral acids with effervescence of carbon dioxide gas, santonin and albumen being precipitated.

Action and Uses.—This salt has over santonin the advantage of greater solubility—if that be indeed an advantage—for not only is its taste more distinct and disagreeable, but it is more rapidly absorbed from the stomach, and is therefore less apt to come into contact with the intestinal parasites it is given to destroy. In animals it produces poisonous effects more speedily than the proportion of santonin contained in it would do. Nevertheless, sodium santoninate has been used with success as an anthelmintic, especially for *lumbricoid worms*. It may be prescribed for adults in doses of Gm. 0.50–0.60 (gr. viij–x) twice a day, and for children in doses of from Gm. 0.10–0.30, (gr. ij–v) mixed with sugar. After the second day a laxative, such as confection of senna or jalap and cream of tartar, should be administered to remove the worms. Enemata of water containing this salt may be used for rectal *ascarides*.

SODII SULPHAS, *U. S., Br.*—Sodium Sulphate.

Sodæ sulphas, Br.; *Natrium sulphuricum*, P. G.; *Sulfas sodicus (natricus)*.—*Glauber's salt*, E.; *Sulfate de soude*, *Sel de Glauber*, Fr.; *Glaubersalz*, G.

Formula $Na_2SO_4.10H_2O$. Molecular weight 321.42.

Origin.—Sodium sulphate is found native in the anhydrous state and crystallized, and also in combination with calcium sulphate. It is present in the water of many mineral springs and in that of certain lakes in Russia and in the western part of the United States. It is stated to have been known in Saxony for a century before it was obtained artificially by Glauber (1658) from the saline residue left in the preparation of hydrochloric acid, and was named after him *Sal mirabile Glauberi*. The same salt, prepared from the mineral spring at Friedrichshall, became known in 1767 as *Sal aperitivum Fridericianum*. It is largely manufactured in the United States, but small and variable quantities of it are also imported from abroad.

Preparation.—This salt is largely obtained in many chemical processes, either as an intermediate or a secondary product, as in the preparation of soda by Leblanc's process; from the mother-liquors of the Stassfurt potash-works; in the preparation of magnesium carbonate; in the manufacture of hydrochloric and nitric acids from sodium chloride and nitrate; in the preparation of table-salt from many saline springs; in the manufacture of sal ammoniac from ammonium sulphate and sodium chloride; in preparing carbon dioxide for the manufacture of mineral waters from sodium bicarbonate and sulphuric acid; and in several other processes. Sodium sulphate as thus obtained is purified by crystallizing it repeatedly from water, if necessary, after neutralization with sodium carbonate.

Properties.—Sodium sulphate crystallizes in large, transparent, colorless, monoclinic prisms, which do not alter the color of red and blue litmus-paper, are inodorous, have a cooling, saline, and distinctly bitter taste, and rapidly effloresce on exposure to the air, leaving a white powder. The crystallized salt must therefore be kept in well-stoppered bottles, and, on account of its low melting-point, in a cool place. It is soluble at 15° C. (59° F.), in 2.8 parts of water. The solubility increases up to 34° C. (93° F.), when its maximum is attained, 1 part of the salt then dissolving in somewhat less than 0.25 part of water; from thence it gradually decreases with rising temperature, until 1 part requires 0.47 part of boiling water for solution. Insoluble in alcohol; soluble in glycerin. When heated to 33° C. (91.4° F.), the salt fuses, and, on being heated to 100° C. (212° F.), loses all of its water (55.9 per cent.). At a red heat the anhydrous salt fuses without decomposition. To a non-luminous flame it imparts an intensely yellow color. The aqueous solution is neutral to litmus-paper. A 5 per cent. aqueous solution of the salt yields with barium chloride a white precipitate insoluble in nitric acid.

Tests.—A 5 per cent. aqueous solution of sodium sulphate should not effervesce on the addition of hydrochloric acid (absence of carbonate), should not be colored or precipitated by ammonium sulphide or hydrogen sulphide (metals), should not become cloudy by

sodium carbonate and heating (earths), and should not give off ammoniacal vapors on being treated with a warm solution of caustic soda (ammonium salt). "If to 5 Cc. of the aqueous solution 1 Cc. of sodium phosphate test-solution and 0.5 Cc. of ammonia-water be added, no turbidity or precipitate should be produced, even after agitation (absence of magnesium). After acidulation with nitric acid, the aqueous solution should remain clear, or at most be rendered only very slightly opalescent on addition of silver nitrate test-solution (limit of chloride)."—*U. S.* 100 grains of it, dissolved in distilled water and acidulated with hydrochloric acid, give, by the addition of barium chloride a white precipitate which, after washing and drying, weighs 72.3 grains, or 1 Gm. yields .723 Gm. of $BaSO_4$.

Composition.—Crystallized sodium sulphate contains 55.9 per cent. water of crystallization, 24.85 per cent. SO_3, and 19.25 per cent. Na_2O. Under certain circumstances the sulphate crystallizes with $7H_2O$, and then contains 47 per cent. of water of crystallization.

SODII SULPHAS EFFERVESCENS, *Br. Add.*, Effervescent sodium sulphate. Dry 25 ozs. of crystallized sodium sulphate until it has lost 56 per cent. of its weight; powder the product and mix it with sodium bicarbonate 25 ounces, tartaric acid 13½ ounces, and citric acid, in powder, 9 ounces. Place the mixture in a dish heated to 93.3°–104.4° C. (200°–220° F.), and when the particles of the powder begin to aggregate, stir them assiduously until they assume a granular form; by means of sieves separate the granules of uniform size and preserve in well-closed bottles. The final product should weigh about 50 ounces.

SODII SULPHAS EXSICCATUS, s. Natrium sulfuricum siccum, *P. G.* It is obtained by exposing the crystallized salt to a moderate heat until its weight has been reduced to one-half, when the white powder is passed through a sieve and preserved in well-stoppered bottles. 4 parts of the completely dehydrated salt represent 9 parts of the crystallized salt; it contains 56.33 per cent. SO_3 and 43.67 per cent. Na_2O.

Action and Uses.—The mode of action of Glauber's salt does not differ essentially from that of other saline cathartics. Like them, it purges only when given in solutions of a certain degree of dilution, and not even then unless the dose exceeds a certain variable limit. There is good reason to believe that too strong or too weak a solution of a purgative salt equally tends to hinder its operation. If the solution is weak and not bulky, it will act by the kidneys rather than by the bowels. Many persons are affected by natural purgative mineral waters in this manner, whatever may be their dose. On the other hand, it is of daily observation that just in proportion to the dilution of a saline cathartic is its relative efficiency as a purgative. This fact is abundantly illustrated by the familiar effects of the saline mineral waters just referred to; they are purgative in doses which contain only an inconsiderable proportion of the neutral salts.

Glauber's salt is almost entirely supplanted by Epsom salt in this country and in England, but in Germany the former is in more common use. It is employed to relieve *plethora*, overcome *constipation*, and to act as a depletory and sedative remedy in various febrile affections, inflammatory and other. It has been especially used in weak solution in *typhoid fever* and in *dysentery*, and probably with more benefit and less mischief than any other active treatment of those affections. Of late years it has been strongly recommended in the form of Carlsbad water (which contains also a little sodium chloride and carbonate), natural or artificial, in cases of simple *ulcer of the stomach*. The water is taken to the extent of about a pint, in divided doses, early in the morning, and fasting, or half an ounce of Glauber's salt may be dissolved in a pint of water and used in the same manner. It is said that in surgical poisoning with *carbolic acid* repeated dressings with a 5 per cent. solution of sodium sulphate are a very efficient antidote (*Amer. Jour. of Med. Sci.*, July, 1879, p. 280).

The *dose* of sodium sulphate as a purgative is from half an ounce to an ounce, dissolved in Gm. 120–250 (f℥iv–viij) of water. Its nauseous bitterness may be partially corrected by the addition of aromatic sulphuric acid or by dissolving it in lemonade or in carbonated water flavored with syrup. Extract or fluid extract of liquorice may be used for the same purpose.

SODII SULPHIS, *U. S., Br.*—SODIUM SULPHITE.

Natrium sulfurosum. Sulfis sodicus (natricus).—*Sulfite de soude*, Fr.; *Natriumsulfit, Schwefligsaures Natron*, G.

Formula $Na_2SO_3.7H_2O$. Molecular weight 251.58.

Preparation.—This salt is formed on passing sulphur dioxide into a solution of sodium carbonate until the color of blue litmus-paper is changed to red, or the solution of a known quantity of sodium carbonate is completely saturated with sulphur dioxide, whereby *sodium bisulphite* is produced; an equal weight of sodium carbonate is dissolved in the liquid, and the solution evaporated to crystallization. The sulphur dioxide decomposes the sodium carbonate, replacing the carbon dioxide which is evolved: $Na_2CO_3 + SO_2$ yields $Na_2SO_3 + CO_2$.

Properties.—Sodium sulphite crystallizes in colorless, transparent, monoclinic prisms, which are inodorous and have a slight alkaline reaction to test-paper and a cooling, saline, and sulphurous taste. The salt effloresces on exposure, and becomes opaque from the loss of water and from oxidation to sulphate, and therefore requires to be kept in well-stoppered bottles. The solution is more rapidly oxidized than the salt, but does not separate sulphur; likewise, not on the addition of hydrochloric acid (difference from thiosulphate). When heated to above 100° C. (212° F.) the salt loses its water of crystallization (50 per cent.), and yields a white powder without melting, but at a red heat fuses into an orange-red mixture of sodium sulphide and sulphate. The salt is nearly insoluble in alcohol, but dissolves readily in water, the anhydrous salt requiring, according to Kremers (1856), at 0° C. (32° F.) 7.07 parts, at 20° C. (68° F.) 3.49 parts, and at 40° C. (104° F.) 2.02 parts, of water. On heating the aqueous solution, saturated in the cold, anhydrous salt is deposited (Rammelsberg). The dry, anhydrous salt Na_2SO_3 (mol. weight 125.86) is nearly permanent in the air, and when immersed in a little water combines with it and forms a solid mass. Muspratt obtained sulphite in oblique prisms containing $10H_2O = 58.8$ per cent. of water of crystallization, but even from supersaturated solutions the salt crystallizes of the above composition (Schultz). The crystallized salt is soluble in 4 parts of water at 15° C. (59° F.) and in 0.9 part of boiling water (*U. S.*). Diluted sulphuric or hydrochloric acid, added to the salt or its solution, liberates sulphur dioxide, which is recognized by its odor. If held in a non-luminous flame an intense yellow color is imparted to the latter.

Tests.—"The aqueous solution (1 in 20) should not be colored or rendered turbid by the addition of an equal volume of hydrogen sulphide test-solution, either before or after the addition of ammonia-water in slight excess (absence of metallic impurities). If a solution of 2.5 Gm. of the salt in 11 Cc. of diluted hydrochloric acid be heated sufficiently to expel the sulphur dioxide, then 0.15 Cc. of barium chloride test-solution added, and the precipitate, if any, removed by filtration, the clear filtrate should remain unaffected by the further addition of barium chloride test-solution (limit of sulphate). If 1.2 Gm. of sodium sulphite be dissolved in 10 Cc. of diluted nitric acid, the solution heated to expel gases, then 0.4 Cc. of decinormal silver nitrate solution added, and the precipitate, if any, removed by filtration, the clear filtrate should remain unchanged by the addition of more silver nitrate solution (limit of chloride). If 0.63 Gm. of the salt be dissolved in 25 Cc. of water recently boiled to expel air, and a little starch test-solution be added, at least 48 Cc. of decinormal iodine solution should be required to produce a permanent blue tint (each Cc. corresponding to 2 per cent. of the pure salt)."—*U. S.*

In the last-mentioned test the reaction between the sodium sulphite and iodine results in the formation of sodium sulphate, as follows: $Na_2SO_3.7H_2O + I_2 = Na_2SO_4 + 2HI + 6H_2O$, and hence each Cc. of decinormal iodine solution containing 0.012653 Gm. of iodine is capable of oxidizing 0.012579 Gm. of the crystallized sulphite.

Composition.—The salt contains 24.6 per cent. Na_2O, 25.4 per cent. SO_2, and 50 per cent. of water of crystallization.

Action and Uses.—These are essentially the same as have been described in connection with sulphurous acid, potassium sulphite, and sodium thiosulphate; that is to say, sodium sulphite checks *putrefaction* and other forms of *fermentation*, and thereby tends to arrest the exhalation of the fetid gases which are formed during these processes. This action, as in the case of sulphurous acid itself, is a purely chemical one, for it is neither more nor less certain in the laboratory than in the body. Like the other compounds of sulphurous acid with alkalies, sodium sulphite has been vaunted as a remedy for the falsely-called zymotic diseases, but clinical experience has condemned this groundless assumption. Comessati used this salt in the treatment of *scabies* as follows: 6¼ oz. of it are dissolved in 2 pints of water, and the solution thoroughly applied at bedtime. On the following morning the skin is bathed with a mixture of 2 ounces of hydrochloric acid in a quart of water. The sodium salt is decomposed, and its sulphur, along with sulphurous acid and sodium chloride, remains upon the skin (*Therap. Gaz.*, ix. 789).

The *dose* of sodium sulphite is Gm. 1.30–4 (gr. xx–lx), largely diluted and frequently

repeated. The solution may be flavored to conceal the taste. 1 part of the salt, dissolved in from 2 to 10 parts of water, may be applied externally, and solutions of half the latter strength or less may be injected into the bladder, vagina, etc.

SODII SULPHOCARBOLAS, *U. S., Br.*—Sodium Sulphocarbolate.

Sodium paraphenolsulphonate, U. S.; *Sulphophénate de soude*, Fr.; *Phenylschwefelsaures Natron*, G.

Formula $NaSO_3C_6H_4(OH).2H_2O$. Molecular weight 231.56.

Origin and Preparation.—If crystallized carbolic acid is mixed with an equal weight of strong sulphuric acid, a new compound is formed, which was first noticed by Laurent (1841), and by him named phenylsulphuric acid, with the formula $C_6H_5HSO_4$. The true constitution of the new compound was shown by Kekulé to be phenolsulphonic acid, $HSO_3C_6H_4(OH)$, the group HSO_3 displacing an atom of H in the benzene nucleus, and not in the hydroxyl group, as formerly supposed. If the mixture of phenol and sulphuric acid be set aside in the cold for some time until it yields a clear solution with water, orthophenolsulphonic acid will be formed, but if the temperature be allowed to rise or increase, various mixtures of the isomeric ortho- and para- varieties of the acid are obtained. In order to produce only the paraphenolsulphonic acid, the mixture is preferably heated on a boiling water-bath for six hours, when it will be found to yield a clear solution with water. After mixing the new acid compound with ten times its weight of water, an excess of barium carbonate is added, and the mixture kept at 100° C. (212° F.) until the acid has been neutralized; it is then filtered, and the solution of barium sulphocarbolate concentrated and mixed with sodium carbonate for mutual decomposition. $Ba(SO_3C_6H_4(OH))_2 + Na_2CO_3 = 2NaSO_3C_6H_4(OH) + BaCO_3$. The solution after filtration (to remove $BaCO_3$) is concentrated, and set aside to crystallize. In place of barium carbonate, lead carbonate may likewise be employed to neutralize the newly-formed phenolsulphonic acid, as lead sulphocarbolate is also soluble in water.

The Br. Ph. does not state which variety of the salt is officially recognized, neither does it designate the temperature at which the reaction between the phenol and sulphuric acid is to be allowed to go on.

Properties.—Sodium sulphocarbolate is in "colorless, transparent, rhombic prisms, slightly efflorescent in dry air, odorless or nearly so, having a cooling, saline, somewhat bitter taste, and a neutral reaction; soluble in 4.8 parts of water, and in 132 parts of alcohol at 15° C. (59° F.), in 0.7 part of boiling water, and in 10 parts of boiling alcohol. When heated the salt loses its water (15.5 per cent.) and becomes white. At a higher temperature it emits inflammable vapors having the odor of carbolic acid, and leaves a residue amounting to 30.6 per cent. of the original weight, the filtered solution of which, acidulated with nitric acid, produces a white precipitate with test-solution of barium chloride. A fragment of the salt imparts an intense yellow color to a non-luminous flame. The dilute, aqueous solution of the salt is colored violet by test solution of ferric chloride."—*U. S.* When fused together with caustic potassa, pyrocatechin is obtained.

Tests.—"In the aqueous solution (1 in 20) of the salt neither hydrogen sulphide test-solution nor ammonium sulphide test-solution should produce any turbidity or coloration (absence of metallic impurities); nor should more than a faint opalescence be produced by barium chloride test-solution (limit of sulphate) or by silver nitrate test-solution (limit of chloride)."—*U. S.*

Allied Compounds.—Other sulphocarbolates may be obtained by accurately precipitating a solution of barium or lead sulphocarbolate by a solution of the respective carbonate or sulphate, filtering, and crystallizing. They are all soluble in water, alcohol, and glycerin, and occasionally have a pinkish tint. The following have been employed:

Potassium Sulphocarbolate, $KSO_3C_6H_4(OH)$, crystallizes in shining needles like the ammonium salt.

Calcium Sulphocarbolate, $Ca(SO_3C_6H_4(OH))_2.6H_2O$, forms scaly crystals.

Magnesium Sulphocarbolate, $Mg(SO_3C_6H_4(OH))_2.7H_2O$, crystallizes in rhombic prisms or needles.

Zinc Sulphocarbolate resembles the preceding in appearance. (See Zincum.)

The following acids are likewise known, but have not been employed in medicine: *Phenoldisulphonic acid*, $(HSO_3)_2C_6H_3(OH)$, and *phenoltrisulphonic acid* $(HSO_3)_3C_6H_2(OH)$; they crystallize in deliquescent needles and are produced from phenol and sulphuric acid at elevated temperatures.

Sodii carbolas, Sodium carbolate (phenate), *E.;* Phénol sodique, *Fr.:* Natronphenylat, *G.*—Carbolic acid dissolves in solution of caustic soda as in other alkalies, and forms monosodium phenate, NaC_6H_5O, but, according to Berthelot (1871), neither basic nor acid compounds; such a concentrated solution may yield crystals of carbolic acid (see page 37). On treating phenol with an excess of melted alkali, Barth (1870) observed that about one-half of it is decomposed, with the formation of *diphenol*, $C_{12}H_{10}O_2$, and a small proportion of oxybenzoic and salicylic acids. On treating phenol with metallic sodium, sodium carbolate will crystallize in white needles. It is therefore difficult to obtain a definite compound in the solid state, but a solution of it is readily obtainable, and this dissolves notable quantities of carbolic acid. Such a solution was official in the P. G. 1872 as

Liquor natrii (sodii) carbolici. It is prepared by melting 5 parts of pure carbolic acid, and adding 1 part of solution of soda spec. grav. 1.332 and 5 parts of distilled water. It is a clear liquid of a specific gravity varying between 1.060 and 1.065, has an alkaline reaction, and may be diluted with water or alcohol without being decomposed, but on the addition of acids carbolic acid is separated. Only one-seventh of the carbolic acid is combined with soda; the remaining six-sevenths are dissolved in the aqueous solution of sodium carbolate.

Similar compounds, but made with impure carbolic acid, are often met with in commerce; on diluting them with water they separate most of the empyreumatic oils with which they are contaminated.

Action and Uses.—The bodies of animals that have taken largely of sodium sulphocarbolate are said to resist putrefaction for a long time. This result is ascribed to its decomposition in the body into carbolic and sulphuric acids; or, rather, the latter acid in combination with sodium is eliminated with the urine, while the carbolic acid exerts its characteristic influence in preventing organic decomposition. Given to man in doses of Gm. 1.30–2 (gr. xx–xxx), it occasions no special symptoms; in twice or three times these doses it only causes some lightness of the head. It was at one time alleged to be a very efficient palliative in *phthisis* and to modify favorably the course of *typhoid fever* and the *eruptive fevers*, and was even vaunted as having a specific power in *scarlatina* (Sansom); but it has, in reality, as little efficacy in these diseases as the numberless other medicines to which similar virtues have been attributed. Miall claims that it arrests the *vomiting* of pregnancy. It may be useful in fermentative *dyspepsia* and *diarrhœa* like other carbolates. Like them, it exerts a more or less favorable action upon parts affected with pseudo-membranous exudation, especially when they tend to *gangrene* or become the seat of fetid decomposition, as in anginose *scarlatina* and *diphtheria;* and it also arrests the growth of *thrush*. Dr. Huse of Rockford, Ill., informs us that he cured all of thirty-six cases of diphtheria of the anginose form by giving from 15 to 40 grains of this salt every third or fourth hour. It may be administered internally in *doses* of from Gm. 0.60–2 (10 to 30 grains) and applied topically in a saturated aqueous solution. The medicinal value of the other sulphocarbolates mentioned above is probably the same as that of the officinal compound.

Sodium carbolate has been credited with antiseptic and germicide powers. Brackenridge attributed to its use the favorable issue of fifty cases of *scarlatina*. Pernot considers it a specific for *whooping cough* when the fumes given off by heating it impregnate the atmosphere breathed by the patients (*Edinb. Med. Jour.*, xxiv. 89). Dr. J. W. White (*The Mouth and the Teeth*, p. 136) says of this preparation that it is an antacid, an astringent, a sedative, a styptic, an antiseptic, and a disinfectant. As a wash for the mouth it is highly useful (when there are no local exciting mechanical causes) where the gums are spongy, swollen, and soft, and bleed at the slightest touch. It checks excessive bleeding after the extraction of teeth and relieves the subsequent soreness of the gums. It gives prompt relief to the distressing pains which sometimes follow extraction, corrects unpleasantness of the breath caused by decayed teeth or by the unhealthy secretions of the mouth, neutralizes acidity, and prevents putrefaction.

Sodium carbolate may be given to adults in the *dose* of from Gm. 1–2 (gr. xv–xxx) several times a day; the former of these doses may be administered to children without any risk.

SODII SULPHOVINAS.—Sodium Sulphovinate.

Sodium ethylsulphate, E.; *Sulfovinate de soude*, Fr.; *Weinschwefelsaures Natron*, G.

Formula $NaC_2H_5SO_4.H_2O$. Molecular weight 165.72.

Preparation.—The preparation of sodium sulphovinate requires the previous formation of *sulphovinic acid* from alcohol and sulphuric acid, of which equal parts by weight are usually employed. On adding the sulphuric acid gradually to the alcohol, the mixture becomes hot and forms sulphovinic acid by ethyl, C_2H_5, of the alcohol taking

the place of 1 atom of hydrogen in the sulphuric acid, water being formed at the same time; $C_2H_5OH + H_2SO_4$ yields $C_2H_5HSO_4 + H_2O$. The acid thus formed is invariably mixed with sulphuric acid, and if neutralized by caustic soda or sodium carbonate, the resulting solution requires to be mixed with an equal bulk of strong alcohol, in which the sodium sulphate is insoluble, leaving an alcoholic solution of sodium sulphovinate, from which the salt is obtained by evaporation. The use of alcohol for removing sodium sulphate is best avoided by neutralizing the crude sulphovinic acid with barium carbonate or lead carbonate whereby insoluble barium or lead sulphate is precipitated, while the corresponding sulphovinate is retained in solution, and, on being decomposed by an aqueous solution of sodium carbonate or sulphate, and filtered from the insoluble barium or lead compound, is converted into sodium sulphovinate, which should be evaporated at a moderate heat and crystallized. Marchand prefers adding calcium carbonate to the crude acid, and decomposing the calcium sulphovinate by sodium carbonate. The yield is usually about equal to the weight of alcohol or of sulphuric acid used.

Properties.—Sodium sulphovinate crystallizes in shining, transparent, flat, six-sided tables, which effloresce on exposure to dry air. When obtained by spontaneous evaporation the salt is granular and forms white opaque crystalline aggregations; and if crystallized from an alcoholic solution it contains alcohol in the place of water of crystallization. Heated to about 80° C. (176° F.), the crystals melt and rapidly part with their water, amounting to 10.8 per cent.; and if the heat is increased to 100° C. (212° F.) or a little above this point, the salt is decomposed, with the formation of sodium sulphate, charcoal, heavy oil of wine, and of sulphurous acid, ethylene, and other gases. The aqueous solution of the salt, when heated to boiling is decomposed, in the same manner as all sulphovinates, into alcohol, which distils off, and acid sodium sulphate: this decomposition takes place more rapidly in concentrated than in diluted solutions. Crystallized sodium sulphovinate dissolves at ordinary temperatures in a little more than half its weight of water, and is soluble in glycerin and ordinary alcohol, sparingly soluble in absolute alcohol, and insoluble in ether. Its solution is neutral to test-paper and has a slightly bitter afterward sweetish taste.

Tests.—The aqueous solution of the salt should yield only a slight precipitate with barium chloride (sulphate), should not be colored by hydrogen sulphide (absence of lead), and should not be rendered turbid by sodium carbonate (absence of lead, barium, and calcium).

Allied Salt.—Sodium Sulphomethylate, $NaCH_3SO_4.H_2O$. This is prepared precisely like the preceding salt, except that methylic alcohol is substituted for ordinary alcohol. It resembles the sulphovinate in properties, and has been recommended for similar purposes.

Action and Uses.—Sodium sulphovinate was proposed as a laxative, on the ground of its being almost tasteless and having but little tendency to occasion colic; but, however real these advantages may be, they are outweighed by its liability to decomposition and to occasion unpleasant symptoms in consequence of its being imperfectly prepared. The *dose* is about Gm. 16 (℥ss).

Sodium sulphomethylate was proposed by Rabuteau (1879) as a purgative salt. 10 Gm. of it, dissolved in 25 Gm. of water, injected into a dog's veins, occasioned constipation. 15 Gm. (½ ounce), dissolved in 2 wine-glassfuls of water and given to a woman in two doses, caused a free evacuation of the bowels. An examination of the urine showed that the salt was excreted as a sulphate. It is too unstable to become of practical value, although its freedom from unpleasant taste recommends it.

A tannate of sodium has been proposed. It was made by dissolving 5 Gm. of tannic acid in 170 Gm. of water, and saturating with sodium bicarbonate. A tablespoonful of it was administered every two hours in several cases of albuminuria, but in no instance did it lessen the discharge of albumen, and in more than one it seems to have been chargeable with producing fatal uræmia (*Centralbl. f. d. ges. Therap.*, i. 186).

SODII VALERIANAS, *Br.*—Sodium Valerianate.

Sodæ valerianas, Br.; *Natrium valerianicum*, *Valerianas sodicus* (*natricus*).—*Sodium valerate*, E.; *Valérianate de soude*, Fr.; *Baldriansaures Natron*, G.

Formula $NaC_5H_9O_2$. Molecular weight 123.77.

Preparation.—Take of Amylic Alcohol (Fusel Oil) 4 fluidounces; Potassium Dichromate 9 ounces; Sulphuric Acid 6½ fluidounces; Solution of Soda a sufficiency; Distilled Water ½ gallon. Dilute the sulphuric acid with 10 fluidounces of the water,

and dissolve the potassium dichromate in the remainder of the water with the aid of heat. When both liquids are cold, mix them with the fusel oil in a matrass, with occasional brisk agitation, until the temperature of the mixture has fallen to about 90° F. Connect the matrass with a condenser, and distil until about half a gallon of liquid has passed over. Saturate the distilled liquid accurately with the solution of soda, remove any oil which floats on the surface, evaporate till watery vapor ceases to escape, and then raise the heat cautiously so as to liquefy the salt. When the product has cooled and solidified, break it into pieces, and immediately put it into a stoppered bottle.—*Br.*

This is a modification of Trautwein's process (1845). An excess of sulphuric acid liberates from potassium dichromate chromium trioxide, which in the presence of amylic alcohol is deoxidized, and then combines with the sulphuric acid to form chromic sulphate, while the amylic alcohol is oxidized to valerianic acid. The reaction takes place according to the equation $3C_5H_{11}OH + 2K_2Cr_2O_7 + 8H_2SO_4 = 3C_5H_{10}O_2 + 2K_2SO_4 + 2Cr_2(SO_4)_3 + 11H_2O$. On subjecting the liquid to distillation, the residue in the retort will contain potassium and chromium sulphates, and in the distillate will be found the valerianic acid. A small portion of the fusel oil escapes oxidation, and is contained in the distillate combined with valerianic acid to *amylo-valerianic ether* or *amyl valerianate* (*valerate*), also known as *apple oil* from its odor when largely diluted; its composition is $C_5H_{11}C_5H_9O_2$. On the addition of caustic soda the valerianic acid is neutralized to sodium valerianate, and the amyl valerianate separates as an oily liquid, which may, however, be decomposed, by warming it with an additional quantity of soda, into sodium valerianate and amylic alcohol. The latter separates as an oily stratum, which is removed, and the clear solution evaporated until all the water has been expelled.

Properties.—Thus prepared, sodium valerianate forms a white crystalline mass which is rather unctuous to the touch, and has a neutral or slight alkaline reaction, a weak odor of valerian when perfectly dry, and a sweet and valerian-like taste. It melts at 140° C. (284° F.) without decomposition to a colorless liquid, and on cooling congeals crystalline; at a higher heat it gives off pungent acid vapors and inflammable gas, and leaves 42.75 per cent. of sodium carbonate. The salt is freely soluble in alcohol and water, and on exposure to the atmosphere liquefies from the absorption of water. On the addition of diluted sulphuric acid a strong odor of valerianic acid is given off.

Tests.—The solution of sodium valerianate in water should not be colored by hydrogen sulphide and ammonium sulphide (absence of metals), and should yield no precipitate with barium chloride (absence of sulphate).

Action and Uses.—This preparation is active only through the valerianic acid it contains. The complaints in which it is used, slight functional derangements of the nervous system, are much more efficiently relieved by the valerianate of ammonium. The *dose* is Gm. 0.06–0.30 (gr. j–v).

SOLIDAGO.—Golden Rod.

Verge d'or, Fr.; *Goldruthe*, G.; *Vara de oro*, Sp.

The leaves and tops of Solidago odora, *Aiton.*

Nat. Ord.—Compositæ, Asteroideæ.

Description.—The *sweet-scented golden rod* is a native of the United States and Canada, and grows on the borders of woods and thickets and in dry or sandy fields. The stem is about 1 M. (40 inches) high, simple, slender, and nearly smooth, or somewhat pubescent in lines. The leaves are numerous, alternate, sessile, about 5 Cm. (2 inches) long, linear-lanceolate, entire, acute, pellucid-punctate, smooth, and on the margin somewhat rough. The flowers are in a terminal pyramidal panicle, composed of spreading racemes, bearing the flower-heads on one side; these are small, have lance-linear appressed yellowish scales, and contain three or four oblong ray-florets and several tubular disk-florets, all of a yellow color, and with terete akenes and a simple bristly pappus. The leaves when bruised have an agreeable anise-like odor and a sweetish aromatic taste. The flowers are likewise pleasantly aromatic; they appear in August and September. In some places the plant is known as *blue mountain-tea.*

Constituents.—The principal constituent is volatile oil; that obtained from the flowers differs from that contained in the leaves, which appears to be related to oil of anise.

Other Species.—Solidago Virga-aurea, *Linné.* This is a variable species, indigenous to Europe, Northern Asia, and on this continent to Canada and the northern portion of the United States. It is from 60–90 Cm. (2 to 3 feet) high, branched above, has lanceolate or lance-oblong,

petiolate, and more or less serrate leaves, and bears the flowers in erect simple wand-like racemes, forming a terminal panicle. The flower-heads contain eight or ten ligulate and several tubular disk-florets of a yellow color. The flowering herb has an aromatic odor and a bitterish and somewhat astringent taste, and has been used in Europe as *herba virgaureæ*. The oblique thin rhizome has likewise been employed.

Action and Uses.—Sweet-scented golden rod owes its virtues to the volatile oil which it contains, and is stimulant, irritant, rubefacient, anodyne, and carminative. The fresh-bruised plant is applied to check *hæmorrhage* from wounds, and the powdered dried leaves employed as a snuff for epistaxis. Its infusion is much used in country practice to produce *diaphoresis*, to allay *colic*, promote *menstruation*, and to cover the taste of nauseous medicines. For the last purpose the essential oil is to be preferred; it is also, like analogous products, sometimes applied as a local anodyne in *neuralgia* and *rheumatism*.

An infusion may be prepared with Gm. 32 in Gm. 500 (an ounce of the herb and a pint) of hot water, and given in *doses* of Gm. 64 (f℥ij). The oil may be prescribed in doses of Gm. 0.06 (♏j +).

Solidago virga aurea has long been used in Europe for diseases of the *urinary organs*, and recently (1886–89) diuretic virtues were attributed to it (*Therap. Monatsh.*, iii. 334; *Lancet*, Sept. 1889, p. 660; *Therap. Gaz.*, xiii. 464). *Baccharis genistelloides* is very bitter, and serves as a substitute for wormwood in *dyspepsia* and atonic *diarrhœa*, and in the so-called *liver complaints* associated with them.

SOPHORA.—Sophora.

Sophora speciosa, *Bentham*.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Description.—An evergreen ornamental shrub or small tree indigenous to Western Texas. It has smooth, oddly pinnate leaves, with three to five pairs of leaflets, which are about 25 Mm. (1 inch) long, ovate in shape, obtuse or somewhat pointed, dark-green and glossy above and pale-green beneath. The flowers are in dense racemes, blue or tinged with white, very fragrant, and have a bell-shaped small calyx and ten nearly free stamens. The pod is indehiscent, 5 to 8 Cm. (2–3 inches) long, nearly terete, or more or less constricted between the seeds, tough, and covered with a pale brownish-gray pubescence. The seeds are globular-ovate, about 1 Cm. (⅔ inch) long, somewhat depressed on the hilum, and of a bright-red color.

Constituents.—Dr. H. C. Wood (1877) isolated from the seeds an alkaloid, *sophorine*, by macerating the powder for several hours in strong alcohol, exhausting it by water acidulated with hydrochloric acid, adding to the liquid an excess of sodium carbonate, and agitating the mixture with chloroform. The chloroform solution is agitated with dilute hydrochloric acid, the aqueous liquid evaporated to a syrup, freed from gummy matter by strong alcohol, the alcohol evaporated, and the treatment with sodium carbonate and chloroform repeated. Sophorine is nearly white, amorphous, yields with chromic and sulphuric acids a dirty deep-purple color, passing through bright-green and bluish into yellowish-brown, and produces with tincture of iron chloride a deep almost blood-red hue, after a time acquiring an orange tint.

Allied Plants.—Sophora sericea, *Nuttall*, is herbaceous, about 25 Cm. (10 inches) high, silky-hairy, and grows from Nebraska and Colorado to Arizona and California. Examined by F. A. Wentz (*Rep. Commiss. Agric.*, 1879), the seeds as well as the root and plant yielded an alkaloid, which was not obtained pure, and may be identical with sophorine.

Sophora japonica, *Linné*, of Eastern Asia, is occasionally cultivated as an ornamental tree. It produces a large number of white or yellowish flowers, the buds of which are used as a substitute for hop and as a yellow dye under the name of *waifa* or *Chinese berries*. The coloring matter was regarded by Stein as being identical with *rutin*, but P. Foerster (1882) obtained from it—his *sophorin*—57.6 per cent. of isodulcit and 46.8 of *sophoretin*, which resembles quercetin, but is not identical with it.

Action.—According to the experiments of Dr. H. C. Wood, its properties depend upon an alkaloid which in frogs produced a rapid loss of reflex activity and power of voluntary movement, due to its action upon the spinal marrow. In a cat a large dose of it speedily occasioned marked weakness in the limbs, disturbance of the respiration, and convulsive movements, with loss of consciousness. A smaller dose excited vomiting, great muscular weakness, profound quietude, and deep sleep, lasting some hours, and ending in recovery. It is stated that sophora-beans are occasionally used by the Indians in Western Texas as an intoxicant—that half a bean will produce a delirious exhilira-

tion, followed by a sleep that lasts for several days; and it is asserted that a whole bean will kill a man. The peculiarities of sophora-beans, as thus described, invite a fuller investigation (*Phila. Med. Times*, vii. 510).

SORBUS.—Mountain-Ash.

Sorbes, Fr.; *Eberesche*, *Vogelbeere*, G.

The fruit of Pyrus (Sorbus, *Linné*, Mespilus, *Scopoli*) aucuparia, *Gærtner*.

Nat. Ord.—Rosaceæ, Pomeæ.

Description.—This species of Sorbus, which is also known as *rowan tree*, is a medium-sized tree indigenous to Europe and Western Asia and cultivated for ornament in North America. It has oddly pinnate leaves, with obtuse, on the lower side downy leaflets, and bears numerous small, globular, juicy, berry-like fruits, which are of a bright-red color, are crowned by the calyx limb, contain three or four cells, each with two seeds, and have an acid taste.

Constituents.—According to Liebig, mountain-ash berries when unripe contain tartaric acid, but when ripe malic and citric acids. Byschl (1854) determined also the presence of tannin, acrid, bitter, and coloring principles, fermentable sugar, and of non-fermentable sugar, which had previously been obtained by Pelouze (1852) by setting the juice aside for about a year, and then evaporating. This *sorbin*, $C_{12}H_{24}O_{12}$, crystallizes in colorless, hard, very sweet prisms, separates cuprous oxide from an alkaline solution of copper, and is not altered by boiling with dilute acids. *Sorbit*, $2C_6H_{14}O_6H_2O$, obtained by Boussingault (1872) from the fermented juice, is isomeric with mannit and dulcit, is very sparingly soluble in cold water, and melts at 102° C. (215.6° F.), and when anhydrous at 110° C. (230° F.). G. Merck and A. W. Hofmann (1859) obtained *parasorbic acid*, an oily liquid of an aromatic odor, slightly soluble in water, freely so in alcohol and ether, and when heated under pressure with potassa converted into crystallizable *sorbic acid*. Both acids have the composition $C_6H_8O_2$. Wick (1851) prepared *amygdalin* from the bark and buds of the mountain-ash.

Allied Plants.—The American mountain-ash, Pyrus (Sorbus, *Marshall*) americana, *De Candolle*, and P. (Sorbus, *Roemer*) sambucifolia, *Chamisso et Schlechtendal*, resemble the preceding species, but have somewhat smaller fruits: the former species grows in the Alleghanies, the latter in the Rocky Mountains, and both extend to New England and far northward through Canada.

Pyrus coronaria, *Linné* (*crab-apple*), and P. arbutifolia, *Linné fil.* (*choke-berry*), have analogous properties.

Crataegus, *haw*, *cockspur-thorn*, etc. The bark, leaves, and fruit of these thorny shrubs are astringent and tonic.

Action and Uses.—The unripe fruit and the bark of the moantain-ash and its European congeners are extremely astringent, and are used in infusions, decoctions, and poultices to constringe *relaxed parts*, as the *throat*, *anus*, and *vagina*, and internally to check *diarrhœa*, etc. The ripe fruit is much used to prepare an infusion whose astringent and acidulous qualities render it a pleasant gargle in acute affections of the *tonsils* and *pharynx*.

SPARTEINÆ SULPHAS, *U. S.*—Sparteine Sulphate.

Sulfate de spartein, Fr.; *Sparteinsulfat*, G.

Formula $C_{15}H_{26}N_2H_2SO_4 + 4H_2O$. Molecular weight 403.23.

The neutral sulphate of an alkaloid obtained from Scoparius.—*U. S.*

Preparation.—The alkaloid sparteine was first isolated by Stenhouse (1853) by extracting the plant with water acidulated with sulphuric acid, concentrating, decomposing with sodium hydroxide, and distilling. For purification the hydrochlorate is prepared and the solution evaporated to dryness, when the salt is decomposed with solid potassium hydroxide. The alkaloid as thus obtained is a liquid distilling at 288° C., very slightly soluble in water, soluble in alcohol, ether, and chloroform, insoluble in benzene and benzin. The sulphate is prepared from the alkaloid by simple neutralization with sulphuric acid and crystallizing.

Properties.—Sparteine sulphate forms "colorless, white, prismatic crystals, or a granular powder, odorless and having a slightly saline and somewhat bitter taste. Liable to absorb moisture when exposed to damp air. Very soluble in water and alcohol. When heated to about 83° C. (181.4° F.), the salt begins to lose its water of crystallization, all of which escapes at 100° C. (212° F.). At about 136° C. (276.8° F.) it melts, and upon ignition it is consumed, leaving no residue. The salt is neutral to litmus-paper.

If 25 Cc. of ether be added to about 0.1 Gm. of sparteine sulphate in a test-tube, then a few drops of dilute ammonia-water, so that the latter shall not be in excess, and afterward adding an ethereal solution of iodine (1 in 50) until the liquid, when shaken, turns from an orange to a dark reddish-brown color, the bottom and sides of the test-tube will after a short time be found coated with minute, dark greenish-brown crystals, distinctly seen with a lens after the liquid has been poured out. On shaking 0.05 Gm. of the salt, in a test-tube, with 5 Cc. of potassium or sodium hydroxide test-solution, the liquid will at first be turbid, and small drops of sparteine will gradually collect on the surface. If a strip of moistened red litmus-paper be suspended in the mouth of the test-tube and a gentle heat then applied, the test-paper will gradually acquire a blue color, but no ammoniacal odor should be perceptible (absence of ammonium salts)."—*U. S.*

Action and Uses.—These are sufficiently discussed under SCOPARIUS. The general result of experience seems to be that neither preparation can be relied upon to regulate the heart's action or to produce diuresis. The average dose of sparteine sulphate is from Gm. 0.016–0.03 (gr. ¼–½) by the mouth, and about half these quantities hypodermically.

SPIGELIA, *U. S.*—SPIGELIA.

Pinkroot, E.; *Spigélie du Maryland*, Fr.; *Marylandische Spigelie*, G.

The root of Spigelia marilandica, *Linné*. Bentley and Trimen, *Med. Plants*, 180.

Nat. Ord.—Loganiaceæ.

Origin.—This plant is variously known as *Maryland pink*, *Carolina pink*, and *worm-grass*. It grows in rich, shady woods, chiefly in the southern part of the United States, but is found northward to Pennsylvania and Wisconsin. The stem is from 25–50 Cm. (10 to 20 inches) high, simple, round below, quadrangular above, and has opposite, sessile, acute, ovate-lanceolate leaves, and a terminal spike of six or eight showy flowers, with funnel-form or somewhat club-shaped corollas, which are nearly 5 Cm. (2 inches) long, externally scarlet-red and internally yellow, and have the stamens exserted. The plant flowers in June and July, and produces two-celled and few-seeded capsules.

Description.—Pinkroot consists of a rhizome with numerous rootlets. The rhizome is from 5–10 Cm. (2 to 4 inches) long, simple or somewhat branched, bent in various directions, but generally horizontal, about 3 Mm. (⅛ inch) thick, somewhat wrinkled longitudinally, frequently with a portion of the recent stem attached, and on the upper side with very short remnants of stems, which are from 3–6 Mm. (⅛ to ¼ inch) apart, and are separated by cup-shaped scars. The numerous curved and bent fibrous rootlets emanate chiefly from below and the sides of the rhizome, and are about 10 Cm. (4 inches) long, brittle and angularly wrinkled longitudinally. The color is brown or purplish-brown; the rootlets are somewhat lighter. Pinkroot has a faint aromatic odor and a sweetish afterward slightly bitter, not disagreeable, taste. When the rhizome is cut transversely, there is seen a thin bark, with a dark outer layer and a light purplish-brown inner layer covering the pale yellowish wood; the central pith is large, somewhat above the middle, and often discolored or decayed. The rootlets have a relatively thicker bark and no central pith.

Spigelia is occasionally seen mixed with a few roots of several plants, doubtless from careless collection, and has been observed as an accidental admixture in serpentaria. We have not observed any adulterations except earthy matter and stems, but we have frequently seen used in its place the root of Phlox, described below.

Allied Drugs.—SPIGELIA ANTHELMINTICA, *Linné*; Spigélie anthelmintique, *Fr. Cod.* This annual plant of tropical America has lance-ovate acute leaves, the upper ones being in whorls of four, and pale-reddish or purplish flowers not over 12 Mm. (½ inch) long; its root is short, blackish, and internally whitish, and is divided into numerous long, thin branches. The plant has in the fresh state a nauseous odor, is bitter and acrid, and is employed like pinkroot.

PHLOX CAROLINA, *Linné* (nat. ord. Polemoniaceæ), together with one or more allied species, is known in some of the Southern States as *Carolina* or *Georgia pink*. That much of the commercial pinkroot is derived from this plant was shown by Dr. A. W. Miller (1875). This drug is of a lighter brown or brownish-yellow color, and consists of a rather knotty rhizome with thickish, straight, and rigid rootlets, from which the bark is easily removed, exposing a straw-colored ligneous thread. The root is employed like spigelia, and is said to be equally efficient. The root of Phlox glaberrima, *Linné*, appears to be likewise used in some localities; it is somewhat darker and less rigid than the preceding, and more closely resembles spigelia.

Constituents.—Pinkroot was examined by Dr. R. H. Stabler (1857), who found in it a little volatile oil, tasteless resin, wax, tannin, and a bitter principle which was not

obtained in the pure state, but was ascertained to be not precipitated by lead acetate, to be soluble in water and alcohol, and to be insoluble in ether; it appears to be precipitated by tannin. W. L. Dudley (1879) obtained by distilling pinkroot with milk of lime a volatile alkaloid, *spigeline*, which gives with iodine a brownish-red precipitate, with metatungstic acid a white flocculent precipitate, and with Mayer's test a white crystalline precipitate soluble in alcohol and ether, and differing from the precipitates of other alkaloids by this test in being soluble in acids.

The West Indian plant was analyzed by Feneulle (1823) and Ricord-Madiana (1828), but the active principle was not isolated.

Action and Uses.—*Spigelia marilandica* appears to have been used medicinally by the aborigines of America, from whom Lining derived a knowledge of its virtues in 1754. It was early recommended by Garden and by Chalmers of South Carolina. The latter says of it: "Of all the vermifuges I am acquainted with, Loricera (called Indian Pink here) hath the best effects; but it must be properly guarded to prevent a drowsiness, violent pains in the forehead and eyes, and a temporary loss of sight which often ensues from the use of it. At such times the eyes lose their luster and the pupils seem much dilated; nay, it affects the nervous system to such a degree that convulsions sometimes supervene, as happened (and they proved mortal the same day) to two lusty children in one family, of seven and five years of age, owing to the too free use of that plant before its properties were fully known to us. The best corrections of it are serpentaria, volatiles, aromaticks, and other such things as excite and support the nervous power" (*An Account of the Weather and Diseases of South Carolina*, Lond., 1776, i. 67). Thompson found that it produced acceleration of the pulse, flushed face, drowsiness, and stiffness of the eyelids (Eberle, *Therapeutics*, p. 155). Spalsbury relates that an infusion of 3 drachms of the root in 3 gills of boiling water was ordered for a child four years of age, to be taken in eight equal doses at intervals of two hours. After the third dose the skin became hot and dry, the pulse 110 and irregular; the face, especially about the eyes, including the lids, was much swollen, and the pupils were widely dilated (*Boston Med. and Surg. Jour.*, Apr. 1855, p. 72). In other cases have been noted nervous excitement of an hysterical sort, headache, strabismus, tremor of the tongue, and general muscular trembling on making exertion. Analogous phenomena were noted by Dr. H. A. Hare when he gave 3 ounces of the fluid extract of spigelia to a dog weighing 40 pounds. They included hurried expiration, dilated pupils, fixed internal strabismus, exophthalmus, retching, unsteady gait, dry mouth and nostrils, general motor paralysis, deep sleep, and coma with slow respiration, which ceased along with the movements of the heart. In the frog the same symptoms occurred. He inferred from his experiment that the drug induces spinal rather than cerebral paralysis, and is a direct depressant of the heart as well as of the respiratory centre (*Med. News*, i. 286).

It is said that an infusion of spigelia is sometimes given as a substitute for ordinary tea to children liable to verminous disorders. It is commonly associated with purgatives when used as an *anthelmintic*, and may be concluded to act upon intestinal worms by benumbing if not killing them, after which the associated medicine expels them from the bowels. In some states of chronic irritation simulating those which usually attend the presence of lumbricoid ascarides in the intestines spigelia is of marked advantage, but its mode of action is obscure. The most usual and the best form of the medicine is that known as "worm tea"—viz.: R. Spigelia Gm. 16 (½ ounce); senna and fennel-seed, of each Gm. 8 (120 grains); manna Gm. 32 (1 ounce); boiling water Gm. 500 (1 pint). Infuse. Sig. Half a wine-glassful three times a day for a child two years old. The fluid extract of spigelia and senna (*U. S. P.* 1870) (see page 706) represented this infusion sufficiently well. The proper remedies for the *toxical effects* of spigelia are wine, ammonia, and other diffusible stimulants.

Spigelia anthelmintica, it is stated by Murray (*Apparatus Medicam.*, i. 545), was first brought into notice about 1750 by Browne, who said that it has been long used as a vermifuge by the Indians and the negroes of the West Indies and South America. On his recommendation it was introduced into England by Hinckley, Brocklesby, and others. Narcotic properties were attributed to it.

SPIRÆA.—Hardhack.

Spiræa tomentosa, *Linné.*

Nat. Ord.—Rosaceæ, Roseæ.

Origin.—Hardhack, also known as *steeple-bush*, *whitecap*, and, like other species of the same genus, as *meadow-sweet*, is a small North American shrub growing from Canada

southward to South Carolina. It is .9–1.2 M. (3 or 4 feet) high, has a slender, red-brown, branching stem with hard brittle wood, and ovate-lanceolate, serrate, dark-green, and beneath rusty tomentose leaves. The root is branching, covered with a thin brown bark, and contains a whitish, hard, and tasteless wood; the taste of the bark is bitterish and strongly astringent. The small purplish-red flowers with conspicuous stamens are in short racemes crowded into a dense pyramidal panicle, make their appearance in July and August, and produce four or five one-seeded follicles. The plant, collected while in bloom, is often employed in preference to the root; it has an agreeable though not a strong aromatic odor, and a very astringent somewhat bitter taste.

Constituents.—Hardhack has not been analyzed; it evidently contains tannin, volatile oil, etc.

Other Species.—Spiræa Aruncus, *Linné*.—Goat's beard, *E.*; Barbe de chèvre, *Fr.*; Bocksbart, *G.*—It grows in Europe and in North America westward from the Catskill and Alleghany Mountains. It is a perennial herb about 90 Cm. (3 feet) high, has smooth thrice-pinnate leaves, with thin, lance-oblong, sharply serrate, and pointed leaflets, and produces numerous small white flowers in slender racemes. It has an agreeable odor and an aromatic, astringent, and bitterish taste.

Spiræa ulmaria, *Linné*, indigenous to Europe and cultivated in gardens, is an herbaceous perennial, with interruptedly pinnate leaves and ovate or lance-oblong serrate leaflets. The flowers (*Ulmaire, Rêne-des-prés, Fr. Cod.*) are in long-peduncled corymbs, small, white, and in cultivation usually double. This, like other herbaceous species of Spiræa, contains *salicylic aldehyde* or *salicylous acid*, $C_7H_6O_2$, which is a colorless strongly aromatic oil, boiling at 196° C. (385° F.), and in aqueous solution colored dark-violet by ferric chloride.

Spiræa filipendula, *Linné*, likewise a European plant, has numerous long radicles, which near their lower end are enlarged to pear-shaped tuberous bodies, sometimes moniliform. These are 25–38 Mm. (1 or 1½ inches) long, blackish-brown externally, internally pale red-brown, and have a sweetish, bitterish, and somewhat astringent taste.

Action and Uses.—The late Drs. Griffith and Ives remarked that the officinal portion of the root (1870) is the least valuable part of the plant, the bark and the leaves being more efficient. It is said to have been used by the aborigines of this country, but was first brought to the notice of physicians in 1810. Its action was compared with that of rhatany, and it was alleged not to disorder the stomach even when taken in large doses. It was used in various forms of *diarrhœa*, including that of typhoid fever, pulmonary consumption, and summer complaint, in passive *hæmorrhages* and *menorrhagia*, in decoction as an injection for *leucorrhœa*, *gleet*, etc., and as a dressing for fungous *ulcers*. The extract has an agreeable odor and an astringent bitter taste, and may be prescribed in the *dose* of Gm. 0.30 (gr. v) or more. The decoction, made by boiling Gm. 30 in Gm. 500 (an ounce of the plant in a pint) of water, may be given cold, in the *dose* of Gm. 30–60 (1 or 2 fluidounces). Although S. tomentosa is somewhat aromatic, it is less so than some other species, and especially S. ulmaria, which was formerly in vogue as a stimulant in *fevers*, as serpentaria is now used, and also for its astringent action in the diseases mentioned above. It appears to have displayed diuretic virtues in several forms of *dropsy*. In Europe an infusion, a decoction, and an extract of it are employed. To S. ulmaria has been attributed the power of overcoming *retention of urine* depending upon enlarged prostate and intercurrent irritation (*Edinb. Med. Jour.*, xxviii. 1036).

SPIRITUS.—Spirits.

Alcoolats, Fr.; *Geiste*, G.

Spirits were formerly prepared almost exclusively by distilling odorous substances with alcohol; at present, however, both the United States and British Pharmacopœias direct most of them to be prepared simply by dissolving the volatile oils and other volatile compounds in alcohol. Since odorous principles volatilize only sparingly with the vapors of alcohol, but more freely with the vapors of water, distilled spirits are made with alcohol sufficiently diluted with water, so that a portion of the latter remains in the still on the completion of the process. The German Pharmacopœia usually directs alcohol and water in the proportion of 3 parts of the former to 3 or 5 parts of the latter; after due maceration with the bruised drug 4 parts by weight of distillate are recovered. The alcoolats of the French Codex are generally made with 60 or 80 per cent. alcohol, the fresh drugs being used whenever practicable. In all cases the alcohol employed should be free from fusel oil, and the drugs should be well bruised and macerated with the alcohol for

one or several days before distillation is commenced. In distilling spirits the same precaution should be adopted as in the distillation of medicated waters (see page 247), with this addition, that ample provision be made for the complete condensation of the vapors. Heat is best applied by means of steam or on a small scale by means of a salt-water bath.

SPIRITUS ÆTHERIS, *U. S.*, *Br.*—Spirit of Ether.

Spiritus ætherеus, P. G.; *Liquor anodynus mineralis Hoffmanni*; *Ether sulfuricus alcoolisatus*, Fr. Cod.—*Éther hydrique* (*sulfurique*) *alcoolisé*, *Liqueur anodine d'Hoffmann*, Fr.; *Hoffmannstropfen*, G.

Preparation.—Ether 325 Cc.; Alcohol 675 Cc.; to make 1000 Cc. Mix them.—*U. S.* Ether 10 fluidounces; rectified spirit 20 fluidounces.—*Br.* Ether and alcohol, of each equal weight.—*F. Cod.* Ether 1 part, alcohol 3 parts.—*P. G.*

This preparation is used in Europe as a simplified form of *Hoffmann's anodyne* and for similar purposes.

SPIRITUS ÆTHERIS COMPOSITUS, *U. S.*, *Br.*—Compound Spirit of Ether.

Hoffmann's anodyne, E.; *Liquor nervine de Bang*, Fr.; *Zusammengesetzter Ätherweingeist*, G.

Preparation.—Ether 325 Cc.; Alcohol 650 Cc.; Ethereal Oil 25 Cc.; to make 1000 Cc. Mix them.—*U. S.*

To prepare 10 fluidounces of compound spirit of ether, mix 3¼ fluidounces of ether, 2 fluidrachms of ethereal oil, and 6½ fluidounces of alcohol.

Oil of wine (undiluted) 3 fluidrachms; ether 8 fluidounces; alcohol 16 fluidounces.—*Br.* For preparing oil of wine the mixture of alcohol and sulphuric acid is directed to be distilled merely until it begins to blacken. (See pp. 1103, 1104.)

Properties.—Compound spirit of ether is a colorless, inflammable liquid, entirely volatilized by heat, but when ignited on glass or porcelain it leaves an almost invisible residue having an acid taste and reddening blue litmus-paper. The spirit is neutral to test-paper, or has only a very slight acid reaction. It has an aromatic ethereal odor and a pungent, slightly sweetish taste. When mixed with water a whitish turbidity is produced from the separation of oil of wine, and a slight opalescence is still observed if 40 drops of the spirit are mixed with a pint of water. If adulterated with a fixed oil, this will separate from the water as a thin film, which, when absorbed by bibulous paper, produces a permanent greasy stain, not disappearing by heat. On evaporating some of the spirit with an excess of aqueous solution of barium chloride, a white precipitate of barium sulphate is produced.

The commercial Hoffmann's anodyne is rarely made by the official formula, but is obtained, as was ascertained by Procter (1852), in the rectification of ether, the last fraction of the distillate, which is contaminated with light and a little heavy oil of wine, being diluted with alcohol and water so as somewhat to resemble the official article; from this it differs in producing only a slight precipitate with barium chloride.

Action and Uses.—This preparation is stimulant, antispasmodic, and anodyne, as are all preparations of alcohol, but in this one the addition of ether and ethereal oil renders its action more prompt and lively. Hence it is universally employed to allay *restlessness*, *sleeplessness*, and *nervous disturbance* in general, especially in the absence of fever, and notably in the manifold manifestations of *hysteria*. It is also a convenient remedy for *flatulent* and so-called *uterine colic*. It may, indeed, be used in all the cases for which sulphuric ether is prescribed internally, and with superior advantage. The *dose* is from Gm. 2–4 (f℥ss–j), properly diluted with sweetened water.

SPIRITUS ÆTHERIS NITROSI, *U. S.*, *Br.*, *P. G.*—Spirit of Nitrous Ether.

Spiritus nitri dulcis, *Spiritus nitrico-ætherеus*.—*Sweet spirit of nitre*, E.; *Ether azoteux alcoolisé*, *Liqueur anodine nitreuse*, Fr.; *Versüsster Salpetergeist*, G.

An alcoholic solution of ethyl nitrite ($C_2H_5NO_2 = 74.87$), yielding, when freshly prepared and tested in a nitrometer, not less than eleven times its own volume of nitrogen dioxide.—*U. S.*

Preparation.—Sodium Nitrite, 770 Gm.; Sulphuric Acid, 520 Gm.; Sodium Carbonate, 10 Gm.; Potassium Carbonate, completely deprived of water by drying, 30 Gm.; Deodorized Alcohol, Water, each a sufficient quantity. Dissolve the sodium nitrite in 1000 Cc. of water, and put the solution into a suitable flask, connected with a condenser kept cold by ice-cold water; then add 550 Cc. of deodorized alcohol and mix well. Through a cork fitted into the mouth of the flask insert a funnel-tube dipping below the surface of the liquid. With the condenser connect a receiver, and keep this surrounded by a mixture of common salt and crushed ice. Then gradually introduce into the flask, through the funnel-tube, sulphuric acid previously diluted with 1000 Cc. of water. Distillation will usually commence before the whole of the acid has been added. When all the acid has been introduced, regulate the distillation by the application or withdrawal of a gentle heat until no more nitrous ether distils over. Wash the distillate, first, with 100 Cc. of ice-cold water to remove any alcohol which may have passed over, and then remove any traces of acid by washing the ether with 100 Cc. of ice-cold water, in which the sodium carbonate had previously been dissolved. Carefully separate the ether from the aqueous liquid, and agitate it, in a well-stoppered vial, with the potassium carbonate to remove traces of water. Then filter it through a pellet of cotton, in a covered funnel, into a tared bottle containing 2000 Cc. of deodorized alcohol. Ascertain the weight of the nitrous ether filtered into the alcohol by noting the increase of weight of the tared bottle and contents, and then add enough deodorized alcohol to make the mixture weigh twenty-two times the weight of the nitrous ether added. Lastly, transfer the product to small, dark, amber-colored, well-stoppered vials, and keep them in a cool place, remote from lights or fire.—*U. S.*

Take of nitric acid 3 fluidounces; sulphuric acid 2 fluidounces; copper, in fine wire (about No. 25), 2 ounces; rectified spirit a sufficiency. To 1 pint of the spirit add gradually the sulphuric acid, stirring them together; then add, in the same way, 3½ fluidounces of the nitric acid. Put the mixture into a retort or other suitable apparatus into which the copper has been introduced and to which a thermometer is fitted. Attach now an efficient condenser, and, applying a gentle heat, let the spirit distil at a temperature commencing at 170° F. and rising to 175° F., but not exceeding 180° F., until 12 fluidounces have passed over and been collected into a bottle kept cool, if necessary, with ice-cold water; then withdraw the heat, and, having allowed the contents of the retort to cool, introduce the remaining ½ ounce of nitric acid, and resume the distillation as before until the distilled product has been increased to 15 fluidounces. Mix this with 2 pints of the rectified spirit, or as much as will make the product correspond to the test of specific gravity and percentage of ether separated by calcium chloride. Preserve it in well-closed vessels.—*Br.*

In the process of the U. S. P., which is a decided improvement on former official methods, sodium nitrite is decomposed by sulphuric acid, and the nitrous acid, in its nascent state, attacks the alcohol, forming ethyl nitrite and water, as follows: $NaNO_2 + H_2SO_4 = HNO_2 + NaHSO_4$; $C_2H_5OH + HNO_2 = C_2H_5NO_2 + H_2O$. The ethyl nitrite, together with some aldehyde and undecomposed alcohol, distils over, and is purified by washing with water and sodium carbonate, and finally freed from water by treatment with anhydrous potassium carbonate. 68.93 parts of absolute sodium nitrite are capable of producing 74.87 parts of ethyl nitrite, and if the official salt (97.6 per cent. $NaNO_2$) be used, the 770 Gm. ordered in the above formula should be able to produce 816.28 Gm. of ethyl nitrite, which would yield 17958 Gm. of the official spirit. In practice there is always some loss, and hence the necessity of ascertaining the exact weight of the purified ether before adding the alcohol.

The second formula gives the process of Prof. Redwood (1867), and yields good results if proper attention be paid to the strength of the acids and the alcohol, and to the temperature; it is, however, best adapted for being worked on a small scale. The sulphuric acid, in the presence of nitric acid, dissolves the copper, forming sulphate of copper and setting nitrous acid free, which in its nascent state acts upon the alcohol, producing nitrous ether and water. The reaction is explained by the equation $C_2H_5OH + HNO_3 + H_2SO_4 + Cu = C_2H_5NO_2 + CuSO_4 + 2H_2O$. (An elaborate paper on the manufacture by this process of spirit of nitrous ether of the strength required by the U. S. P. was read by Prof. Diehl (1877) before the Louisville College of Pharmacy.)

Older formulas differ from Redwood's either in acting upon alcohol directly by nitric acid or in generating nitric acid from potassium nitrate and sulphuric acid in the presence of alcohol. In either case the result is much influenced by the strength of the acid and by the temperature, and a larger quantity of aldehyde is always thus produced than in

the presence of copper. The action of nitric acid upon alcohol, and the production of aldehyde are explained by the equation $2C_2H_5OH + HNO_3 = C_2H_4O + C_2H_5NO_2 + 2H_2O$. The German Pharmacopœia directs a mixture of 5 parts of alcohol and 3 of nitric acid to be set aside for twelve hours, and then distilled into 5 parts of alcohol, the resulting solution being neutralized with magnesia and rectified.

It has likewise been suggested to prepare this spirit from pure nitrous ether or ethyl nitrite by mixing it with alcohol in a definite proportion. This would doubtless be the most rational way of preparing the spirit, but the obstacles to it are the difficulty of obtaining the ether in the pure state, and, after it has been obtained, the preservation of it for any length of time.

ETHYL NITRITE, $C_2H_5NO_2$, is a thin, pale-yellow liquid having a pungent, ethereal, apple-like odor. It boils at 17.5° C. (72.5° F.), is somewhat soluble in water, and on keeping acquires an acid reaction.

Properties.—Prepared by either process, spirit of nitrous ether is a transparent, volatile, inflammable, and nearly colorless liquid, with a slight yellowish or greenish-yellow tint, and has an agreeable, ethereal, somewhat fruit-like odor, free from pungency, and a sharp and burning, or, after diluting with water, a sweetish and cooling ethereal, taste. It mixes with water in all proportions, the liquid remaining clear and transparent. When freshly prepared, or even after being kept for some time with but little exposure to light and air, it is neutral to litmus-paper. When long kept, or after having been freely exposed to air and light, it acquires an acid reaction, but it should not effervesce when a crystal of potassium bicarbonate is dropped into it. If agitated with a solution of ferrous sulphate and a little strong sulphuric acid, it acquires a dark olive-brown tint. The spirit of the Br. P. contains about 2.63 per cent. of nitrous ether and has the specific gravity 0.845; the U. S. P. requires about 4 per cent. of pure ethyl nitrite and a specific gravity of 0.836–0.842 at 15° C. (59° F.); the P. G. gives the specific gravity as 0.840–0.850, but makes no requirement as to amount of ethyl nitrite present.

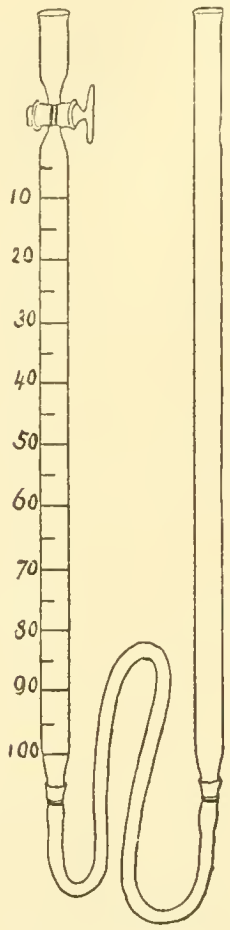
Tests.—"A portion of the spirit, in a test-tube half filled with it, plunged into water heated to 65° C. (149° F.), and held there until it has acquired that temperature, should boil distinctly on the addition of a few small pieces of glass. If 10 Cc. of the spirit be mixed with 5 Cc. of potassium hydroxide test-solution previously diluted with 5 Cc. of water, the mixture will assume a yellow color which should not turn decidedly brown within twelve hours (limit of aldehyde). If 5 Cc. of recently prepared spirit of nitrous ether be introduced into a nitrometer, and followed, first, by 10 Cc. of potassium iodide test-solution, and then by 10 Cc. of normal sulphuric acid, the volume of nitrogen dioxide generated at the ordinary, indoor temperature (assumed to be at or near 25° C. or 77° F.) should not be less than 55 Cc. (corresponding to about 4 per cent. of pure ethyl nitrite)." —*U. S.* "10 Gm. of the spirit should not have an acid reaction after 3 drops of volumetric solution of potassa have been added (limit of free acid)."—*P. G.* The *Br. P.* requires the spirit when fresh to yield seven times, and when old about five times, its volume of nitric oxide gas.

The pharmacopœial quantitative test is that first suggested in 1885 by A. H. Allen (*Pharm. Jour. and Trans.*, vol. xv. p. 673), and is much simpler than other methods in use prior to that time. The nitrometer (see Figs. 291, 292) is completely filled with saturated solution of sodium chloride, including the bore of the glass stopcock, and great care must be observed that no air enter while the different liquids are allowed to flow from the cup into the nitrometer tube: this is best avoided by washing the cup with a few Cc. of alcohol or salt solution after the spirit of nitrous ether has been run into the tube, and allowing 0.2 or 0.3 Cc. of fluid to remain in the cup. The results obtained by Allen's method are remarkably constant, and can be made strictly accurate by allowing 1.5 Cc. for solubility of the gas, and making proper corrections for temperature and atmospheric pressure.

For all practical purposes the official nitrometric test will suffice, as any spirit of nitrous ether containing 4 per cent. and over of ethyl nitrite may be considered as of pharmacopœial strength. The following equation will show the reaction taking place in the nitrometer: $C_2H_5NO_2 + KI + H_2SO_4 = C_2H_5OH + KHSO_4 + I + NO$; from this we see that 74.87 Gm. of ethyl nitrite yield 29.97 Gm. of nitric oxide, which will measure under normal pressure at 0° C. (32° F.) 22320 Cc., or at 15° C. (59° F.) 23550 Cc. Hence 1 Gm. of ethyl nitrite yields at 0° C. 298.132 Cc. of NO gas, or 1 Cc. of the gas will represent, under the same conditions, 0.00335422 Gm. of ethyl nitrite. Since gases under normal pressure increase $\frac{1}{273}$ in volume for every 1° C. (1.8° F.) increase in temperature above zero, every Cc. of gas increases by 0.003663, and proper corrections must

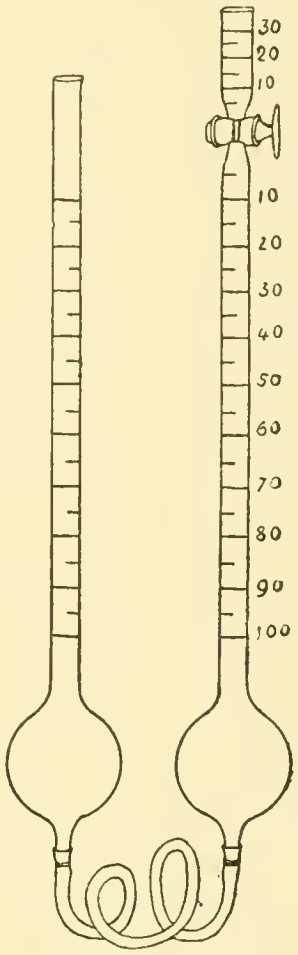
be made if accurate results are asked for. (See also Gasometric Determinations, under List of Pharmacopœial Tests, in Appendix.) To find the exact percentage of ethyl nitrite

Fig. 291.



Lunge's Nitrometer.

Fig. 292.



Curtman's Nitrometer.

present in any sample, first ascertain the exact volume of NO gas liberated at 0° C. (32° F.). This is done by dividing the number of Cc. of gas obtained in the official test by 1 plus as many times 0.003663 as the number of degrees Centigrade of temperature; then multiply the number of Cc. so found by 0.00335422, which will give the weight of the ethyl nitrite present, for each Cc. of NO gas represents 0.00335422 Gm. of $C_2H_5NO_2$; now divide by the number of Cc. of the sample used in the test, multiply by 100, and divide by the specific gravity of the sample. If the barometric pressure be not normal (760 Mm. or 30 inches), a correction of gas-volume should also be made for it after the correction for temperature, as follows: multiply the volume by the number of millimeters or inches of pressure indicated, and divide the product by 760 or 30 as the case may be. If 55 Cc. NO gas are obtained at 25° C. and 750 Mm. pressure from 5 Cc. of spirit of nitrous ether having the specific gravity 0.840, the actual amount of ethyl nitrite present would be 3.971 per cent.; $55 \div 1.091575\ [1 + (.003663 \times 25)] = 50.38$; 50.38×750 and $\div 760 = 49.71$; $49.71 \times 0.00335422 \div 5$ and $\times 100 = 3.3354363 +$; $3.3354363 \div 0.840 = 3.971$.

Preservation.—Spirit of nitrous ether should never be kept in large or partially filled bottles, nor exposed to light, as it thus rapidly undergoes oxidation and becomes worthless; neither should it be purchased in bulk, as it is impossible to preserve the quality of it when kept in carboys or large bottles which are frequently opened and never securely stoppered. We have frequently examined samples of spirit of nitrous ether drawn from carboys in the cellar of wholesale drug-houses, and found them far below the official requirements, often as low as $\frac{1}{3}$ or $\frac{1}{2}$ per cent. of ethyl nitrite. Even if carefully protected against air and light, the solution slowly decomposes and becomes gradually weaker. The concentrated spirit obtained by distillation may be preserved in the same manner, and if well washed with ice-cold water requires merely dilution with alcohol to furnish an unexceptionable preparation. The free acid which is formed by the influence of atmospheric oxygen may be neutralized by magnesia or by potassium bicarbonate, but

the spirit should not be kept continuously in contact with these chemicals. It has, however, been recommended to keep in the bottle with the spirit some crystals of potassium tartrate, whereby free acid will be neutralized, a corresponding amount of potassium bitartrate being formed.

Action and Uses.—The vapor of this liquid when inhaled by man causes giddiness, headache, throbbing of the arteries, and (in excessive quantities) confusion of mind, muscular reaction, cyanosis, a thready pulse, and spasms. Prolonged immersion in its vapor has been fatal. In very large doses it irritates the stomach, especially if the preparation contains, as it often does, free acid, causing vomiting and colic. In medicinal doses it is decidedly diuretic or diaphoretic, according as the skin is cool or warm. In *febrile conditions* it is much used to promote critical sweating, which it properly does by abating the morbid activity of the heart and tension of the arteries. Its efficacy in this respect is very marked in slight and ephemeral febrile affections, especially in such as are produced by an arrest of perspiration. It is usually associated with the neutral or the effervescing mixture and minute doses of some antimonial preparation.

As a *diuretic* it is commonly employed to relieve *strangury* produced by cantharides, in all painful affections of the *urinary apparatus*, whether occasioned by calculous or inflammatory disorders, and in the various affections of the *kidneys* in which congestion of those organs and diminished secretion of urine occur. In all of these cases the medicine should be associated with diluent drinks, weak saline solutions, or diuretic infusions. Of salines the most suitable are the acetate, tartrates, and carbonates of potassium, and of vegetable infusions those of digitalis and juniper. In chronic renal dropsy it is less useful than in dropsy of cardiac origin.

This medicine is often serviceable in relieving *flatulent* distension of the stomach and *nausea*, especially when it is associated with aromatic spirit of ammonia. It is in common use to quiet *nervous agitation*. It may be inhaled with advantage to allay *coughing* in diseases of the air-passages. It is a soothing application to the forehead in neuralgic *headache*, but if frequently applied it irritates the skin, especially if it is not freshly prepared. It is said to have cured certain hard swellings of the lip supposed to be cancerous (*papilloma, epithelioma*), but which are most generally non-malignant.

The *dose* of spirit of nitrous ether in febrile affections is Gm. 1.30–2 (♏xx–xxx), repeated every half hour or hour and given in sweetened water. As a diuretic from Gm. 2–4 (fʒss–j) of it should be given every three or four hours in a diuretic mixture, solution, or infusion. As a nervous stimulant the dose should not be less than Gm. 4 (fʒj).

Ethyl nitrite was used by Fraser in a case of *chronic bronchitis* with impeded respiration. He found that 2 minims of a 50 per cent. alcoholic solution of the compound produced an immediate palliation of the oppression and bronchial rales, which continued for several hours (*Amer. Jour. Med. Sci.*, Feb. 1888, p. 126). Dr. Leech has apparently proved that the virtues of spirit of nitrous ether are due chiefly to the ethyl nitrite it contains, and that the compound acts by relaxing the spasm of the bronchia and arterioles, and thereby lessening the strain upon the heart (*Lancet*, Feb. 1889, p. 240).

SPIRITUS AMMONIÆ, *U. S.*—Spirit of Ammonia.

Liquor ammonii caustici spirituosus; Spiritus ammoniaci caustici Dzondii.—Ammoniated alcohol, E.; *Alcoolat ammoniacal, Liqueur d'ammoniaque vineuse*, Fr.; *Weingeistiges Ammoniak*, G.

Preparation.—Stronger Ammonia-water 250 Cc.; Alcohol, recently distilled and which has been kept in glass vessels, a sufficient quantity. Pour the stronger water of ammonia into a flask connected with a well-cooled receiver, into which 500 Cc. of alcohol are introduced. Heat the flask carefully and very gradually to a temperature not exceeding 60° C. (140° F.), and maintain it at that temperature for about ten minutes. Then disconnect the receiver, and, having ascertained the ammoniacal strength by means of normal sulphuric acid (rosolic acid test-solution being used as an indicator), add enough alcohol to make the product contain 10 per cent. by weight of ammonia. Keep the product in glass-stoppered bottles in a cool place.—*U. S.*

In the former editions of this work we have pointed out the disadvantages of the process of 1870, which directed the generation of ammonia from ammonium chloride and lime, and showed the convenience of evolving the gas from stronger ammonia-water without unduly contaminating the alcohol with water. 250 Cc. of stronger ammonia-water of full strength, weighing 225.25 Gm., contain 56.3 Gm. of ammonia, one-half of which is readily given off at a temperature not exceeding 45° C. (113° F.); but 41 Gm. of

ammonia being required for 500 Cc. of alcohol, a somewhat higher heat is required, which, however, should not exceed 60° C. (140° F.). After the evolution of ammonia ceases, the ammoniacal alcohol (3.4 Gm. or 4.2 Cc.) is tested with sulphuric acid in the manner directed by the Pharmacopœia, and if more than 20 Cc. of the normal acid are needed for neutralization, the alcohol required for dilution is readily calculated; but if the liquid becomes neutral with a smaller quantity of the volumetric solution, the alcohol should be further charged with ammonia gas evolved from a fresh portion of strong ammonia-water; increasing the heat is inadmissible, since too large a proportion of water would pass over. Alcohol which has been kept in a barrel is apt to contain more or less organic matter in solution, which would be darkened in color by ammonia; hence the recommendation to use only alcohol which after rectification has been preserved in glass vessels.

Properties.—Spirit of ammonia is a colorless liquid having a strong ammoniacal and at the same time spirituous odor and a spec. grav. of about 0.810 at 15° C. (59° F.). When diluted with water it has the same behavior to reagents as ammonia-water, and its purity and strength may be determined in the same manner as for the latter. "3.4 Gm. spirit of ammonia, diluted with distilled water, should require for complete neutralization 20 Cc. of normal sulphuric acid, rosolic acid being used as indicator (=10 per cent. NH_3)."—*U. S.*

Action and Uses.—The action and uses of this preparation have been described under Ammonia. It is seldom prescribed internally, the aromatic spirit and the fetid spirit being more appropriate for this purpose as a general rule. It has the advantage of not rendering turbid mixtures containing resins and other substances which are precipitated by water, and hence it is a common ingredient in stimulating liniments, of which it should form not more than one-sixth part. Its *dose* is Gm. 0.60–2 (gtt. x–xxx) in a wine-glassful of water.

SPIRITUS AMMONIÆ AROMATICUS, *U. S., Br.*—Aromatic Spirit of Ammonia.

Alcoolat ammoniacal aromatique, Fr.; *Aromatischer Ammoniakgeist*, G.

Preparation.—Ammonium Carbonate, in translucent pieces, 34 Gm.; Ammonia-water 90 Cc.; Oil of Lemon 10 Cc.; Oil of Lavender-flowers 1 Cc.; Oil of Nutmeg 1 Cc.; Alcohol 700 Cc.; Distilled Water a sufficient quantity; to make 1000 Cc. To the ammonia-water, contained in a flask, add 140 Cc. of distilled water, and afterward the ammonium carbonate reduced to a moderately fine powder. Close the flask and agitate the contents until the carbonate is dissolved. Introduce the alcohol into a graduated bottle of suitable capacity, add the oils, then gradually add the solution of ammonium carbonate, and afterward enough distilled water to make the product measure 1000 Cc. Set the liquid aside during twenty-four hours in a cool place, occasionally agitating, then filter it through paper in a well-covered funnel. Keep the product in glass-stoppered bottles in a cool place.—*U. S.*

Oil of nutmeg 4½ fluidrachms, oil of lemon 6½ fluidrachms, alcohol 6 pints, water 3 pints; distil 149 fluidounces. Place the last 9 oz. of distillate in a bottle with ammonium carbonate 4 oz. and strong ammonia solution 8 fl. oz.; warm gently to 140° F. until dissolved; filter through cotton and gradually mix with the distillate.—*Br.*

On adding ammonia-water to official ammonium carbonate, normal ammonium carbonate is formed, which is readily soluble in alcohol. This is the compound aimed at by both pharmacopœias. If official ammonium carbonate is treated with alcohol, normal ammonium carbonate will be dissolved, and acid ammonium carbonate, being nearly insoluble, will be left behind. An insoluble saline precipitate will therefore indicate either a deficiency in the strength of the ammonia-water or a partial decomposition of the carbonate used. This salt should be employed only in translucent masses, and the effloresced portion, which contains variable proportions of acid ammonium carbonate, should be rejected for this preparation. In order to ensure the complete change of the ammonium salt, we have found it advantageous to allow the mixture of ammonium carbonate, distilled water, and ammonia-water to stand for some time (say twelve hours) before mixing it with the alcoholic solution of the oils. The change effected is readily explained as follows: $NH_4HCO_3.NH_4NH_2CO_2$ (official carbonate) + NH_4OH (ammonia) = $2(NH_4)_2CO_3$ (normal carbonate). A. Blair (1885) has shown that oil of nutmeg is preferable to oil of pimenta, which causes the spirit to become red or brown.

Properties.—This spirit is colorless or yellowish, has an aromatic and at the same

time ammoniacal odor, effervesces with acids, becomes milky on the addition of water, and has the specific gravity 0.905 *U. S.* (0.886 *Br.*).

Action and Uses.—This is a mild preparation of ammonia, which is used almost exclusively for the relief of *headache*, and especially of that form of it which is attended with *acidity* of the stomach and *flatulent* eructations. It probably exerts a double action—upon the stomach, neutralizing its acidity and provoking the expulsion of its gaseous contents, and upon the nervous system by a gentle stimulant action which allays nervous pain.

The *dose* of aromatic spirit of ammonia is Gm. 2–4 (f℥ss–j), properly diluted.

SPIRITUS AMMONIÆ FŒTIDUS, *Br.*—Fetid Spirit of Ammonia.

Alcoolat ammoniacal fétide, Essence antihystérique, Fr.; *Ammoniakalischer Stinkasantgeist*, G.

Preparation.—Take of Asafetida 1½ ounces; Strong Solution of Ammonia 2 fluidounces; Rectified Spirit a sufficiency. Break the asafetida into small pieces and macerate it, in a closed vessel, in 15 fluidounces of the spirit for twenty-four hours; then distil off the spirit, mix the product with the solution of ammonia, and add sufficient rectified spirit to make 1 pint (Imperial).—*Br.*

On distilling the tincture of asafetida prepared as above directed, a portion of the volatile oil of asafetida passes over; the finished preparation is therefore an alcoholic solution of this volatile oil mixed with ammonia-water. *Aqua fatida antihysterica* (*s. Pragensis*) is a weak distilled spirit free from ammonia, but contains the volatile products of galbanum, myrrh, valerian, zedoary, angelica, peppermint, wild thyme, English chamomile, and castor, in addition to the oil of asafetida.

Action and Uses.—The purpose of this preparation is to associate a special nervous stimulant with ammonia. Asafetida is often indicated where ammonia is appropriate, and especially in cases of *hysterical* derangements, whether exhibited in general nervous disorder or in that of a particular organ, as the larynx, the stomach, the bowels, or the uterus. It may be usefully associated with other antacids and with carminatives in *flatulent colic* from indigestion. The *dose* is from Gm. 2–4 (f℥ss–j).

SPIRITUS AMYGDALÆ AMARÆ, *U. S.*—Spirit of Bitter Almond.

Essence of bitter almond, E.; *Alcoolat (Esprit) d'amandes amères*, Fr.; *Bittermandelgeist*, G.

Preparation.—Oil of Bitter Almond 10 Cc.; Alcohol 800 Cc.; Distilled Water a sufficient quantity; to make 1000 Cc. Dissolve the oil in the alcohol, and add enough distilled water to make the product measure 1000 Cc.—*U. S.*

Uses.—The spirit of bitter almond may perhaps be more eligible than the oil itself for the dosage of the latter. Gm. 32 (a fluidounce) contain about 5 minims of the oil.

SPIRITUS ANISI, *U. S.*—Spirit of Anise.

Alcoolat (Esprit) d'anis, Fr.; *Anisgeist*, G.

Preparation.—Oil of Anise 100 Cc.; Deodorized Alcohol 900 Cc.; to make 1000 Cc. Mix them.—*U. S.*

The *essence of anise* of the British Pharmacopœia has more than twice the strength in oil of anise of the foregoing (see page 625).

Uses.—Spirit of anise is used for the relief of *flatulent colic* and as a flavoring ingredient of mixtures, in the *dose* of Gm. 4–8 (f℥j–ij).

SPIRITUS ARMORACIÆ COMPOSITUS, *Br.*—Compound Spirit of Horseradish.

Esprit de raifort composée, Alcoolat antiscorbutique, Fr.; *Meerrettiggeist*, G.

Preparation.—Take of Horseradish-root, scraped, Bitter Orange-peel, cut small and bruised, each 20 ounces; Nutmeg, bruised, ½ ounce; Proof Spirit 1 gallon; Water 2 pints. Mix, and distil a gallon (Imperial) with a moderate heat.—*Br.*

This preparation is an alcoholic solution of the volatile oils of the drug used.

Uses.—This compound is appropriate in cases of atonic *dropsy*, especially of renal origin, but is more or less efficient in all forms of dropsy in which stimulant diuretics are indicated. It may be added with advantage to various diuretic infusions, such as the compound infusion of juniper, the infusion of digitalis, etc. The *dose* is Gm. 4–8 (f℥j–ij).

SPIRITUS AURANTII, *U. S.*—Spirit of Orange.

Esprit d'orange, Fr.; *Orangengeist*, G.

Preparation.—Oil of Orange-peel 50 Cc.; Deodorized Alcohol 950 Cc.; to make 1000 Cc. Mix them.—*U. S.*

Uses.—Like the tinctures of orange-peel, it is well adapted for flavoring mixtures.

SPIRITUS AURANTII COMPOSITUS, *U. S.*—Compound Spirit of Orange.

Esprit d'orange composée, Fr.; *Zusammengesetzter Orangengeist*, G.

Preparation.—Oil of Orange-peel 200 Cc.; Oil of Lemon 50 Cc.; Oil of Coriander 20 Cc.; Oil of Anise 5 Cc.; Deodorized Alcohol a sufficient quantity; to make 1000 Cc. Mix them. Keep the product in completely filled, well-stoppered bottles in a cool and dark place.—*U. S.*

To make 1 pint of compound spirit of orange dissolve 3 fluidounces and 96 minims of oil of orange-peel, 384 minims of oil of lemon, 154 minims of oil of coriander, and 39 minims of oil of anise, in sufficient deodorized alcohol to make 16 fluidounces of solution.

Uses.—This compound seems to be an eligible addition to the preparations of orange-peel, but hardly as much so to the numerous preparations for the relief of flatulent colic. It may be given somewhat diluted in doses of Gm. 4 (a teaspoonful). Its chief use is in the preparation of *Aromatic Elixir*.

SPIRITUS CAJUPUTI, *Br.*—Spirit of Cajuput.

Alcoolat (Esprit) de cajeput, Fr.; *Cajeputgeist*, G.

Preparation.—Take of Oil of Cajuput 1 fluidounce; Rectified Spirit 49 fluidounces. Dissolve.—*Br.*

Uses.—Being merely a solution of oil of cajuput in alcohol, it might be made by extemporaneous prescription. Each fluidrachm of the spirit contains 1½ minims of the oil, and the *dose* is Gm. 2–4 (ʒss–j).

SPIRITUS CAMPHORÆ, *U. S., Br.*—Spirit of Camphor.

Alcohol camphoratus, Fr. Cod.; *Spiritus camphoratus*, P. G.; *Tinctura camphoræ.—Tincture of camphor*, E.; *Esprit de camphre, Alcool camphré*, Fr.; *Kampferspiritus*, G.

Preparation.—Camphor 100 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Dissolve the camphor in 800 Cc. of alcohol, filter through paper, and pass enough alcohol through the filter to make the product measure 1000 Cc.—*U. S.*

To make 1 pint of spirit of camphor dissolve 1¾ av. ozs. of camphor in 12 fluidounces of alcohol, and add to the solution sufficient alcohol to bring the volume up to 16 fluidounces.

Take of camphor 1 ounce; rectified spirit 9 fluidounces. Dissolve.—*Br.*

Dissolve 1 part of camphor in 9 parts of alcohol.—*F. Cod.*

Dissolve 1 part of camphor in 7 parts of alcohol, and to the solution add 2 parts of water.—*P. G.*

Uses.—The internal use of this preparation of camphor is seldom appropriate, chiefly because the camphor is separated immediately on coming in contact with the moisture of the mouth, fauces, etc. Externally, it is applied, as camphorated liniment is, for allaying pain in *sprained*, *chafed*, and *contused* parts, but it is preferable to the oily preparation whenever the local pain is *neuralgic* or is attended with inflammation, because in the latter case the evaporation of the alcohol produces a sense of coolness which is very grateful. Its anodyne and sedative action is frequently invoked in bathing the mammæ to diminish the *secretion of milk* after parturition or to assist in drying it up for weaning. Applied on cotton to an exposed nerve-pulp, it mitigates, and may quite remove, the *toothache*. Like powdered camphor, it may be used advantageously in *hospital gangrene* and in various *ulcers* of an indolent nature.

The *dose* of spirit of camphor is Gm. 0.30–2 (♏ v–xxx).

SPIRITUS CHLOROFORMI, *U. S., Br.*—Spirit of Chloroform.

Alcoolat de chloroforme, Fr.; *Chloroformspiritus*, G.

Preparation.—Purified Chloroform 60 Cc.; Alcohol 940 Cc.; to make 1000 Cc. Mix them.—*U. S.*

To make 1 pint of spirit of chloroform mix 461 minims of chloroform with sufficient alcohol to bring the volume up to 16 fluidounces. Each fluidounce contains nearly 30 minims (28.8 +) of chloroform.

Chloroform 1 fluidounce; rectified spirit 19 fluidounces; dissolve.—*Br.*

The preparation was formerly known as *chlorie ether.*

Uses.—This is a convenient preparation for administering chloroform by the stomach. It may be prescribed in *colic*, whether flatulent, neuralgic, or biliary, and indeed in almost all painful abdominal disorders. *Dose*, Gm. 1.20–4 (ɱxx–lx) or more, properly diluted.

SPIRITUS CINNAMOMI, *U. S., Br.*—Spirit of Cinnamon.

Alcoolat de cannelle, Fr.; *Zimmtspiritus*, G.

Preparation.—Oil of Cinnamon 100 Cc.; Alcohol 900 Cc.; to make 1000 Cc. Mix them.—*U. S.*

Oil of (Ceylon) cinnamon 1 fluidounce; rectified spirit 49 fluidounces.—*Br.*

Uses.—It may be prescribed, pure, in the *dose* of Gm. 0.60–1.30 (gtt. x–xx) in cases of *colic* with diarrhœa, and as a flavoring addition to various mixtures. But for the latter purpose cinnamon-water is more commonly used.

SPIRITUS FRUMENTI, *U. S.*—Whiskey.

Eau de vie de grains, Fr.; *Kornbranntwein*, G.

An alcoholic liquid obtained by the distillation of the mash of fermented grain (usually corn, wheat, or rye), and at least two years old.—*U. S.*

Origin and Preparation.—The term "whiskey" is supposed to be derived from *usque*, the first two syllables of *usquebaugh*, the original name in Ireland—itself from Irish *uisge* and *beatha*, "life," *Uisge beatha*, *Aqua vitæ*, "Water of life" (Dunglison's *Dictionary*). In Europe whiskey is often made by fermenting potatoes, but likewise from different kinds of grain; in Great Britain principally from barley, oats, and rye. In the United States rye, maize, and wheat are mostly employed for the manufacture of whiskey either in the raw state or after having been previously malted, when it furnishes a product of better flavor. The fermenting mixture is called the *mash*. During the fermentation the starch is converted into sugar, and finally into alcohol and carbon dioxide (see page 148). The mixture is now subjected to distillation, and the weak spirit, called *low wine*, is rectified, and thus obtained stronger and less charged with fusel oil, which comes over chiefly in the last portions of the distillate. The *raw whiskey* is kept in barrels or tanks for several years, during which time it acquires mellowness and is improved in flavor, doubtless in consequence of the formation of various compound ethers.

Properties.—Whiskey is a spirituous liquid, usually of a yellowish or amber color, due to coloring matter and to a trace of tannin derived from the tanks in which it has been kept, and to a trace of sugar which has probably been added in the form of caramel. The density of whiskey depends on the percentage of alcohol, and is to a slight extent influenced by the amount of the coloring and extractive matters; it should be not above .930, nor below .917, corresponding, approximately, to an alcoholic strength of 44 to 50 per cent. by weight or 50 to 58 per cent. by volume. The disagreeable odor of raw whiskey is mainly owing to a small quantity of amylic alcohol, which on keeping is changed into an ether, and perhaps partly into valerianic acid; œnanthylic and other allied acids are likewise present to a slight extent. Old whiskey has a slight acid reaction, due to the formation of a minute quantity of acetic and, according to Kappel (1859), of valerianic, acid. For neutralizing the acidity of good whiskey 20 Cc. require usually between 0.8 and 1.0 Cc. of $\frac{1}{10}$ normal solution of alkali, indicating between 0.113 and 0.142 Gm. of acetic acid or its equivalent. The acidity slowly increases with age up to a certain degree; in one case 2.25 Cc. of $\frac{1}{10}$ normal alkali were required for 20 Cc. of whiskey.

Tests.—On evaporating whiskey by a moderate heat nearly to dryness, the residue which is left should have a slightly aromatic and rather insipid, but not an acrid, taste. The most convenient test for recognizing the origin of whiskey is that proposed by Molnar. A small quantity of it is heated with a slight excess of caustic potassa until the alcohol has been completely evaporated; the compound ethers are thereby decomposed, and on adding an excess of sulphuric acid the volatile acids are liberated, and from their odor the source is recognized. *Apple whiskey* distilled from cider gives off a decided fruit odor; the odors of whiskies of different kinds of grain are sufficiently distinct from one another, but to readily recognize them considerable experience is required.

"If 100 Cc. of whiskey be very slowly evaporated in a weighed capsule on a water-bath, the last portions volatilized should not have a harsh or disagreeable odor (absence of more than traces of fusel oil from grain or potato spirit). The remaining residue, fully dried at 100° C. (212° F.), should weigh not more than 0.25 Gm. (absence of undue amounts of solids). This residue should have no sweet or distinctly spicy taste (absence of added sugar, glycerin, or spices). It should nearly all dissolve in 10 Cc. of cold water, forming a solution which is colored light-green by a dilute solution of ferric chloride (traces of oak tannin from casks). 100 Cc. of whiskey should be rendered distinctly alkaline to litmus by 1.2 Cc. of normal potassium hydroxide solution (limit of free acid)."—*U. S.*

Action and Uses.—Whiskey has probably been made officinal because genuine brandy of good quality is not readily procured. It is one of the unfounded claims of science that bodies of apparently the same composition are identical in their action, for experience daily shows that physiological effects cannot be predicted upon chemical grounds alone. The action of whiskey, both immediate and remote, differs in many respects from that of brandy, and the former liquor made from rye is not identical with that distilled from wheat, nor are potato brandy and grape brandy alike in their effects. Whiskey, and also gin, besides being less palatable to all but the coarsest tastes than brandy, are much more apt than the latter to produce functional and then organic diseases of the stomach, liver, and kidneys, and their immediate operation is less genial and exhilarating. In the absence of pure brandy, whiskey is probably the best of the alcoholic distilled liquors, since its comparative cheapness in a great measure removes the temptation of dealers to adulterate it. The proper occasions and indications for its medicinal use, both internal and external, are described under Alcohol and Vinum Album.

SPIRITUS GAULTHERIÆ, *U. S.*—Spirit of Gaultheria.

Alcoolat (*Esprit*) *de gaulthérie*, Fr.; *Bergtheespiritus* (*geist*), G.

Preparation.—Oil of Gaultheria 50 Cc.; Alcohol 950 Cc.; to make 1000 Cc. Mix them.—*U. S.*

"Essence of wintergreen" has been in use for a long time, but was prepared of varying strength. The pharmacopœial formula is intended to accomplish uniformity.

Uses.—This preparation is more convenient than the oil of gaultheria for giving an agreeable flavor to medicinal preparations.

SPIRITUS GLONOINI, *U. S.*—Spirit of Glonoin.

Spirit of nitro-glycerin.

An alcoholic solution of glonoin or nitro-glycerin, $C_3H_5(NO_3)_3$, containing 1 per cent., by weight, of the substance. Spirit of glonoin should be kept and transported in well-stoppered tin cans (*never* in glass or other fragile vessels), and should be stored in a cool place, remote from lights or fire. Great care should be exercised in handling, packing, transporting, or storing the spirit, since a dangerous explosion may result if any considerable quantity of it be spilled and the alcohol be partly or wholly lost by evaporation.

Properties and Tests.—"A clear, colorless liquid, possessing the odor and taste of alcohol. Caution should be exercised in tasting it, since even a small quantity of it is liable to produce a violent headache. The same effect is produced when it is freely applied to the skin. It is neutral to litmus-paper. Specific gravity 0.826 to 0.832 at 15° C. (59° F.). On diluting 10 Cc. of the spirit with 15 Cc. of water, both liquids, as well as the mixture, when measured, being brought to 15° C. (59° F.), the liquid will exhibit at most a faint cloudiness, but the addition of a further portion of 5 Cc. of water should produce a white turbidity. If the specific gravity of the spirit be higher than 0.840, or if 10 Cc. of it are rendered turbid by less than 10 Cc. of water, the spirit should be rejected.—*U. S.*

Preparation of Nitro-glycerin.—This compound, also known as trinitrin, glonoin, and propenyl trinitrate, was discovered by Sobrero (1847), and may be prepared either by gradually adding 7 parts of dehydrated glycerin to a well-cooled solution of 20 parts of sodium nitrate in 40 parts of sulphuric acid spec. gr. 1.840, the mixture being kept cool, or 1 part of glycerin may be slowly added, with frequent stirring, to 7 parts of a mixture composed of 1 part of nitric acid spec. gr. 1.47 and 2 parts of strong sulphuric acid, the temperature being carefully kept below 26.6° C. (80° F.) The reaction taking place by either process, between the nitric acid and glycerin, results in the pro-

duction of propenyltrinitrate or trinitro-glycerin: thus, $C_3H_5(OH)_3 + 3HNO_3 = C_3H_5(NO_3)_3 + 3H_2O$. In either case the nitro-glycerin separates in the form of an oily layer, and is then washed with water, and finally with very dilute soda solution, until all acid reaction ceases. The product amounts to about two and one-third times the weight of glycerin employed. It is a colorless or pale-yellowish oily liquid of 1.60 specific gravity, and crystallizes when cooled to —20° C. (—4° F.). It may be freed from water by treatment with 10 per cent. of glycerin, in which nitro-glycerin is insoluble, although it is miscible in all proportions with ether, chloroform, phenol, and glacial acetic acid. 1 Gm. of nitro-glycerin requires for solution 3.5 Cc. absolute alcohol, 10 Cc. alcohol, spec. grav. 0.830, 18 Cc. methyl or amyl alcohol, 120 Cc. carbon disulphide or 800 Cc. water. It is without odor, but its vapors produce intense headache; its taste is sweet and pungently aromatic. When ignited in the open air it burns quietly and incompletely, but when heated in closed vessels or by percussion, it explodes with great violence; sometimes it explodes spontaneously. Nitro-glycerin forms the basis of various blasting compounds known as *dynamite*, *giant-powder*, *glyoxylin*, *dualin*, etc. According to A. Nobel, 1 volume yields upon explosion about 10400 volumes of gas.

Uses.—Spirit of glonoin is convenient for dosing nitro-glycerin, of which it contains 1 per cent. by weight. The dose is stated to be 1 drop three times a day, gradually increased to 10 or even 20 drops, and given in water.

SPIRITUS JUNIPERI, *U. S., Br.*—Spirit of Juniper.

Alcoolat (*Esprit*) *de genièvre*, Fr.; *Wachholderspiritus*, G.

Preparation.—Oil of Juniper 50 Cc.; Alcohol 950 Cc.; to make 1000 Cc. Mix them.—*U. S.*

Oil of juniper 1 fluidounce; rectified spirit 49 fluidounces; dissolve.—*Br.*

Macerate for twenty-four hours 5 parts of bruised juniper-berries with 15 parts each alcohol and water, and distil 20 parts.—*P. G.*

The spirit made from the volatile oil distilled from juniper-berries is much more agreeable than if the common oil of juniper is used. Age improves the flavor.

Action and Uses.—This preparation is carminative and diuretic, and is useful as an addition to infusions and mixtures employed in the treatment of *dropsy*. Its *dose* is Gm. 2–4 (ɱ xxx–lx).

SPIRITUS JUNIPERI COMPOSITUS, *U. S.*—Compound Spirit of Juniper.

Preparation.—Oil of Juniper 8 Cc.; Oil of Caraway 1 Cc.; Oil of Fennel 1 Cc.; Alcohol 1400 Cc.; Water a sufficient quantity; to make 2000 Cc. Dissolve the oils in the alcohol, and gradually add enough water to make the product measure 2000 Cc.—*U. S.*

To make 1 pint of compound spirit of juniper dissolve 30 minims of oil of juniper and 4 minims each of fennel and oil of caraway in 11¼ fluidounces of alcohol, and gradually add enough water to bring the volume up to 16 fluidounces.

This spirit is an official substitute for *gin*, a spirit distilled in some parts of Europe from juniper-berries, to which sometimes other aromatics are added. It has the advantage of uniformity of composition over the commercial article, and if good volatile oils are used the flavor is agreeable and will improve by age.

Action and Uses.—The addition of caraway and fennel oils to that of juniper in this compound increases the virtues it derives from the last-named ingredient, and especially gives it a carminative operation, which is often called for in abdominal *dropsy*; for in that disease the abdominal and intestinal walls lose their contractile power and become distended by the gases formed in the cavity of the bowel. It is commonly added to diuretic infusions. The *dose* is Gm. 4–16 (fʒj–iv).

SPIRITUS LAVANDULÆ, *U. S., Br.*—Spirit of Lavender.

Alcoolat (*Esprit, Eau*) *de Lavande*, Fr.; *Lavendelspiritus*, G.

Preparation.—Oil of Lavender-flowers 50 Cc.; Deodorized Alcohol 950 Cc.; to make 1000 Cc.; Mix them.—*U. S.*

Oil of lavender 1 fluidounce; rectified spirit 49 fluidounces; dissolve.—*Br.*

Macerate for twenty-four hours lavender-flowers 5 parts, with alcohol and water each 15 parts, and distil 20 parts.—*P. G.*

For use as a perfume a small quantity of oil of bergamot, tincture of musk, or tincture of ambergris is sometimes added, the addition of the tincture being made to the distilled spirit.

Action and Uses.—Spirit of lavender—or, as it is commonly called, lavender-water—is more generally used as an agreeable and refreshing perfume than as a medicine. It is popularly employed to bathe the forehead, etc. in cases of *headache*, *fever*, etc. It may be given internally in *doses* of Gm. 2–4 (f℥ss–j).

SPIRITUS LIMONIS, *U. S.*—Spirit of Lemon.

Essence of lemon, E.—*Alcoolat* (*Esprit*) *de citron*, Fr.; *Citronenessenz*, G.

Preparation.—Oil of Lemon 50 Cc.; Lemon-peel, freshly grated, 50 Gm.; Deodorized Alcohol a sufficient quantity; to make 1000 Cc. Dissolve the oil of lemon in 900 Cc. of deodorized alcohol, add the lemon-peel, and macerate for twenty-four hours; then filter through paper, adding through the filter enough deodorized alcohol to make the spirit measure 1000 Cc.—*U. S.*

To make 1 pint of essence of lemon macerate 384 minims of oil of lemon and 386 grains of freshly-grated lemon-peel with 14.5 fluidounces of deodorized alcohol for twenty-four hours; then filter, and add sufficient deodorized alcohol to bring the volume up to 16 fluidounces.

Macerate for two days 500 parts of fresh rind of lemon with 3000 parts of 80 per cent. alcohol, and distil until all the alcohol has passed over.—*U. Cod.*

Uses.—This preparation is only used for flavoring simple syrup and medicinal mixtures.

SPIRITUS MENTHÆ PIPERITÆ, *U. S., Br., P. G.*—Spirit of Peppermint.

Essence of peppermint, E.; *Alcoolat* (*Essence*) *de menthe poivrée*, Fr.; *Englische Pfefferminzessenz*, G.

Preparation.—Oil of Peppermint 100 Cc.; Peppermint, in coarse powder, 10 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Dissolve the oil of peppermint in 900 Cc. of alcohol, add the peppermint, and macerate for twenty-four hours; then filter through paper, adding through the filter enough alcohol to make the spirit measure 1000 Cc.—*U. S.*

Oil of peppermint 1 fluidounce; rectified spirit 49 fluidounces; dissolve.—*Br.*

The formula of the P. G. agrees with that of the U. S. P., except that the spirit is made by weight and is not colored. The spirit of the Br. P. is one-fifth, but the essentia (see p. 625) is about double, the strength of the above.

Uses.—This preparation is the most convenient form for the ordinary administration of peppermint. The *dose* of the American preparation is Gm. 0.30–1 (gtt. v–xv), taken on loaf sugar or in sweetened water. The *dose* of the British spirit is (Gm. 2–4 (f℥ss–j).

SPIRITUS MENTHÆ VIRIDIS, *U. S.*—Spirit of Spearmint.

Essence of spearmint, E.

Preparation.—Oil of spearmint 100 Cc.: Spearmint in coarse powder, 10 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Dissolve the oil of spearmint in 900 Cc. of alcohol, add the spearmint, and macerate for twenty-four hours; then filter through paper, adding through the filter enough alcohol to make the spirit measure 1000 Cc.—*U. S.*

The analogous preparation used in France is distilled from fresh crisped mint, and that used in Germany as *Englische Krauseminzessenz* is made by dissolving 1 part of oil of crisped mint in 9 parts (by weight) of alcohol.

Uses.—This preparation is less energetic than that of peppermint. It may be given in the *dose* of Gm. 1.30–2.60 (♏xx–xl).

SPIRITUS MYRCIÆ, *U. S.*—Spirit of Myrcia.

Bay-rum, E.

Preparation.—Oil of Myrcia 16 Cc.; Oil of Orange-peel 1 Cc.; Oil of Pimenta 1 Cc.; Alcohol 1220 Cc.; Water a sufficient quantity; to make 2000 Cc.. Mix the oils

with the alcohol, and gradually add water until the solution measures 2000 Cc. Set the mixture aside, in a well-stoppered bottle, for eight days; then filter through paper in a well-covered funnel.—*U. S.*

To make 1 pint of bay-rum dissolve 60 minims of oil of myrcia and 4 minims each of oil of orange-peel and oil of pimenta in 10 fluidounces of alcohol, and gradually add enough water to bring the volume of the mixture up to 16 fluidounces.

On diluting an alcoholic solution of volatile oils rapidly with water a milkiness is apt to be produced, which is subsequently not readily removed by agitation; it is therefore directed to add the water gradually, so that the appearance of a permanent milkiness may be avoided as much as possible. If after a week the spirit cannot be decanted or filtered clear, it may be treated with paper-pulp or other material (except cotton-fibres) usually used in the preparation of medicated waters.

Bay-rum is distilled in several of the West Indian islands from the fresh leaves of Myrcia acris (see p. 1137), to which a certain proportion of the fruit is added, St. Croix rum being used for the best quality: its flavor is affected by the employment of the leaves of different varieties of the plant, or probably of different closely-allied species of myrtles. (See paper by A. H. Riise in *Amer. Jour. Phar.*, 1882, p. 278.) However, most of the bay-rum consumed in the United States is now manufactured here, a small portion being distilled from the dried leaves. The pharmacopœial formula furnishes a preparation of agreeable fragrance and of a pale-yellowish color or nearly colorless.

Uses.—Bay-rum, like lavender-water, is used exclusively as a perfume and as a refreshing application to the forehead in *headache* and to other parts irritated by heat or chafing.

SPIRITUS MYRISTICÆ, *U. S., Br.*—Spirit of Nutmeg.

Alcoolat (Esprit) de muscade, Fr.; *Muskatspiritus*, G.

Preparation.—Oil of Nutmeg 50 Cc.; Alcohol 950 Cc.; to make 1000 Cc. Mix them.—*U. S.*

Take of volatile oil of nutmeg 1 fluidounce; rectified spirit 49 fluidounces; dissolve.—*Br.*

In France this spirit is prepared by macerating for four days 500 parts of bruised nutmeg with 4000 parts (by weight) of 80 per cent. alcohol, and distilling as long as alcohol passes over.

Uses.—Spirit of nutmeg is used as a flavoring ingredient, but less commonly than other aromatics. Its *dose* is Gm. 2–4 (f℥ss–j).

SPIRITUS ODORATUS, *U. S., 1880.*—Perfumed Spirit.

Spiritus (Aqua) coloniensis, Alcoolatum fragrans.—Cologne-water, E.; *Eau de Cologne, Alcoolat de citron composé*, Fr.; *Kölnisches Wasser*, G.

Preparation.—Oil of Bergamot 16 parts (2 oz. av. or 17½ fluidrachms); Oil of Lemon 8 parts (1 oz. av. or 9 fluidrachms); Oil of Rosemary 8 parts (1 oz. av. or 8½ fluidrachms); Oil of Lavender-flowers 4 parts (½ oz. av. or 4¼ fluidrachms); Oil of Orange-flowers 4 parts (½ oz. av. or 4⅓ fluidrachms); Acetic Ether 2 parts (¼ oz. av. or 2⅛ fluidrachms); Water 158 parts (19¾ oz. av. or 19 fluidounces); Alcohol 800 parts (100 oz. av. or 7 pints 5 fluidounces); to make 1000 parts (125 oz. av. or 8½ pints). Dissolve the oils and the acetic ether in the alcohol, and add the water. Set the mixture aside in a well-closed bottle for eight days, then filter through paper in a well-covered funnel.

The formula of the French Codex is similar. This spirit should be kept on hand for some time, when its fragrance will improve.

Uses.—Cologne-water would seem to pertain to the perfumer rather than to the pharmacist or physician, and therefore to be quite misplaced in a pharmacopœia.

SPIRITUS PHOSPHORI, *U. S.*—Spirit of Phosphorus.

Tincture of phosphorus, E.; *Alcoolat (Esprit) de phosphore*, Fr.; *Phosphorspiritus*, G.

Preparation.—Phosphorus 1.2 Gm.; Absolute Alcohol a sufficient quantity; to make 1000 Cc. Weigh the phosphorus in a tared capsule containing water, then dry it carefully and quickly with blotting-paper, and introduce it into a flask containing 1000 Cc. of absolute alcohol. Connect the flask with an upright condenser supplied by cold water, and apply the heat of a water-bath, so that the alcohol may be kept gently boiling, until the phosphorus is dissolved. Then allow the liquid to become cold, and, if

necessary, add to it enough absolute alcohol to make it measure 1000 Cc. Lastly, transfer the spirit to small, dark amber-colored vials, which should be securely stoppered and kept in a cool and dark place.—*U. S.*

To prepare 1 pint of spirit of phosphorus 9 grains of phosphorus should be dissolved in 16 fluidounces of absolute alcohol.

Each Cc. of the solution contains 0.0012 Gm., or each fluidounce a little more than $\frac{1}{2}$ grain ($\frac{9}{16}$) of phosphorus.

Uses.—This solution forms a convenient means of dosing phosphorus. "Each fluidrachm contains $\frac{1}{12}$ grain of phosphorus, or 14.4 minims contain $\frac{1}{50}$ grain of phosphorus."

SPIRITUS ROSMARINI, *Br.*—Spirit of Rosemary.

Spiritus anthos.—Alcoolat (Esprit) de romarin, Fr.; *Rosmarinspiritus*, G.

Preparation.—Take of Oil of Rosemary 1 fluidounce; Rectified Spirit 49 fluidounces; dissolve.—*Br.*

The preparation known in Europe, and formerly much employed, as *Aqua Reginæ Hungariæ* (Eau de la reine de Hongrie, *Fr.*), is a compound spirit of rosemary, usually containing a little lavender, sage, or other aromatic oil.

Action and Uses.—This preparation is but little used in the United States. It is worthy of being more generally employed, not only for its perfume, which is very grateful to most persons, but as a stimulant in nervous and *hysterical* conditions, and locally for the relief of *muscular* and *neuralgic pains*. Like the oil of rosemary, it may be added to stimulating and anodyne liniments. Gm. 4 (1 fluidrachm) of the spirit contain nearly 1 minim of the oil.

SPIRITUS TENUIOR, *Br.*—Proof Spirit.

Preparation.—Take of Rectified Spirit 5 pints; Distilled Water 3 pints; mix.—*Br.*

It has the specific gravity 0.920 (see page 150).

Uses.—This form of alcohol is employed in medicine only as a lotion for *contusions, rheumatic pains, etc.*

SPIRITUS VINI GALLICI, *U. S., Br.*—Brandy.

Spiritus vini Cognac, P. G.—*Spirit of French wine*, E.; *Eau de vie, Cognac*, Fr.; *Franzbranntwein*, G.

An alcoholic liquid obtained by the distillation of the fermented, unmodified juice of fresh grapes, and at least four years old.—*U. S.*

Origin and Preparation.—Brandy is made in France by distilling different kinds of wine. The colorless spirit (*white brandy*) thus obtained is kept for some time in new oak casks, where it gradually acquires a light-amber tint (*pale brandy*). The darker-colored varieties have their color deepened by the addition of caramel. The brandies obtained in different districts of France are not esteemed alike, those of Cognac and Armagnac being deemed the best, owing to the agreeable mildness of their flavor; next in order are those from Bordeaux and Rochelle. The lees of wines and the marc of grapes are also distilled, and furnish a spirituous liquid called in France *eau de vie de marc*, which is highly charged with odorous principles, and is used as an addition to other brandies and for imitating brandy by mixing the liquid with pure rectified spirit. The odorous constituents separated from all or most of the alcohol are sometimes met with in commerce as *oil of grapes*. Large quantities of brandy are also distilled in Spain and Portugal, and of recent years in Germany.

Considerable brandy is now made in the United States, and is usually distinguished as Catawba and California brandy. *Catawba brandy* is made in the vine-growing districts of the Ohio and Mississippi Valley, according to E. S. Wayne (1855), from the lees and from the marc. That made from the lees is the best, and has the flavor of Catawba wine. When distilled from the marc it has an unpleasant taste, and contains a large amount of fusel oil, but is mellowed down by age. *California brandy* is made from the lees and marc, which are thrown together with poor wines and distilled, the distillate being tinged by the addition of caramel (*Proc. Amer. Phar. Assoc.*, 1866, p. 64).

The British Pharmacopœia recognizes only the spirit of French wine, while the U. S. and German Pharmacopœias admit all spirits obtained from fermented grapes or wine, without designating French wine.

Properties.—Brandy is a spirituous, amber-colored liquid having a peculiar flavor, which is improved by age; hence the U. S. P. directs it to be used only when at least four years old. The flavor depends upon the variety of grapes used, upon their ripeness, upon the care bestowed upon fermentation and distillation, and upon the age of the wine, an older wine yielding a more fragrant distillate. The specific gravity of brandy is required to be between .925 and .941 (*U. S.*), corresponding, approximately, to an alcoholic strength of 39 to 47 per cent. by weight, or 46 to 55 per cent. by volume (between .920 and .924, corresponding to between 46 and 50 per cent. by weight of alcohol, *P. G.*). It has a slight acid reaction, which is, at least in part, due to the presence of acetic acid. We have found good brandy to require for the neutralization of 20 Cc. from 1.3 to 1.7 Cc. of $\frac{1}{10}$ normal alkali solution, indicating from .185 to .241 Gm. of free acetic acid in the pint. The odor is due to minute quantities of œnanthic, acetic, and perhaps propylic and allied ethers; its quality is best ascertained by pouring some of the brandy into a wine-glass, then emptying the latter, and, without washing or wiping it, setting it aside; the peculiar fragrance becomes then more apparent, and is still noticeable after a day, while the odor of brandy which had been diluted with deodorized spirit becomes weak and disappears in the course of a few hours, during which time also the odor of whiskey or similar spirits becomes apparent. Brandy assumes a dark-greenish color on the addition of ferric chloride, owing to the presence of tannin derived from the casks or from catechu, etc. purposely added. Sugar can usually be detected in the extract by Trommer's test, and is derived from caramel.

Tests.—The addition of grains of paradise, Cayenne pepper, and similar substances, sometimes used for imparting artificial strength to brandy, is detected by the sharp or burning taste of the extract left on evaporation. With sufficient practical experience the origin of brandy may be recognized by Molnar's method (see SPIRITUS FRUMENTI), but it is more difficult to distinguish by their odors the ethers and fusel oils of the French wines used for making brandy than the fusel oils of different kinds of grain. "If 100 Cc. of brandy be very slowly evaporated in a weighed capsule on a water-bath, the last portion volatilized should have an agreeable odor, free from harshness (absence of fusel oil from grain or potato spirit). The residue, dried at 100° C. (212° F.), should weigh not more than 1.5 Gm. (absence of an undue amount of solids). This residue should have no sweet or distinctly spicy taste (absence of added sugar, glycerin, or spices). It should nearly all dissolve in 10 Cc. of cold water, forming a solution which is colored light-green by a dilute solution of ferric chloride (traces of oak tannin from casks). 100 Cc. of brandy should be rendered distinctly alkaline to litmus by 1 Cc. of the normal volumetric solution of potassium hydroxide (limit of free acid)."—*U. S.*

Action and Uses.—The virtues of brandy have been set forth in the article on ALCOHOL. It may be sufficient here to repeat that true brandy—that is, made from wine—has qualities peculiar to itself and unlike those belonging to other distilled spirits. It is not only more palatable, more cordial to the stomach, and produces a more grateful exhilaration; but is less apt than gin or whiskey to occasion disease of the liver or kidneys.

SPONGIA.—SPONGE.

Éponge, Fr.; *Schwamm*, *Badeschwamm*, G.; *Esponja*, Sp.

Spongia officinalis, *Linné.*
Class Poriphera. *Ord.* Ceratospongiæ.

Origin and Description.—Sponges belong to the lowest animals which live in water, and are attached to rocks or other substances. They consist of a framework arising from a broad base and forming a ramifying and anastomosing tissue, which is traversed by numerous canals and pores and covered with a glairy or gelatinous substance. In some genera the skeleton is formed, to a greater or less extent, of siliceous or calcareous spicules; in others the whole body consists of a gelatinous substance. The sponges which are in common use belong to a few species, the skeleton of which is entirely or nearly free from spicules, and forms cup-shaped or convex, porous, and lacunose masses, with circular vents on the surface. They are collected by divers, who tear them from the rocks, or they are detached by means of a fork fastened to the end of a long pole. The gelatinous animal matter is removed by burying them for several days in sand, and afterward soaking, squeezing, and washing them.

The best variety of sponge comes from the Mediterranean, and is chiefly collected in the neighborhood of Greece and near the coast of Syria. It is known in commerce as

Mediterranean and *Turkish sponge*, and comes in cup-shaped pieces of various sizes, having a soft, elastic, and compressible fibrous framework. The *Bahama* or *West Indian sponge* is collected near the Bahama Islands, and forms convex or oblong pieces, with somewhat projecting lobes and of a coarser texture than the preceding. As met with in commerce, sponge generally contains a large quantity of sand, from which it is freed by beating, and various calcareous matters, which are removed mechanically or by dissolving them with the aid of dilute hydrochloric acid. After it has been cleaned it is sometimes *bleached*, either by means of a solution of sulphurous acid prepared from sodium thiosulphate and hydrochloric acid or preferably by chlorine-water. A still better process is dipping the sponge for five or ten minutes into a 2 per cent. solution of potassium permanganate, and subsequently immersing it in a 2 per cent. solution of oxalic acid to which a little sulphuric acid has been added; the latter treatment removes the brown manganic oxide and leaves the sponge white, without affecting its durability.

Composition.—The organic matter of sponge is a proteid called *spongin*, which was formerly supposed to be closely allied to, or identical with, *fibroin* or *sericin* of silk, but was proven by Schlossberger (1858) and Staedeler (1859) to be entirely distinct, in being insoluble or very slowly soluble in ammoniacal solutions of the oxides of nickel and copper, and in the behavior to hot diluted sulphuric acid, with which it yields *leucin* and *glycocoll*, while sericin yields by this treatment tyrosin and serin, and is readily dissolved by solutions of nickel and copper in ammonia. Spongin is soluble in hot solution of caustic potassa and in hot mineral acids.

Derivatives and Allied Product.—Spongia usta, *Fr. Cod.* Burnt sponge, *E.;* Eponge torrifiée, *Fr.*—Heat clean sponge, cut into small pieces, in a coffee roaster until about one-fourth its weight has been given off. The residue consists mainly of charcoal, with 25 to 30 per cent. of calcium sulphate, 10 per cent. of silica, 9 per cent. of ferrous oxide, the remainder being magnesium carbonate, potassium chloride, and calcium phosphate, and about ½ to 1 per cent. of sodium iodide (Herberger).

Spongia cerata.—Sponge tent, *E.;* Éponge préparée à la cire, *Fr.;* Wachsschwämme, *G.*—Sponge is freed from foreign matters by beating and washing, then dried, cut into proper shape, dipped into yellow melted wax, pressed between hot iron plates, and when cold freed from the excess of wax.

Spongia compressa, Compressed sponge, *E.;* Funiculo pressa, *F. Cod.;* Éponge préparée à la ficelle, *Fr. Cod.;* Pressschwamm, *G.;* Esponga preparada, *Sp.*—Perfectly clean, fine sponge is cut into elongated pieces while moist, securely tied by means of twine into cylindrical pieces, and then dried.

Vegetable Sponge, or Gourd Towel. The fibrous network of the fruit of Luffa ægyptiaca, *Miller* (Momordica Luffa, *Linné;* nat. ord. Cucurbitaceæ), has been used to some extent, under these and similar names, like a sponge and flesh-brush. Luffa Petola, *Seringe*, and L. fœtida, *Cavanilles*, yield similar products. The fleshy portion of these fruits is edible, though not very palatable; several other species are violently purgative and emetic.

Action and Uses.—Before the discovery of iodine, roasted or so-called "burnt" sponge was generally used in the treatment of *goitre*, both internally and externally, and certainly with excellent results in appropriate cases; but it is now wholly superseded by the preparations of iodine. Sponge is familiarly employed for countless domestic purposes which require the use of a porous, compressible, and elastic substance capable of holding liquids, and, amongst others, for partial or general baths, which are of such great hygienic importance. Its use in medicine and surgery for absorbing blood, pus, and other animal liquids is equally familiar, and not less so are the dangers to which it exposes the patients in hospitals by carrying from one to another the germs of infectious diseases. Sponges that have been used in surgical operations and dressings should never be dried before being thoroughly purified with boiling water. The elasticity of sponge renders it an efficient means of dilating wounds, sinuses, the natural apertures of the body, etc. For this purpose it should be introduced in a dry and compressed state, when, by absorbing the liquids of the part, it gradually expands with irresistible force. To promote its introduction into narrow canals, such as that of the neck of the uterus, compressed sponge, saturated or merely coated with wax, is of the greatest utility. (Compare A. Smith, *Med. News*, xl. 197.) It is used to dilate wounds, etc. in order to facilitate the extraction of foreign bodies or the discharge of secretions, as well as the introduction of probes, forceps, and other surgical instruments. In the cervix uteri it is employed to relieve *dysmenorrhœa* and also to induce *premature labor*. Sometimes the sponge, before being compressed and coated with wax, is saturated with a solution adapted to stimulate or otherwise modify the condition of the part.

STANNUM.—Tin.

Etain, Fr.; *Zinn*, G.

Symbol Sn. Atomicity bivalent and quadrivalent. Atomic weight 118.8.

Origin and Preparation.—Tin is rarely found in the metallic state. Its most important ore is a binoxide, SnO_2, known as *tinstone*, which is usually imbedded in granite, quartz, or slate, and often associated with iron pyrites, and with tungstate of iron and manganese, known as the mineral *wolfram*. It is rarely met with as silicate, and is present in *columbite*, *tantalite*, and allied minerals, and in minute proportions in the mineral waters of Saidschütz and other places. The most important tin-mines are in Devonshire and Cornwall in Great Britain and in Malacca and Banca, but tin is likewise obtained in Australia, Bohemia, Saxony, and some parts of the United States. Australian tin sometimes contains gold. The tinstone is stamped into a coarse powder, freed from lighter minerals by washing with a stream of water, roasted to expel arsenic and sulphur, again washed with water, mixed with powdered coal and a little lime or fluor-spar for the purpose of forming a fusible slag, and then reduced on the hearth of a reverberatory furnace.

Properties.—Tin is a bluish-white metal of the specific gravity 7.3, softer than gold, but harder than lead, and when bent emitting a crackling sound. It may be rolled or hammered into *foil*, at 100° C. (212° F.), drawn into wire, and at 200° C. (392° F.) is so brittle that it may be readily reduced to powder. It melts near 230° C. (446° F.), and, according to Nies and Winkelmann (1882), on congealing increases in volume 0.7 per cent. While cooling it is readily converted into powder by trituration in a hot iron mortar; after sifting it constitutes *Stanni pulvis*, which was formerly employed. It is but superficially oxidized in moist air, and will effectually protect iron from rusting as long as the coating is perfect. Its alloy with lead forms *pewter*, *Britannia metal*, and *solder;* alloyed with copper it constitutes *gun-metal* and *bronze;* and by combining 4 parts of tin with 3 of cadmium, 8 of lead, and 15 of bismuth a fusible alloy is obtained melting at 60° C. (140° F.).

Metallic tin dissolves in hot, strong sulphuric acid to tannic sulphate, evolving sulphur dioxide. Strong hydrochloric acid dissolves it to stannous chloride, and nitromuriatic acid yields with it stannic chloride. *Stannous salts* are precipitated brown by hydrogen sulphide, the precipitate being soluble in ammonium sulphide. Gold chloride produces a deep-purple precipitate (*purple of Cassius*), and mercuric chloride is reduced either to calomel or to a gray powder of metallic mercury. This reaction explains the value of stannous chloride as a test for salts of mercury. *Stannic salts*, of which the chloride, $SnCl_4$, is used by dyers, do not react with the chlorides of gold and mercury, but yield with hydrogen sulphide a yellow precipitate which is soluble in ammonium sulphide. *Sodium stannate*, $Na_2SnO_3.4H_2O$, is used by calico-printers as a mordant, and is prepared on the large scale by fusing tin ore with soda and sodium nitrate or by boiling it with caustic soda. Both stannous and stannic salts are precipitated white by caustic potassa; the precipitates are soluble in an excess of potassa, and the alkaline solution, when obtained from stannous salts, yields on boiling a black precipitate of stannous oxide. Of the sulphides, *stannic sulphide*, SnS_2, is of interest; it is made by heating a mixture of tin amalgam, sulphur, and sal ammoniac, when it remains behind in golden-yellow scales, ammonium chloride and sulphide and chloride of mercury subliming; when ground, stannic sulphide is known as *mosaic gold* and *bronze powder*.

Action and Uses.—Since the time of Paracelsus, at least, tin filings have been used as a remedy for *tape-worms*, and a list of eminent physicians might be given, including some of the most distinguished helminthologists, who vaunted their efficacy and recommended their use. Their testimony may certainly be taken to qualify the judgment of Küchenmeister when he writes: "Once for all, I protest against the administration of tin filings, and I believe that no one can have much pleasure in giving this remedy who has seen the ecchymotic irritation of the intestine after its administration to living animals, and heard them whining or seen them writhing about during life." Even if this criticism were admitted to be just, it would not affect the question of the efficacy of the powdered metal or of tin prepared by precipitation from its chloride. The eminent authority above mentioned admits it to be real. When tin filings were employed they were supposed to act mechanically, subjecting the worms to such rude attrition as to destroy them; but since the salts of tin have sometimes proved to be tæniacide, and since precipitated tin has had a like effect, it is more probable that some inherent quality of the metal must be invoked to explain its operation. Moreover, it is stated upon good

authority that in certain rural districts of France it is customary to use, as a vermifuge, sweetened wine that has been kept for twenty-four hours in a tin vessel. The action of vegetable and animal acids upon the tin of vessels containing so-called canned goods, and into which air has found access through imperfect sealing or by breakage, produces hydroxide and chloride of tin, which have poisoned those who made use of the food. One investigator found in twenty-three samples of canned fruits an average quantity of 5.2 grains of stannous hydroxide to the pound (Hare, *Fiske Fund Prize Essay*, 1886). The activity of the salts of tin is illustrated by the experiments of White (*Archiv f. exp. Path., etc.*, xiii. 53). They were seen to act upon the digestive canal and upon the central nervous system, in the former producing the symptoms and lesions of irritant poisons, and in the latter paralysis. The urine was diminished and its specific gravity increased, and it contained albumen. The author assimilates tin with lead in its action on the animal economy. Patenko found that the bichloride was a local irritant and anæsthetic, and acted on the central nervous system and the muscles (*Ther. Gaz.*, x. 337, 622), and Ungar and Bodländer's experiments showed that the introduction into the system even of non-corrosive tin salts will produce morbid symptoms, and finally death (*Bull. de Thérap.*, cxiv. 323).

Formerly, tin filings were administered in the *dose* of 20 grains, gradually increased to Gm. 1.30–16 ($\frac{1}{2}$ ounce). Powder of tin may be prescribed in the dose of about Gm. 4 (1 drachm). It should be given in a syrup or electuary, and after the bowels have been completely cleansed by a purgative. The bisulphuret of tin has also been used as a tæniafuge, in doses of from Gm. 8–16 (2 to 4 drachms), in the same manner as the powdered metal. Chloride of tin has been employed for the same purpose, "as an antispasmodic in epilepsy, chorea, and other convulsive diseases, as a stimulant to paralyzed muscles in paraplegia, as an antidote in poisoning by corrosive sublimate, and as an internal application in chronic skin diseases" (Pereira). It was administered internally in the *dose* of Gm. 0.004–0.03 ($\frac{1}{16}$ to $\frac{1}{2}$ grain), and in an aqueous solution prepared by dissolving Gm. 0.01 in Gm. 32 ($\frac{1}{6}$ grain in an ounce) of water. It acts topically as an astringent, irritant, and caustic, and in poisonous doses causes convulsions and sometimes paralysis. *Stannous chloride* has been recommended by Abbott as a surgical disinfectant (*Med. News*, xlviij. 120).

STAPHISAGRIA, *U. S.*—Staphisagria; Stavesacre.

Staphisagriæ semina, Br.; *Semen staphisagriæ, s. Staphidis agriæ, s. pediculares.*—*Staphisaigre*, Fr.; *Stephanskörner, Läusekörner*, G.; *Estafisagria, Albarraz*, Sp.

The seed of Delphinium Staphisagria, *Linné*, s. Staphisagria macrocarpa, *Spach*. Bentley and Trimen, *Med. Plants*, 4.

Nat. Ord.—Ranunculaceæ, Helleboreæ.

Origin.—This annual pubescent herb is indigenous to the countries bordering on the Mediterranean, and is cultivated in some parts of Southern Europe. It attains a height of about 1 M. (40 inches), and has alternate, long-petioled, palmately five- to nine-parted leaves, the leaves being lanceolate and entire or three-lobed. The pale blue or purplish flowers are long-peduncled, arise from the axils of leafy bracts, have two of the petals spurred, both spurs being enclosed in that of the calyx, and produce three hairy follicles, each containing about twelve seeds. The unpleasantly odorous plant (and particularly the seeds) has been employed from an early period.

Description.—Stavesacre-seeds are from 4–6 Mm. ($\frac{1}{6}$ to $\frac{1}{4}$ inch) long and 3–5 Mm. ($\frac{1}{8}$ to $\frac{1}{5}$ inch) broad, acutely angled and irregularly flattish-tetrahedral, one side being somewhat convex. The brittle testa is at first of a brown or blackish-brown, afterward of a brownish-gray, color, wrinkled and pitted with flattish depressions, the intervening ridges forming net-like meshes. The nucleus is whitish, when old brownish, and consists of an oily albumen enclosing at its sharper end a small straight embryo. The seeds have a faint somewhat narcotic odor and a bitter, burning, and biting taste.

Constituents.—Marquis (1877) isolated four optically inactive alkaloids—delphinine, $C_{22}H_{35}NO_6$; delphinoidine, $C_{42}H_{68}N_2O_7$; delphisine, $C_{27}H_{46}N_2O_4$; and staphisagrine, $C_{22}H_{32}NO_5$. *Delphinine* was discovered in 1819 by Lassaigne and Feneulle, and simultaneously by Brandes. It is nearly insoluble in water, dissolves at 20° C. (68° F.) in 21 parts of alcohol, 11 parts of ether, and 16 parts of chloroform, crystallizes in flat prisms, has a bitter taste, followed by persistent tingling, is precipitated by the group reagents, but gives no characteristic color reaction; it does not melt at 120° C. Studer (1872) found it to melt at 90° C. (194° F.), and to dissolve with a reddish color in sul-

phuric acid containing a trace of iron. *Delphinoidine* is amorphous, melts between 110° and 120° C. (230° and 248° F.), dissolves in 6500 parts of water, in 3 parts of ether, and is freely soluble in chloroform and alcohol. Its characteristic reactions are with sulphuric acid dark-brown, red-brown; with Fröhde's reagent, dark-brown, blood-red, cherry-red; with sugar and sulphuric acid, brown, green; with sulphuric acid and bromine-water, violet-red, cherry-red, blood-red. *Delphisine* resembles the preceding in solubility and behavior, but forms wart-like crystals and contains more nitrogen. *Staphisagrine* or *staphisaine* was first obtained by Couërbe (1833), and Dardel's *staphisine* (1864) seems to be identical with it. It melts at 90° C. (194° F.), dissolves at 15° C. (59° F.) in 200 parts of water, in 855 parts of ether, and is very freely soluble in alcohol and chloroform; its characteristic reactions are with sulphuric acid faintly cherry-red, violet; with Fröhde's reagent, brown-red, violet-brown; with sugar and sulphuric acid, dingy-brown; with sulphuric acid and bromine-water, transiently reddish; with fuming nitric acid, blood-red; with nitric acid sp. gr. 1.4, brownish, resinous. The integuments of the seed appear to be the principal seat of the alkaloids, one of which yields a crystalline sparingly soluble salt with chromic acid (*Pharmacographia*).

The seeds contain from 25 to 30 per cent. of non-drying fixed oils, resins, coloring matter and other constituents not investigated; they yield about 8 to 10 per cent. of ash.

Allied Plants.—Delphinium Consolida, *Linné.*—Larkspur, Lark's claw, Knight's spur, *E.*; Pied d'alouette, *F.*; Rittersporn, Lerchenklaue, Hornkümmel, *G.*—This glabrous annual herb, which is a common weed in the grain-fields of Central Europe, is often met with as an ornamental plant in gardens, and has been naturalized in some parts of the United States from Pennsylvania to Virginia. It has the leaves dissected into narrow linear lobes, and its purplish-blue (in cultivation sometimes whitish) flowers are upon rather filiform peduncles in loose terminal racemes. The five sepals are petal-like, the upper one produced into a spur longer than the calyx; the petals are united, with one spur enclosed in the calyx-spur; the pistil is single, and the smooth follicle many-seeded. The seeds are quite small, irregularly tetrahedral, pointed, rough, and pitted upon the surface, with a black testa and a whitish nucleus consisting of an oily albumen and a small straight embryo. All parts of the plant are inodorous and have a bitter, burning, and biting taste. The plant is said to have received its specific name from the supposed power of its flowers of healing or consolidating wounds. The *consoude* of the French is comfrey.

The leaves, flowers, and seeds have been employed in medicine, and were designated as *herba*, *flores*, and *semen consolidæ*, s. *consolidæ regalis*, s. *calcatrippæ*; the seeds as *delphinium* (*U. S. P.* 1870). Thos. C. Hopkins (1839) obtained from the seeds an alkaloid, which he regarded as identical with delphinine. Masing (1883) obtained from the dry herb 0.02 per cent. of *calcatripine*, which is soluble in alcohol, ether, and chloroform, and appears to be easily decomposed by chemicals. It is colored by sulphuric acid red-brown, violet-brown, gray-brown; by Fröhde's reagent, olive-green, gray-yellow; by sugar and sulphuric acid, red-brown, greenish-blue; by sulphuric acid and a nitrate, orange-red, golden-yellow.

Delphinium Ajacis, *Linné*, of Southern Europe, is more frequently cultivated in gardens than the preceding species, has denser and longer racemes of flowers upon shorter and thick peduncles, and pubescent follicles, and possesses the same properties.

Delphinium exaltatum, *Aiton*, has the segments of the leaves narrow and cuneiform; the bright purplish-blue numerous flowers are in narrow racemes and have a straight spur a little longer than the calyx. The plant grows in the Middle States.

Delphinium azureum, *Michaux*, grows from Wisconsin to Arkansas and the Rocky Mountains, and has linear leaf-lobes and sky-blue or whitish flowers with a curved or ascending spur.

Action and Uses.—The no longer official plant, or larkspur, D. consolida, of which the flowers, as well as the seeds, have been employed in medicine, and also the tall larkspur (D. exaltatum), appear to possess acrid and irritant qualities, and in large doses to excite vomiting and purging. They have been used in the treatment of *scrofula*, *dropsy*, and spasmodic *asthma*, generally in the form of a tincture, which has also been much employed as a lotion or in an ointment for the cure of *itch* and the destruction of *lice*. D. consolida has of late been recommended for similar purposes (*Bull. de Thérap.*, civ. 480) and for ulcerated *buboes*. An infusion of the flowers in water or in vinegar, 3 parts in 100, has been used. Analogous qualities are ascribed to D. Ajacis by Benvenuti, who states that it hastens the cicatrization of wounds, as D. consolida is also believed to do. Its effects are ascribed to the alkaloid *delphinine*, which has also been obtained from D. staphisagria. It has an acrid, hot taste, irritates the fauces, and is emetic and purgative. In an ointment and rubbed upon the skin, delphinine causes a burning and prickling sensation and a transient redness, such as veratrine occasions. In the case of a man affected with torpor of the brain and abnormal excitability of the spinal cord Albers observed the following effects of doses of Gm. 0.015 (gr. $\frac{1}{5}$) repeated four times a day for several days: salivation, burning, redness, and swelling of the throat, nausea, retching, loss of appetite, straining at stool without evacuation, dysury, prickling and itching of the skin, great

restlessness, and a small but otherwise normal pulse. The intelligence was not further impaired, and the muscular power was rather augmented (*Prager Vierteljahrs.*, lxii.; *Analekt.*, p. 14). According to Boehm, staphisagrine (staphisaine) is a much less powerful poison to animals than delphinine, whose action, however, resembles its own in causing death by asphyxia. But it does not produce the energetic convulsions of delphinine, nor depress the pulse like that alkaloid; nor does it affect the cerebral functions, for the animals under its influence continue to react almost until death, and do not fall into a comatose condition. Husemann and Hilger epitomize its physical action thus: Delphinine acts chiefly on the respiration and the circulation, and but little on the peripheral nerves. Primarily it affects the respiratory muscles most; in which respect, and in the fact that its fatal action may be prevented by artificial respiration, it is analogous to aconite (*Die Pflanzenstoffe*, 2te Aufl., p. 617; Kobert, *Amer. Jour. Phar.*, lxii. 394). On the other hand, Gauthier places its analgesic quality highest; next, in large doses, it paralyzes the motor nerves; it first excites the heart, and ultimately arrests it in diastole; it renders respiration irregular, then tetanizes the respiratory muscles and kills by asphyxia; it excites vomiting and diarrhœa; it first contracts and then dilates the pupil (*Lond. Med. Record*, Oct. 15, 1887). From the citations it is evident that different experimenters have reached inharmonious conclusions.

Delphinine has been used with reputed success in the local treatment of *neuralgia* by applying it over the superficial sensitive points of the affected nerves. *Earache* and *toothache* have also been relieved by it. The *dose* of delphinine has been stated to be Gm. 0.03 (gr. ss), repeated at intervals of three or four hours, but more recent authorities state it should be between Gm. 0.001–0.006 ($\frac{1}{60}$ and $\frac{1}{10}$ gr.), given internally and not subcutaneously. A solution of from Gm. 1–2 in Gm. 32 (16 to 30 grains of the alkaloid in an ounce of alcohol) may be used as a liniment, and an ointment may contain Gm. 0.60–2.60 (10 to 40 grains) of delphinine to an ounce of lard.

STATICE.—Marsh Rosemary.

Inkroot, *Sea-lavender*, E.; *Romarin des marais*, *Lavande triste*, F.; *Strandnelke*, G.

The root of Statice Limonium, *Linné*, variety caroliniana, *Gray* (Statice caroliniana, *Walter*). Bentley and Trimen, *Med. Plants*, 166.

Nat. Ord.—Plumbaginaceæ.

Origin.—Marsh rosemary is a perennial acaulescent plant which grows near the seashore and in inland salt marshes of Southern and Western Europe. The variety caroliniana is an American plant, and grows in similar localities on the Atlantic coast. It has a tuft of spatulate-oblong or oblanceolate, bristly pointed, one-ribbed leaves, and produces in August a much-branched, panicled scape, bearing numerous small lavender-colored or purplish-blue flowers; the fruit is a one-seeded utricle contained in the base of the calyx. The root should be collected in autumn.

Description.—The root of marsh rosemary is several-headed, from 30–60 Cm. (1 to 2 feet) long and 25 Mm. (1 inch) or more thick. The upper part is closely annulate, and the stout branches, after drying, are longitudinally wrinkled. The root has a deep brownish-purple color externally, is somewhat paler internally, fleshy in the fresh state, and after drying tough and compact. It breaks with a short fracture, exhibiting a rather thick bark, and in the meditullium narrow pale-yellow wood-wedges. The root is without odor and has a strongly astringent and slightly bitter taste. E. L. Reed (1879) stated that when collected from swampy localities the root is long and little branched, but when grown in a sandy soil it is short and considerably branched.

Constituents.—Edward Parrish (1842) found in the root 12.4 per cent. of tannin, a trace of volatile oil, a little caoutchouc-like matter, gum, and other common vegetable principles; among the inorganic constituents the sodium sulphates and the chlorides and magnesium are found. H. K. Bowman (1869) estimated the tannin by means of gelatin, and determined the amount to be from 14 to 18 per cent. of the air-dry root. It reacts greenish-black with ferric salts.

Allied Drugs.—The roots of most other species of Statice have similar properties. St. speciosa, *Linné*, is used in Siberia; St. latifolia, *Smith*, in Southern Russia; and St. brasiliensis in Brazil, where it is known as *bayeuru* and *biacuru*; the latter contains 12.5 per cent. of tannin and 1.3 per cent. of acrid pungent resin (Ch. Symes, 1878). F. A. Dalpe (1884) obtained from the air-dry root 9.7 per cent. of ash and an alkaloid, *bayeurine*, which crystallizes from ether and chloroform in small white feathery needles and dissolves in sulphuric acid with a red color. St. mucronata, *Linné*, of Morocco, has a root with a whitish meditullium, and is said to possess nervine properties.

Action and Uses.—Marsh rosemary was anciently renowned as a remedy for pulmonary and uterine *hæmorrhage*, and for *dysentery* and other fluxes. In recent times it has been used, like kino and other vegetable astringents, for similar purposes, and still oftener in gargles for the cure of ulcerated, aphthous, and other forms of *sore throat*. The emetic action ascribed to it is probably developed only when its dose is excessively large. It may be used in tincture, decoction, or infusion. S. brasiliensis, or bayeuru, is used by the natives "as an astringent and discutient remedy in all kinds of enlargements and glandular swellings, internally as a fomentative, and frequently as a vapor" (*Am. Jour. Phar.*, lvi. 361).

STILLINGIA, *U. S.*—Stillingia.

Queen's root, Queen's delight, Silver leaf, E.; *Stillingie*, Fr., G.

The root of Stillingia sylvatica, *Linné*, s. Sapium sylvaticum, *Torrey*. Bentley and Trimen, *Med. Plants*, 241.

Nat. Ord.—Euphorbiaceæ.

Origin.—A perennial lactiferous herb growing in dry and sandy soil in the Southern United States as far north as Eastern Virginia. The stems are erect 60–90 Cm. (2 or 3 feet) high, and have nearly sessile, alternate, elliptic, or lance-oblong, finely serrate, smooth, and spreading leaves. The flowers are small, in dense catkin-like spikes, the upper ones with two stamens, the lower ones pistillate, fertile, and with three diverging stigmas on the thick style. The root should be collected late in autumn or early in spring.

Description.—Stillingia-root is about 30 Cm. (1 foot) long, nearly 5 Cm. (2 inches) in diameter above, tapering downward, little branched, but somewhat fibrous. It is crowned with the short remnants or scars of numerous stems, is fleshy when fresh, after drying compact and wrinkled longitudinally. Externally, it is of a light brown-gray color, and internally of a pinkish tint. The root is tough and tenacious and breaks with a fibrous fracture. On transverse section are seen a rather thick bark, the inner layer of which is pale pinkish-brown and dotted with numerous brown-yellow resin-cells, and a radially striate porous meditullium containing resin-cells in the medullary rays. The odor of the fresh root is rather strong and disagreeable, but after drying is much weaker and less unpleasant; its taste is bitter and acrid, leaving a burning impression on the palate.

Constituents.—From some experiments made by Wm. Saunders (1868) it appears that, though the odor of the root may be diminished on drying and keeping, the pungency is scarcely lessened by exposure for a year to light and air. The pungency seems to be due to a resinous constituent which is readily soluble in alcohol. The so-called *oil of stillingia*, as found in the market, is intended to be the ethereal extract, but sometimes possesses scarcely any of the persistent acrimony of the root. Stillingia contains also starch, tannin, and, according to J. H. Harmanson (1882), another principle, which, like tannin, discharges the blue color of iodide of starch, and which is insoluble in alcohol and ether, but readily soluble in hot water, and is destroyed on being boiled with diluted acids.

Allied Species.—Stillingia (Excæcaria, *Müller*, Croton, *Linné*, Sapium, *Roxburgh*) sebifera, *Michaux*. This is a medium-sized tree indigenous to China and somewhat cultivated in tropical countries. The ovate three-celled fruit contains three seeds imbedded in a solid inodorous fat, which consists principally of palmitin, with a little stearin, melts at 44.5° C. (112° F.), and is known as *Chinese tallow*. After separating the tallow by boiling water, the seeds yield by pressure a drying oil which melts at 35° C. (95° F.), and then remains liquid for a long time.

Action and Uses.—The root, when chewed and the juice swallowed, causes heat in the mouth and fauces and along the œsophagus, increased salivation, and burning in the stomach, and in susceptible persons vomiting also. It loses these qualities by drying (Frost). Stillingia was originally introduced as an emetic and alterative, and has been more or less used, especially in the Southern States, for the cure of *scrofula*, *syphilis*, and *cutaneous* and *hepatic* disorders. The evidences of its power do not appear to be very convincing. Thus, it is credited with curing phagedenic chancres which nothing else could arrest, but it appears that with each dose of a decoction of stillingia 4 drops of nitric acid were given. Now, nitric acid is reputed to cure syphilis. In 1846, Frost claimed for stillingia curative virtues in scrofula and syphilis, but he associated with it sarsaparilla, guaiac, and sassafras (*Charleston Jour.*, i. 617). A similar estimate must be formed of the judgment expressed by Lopez (*New Orleans Med. and Surg. Jour.*, ii. 40),

and by Cornell (*Boston Med. and Surg. Jour.*, Aug. 1857, p. 37). Stillingia is best given in a decoction made with Gm. 32 of the bruised root (1 ounce) in Gm. 750 (1½ pints) of water, gradually reduced to a pint. *Dose*, a wine-glassful two or three times a day. The *dose* of the powder is Gm. 1–2 (gr. xv–xxx).

STRAMONIUM.—Stramonium; Thornapple.

Stramoine, Pomme-épineuse, Fr.; *Stechapfel, Dornapfel*, G.; *Estramonio, Toloache*, Sp.

Datura Stramonium, *Linné*. Bentley and Trimen, *Med. Plants*, 192.

Nat. Ord.—Solanaceæ.

1. The Leaves. Stramonii folia, *U. S.*, *P. G.* Herba stramonii.—Stramonium-leaves; Thornapple-leaves, *E.;* Feuilles de stramoine, *Fr.;* Stechapfelblatter, *G.;* Hojas del estramonio, *Sp.*

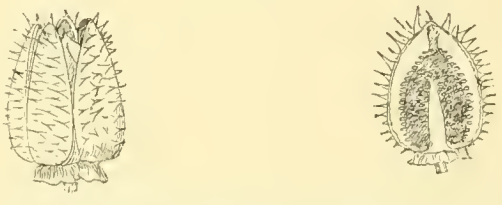
2. The Seeds. Stramonii semen, *U. S.* Stramonii semina, *Br.;* Stramonium-seeds, *E.;* Semences (graines) de stramoine, *Fr.;* Stechapfelsamen, *G.;* Semillas del estramonio, *Sp.*

Origin.—Stramonium is known in the United States as *Jamestown weed* and *Jimson weed*. It is very unequally distributed, being quite common in some localities and rare in others, and grows in waste places and along roadsides throughout the greater part of the world, with the exception of the colder countries. Its native country is not certainly known, but it is now by most botanists believed to be indigenous to Asia. De Candolle refers it to the countries bordering on the Caspian Sea; others regard it as coming from Northern India. It is a coarse-looking annual weed, with a white, conical, branching root and an erect, nearly smooth, pale-green, and succulent stem,

Fig. 293.

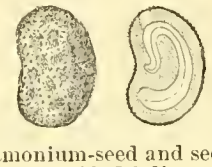
Datura Stramonium, *Linné:* flowering branch.

Fig. 294.



Capsule, mature, with two valves removed, showing partitions and position of seeds (reduced).

Fig. 295.



Stramonium-seed and section, magnified 3 diam.

with repeatedly forked branches. The flowers are on short stalks singly in the forks, have a long tubular five-angled calyx with a short five-toothed limb, and a white, tubular, funnel-shaped, five-plaited, and five-pointed corolla. The capsule is 5–7 Cm. (2 to 3 inches) long, surrounded below by the spreading base of the calyx, ovate in shape, obtusely quadrangular, covered with spines, in the lower portion four-celled, but only two-celled above, opens by four valves, and contains numerous seeds.

Datura Tatula, *Linné*, resembles the official plant very closely, is found in similar localities, and is distinguished by its purple-colored stem, the darker-green foliage with occasionally purplish petioles and nerves, and by the purple color of the flowers and anthers. Many botanists regard it merely as a variety of Stramonium, but there are evident hybrids between the two forms, and, according to Naudin (1852), the seedlings from these are again either D. Stramonium or D. Tatula. De Candolle considers this species to be indigenous to South America, but it has spread over the greater part of the world.

Description.—1. The Leaves. These should be collected while the plant is in bloom, which commences early in summer. They are situated on the forks on long petioles, vary in length from 7–20 Cm. (3 to 8 inches) and in width from 5–12 Cm. (2 to 5 inches), are ovate in shape, and have an unequal base, one side being decurrent on the

petiole. The apex is pointed and the margin coarsely and unequally sinuate-toothed. The leaves are rather fleshy when fresh, and have a disagreeable narcotic odor, but after drying are thin, brittle, and nearly inodorous. Young leaves are downy; older ones are smooth or slightly downy on the nerves beneath, and frequently perforated with nearly circular holes. Their taste is unpleasant, saline, and bitter.

2. The Seeds. When ripe the seeds are of a dull brownish-black color, about 4 Mm. ($\frac{1}{6}$ inch) long, 2.5 Mm. ($\frac{1}{10}$ inch) broad, and about 1 Mm. ($\frac{1}{25}$ inch) thick; they are reniform, flattened, finely pitted, and somewhat coarsely reticulate, and have the hilum on the sinus. The testa is hard, and encloses a white oily albumen in which is imbedded the cylindrical embryo, curving parallel with the edges of the seed. The seeds are inodorous or nearly so, except after being bruised, when they emit a heavy unpleasant odor; their taste is oily and bitter.

Constituents.—The alkaloid *daturine* was discovered in the seeds by Geiger and Hesse (1833), and subsequently found in other parts of the plant. According to Brandes, the seeds contain it combined with malic acid. Von Planta (1850) pronounced this alkaloid to be identical with atropine in composition, solubility, and fusibility. But the physical experiments performed by Von Schroff (1852) demonstrated the two alkaloids, though acting qualitatively alike, to be very unequal in their effects, daturine being about twice as strong as atropine. Subsequently, Erhard (1866) observed also some of their salts to differ in their crystalline forms. These differences have been explained through the researches of Ladenburg (1880), according to which daturine is a mixture of *atropine* and *hyoscyamine* (see pp. 305 and 854), the latter usually predominating; but Ernst Schmidt (1881) obtained also daturine which consisted principally of atropine. The other constituents of the seeds are about 25 per cent. of a bland fixed oil, mucilaginous, resinous, and other common principles, and about 3 per cent. of ash. Trommsdorff isolated *stramonin* as a white tasteless powder, insoluble in water, readily soluble in fixed and volatile oils, soluble in ether, and sparingly soluble in alcohol; it does not appear to have been further investigated. The leaves contain only about .02 per cent. of alkaloid, besides mucilage, albumen, potassium nitrate, etc.; they yield about 17 per cent. of ash.

Allied Drugs.—Datura alba, *Nees*, of India, has rather small subglobular and sharply spinous capsules and irregular triangular yellowish-brown, roughish seeds, which are used like those of the preceding species.

Datura metel, *Linné*, which grows in Africa and Southern Asia, has obliquely cordate, somewhat sinuate toothed or nearly entire, soft-hairy leaves, and pendulous spiny capsules with brownish-yellow seeds.

Datura sanguinea, *Ruiz et Pavon*, a shrub or small tree of Peru, has oblong, pointed, and sinuate-toothed, on the lower side downy, leaves, and large flowers with a corolla, the lower half of which is yellow and the upper half blood-red.

Action and Uses.—Stramonium and belladonna and their respective alkaloids, daturine and atropine, are almost identical in their action upon man. Indeed, they are held to be quite identical by some of the highest authorities (*Archives gén.*, Jan. 1881, p. 12; *Am. Jour. Pharm.*, lvi. 440). The powdered leaves of stramonium in Gm. 0.12 (2-grain) doses slightly increase the fulness and frequency of the pulse, occasion a little giddiness, and render the skin warm and the hands and face moist. Gm. 0.30 (5-grain) doses cause dilatation of the pupils, difficulty of speech, nausea, thirst, dryness of the throat, relaxation of the bowels, an increased flow of urine, and some feverishness. Poisonous doses produce a condition like that of high fever with delirium; the patient may talk volubly and laugh, or become violent, biting and striking furiously, and usually there is evidence of various, and sometimes grotesque, hallucinations; the movements may resemble those in chorea or in alcoholic intoxication; the head is dizzy, heavy, or light, and there is a tendency to faint; the face is flushed, and occasionally swollen, the eye bright, the conjunctiva injected, the pupil dilated, and the sight confused; the skin is sometimes covered with a bright-red eruption, which may be followed by a crop of minute vesicles, or the eruption may resemble erysipelas at first and measles afterward. In some cases hydrophobic phenomena occur, the sight of water or the attempt to drink producing a convulsive paroxysm. In rare fatal cases the phenomena of excitement sooner or later are succeeded by stupor, insensibility, relaxation, and even paralysis; the pupils are inordinately dilated, the pulse is rapid and thready, and the skin hot and perspiring. In no case is there any tendency to sleep, but, on the contrary, persistent insomnia. When recovery takes place there is no distinct recollection of what has occurred. Among the perversions of the senses it has been noticed that all black objects appear green. A fatal case in a healthy man of fifty is reported by Newton (*Med. Record*,

xviii. 289), and one of a child (*Med. News*, lvii. 272). Cases of recovery have been published by Terry (*Boston Med. and Surg. Jour.*, Feb. 1882, p. 123), Rubio, etc. (*Phila. Med. Times* xii. 458; xiii. 280); McCutcheon (*New Orleans Med. and Surg. Jour.*, Oct. 1885); Gratiot (*Jour. Am. Med. Assoc.*, vi. 400); Pedicini (*Therap. Gaz.*, xiii. 844). A case of death following the application of a poultice of stramonium-leaves to an open cancer of the breast has been related to us (Nov. 1871). A curious illustration of stramonium intoxication is presented by the narrative of its use in Mecca for criminal purposes (*Jour. Am. Med. Assoc.*, i. 22). Daturine occasions phenomena essentially identical with the above and with those caused by atropine, but with more depression, failure of the pulse, and insensibility; according to some observers, it dilates the pupils more rapidly, although less persistently, than atropine. Other reporters, however, furnish a different result, asserting that as a mydriatic daturine is three times as strong as atropine and its action more prolonged. It is generally accepted, as being proved by the above phenomena, that stramonium and daturine expend their power mainly upon the vasomotor nerves, in small doses contracting, but in large doses, paralyzing, the capillaries. These actions are identical with those which experiment and observation have shown to be exerted by hyoscyamine. Regnault and Valmont concluded from their experiments that daturine is identical with atropine, and that hyoscyamine is often really impure atropine (*Archives gén.*, Jan. 1881, p. 16), and Oliver reached the same conclusion in regard to the action of daturine and hyoscyamine (*Amer. Jour. Med. Sci.*, July, 1882, p. 102).

At one time stramonium was believed to be a valuable remedy in various forms of *insanity*, in *mania* as well as in *melancholia*, but experience has not confirmed the favorable judgment. Yet there are isolated cases in which phantasmal delirium appears to have been removed by this medicine (I. Moreau, *Le Traitement des Hallucinations*, 1841). A similar statement may be made respecting its use in *epilepsy*, and there is at least every reason to regard it as not less efficacious than belladonna in that disease. It is said to be employed in India in the treatment of *hydrophobia* (*Times and Gaz.*, Dec. 1885, p. 894). The utility of stramonium in *spasmodic asthma* cannot rationally be called in question; the evidence in its favor is drawn from too many and too widely different sources to be gainsaid. The scepticism upon this point expressed by certain writers may fairly be attributed to their having failed to discriminate between pure asthma and asthma or dyspnœa connected with pulmonary or cardiac disease. In the latter category the medicine must usually fail, either partially or wholly, and may even aggravate the symptoms, while in pure nervous asthma there can be no doubt of its power to relieve the paroxysms. It should be used as follows: Gm. 1 (about 15 grains) of dried stramonium-leaves or half that quantity of the fibres of the dried root may be smoked at once, mixed with sage-leaves or tobacco in a pipe or a cigarette. Or else tobacco steeped in a strong decoction of stramonium may be smoked in a pipe, or cigars impregnated with the same liquid may be used. If possible, the smoke should be drawn into the lungs. An atomized decoction of stramonium has been used, but is less efficient. Sawyer (*Birmingham Med. Rev.*, May, 1887) recommends 1 part each of potassium nitrate and anise-seed, and 2 parts of stramonium-leaves, powdered, formed into cones, and lighted, the patient to inhale the fumes. Of other spasmodic affections more or less benefited by this medicine may be mentioned *whooping cough*, *dysmenorrhœa*, and *retention of urine* caused by spasm of the neck of the bladder. In the latter case bruised fresh stramonium-leaves may be used or stramonium ointment may be rubbed upon the perineum. The rectal tenesmus, burning pain, etc. due to *hæmorrhoids*, *fissure*, and other affections of the anus and rectum may be greatly palliated by stramonium. A convenient formula for this purpose is the following: R. Ung. stramon., Ung. gallæ, Cerat. plumbi subacet., āā q. s.—M. S. Apply within the anus after defecation and washing.

The apparent identity of the physiological actions of stramonium and belladonna and of their respective alkaloids naturally suggested an identity in their therapeutic powers. But it does not really exist. Their differences are most conspicuous in the treatment of *neuralgic* affections. In these belladonna is much more efficient than stramonium; indeed, while the former and atropine are among the most reliable of antineuralgic medicines, stramonium is comparatively inefficacious and daturine has been but little used. Moreover, stramonium is much more employed as a local anodyne in superficial neuralgia, while belladonna is even more active as an internal than as a topical remedy for these as well as for the deeper-seated neuralgic affections. If stramonium is prescribed for them internally, it should be given in such repeated doses as will develop the specific action of the medicine.

In subacute and chronic articular and in muscular *rheumatism* bruised fresh stramonium-leaves produce an anodyne effect, and the ointment may be applied with some benefit, but the action of either is inferior to that of belladonna or of opium; the leaves make a convenient and efficient anodyne application to *bruises*, *sprains*, and various local injuries, including poisoning by *Rhus toxicodendron*. There is some authority for attributing to stramonium in full and repeated doses a certain control over the course of acute articular rheumatism, but the evidence is too scanty and ambiguous to inspire much confidence.

In the absence of belladonna, stramonium may be used to produce *dilatation of the pupil*. It has this effect whether it is given internally or is topically applied. Daturine has been employed for the same purpose, and, as before stated, by some is held to be less irritating to the eye than atropine, while others make the opposite statement.

The average *dose* of the leaves or the root of stramonium is about Gm. 0.12 (gr. ij) and of the seeds about Gm. 0.06 (gr. j) repeated at intervals of several hours and until it begins to dilate the pupil. The *dose* of daturine, hypodermically, is from Gm. 0.001–0.003 ($\frac{1}{60}$ to $\frac{1}{20}$).

The physiological and clinical antidote to stramonium is opium. Numerous cases are reported in which opium or its liquid preparations, and especially morphine hypodermically, have apparently saved the lives of persons poisoned by stramonium. In the case of an adult Gm. 1 (gr. xv) of morphine hydrochlorate was administered by the mouth before the safety of the patient was secured (Anderson, *Ranking's Abst.*, xxx. 276). A case is reported by Roth (*British Med. Jour.*, Sept. 19, 1885) in which repeated subcutaneous injections of about $\frac{1}{12}$ gr. of *pilocarpine* appeared to control the symptoms and hasten recovery.

STRONTII BROMIDUM, *U. S.*—Strontium Bromide.

Bromure de strontium, Fr.; *Strontiumbromid*, G.

Formula $SrBr_2.6H_2O$. Molecular weight 354.58.

Preparation.—Strontium bromide is best made by neutralizing diluted hydrobromic acid with strontium carbonate (free from barium and calcium) in excess, filtering the mixture, and evaporating the clear solution until crystals begin to form. Upon cooling the salt separates in crystals, which are then carefully dried to prevent efflorescence at high temperature.

Properties.—Strontium bromide occurs in colorless, transparent, hexagonal crystals, odorless and having a bitter saline taste; they are very deliquescent, and should be kept in well-stoppered vials. The salt is soluble in 1.05 parts of water at 15° C. (59° F.) and in 0.5 part of boiling water, the aqueous solution being neutral to litmus-paper: it is readily soluble in alcohol, and is precipitated from this solution upon the addition of an equal volume of ether, in which it is insoluble. To a non-luminous flame the salt communicates an intensely red color. When heated the crystals first melt, and at 120° C. (248° F.) lose all their water of crystallization (30.4 per cent.); the anhydrous salt fuses at 630° C. (1166° F.). With calcium sulphate the aqueous solution of the salt (1 in 20) slowly forms a white precipitate of strontium sulphate, insoluble in diluted acids; the same reaction occurs more quickly with diluted sulphuric acid, potassium sulphate, and other soluble sulphates. With potassium chromate it forms a yellow precipitate of strontium chromate soluble in acetic acid. With ammonium carbonate or sodium carbonate it forms a white precipitate of strontium carbonate, soluble with effervescence in acetic acid. If a few drops of chloroform be added to 5 Cc. of the solution, then 1 Cc. of chlorine-water and the mixture shaken, the liberated bromine will dissolve in the chloroform, communicating to it a yellow or brownish-yellow color.

Tests.—"A 5 per cent. aqueous solution of strontium bromide should form no precipitate with potassium dichromate test-solution (absence of barium), nor should it be affected by hydrogen sulphide either before or after addition of a drop of hydrochloric acid (absence of arsenic, lead, copper, etc.), nor by ammonium sulphide test-solution (absence of iron, aluminum, etc.)."—(*U. S.*) Iodine will be detected by the blue color produced upon addition of 1 or 2 drops of chlorine-water to 5 Cc. of the aqueous solution, previously mixed with a little gelatinized starch. The salt is usually found pure, excepting a small proportion of chloride, the limit of which is prescribed by the U. S. P. at 2 per cent., as follows: If 0.3 Gm. of strontium bromide, rendered anhydrous by thorough drying before being weighed, be dissolved in 10 Cc. of water, and 3 drops of potassium dichromate test-solution be added, it should require not more than 24.6 Cc. of decinormal

silver nitrate solution to produce a permanent red color. The reaction is identical with that explained under POTASSIUM BROMIDE: each 0.1289 Cc. of decinormal silver nitrate solution used in excess of 24.32 Cc., the quantity necessary to precipitate 0.3 Gm. of anhydrous absolute strontium bromide, will indicate 1 per cent. of chloride present. In the official test $24.60-24.32 = 0.28$ and $0.28 \div 0.1289 = 2.17$ (practically 2 per cent.).

The preparation of *pure* strontium carbonate is attended with more or less difficulty, and H. B. Dunham (1893) proposes to use strontium hydroxide instead, which latter can either be dissolved in the respective acids or can be decomposed by the necessary salts of ammonium. Strontium hydroxide $Sr(OH)_2$, strictly pure, can be rapidly prepared, according to Dunham, by heating strontium nitrate in a capsule for about twenty minutes over a direct fire, which converts it into oxide: the latter is mixed with more than sufficient water to slake it, and after subsiding the clear liquid is poured off, and the residue is again treated with water in the same manner: by this treatment all barium hydroxide is effectually removed, being soluble in 20 parts of water, whereas the strontium hydroxide requires 60 parts of cold water. To free the strontium salt from any calcium possibly present, it is now dissolved in boiling water (requiring 2.4 parts), and the solution then set aside to crystallize: the crystals occur in transparent square prisms with 8 molecules of water.

Action and Uses.—In 1890, Laborde demonstrated the innocuousness of the strontium salts on animals and on man, and ascribed to them a diuretic action. Bantron considered the action of the nitrate as merely negative, but Sée, and afterward Coronedi, found that the bromide especially was a sedative of various *gastric disorders* of nervous origin, in which respect their opinion was confirmed by Féré, S. Solis Cohen, and others. The action of the bromide in these cases is only what analogy would render probable. According to Dujardin-Beaumetz, the lactate of strontium reduces the proportion of albumen in *albuminuria;* and Malbec claims for it a sedative action on the heart in diseases of its valves and of its muscular tissue. In the treatment of chronic *epilepsy* Berkley has reported the superiority of strontium bromide over the other bromides to consist in it not producing a rash or a marked somnolent effect. He prescribed it in doses of Gm. 1.30–2 (gr. xx–xxx) (*Johns Hopkins Hospital Bulletin*, iv. 50). According to Sée, the daily dose of the strontium bromide should be Gm. 8–12 (gr. cxx–clxxx); Laborde states it at Gm. 2–4 (gr. xxx–lx); Malbec prescribes the dose of the lactate as Gm. 2–10 (gr. xxx–cl) a day, and of the iodide the same as of the potassium salt.

STRONTII IODIDUM, *U. S.*—STRONTIUM IODIDE.

Iodure de strontium, Fr.; *Strontiumjodid*, G.

Formula $SrI_2.6H_2O$. Molecular weight 448.12.

Preparation.—Like other strontium salts, the iodide is no doubt best prepared by neutralizing the respective acid with strontium carbonate. Since hydriodic acid is rather unstable, a freshly prepared solution of it should be employed, the excess of strontium carbonate removed by filtration, and the clear solution concentrated by evaporation, when cold, strontium iodide will separate in crystals.

As stated under STRONTIUM BROMIDE, the iodide may also be obtained by neutralizing hydriodic acid with strontium hydroxide and evaporating the solution to the crystallizing point.

Properties.—Strontium iodide occurs in colorless, transparent, hexagonal plates, odorless and having a bitterish, saline taste. The salt is deliquescent, and easily colored yellow by exposure to the air and light; hence it should be kept in dark amber-colored glass-stoppered vials. "It is soluble in 0.6 parts of water at 15° C. (59° F.) and in 0.27 parts of boiling water; also soluble in alcohol and slightly in ether; the aqueous solution is neutral or only very slightly acid to litmus-paper. When cautiously heated, the crystals melt and gradually lose their water of crystallization (24.05 per cent.), becoming anhydrous: at a red heat they are decomposed, losing iodine, and leaving a residue of strontium oxide."—*U. S.* To a non-luminous flame the salt communicates an intensely red color. If 1 Cc. of chlorine-water be added to 5 Cc. of an aqueous solution of the salt after addition of a few drops of gelatinized starch, a bluish-black color will appear. Toward calcium or potassium sulphate, potassium chromate, and sodium or ammonium carbonate strontium iodide behaves precisely like the bromide.

Tests.—Barium can be detected in strontium iodide by the appearance of turbidity in an aqueous solution upon addition of potassium dichromate. The aqueous solution

should not be affected by hydrogen sulphide either before or after addition of a drop of hydrochloric acid (absence of arsenic, lead, copper, etc.), nor by ammonium sulphide solution (absence of iron, aluminum, etc.). "If 0.3 Gm. of strontium iodide, rendered anhydrous by thorough drying before being weighed, be dissolved in 10 Cc. of water, and 3 drops of potassium dichromate test-solution be added, it should require not more than 18 Cc. of decinormal silver nitrate solution to produce a permanent red color (corresponding to at least 98 per cent. of pure salt)."—*U. S.* Since 0.3 Gm. of anhydrous absolute strontium iodide require 17.62 Cc. and 0.3 Gm. of anhydrous absolute strontium chloride, 37.21 Cc. of decinormal silver solution for complete precipitation, it follows that each 0.1959 Cc. of silver solution used in excess of 17.62 Cc. must indicate 1 per cent. of chloride; hence in the official test 18—17.62 = 0.38, and 0.38 ÷ 0.1959 = 1.94 (very nearly 2 per cent.).

STRONTII LACTAS, *U. S.*—Strontium Lactate.

Lactate de strontium, Fr.; *Strontium-lactat, Milchsaurer Strontian.*

Formula $Sr(C_3H_5O_3)_2.3H_2O$. Molecular weight 318.76.

Preparation.—Strontium lactate is made from the carbonate by dissolving it in lactic acid somewhat diluted with water; if necessary heat is applied to effect solution. After filtration the solution is evaporated with moderate heat to dryness.

Like strontium bromide and iodide, the lactate is readily made from the hydroxide by addition to lactic acid until a neutral solution is obtained, and evaporating this to dryness.

Properties.—Strontium lactate occurs as a white granular powder or in crystalline nodules, odorless, and of a slightly bitter, saline taste. "The salt is permanent in the air, and soluble in 4 parts of water at 15° C. (59° F.), and in less than 0.5 part of boiling water. The solution, saturated at a boiling heat, remains liquid for many hours, even after being cooled to 0° C. (32° F.). The salt is also soluble in alcohol. Its reaction is slightly acid. When heated to 110° C. (230° F.), it loses its water (16.9 per cent.); at a higher temperature it first fuses, then is decomposed, giving off inflammable vapors, and leaves a residue of strontium carbonate and carbon, which, on addition of hydrochloric acid, effervesces, and colors a non-luminous flame intensely red."—*U. S.* The various reactions with calcium, potassium, ammonium, and sodium salts mentioned under Strontium Bromide occur also with an aqueous solution of the lactate. If to 5 Cc. of a 5 per cent. aqueous solution of the salt 1 Cc. of sulphuric acid be added, and then 1 Cc. of decinormal potassium permanganate solution, the red color will rapidly disappear, while the mixture will effervesce and give off the odor of aldehyde.—*U. S.*

Tests.—"If 1 Gm. of the salt be dissolved in 19 Cc. of water, it should form a perfectly clear, colorless solution, leaving no insoluble residue (absence of carbonate, oxalate, etc.). The aqueous solution should not be affected by hydrogen sulphide test-solution., either before or after acidulation with a drop of hydrochloric acid (absence of arsenic, lead, etc.), nor by ammonium sulphide test-solution (absence of iron, aluminum, etc.) No turbidity should be produced in the solution by potassium dichromate test-solution (absence of barium). If 0.5 Cc. of silver nitrate test-solution be added to 5 Cc. of the aqueous solution, not more than a slight opalescence should be perceptible (limit of chloride, etc.). If 0.5 Gm. of the salt be placed upon a watch-glass, and 1 Cc. of sulphuric acid be carefully poured upon it, no effervescence should occur (absence of carbonate, oxalate, etc.); nor should any penetrating odor be perceptible, even after gentle heating (absence of butyrate, propionate, etc.); nor should the acid assume, within ten minutes, a deeper color than a pale straw-yellow (limit of readily carbonizable, organic impurities). If 1.33 Gm. of the salt, previously rendered anhydrous by careful drying at 110° C. (240° F.), be ignited until most of the carbon has disappeared, and then dissolved in 10 Cc. of water, it should require, for complete neutralization, not less than 9.9 Cc. of normal sulphuric acid (corresponding to at least 98.6 per cent. of the pure salt), methyl-orange being used as indicator."—*U. S.*

Each gramme of anhydrous strontium lactate upon ignition yields 0.555 Gm. of strontium carbonate, and as each Cc. of normal sulphuric acid requires, according to the equation $SrCO_3 + H_2SO_4 = SrSO_4 + CO_2 + H_2O$, 0.073525 Gm. of the carbonate for neutralization, it will correspond to 0.13244 of anhydrous strontium lactate; 0.13244 × 9.9 = 1.311 +, which is 98.6 per cent. of 1.33.

STROPHANTHUS, *U. S., Br. Add.*—Strophanthus.

Semen strophanthi, P. G.—*Strophanthus-seed*, E.; *Semence de strophanthe*, Fr.; *Strophanthussamen*, G.

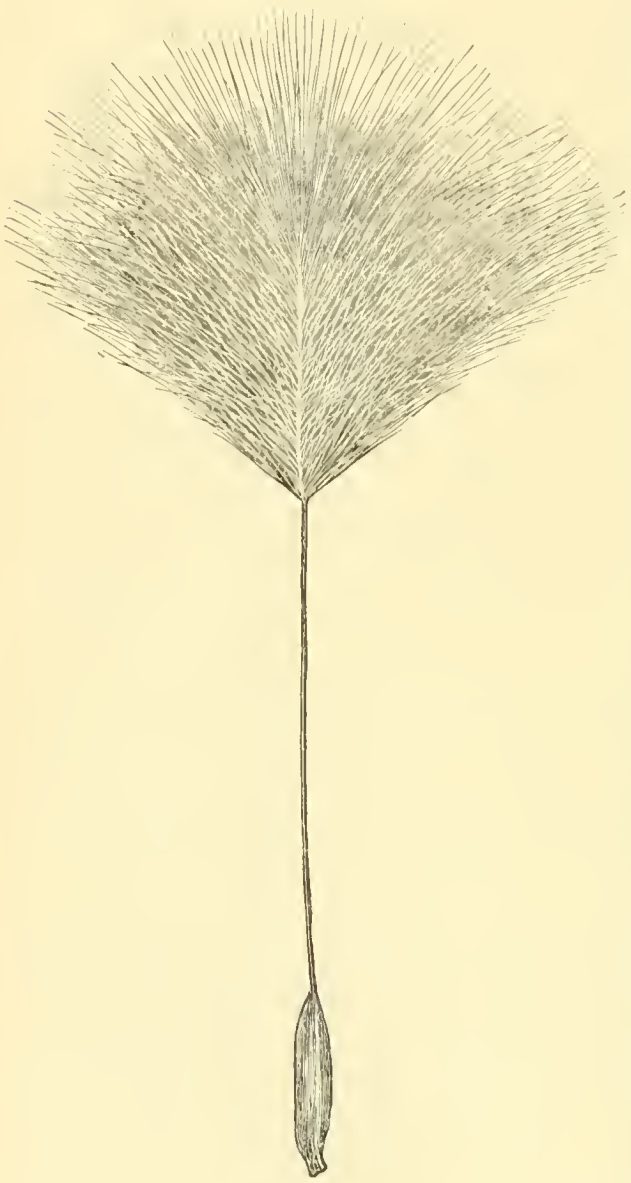
The seed of Strophanthus hispidus, *De Candolle* (var. Kombé, *Oliver*, Br., P. G.), deprived of its long awn.

Nat. Ord.—Apocynaceæ.

Origin.—The genus is principally found in tropical Africa, where the plants are used to prepare an arrow-poison known as *iné* and *kombé*. The genus is characterized by possessing long capsules enclosing about two hundred seeds, each furnished with a long awn, which is terminated by a brush of long fine silky hairs. The capsule or follicle of the species under consideration is from 20 to 30 Cm. (8–12 inches) long, is linear-oblong, and pointed. The seeds are imported either in the follicles or loose, and then often freed from the awns, which are very brittle.

Description.—Strophanthus-seeds are about 15 Mm. ($\frac{3}{5}$ inch) long and 4 to 5 Mm. ($\frac{1}{6}$ to $\frac{1}{5}$ inch) broad: at the apex they are narrowed into the long and brittle awn, and at the base are rather blunt. The awn is from 7 to 10 Cm. (3 to 4 inches) long, bare on the lower part, and above is beset on all sides with delicate white silky hairs, which are about 5 Cm. (2 inches) long. The seed is oblong-lanceolate in outline, grayish-brown externally, and covered with appressed silky hairs. The seed is flattened and obtusely two-edged; on the one side is a longitudinal ridge which is prolonged into the awn. The kernel is white and oily, and consists of a straight embryo having two thin cotyledons surrounded by a thin albumen (perisperm). Strophanthus is nearly inodorous and has a very bitter taste. "A decoction prepared with 1 part of the seed and 10 parts of water has a brownish color, and is not changed in appearance on the addition of solution of iodine, ferric chloride, or potassium mercuric iodide."—*U. S., P. G.*

Fig. 296.



Strophanthus.

Constituents.—Strophanthus contains a glucoside, strophanthin, which was isolated by Hardy and Gallois (1877). It was extracted by treating the seeds, freed from the hairs, with alcohol slightly acidulated with hydrochloric acid, the tincture evaporated to a soft extract, and treated with cold water. This solution left on spontaneous evaporation strophanthin in shining white crystals. Fraser has since pointed out that the crystals obtained by Hardy and Gallois are probably a decomposition-product of strophanthin, and which he named strophanthidin. As the principle itself is a glucoside readily decomposed by acids, so Fraser (1887) proposed the extraction without the intervention of any acid, using only dilute alcohol for ether, dissolving in water, and treating the precipitate obtained by tannin with lead oxide, extracting this with alcohol, dissolving this in a small quantity of alcohol, precipitating with ether, and then passing carbon dioxide into the weak alcoholic solution to free it from lead. After filtration the solution is evaporated at a low temperature and dried over sulphuric acid. As thus obtained, strophanthin is imperfectly crystalline, neutral to test-paper, very bitter, freely soluble

in water, less so in alcohol, and is insoluble in ether and chloroform. Besides the glucoside, strophanthus contains also kombic acid.

A characteristic reaction for strophanthin is proposed by Helbing in the following: When to a few drops of an aqueous strophanthin solution a trace of ferric chloride is added, and then some sulphuric acid, a red-brown precipitate appears, which gradually, within one or two hours, becomes emerald- or dark-green, this color remaining for a long time.

False Strophanthus-seeds.—The seed of Str. dichotomus, *De Candolle*, is brown or chestnut-brown in color, and less densely covered with hairs; it otherwise resembles the above.

Kicksia africana, *Bentham*, yields seeds which are dark-brown, slightly bitter, and possess neither the bearded awn nor the appressed hairs as found in strophanthus-seeds.

Physiological Action.—In 1865, Pelikan described a new heart-poison, which primarily arrested that organ. In the same year Hilton-Fagge and Stevenson ascribed to it similar qualities. But the earliest thorough study of strophanthus, under the name of *inée*, was made in 1872 by Polaillon and Carville (*Archives de Physiol.*, iv. 523). They showed that it produced tonic contraction of the heart, ending in arrest of the organ, involving death by syncope, and usually accompanied by nausea and vomiting. "Inée," they said, "is essentially a muscular poison, destroying the contractility both of smooth and striated muscles; but it does not appear to act upon the peripheral blood-vessels nor upon the nervous system." Meanwhile, in 1870, Fraser had described it as an arrow-poison, but in 1885 (*British Med. Jour.*, Nov. 1885, p. 904) he defined its action in the terms previously used by the French authors, adding that its control of the heart was more powerful and certain than that of digitalis. Thus a solution of strophanthin 1 : 6,000,000 more readily arrested the separated frog's heart than a solution of digitalin 1 : 100,000; but a solution of digitalin 1 : 20,000 passed through the blood-vessels of a frog whose central nervous system had been destroyed, contracted them strongly, while a solution of strophanthin 1 : 3000, or even 1 : 2000, produced a slight and temporary effect only. He agreed with other observers that it does not contract the arteries, although it increases the blood-pressure. He did not find that it lowered the pulse-rate in health, nor that it became diuretic or antipyretic except under certain conditions of the heart and temperature. Among later authorities also, Eichhorst says that only "under certain conditions" does it become diuretic, and that even then its action is very slight (*Centralbl. f. d. g. Therap.*, vi. 150); yet he observed copious diuresis follow its use in ascites. Rosenbusch regarded its diuretic power as distinct though slight (*Med. News*, lii. 238), and as developed only when the heart is obstructed (*Bull. de Thérap.*, cxv. 281). On the other hand, Dujardin-Beaumetz pronounced it a powerful diuretic, provided that the kidneys are sound, and especially when it regulates imperfect compensation in the heart. Csatáry maintained that in a healthy condition the medicine is not diuretic, and that the condition of the kidneys does not modify this action, which he held is due to the increased pressure of the blood consequent upon the toxic influence of the medicine on the heart (*Centralbl. f. d. g. Ther.*, v. 701). In singular contrast to these judgments is that of Lemoine (*Annuaire de Thérap.*, 1883, p. 243), who affirms that polyuria is the most constant of all the effects of strophanthus even in healthy persons, and that it continues even for a long time after the medicine is suspended. He notes, however, that strophanthin is not diuretic, the two differing like digitalis and digitalin. Again, Mairet and others declare that the medicine produces diuresis only by a direct action on the kidneys (*Med. News*, liii. 419). The divergencies and oppositions of opinion here stated have not been altogether reconciled by later observation. But the conclusions that seem to be established are—that strophanthus invigorates the heart-muscle while dilating its cavities and the arteries, and yet raising the pressure within them, leaving the pressure in the veins unchanged; that it reduces the force and the frequency of the heart-beat, and regulates its rhythm when irregular; that it is diuretic (although this point is not admitted by all); that its effects are not cumulative; and that occasionally it excites nausea, vomiting, and diarrhœa (Lee and Gley, *Amer. Jour. Med. Sci.*, xcvii. 176; Haas, *ibid.*, p. 823; Lemoine, *ibid.*, p. 391; Egasse, *Bull. de Thérap.*, cxvi. 83; Popper, *Centralbl. f. Thérap.*, vii. 410; Blumenau, *ibid.*, 343; Kugler, *Bull. et Mémoires Soc. Thérap.*, 1889, p. 224).

The influence of strophanthus on the pulse appears to have been less carefully studied than its other effects, especially if we are to accept the report of Drasche, which is opposed to the original statement of Fraser. According to Drasche (*Centralbl. f. d. g. Med.*, vi. 347), 5 drops of the tincture reduces the pulse of a healthy man by eight to

twelve beats a minute; and 10 drops would in half an hour reduce it by twelve to twenty beats. In one case after a dose of 20 drops it fell from 84 to 54, while the temperature declined 1° C. In a case of pneumonia the reduction is said to have been even greater. Strophanthin is a local anæsthetic, but its irritant action renders this quality of little avail.

The poisonous action of the drug is sometimes developed. Haas (*Centralbl. f. d. g. Ther.*, vi. 16) met with three cases of cardiac and valvular obstruction treated by its means, in which the patient became cyanotic and suffered from dyspnœa and great cardiac distress, followed by collapse. It is to be remarked that nothing is here said of pulse-reduction, of pallor, or of vomiting, symptoms which attend digitalis-poisoning. Eichhorst, on the other hand, speaks of a woman with mitral insufficiency and congestive symptoms who drank Gm. 10 (ʒiijss) of tincture of strophanthus without injury (*Centralbl. f. d. g. Ther.*, vi. 150). The case is related by Dr. H. Y. Evans of a child five years old who was said to have taken 20 drops of a tincture of S. hispidus. The face was flushed, the skin hot and dry, the pupils dilating and contracting alternately every few seconds, the pulse 140 and full, the heart acting vigorously with a slight murmur, the mind clear, but the patient loquacious. Recovery followed the use of emetics, but no urine was passed for ten hours (*Med. News*, lii. 674). These symptoms, it will be seen, were quite unlike those attributed to strophanthus.

Uses.—Fraser proved, clinically, that strophanthus and strophanthin gave tone to the heart rendered weak and irregular by degenerative or by obstructive lesions. He held them to be more powerful than digitalis and digitalin in such cases, and that the most satisfactory results were obtained in mitral disease without muscular degeneration of the heart. He did not find strophanthus hæmostatic, as digitalis is, by constricting the arteries, or that it was ever explosive in its action, or that it was as apt to occasion intestinal disorder. In the main, these conclusions have been confirmed by later observation (S. C. Chew, *Med. Record*, xxxi. 516; Hutchinson, *Brit. Med. Jour.*, May 7, 1887; Pino, *Med. News*, li. 189; Makenna, *Brit. Med. Jour.*, Sept. 3, 1887; Mays, *Med. News*, li. 472). Zerner and Löw more specifically state that the efficiency of the medicine will depend upon the proportion of sound tissue remaining in the heart, but that in valvular disease without impairment of the heart-muscle it, no more than digitalis, affords the same degree of relief as when the heart is positively or relatively weak (*Centralb. f. d. g. Ther.*, v. 618). It was observed by Haas that fever interfered with the action of strophanthin. He also alleged that it restricted the range and lessened the force of the apex impulse, but did not diminish the intensity of the normal sounds or of the murmurs (*Centralb. f. d. g. Ther.*, vi. 14).

In comparison with digitalis, strophanthus cannot be said to have inspired the same confidence as a regulator of the disordered heart. For, while Csatáry points out the uncertainty of digitalis and its preparations (*ibid.*, vi. 701), and Haas maintains the superiority of strophanthus because its action is quicker and surer and does not derange the digestion or appetite, and Quinlan adopts a similar view (*Brit. Med. Jour.*, Aug. 27, 1887), the greater number award the superiority to digitalis. Hochhaus states that the latter has frequently to be used to reinforce the former, and that the indications for its use are more definite (*Cent. f. d. g. Ther.*, v. 699); Eichhorst maintains that although the two agents act upon the heart alike (?), yet digitalis acts more promptly and surely, while strophanthus has the advantage of not exerting a cumulative action (*ibid.*, vi. 150); Suckling declares the inferiority of strophanthus (*Brit. Med. Jour.*, Nov. 19, 1887), in which judgment Graetz concurs, but adds that its chief value consists in its power of dissipating paroxysms of cardiac disorder (*Centralb. f. d. g. Ther.*, vi. 217); and Fränkel regards it as rather an adjuvant to digitalis than as a substitute for it (*ibid.*, p. 272); that it is more effective in functional than in organic heart diseases (in which opinion several reporters concur); and, contrary to general testimony, that even when it acts favorably it does not show its influence within twenty-four hours. Some of these dissidences of opinion may be reconciled by noting that when strophanthus relieves cardiac disorder which digitalis has not palliated, but perhaps aggravated (Domme, *Therap. Monatsh.*, iii. 82; Hare, *University Med. Mag.*, i. 342), the explanation is that the one increases the capacity of the heart, while the other diminishes it. It has been suggested that digitalis is most efficient in reducing the frequency and increasing the tension of the pulse, and that strophanthus is indicated when digitalis fails in its sedative as well as its diuretic action, and that in some cases the two may be profitably associated. Briefly, the indications for the use of strophanthus in heart disease are irregularity and insufficiency of the action of the heart and their consequences—viz. tissue-degeneration, valvular obstruc-

tion, and cardiac distress, varying from oppression to *angina pectoris*. (Compare Dujardin-Beaumetz, *Bull. de Thérap.*, cxvi. 88; Bucquoy, *Archives gén.*, Feb. 1889, p. 244; Haas, *Cent. f. Ther.*, vii. 219; Sée, *Bull. de Thérap.*, cxvi. 90; Devine, *Boston Med. and Surg. Jour.*, Nov. 1888, p. 479; Dale, *Med. News*, liii. 716; Pope, *Lancet*, Apr. 1889, p. 739.)

It seems probable that the power of this drug to concentrate the heart's energy without constringing the arteries renders it peculiarly efficient in *cardiac dropsy*, enabling it to overcome the stagnations and *congestions* accompanying the latter, and especially those of the *kidneys* and *lungs* (V. I. Bowditch, *Boston Med. and Surg. Jour.*, Mar. 1887, p. 253), and at the same time, by its diuretic action, the various effusions due to vascular engorgement. Haas (*Cent. f. d. g. Therap.*, vi. 14) and Langaard (*Practitioner*, xl. 59) think it should supersede digitalis in the treatment of cardiac dropsy, and Poulet (*Bull. de Thérap.*, cxiii. 529) in that of renal or scarlatinous dropsy. Hutchinson attributes to the diuretic action of the medicine the relief obtained in a case of *renal calculi* (*Provincial Med. Jour.*, Oct. 1, 1887). It is hardly necessary to catalogue several other diseases in which strophanthus has been said to be useful; the list, however, includes typhoid and other fevers, nervous asthma, pneumonia, phthisis, peripheral paralysis, etc. Its alleged utility in nervous *asthma* is less open to doubt. Like erythrophleine and helleborine, strophanthin has a local anæsthetic action, but is too irritating for practical use (Steinbach; Hare and De Schweinitz, *Therap. Gaz.*, xiii. 821). Riffat claims that the tincture cures *urticaria* (*Practitioner*, xliii. 380), and Brower reports having cured *exophthalmic goitre* by doses of 2 drops every six hours, gradually increased to 10 drops (*Jour. Amer. Med. Assoc.*, xi. 628); and Ferguson claims to have palliated the symptoms by the same means (*Med. News*, lvii. 633; *Jour. Amer. Med. Assoc.*, xxi. 187).

Tincture of strophanthus (1 : 20) may be given to children in doses of 1 drop three times a day; to adults, Gm. 0.25–0.50 (♏4–8) two or three times a day, largely diluted with water and an aromatic syrup, and reduced if nausea or vomiting occur. The extract has been used in the dose of Gm. 0.001 (gr. $\frac{1}{48}$). Strophanthin cannot well be administered hypodermically, owing to the irritation it produces. It has been given internally as follows: Strophanthin Gm. 0.002–0.004 ($\frac{1}{32}$–$\frac{1}{16}$); distilled water Gm. 180 (f℥vj); simple syrup Gm. 30 (f℥j), for a day's use, in three or four doses. But the tincture and the extract are both preferable for convenience as well as safety.

Under the name of *ouabaïne*, Varigny and Langlois have described the action of an African arrow-poison whose effects closely resemble those of strophanthus in that it occasions a persistent contraction of the heart-ventricles, besides causing a gradual suspension of respiration (*Annuaire de Thérap.*, 1888, pp. 305, 306, 308). Indeed, it is regarded as identical with strophanthin (Egasse, *Bull. de Thér.*, cxvi. 76), in spite of the effects of it just mentioned. It has been alleged to reduce the number and severity of the paroxysms of whooping cough when given to a child five years old in doses of Gm. 0.00006 ($\frac{1}{10000}$ grain) every three hours (*Med. News*, lvi. 562). Others have given it in doses of Gm. 0.0003 ($\frac{1}{2000}$ grain).

STRYCHNINA, *U. S., Br., F. Cod.*—Strychnine.

Strychnia, Br.; *Strychninum.—Strychnine*, Fr.; *Strychnin*, G.

Formula $C_{21}H_{22}N_2O_2$. Molecular weight 333.31.

An alkaloid obtained from Nux vomica, and also obtainable from other plants of the nat. ord. Loganiaceæ.—*U. S.*

Preparation.—Take of Nux Vomica 1 pound; Lead Acetate 180 grains; Ammonia-water, Rectified Spirit, Distilled Water a sufficiency. Subject the nux vomica for two hours to steam in any convenient vessel; chop or slice it; dry it in a water-bath or hot-air chamber, and immediately grind it in a coffee-mill. Digest the powder at a gentle heat for twelve hours with 2 pints of the spirit and 1 of the water; strain through linen, express strongly, and repeat the process twice. Distil off the spirit from the mixed fluid, evaporate the watery residue to about 16 ounces, and filter when cold. Add now the lead acetate, previously dissolved in distilled water, so long as it occasions any precipitate; filter; wash the precipitate with 10 ounces of cold water, adding the washings to the filtrate; evaporate the clear fluid to 8 ounces, and when it has cooled add the ammonia in slight excess, stirring thoroughly. Let the mixture stand at the ordinary temperature for twelve hours; collect the precipitate on a filter, wash it once with a few ounces of cold distilled water, dry it in a water-bath or hot-air chamber, and boil it with successive portions of rectified spirit till the fluid scarcely tastes bitter. Distil off most of the spirit,

evaporate the residue to the bulk of about ½ ounce, and set aside to cool. Cautiously pour off the yellowish mother-liquor (which contains the brucia of the seeds) from the white crust of strychnia which adheres to the vessel. Throw the crust on a paper filter, wash it with a mixture of 2 parts of rectified spirit and 1 of water till the washings cease to become red on the addition of nitric acid; finally, dissolve it by boiling it with an ounce of rectified spirit, and set it aside to crystallize. More crystals may be obtained by evaporating the mother-liquor.—*Br.*

This process is a modification of the one proposed by Wittstein. The tincture, prepared with about 55 per cent. alcohol, is concentrated, and the resinous and other insoluble matter separated by filtration. Lead acetate precipitates from the filtrate igasuric acid and coloring matter, and leaves the alkaloids in solution as acetates. These are decomposed by ammonia, and the precipitated alkaloids treated with hot alcohol, from the concentrated solution of which strychnine crystallizes, and is entirely purified from brucine and coloring matter by washing with alcohol of about 55 per cent. and by recrystallization from strong alcohol.

O. Henry (1830) recommended the exhaustion of nux vomica by means of alcohol acidulated with sulphuric acid and the liberation of the alkaloids by lime. Duflos recommended a similar process, using acidulated water for exhausting the drug; and this is frequently followed when working on the large scale, and was adopted by the U. S. P. 1870. Powdered nux vomica, or the drug softened by steam and while hot crushed between rollers, is exhausted by boiling with very dilute hydrochloric or sulphuric acid; the decoction contains the alkaloids as hydrochlorates or sulphates, together with the liberated igasuric acid, mucilaginous compounds, coloring matter, and other principles. On the addition of slaked lime the salts of the alkaloids are decomposed, calcium chloride or sulphate is formed, and strychnine and brucine are precipitated, together with the excess of lime employed, and with calcium sulphate. On washing this precipitate with water, the foreign principles are mostly removed, and by treatment with cold diluted alcohol the brucine is dissolved. The residue now consists essentially of lime and strychnine, the latter of which is taken up by boiling alcohol, and further purified by converting it into sulphate soluble in water, decolorizing with animal charcoal, and precipitating with an alkali; or, the washed and dried precipitate by lime is at once exhausted with boiling alcohol, and the mixed strychnine and brucine are purified by treatment with sulphuric acid, animal charcoal, and ammonia, and separated by dissolving in hot alcohol, when, on cooling, strychnine will crystallize and brucine remain in the mother-liquor.

Various other processes have been proposed, differing mainly in the manner in which the alkaloids are liberated and afterward separated from each other. Magnesia or sodium carbonate may be substituted for the lime and ammonia in the above processes; and benzene was suggested by Boiraux and Léger (1875) for dissolving strychnine from the mixed alkaloids, brucine, it is stated, being completely insoluble in that menstruum.

Properties.—Strychnine is seen in commerce as a white crystalline powder or crystallized in colorless, short, quadrangular prisms or octahedrons of the rhombic system. It is permanent in the air, inodorous, has a very persistent bitter taste, which is still perceptible if strychnine is dissolved in 700,000 parts of liquid. The alkaloid has an alkaline reaction, melts below 268° C. (514° F.), is sublimable only when very minute quantities are carefully heated (Hellwig, 1864), and is decomposed at a higher heat. Pelletier and Caventou, who discovered this alkaloid in 1818, found it soluble in about 6700 parts of cold and 2500 parts of boiling water, and to be insoluble in absolute ether. It dissolves in 110 parts of cold and 12 parts of boiling alcohol (*U. S.*); in 107 parts of 95 per cent. alcohol, 180 parts of amylic alcohol, 165 parts of benzene, and in 1250 parts of commercial ether (Dragendorff); in about 5 parts of chloroform (Pettenkofer), in 300 parts of glycerin (Cass and Garot); and is also soluble to some extent in volatile and fixed oils and in creosote. Its solubility in water is not increased by ammonia or caustic potassa, but dilute acids render it much more soluble, with the formation of neutral salts, which are mostly crystallizable and are precipitated by alkalies, alkali carbonates, chromates, and, after some time, by soluble bicarbonates. Lextrait (1881) obtained long needles of a compound consisting of 3 molecules of strychnine and 1 of iodoform; it becomes yellow at 90° C. (194° F.), is very sparingly soluble in alcohol, and dissolves freely in ether and chloroform, decomposing when kept in solution.

Strychnine and its salts dissolve in concentrated sulphuric acid without color, but on the addition of a little peroxide of lead a beautiful blue color is produced, passing into violet, red, and finally into yellow (Marchand). If a small crystal of potassium dichromate is used instead of the lead oxide, a deep violet color is produced, or a blue color if

strychnine is in excess (Otto). A similar color is obtained with sulphuric acid and potassium ferricyanide (Davy); it passes like the preceding, though more slowly, through red into yellow, and finally fades. The solution of strychnine in sulphuric acid containing some nitric acid yields on the addition of manganese dioxide a purplish-violet color (Mack, Erdmann), and a similar color, but rapidly fading to yellow, is produced with chloric, chlorous, and iodic acids and their salts, with manganic sulphate and potassium permanganate (Lefort). If much contaminated with organic matter, the alkaloid is best purified by dissolving it in a dilute acid, so as to free it from fatty and resinous matters, liberating it by ammonia, and dissolving it by agitation with chloroform; if necessary, the process is repeated, and the residue from the evaporation of chloroform is tested as above. If the above tests are carefully applied, a very minute quantity may be detected, according to Wenzell (1870), in a solution containing the $\frac{1}{900000}$ part of strychnine.

"On dissolving 0.02 Gm. of strychnine in 2 Cc. of nitric acid (sp. gr. 1.300) in a small test-tube, the acid should not turn more than faintly yellow (limit of brucine.)"—*U. S.*

The composition of strychnine is expressed by the formula $C_{21}H_{22}N_2O_2$ (Regnault); according to Schützenberger (1858), it sometimes contains 22 or 20 C.; Claus (1881) observed a strychnine with 22 C.

Tests.—The freedom from inorganic matters is readily proven by the absence of ash on incinerating a portion. Concentrated nitric acid should not produce a red color, or only a very faint one, showing the absence of more than traces of brucine.

STRYCHNINÆ SULPHAS, *U. S.*—Strychnine Sulphate.

Strychninum sulfuricum.—Sulfate de strychnine, Fr.; *Schwefelsaures Strychnin*, G.

Formula $(C_{21}H_{22}N_2O_2)_2H_2SO_4.5H_2O$. Molecular weight 854.24.

Strychnine sulphate should be kept in well-stoppered vials.

Preparation.—In preparing this salt it is best to use the strychnine in the form of powder, and add it in slight excess to warm dilute sulphuric acid; the filtrate from the undissolved strychnine will yield the salt on being evaporated spontaneously to dryness; on the cooling of the hot saturated solution a salt with $5H_2O$ crystallizes in long thin prisms.

Properties.—Strychnine sulphate crystallizes in colorless or white prismatic crystals containing 10.51 per cent. of water of crystallization. The salt has a neutral reaction, is inodorous, and has the intensely bitter taste and the color reactions of strychnine salts. On exposure it becomes superficially opaque through efflorescence. According to the U. S. P., it is soluble in 50 parts of water and in 100 parts of alcohol at 15° C. (59° F.), in 2 parts of boiling water, and in 8.5 parts of boiling alcohol: also soluble in 26 parts of glycerin, but insoluble in ether. Lextrait (1882) recommends the salt with $5H_2O$, which is uniformly obtained by crystallizing from alcohol of more than 50 per cent. strength. The Pharmacopœia has made the salt with 5 molecules of water of crystallization official, in place of the one with 6 molecules of the revision of 1880. When this is heated to 100° C. (212° F.), it slowly loses its water of crystallization (10.51 per cent.); more rapidly when heated at 110° C. (230° F.) and when quickly heated to 200° C. (392° F.), the salt fuses. The aqueous solution of the salt gives with barium chloride a white precipitate of barium sulphate, and with potassa or ammonia a white precipitate of strychnine which shows the reactions described above. When heated to redness the salt should leave no residue.

From the observations of Rammelsberg and of Lextrait it appears that in Europe the normal and acid sulphates are used indiscriminately; the former (pharmacopœial) salt contains 75.43 per cent. of strychnine, while the latter contains 71.36 per cent., its formula being $C_{21}H_{22}N_2O_2H_2SO_4.2H_2O$, and it becomes anhydrous at 150° C. (302° F.).

Test.—"On dissolving 0.05 Gm. of strychnine sulphate in 2 Cc. of nitric acid (specific gravity 1.300), in a small test-tube, the acid should not turn more than faintly yellow (limit of brucine)."—*U. S.*

Other Salts of Strychnine.—Strychninæ acetas. The neutral salt crystallizes with difficulty, and on evaporating its solution loses a portion of the acid; it dissolves in 96 parts of water and in 15.1 parts of chloroform.

Strychninæ hydriodas, $C_{21}H_{22}N_2O_2.HI$; molecular weight 460.84. It is sparingly soluble in cold water, but dissolves more freely in alcohol. It is prepared by adding solution of potassium iodide to the solution of a strychnine salt, dissolving the precipitate in alcohol, and crystallizing. It forms quadrangular needles or white scales, has a very bitter taste, and contains 72.3 per cent. of strychnine.

Strychninæ hydrobromas, $C_{21}H_{22}N_2O_2.HBr$; molecular weight 414.07. Bullock (1875) recommended its preparation from 45 grains of strychnine sulphate dissolved in a mixture of 1 fluidounce of water and 2 fluidrachms of alcohol. To this solution is added a solution of 11.7 grains of potassium bromide in 1 fluidrachm of water and 1 fluidounce of alcohol. The precipitated potassium sulphate is filtered off, the filtrate is mixed with a fluidounce of water, concentrated, and crystallized. It forms prismatic needles which are sparingly soluble in alcohol, more readily soluble in dilute alcohol, and require about 32 parts of cold water for solution. It contains 80 per cent. of strychnine.

Strychninæ hydrochloras, $2(C_{21}H_{22}N_2O_2.HCl).3H_2O$; molecular weight 793.24. It is best prepared by dissolving strychnine in warm dilute hydrochloric acid, and crystallizes in silky needles, which lose their water of crystallization at 120° C. It dissolves in 50 parts of cold water, and contains 84 per cent. of strychnine.

Strychninæ nitras; Strychninum nitricum, *P. G.* On dissolving strychnine in warm very dilute nitric acid the solution yields, on cooling, colorless needles of a silky lustre and very bitter taste. The salt is soluble in 90 parts of cold and in 3 parts of boiling water, and in 70 parts of cold and 5 parts of boiling alcohol. It is less freely soluble in absolute alcohol and fixed oils is insoluble in ether, but dissolves in 26 parts of glycerin. Its composition is $C_{21}H_{22}N_2O_2.HNO_3$ molecular weight 396.20. It contains 84 per cent. of strychnine.

Action and Uses.—It may reasonably be believed—1, that strychnine does not act upon the muscles, the nervous extremities, or the nerve-trunks; 2, that it does act upon the nerve-centres in the medulla oblongata and medulla spinalis; and, 3, that it acts upon those centres first by stimulating them when given in small doses, and by exhausting them, and thereby exaggerating their reflex irritability, when poisonous doses are used, in this respect falling under the general law that the actions of small and of large doses of an active agent are antagonistic to one another. (Compare Poole, *Med. Record*, xix. 201.) The latter of the two effects are probably dependent, in part at least, upon the power of strychnine to contract the arteries and the heart and to slow the pulse. It is essentially through spasm, in so far as it throws the respiratory muscles into tonic contraction and by rendering the chest immovable, that it tends to produce asphyxia, with its usual symptoms of dark venous congestion of the eyes and interior of the mouth. This explanation renders clear the agency of artificial respiration in saving the life of animals in strychnine poisoning (Richet, *Med. News, etc.*, Nov. 1880, p. 659), and the effect of keeping the frog's skin moist in preventing or delaying the fatal action of the poison upon this animal. (For an exhaustive study of the physiological action of strychnine see Reichert, *Therap. Gaz.*, vol. xvi.) Powdered nux vomica and also strychnine rubbed upon the skin persistently act as local irritants: this action is greatly intensified if they are applied to the raw cutis, and may be attended with specific general symptoms. In small doses, internally, they are tonics, increasing the appetite and the urinary secretion, and the fecal discharges also when these are infrequent, but diminishing the latter when their frequency is due to atony of the bowels. Like other bitter tonics, their prolonged and excessive use deranges the digestion. They appear to augment the biliary and pancreatic secretions. Strychnine is excreted with the urine, and occasions an increased frequency of urination, but in excess produces spasm of the neck of the bladder, and ultimately impaired contractile power in this organ. It probably excites uterine contraction, promotes menstruation, disposes to venery, and provokes erections of the penis. It exerts no perceptible action upon the brain, but seems to increase the functional activity of the special senses.

When strychnine acts poisonously but gradually, owing to the moderate dose taken or to its slow absorption from the stomach, the patient complains first of general uneasiness, restlessness, soreness and heaviness of the limbs, and stiffness of the joints and muscles, particularly of those of the chest and lower jaw; and these effects are succeeded by spasmodic symptoms. When the dose has been large and the conditions are favorable to its rapid absorption, the phenomena may be clonic convulsions or violent muscular twitchings, which, with the accompanying sensation, have been compared to the effects of an electric shock. Whether rapid or slow in their access, these phenomena are excited and intensified by all external stimuli. They are succeeded by tetanic muscular spasms, during which the arms are rigidly bent and the legs outstretched, the hands being clenched and the feet extended and arched, the lower jaw firmly fixed against the upper, and the body arched forward. The rigid contraction of the respiratory muscles renders breathing laborious or even temporarily suspends it, and, as a consequence of the immobility of the chest, the blood accumulates in the veins and gives a livid color to the skin. The pulse is rapid and unequal both in volume and force, and the heart-beat is also hurried and fluttering. The retracted corners of the mouth disclose the set teeth, and foam issues from between them, while the staring eyes with dilated pupils and the contracted brows give

to the countenance an expression of anguish mingled with fright. The mind generally remains unaffected, and pain is not often complained of. The convulsions may be altogether tonic, and so continue without interruption until death, but more usually they are clonic also, and are interrupted by intervals of calm, or rather of exhaustion. But during such intervals the slightest stimulus may suddenly renew them, but superficial contact rather than firm pressure. Generally the spasms grow less violent, but not so the disorder of the circulation and the exhaustion of muscular power: they become more and more marked until death, which may be due immediately to asphyxia or to asthenia, according as life terminates during a paroxysm or not. The onset and course of the symptoms are not always the same. Muscular rigidity may first affect the spine and be accompanied by neuralgia of the spinal nerves, or the attack may commence with shrieks of pain or alarm, or with giddiness, insensibility, and convulsions; or vomiting may occur among the earliest symptoms.

In fatal poisoning by strychnine death may take place within five minutes, and is hardly ever delayed more than five or six hours. Even when poisonous doses are not followed by death, their effects may continue to be observed in extreme fatigue and exhaustion, paralysis of the bladder, and sometimes muscular stiffness and neuralgic pains of several days' duration. Albuminuria has sometimes been observed.

After death caused by strychnine cadaveric rigidity is usually marked with opisthotonos, clenching of the hands, and flexion of the arms across the chest. The face is usually pale, but sometimes livid. The muscles are rigid, and all the internal organs are gorged with dark and fluid blood, the cerebral and spinal membranes not more so nor more uniformly than the rest; the latter may contain a serous effusion; the heart may either be contracted, dilated, or natural. The urinary bladder is generally contracted. It is remarkable that the muscular rigidity may persist for months after death. These lesions indicate the effects rather than the mechanism of strychnine-poisoning. But they agree with the symptoms in showing that the cause of death by this poison is primarily asphyxia produced by rigidity of the muscles of respiration. This view does not exclude, as a possible factor in producing the result, exhaustion of the heart or spasm of that organ.

Strychnine was first employed medicinally in the treatment of *paralysis*, and continues to be used for this affection more than for any other. But it is not equally beneficial in all forms of the disease. As already stated, it is apt to aggravate those paralyses which depend upon a recent central lesion, but it is appropriate in the same cases when the acute stage has passed and the symptoms remain stationary. In such cases the paralyzed muscles are the first to exhibit the specific action of the medicine. The use of strychnine has been praised more than it deserves in cases of *infantile spinal paralysis*, a disease in which restoration of muscular power is extremely are. The dose should not exceed Gm. 0.0005 (gr. $\frac{1}{120}$) twice a day. It is now demonstrated, as it was long ago observed, that strychnine is most efficient in the cure of functional paralysis, whether depending directly upon anæmia of the spinal cord or upon general exhaustion. Such are cases due to venereal excesses, hysteria, intense mental emotion, concussion of the spinal marrow, abuse of opium or alcohol, lead-poisoning, gout, rheumatism, etc. Paresis of the *ocular muscles* has been cured by the use of preparations of nux vomica (De Schweinitz, *Med. News*, lv. 477). It is claimed by some (Jewell, *Practitioner*, xxvii. 377) that even in advanced *myelitis* this medicine will cause improvement after the failure of other remedies. Contrary to what would have been expected, the doses which he found efficient were large. It may be added that subsequent observation has not at all agreed with this conclusion. Dr. L. Gray and others found that doses of Gm. 0.006 (gr. $\frac{1}{10}$) could not be tolerated (*Am. Jour. Med. Sci.*, Oct. 1885, p. 381). Naunyn has faith in the efficacy of strychnine used subcutaneously in most of these cases, provided the dose is duly regulated (*Centralbl.*, vii. 282). *Diphtherial paralysis* is, more than any other form, benefited by strychnine, whose special stimulus co-operates with that of electricity, mechanical excitants, tonics, nutrients, etc. The semi-paralytic condition sometimes induced by the *bromides* is benefited by this medicine. It is less necessary, yet of very great utility, in *paralysis from lead*. An *ecbolic* action has been ascribed to strychnine on the ground of it having seemed to produce tonic contractions of the uterus and premature delivery of a woman in the eighth month of pregnancy (Lewis Smith, *Med. Record*, xviii. 578).

Although physiological experiments do not lead to the suggestion that strychnine acts upon the peripheral ends of nerves, clinical observation, as in so many other cases, is supposed to have demonstrated what the former method has failed to show. For more than

forty years strychnine has been well known to be efficacious in cases of *amaurosis* when applied endermically around the orbit; more recently it has been used by friction and hypodermically, by the instillation of dissolved strychnine in the eye, and also internally. These methods have greatly ameliorated and often cured the disease, not only in cases of purely functional disorder, but of a greater or less alteration of the retina as revealed by the ophthalmoscope (*Centralbl. f. d. g. Therap.*, ii. 228). Inflammatory affections of the eye in their active stage are unsuitable for this medication, and so is impairment of vision depending upon intracranial causes, but it is often useful in disorders of accommodation. The greater number of ophthalmic surgeons insist upon the application of the medicine to the neighborhood of the eye, but others admit that it is equally efficacious wherever introduced. The latter are probably right. It has been employed with marked success in *night-blindness*.

Nux vomica and also strychnine have long been used for the cure of *prolapsus of the rectum* by the mouth, by enema, by hypodermic injection, and by application to the blistered skin (Stillé, *Therapeutics*, 4th ed., ii. 186; *Med. Record*, xviii. 682; *Med. News*, xlviii. 36). *Paralysis of the bladder*, occasioning either retention or incontinence of urine, and the latter affection in the form of *nocturnal incontinence* in children, has frequently been cured by the use of strychnine by the mouth, sometimes by injecting a solution of it into the bladder, and again by the hypodermic injection of nitrate of strychnine. *Sexual impotence* is often diminished or even cured by this medicine when it depends upon asthenia of the spinal cord or upon general debility. Generally, however, it should form only one element of a complex treatment adapted to the peculiarities of each case. It has been thought to excite the gravid uterus and cause *abortion*, and to prevent *post-partum hæmorrhage* when a predisposition to it exists. Saccharine *diabetes* is alleged to have been cured by nux vomica (*Practitioner*, xxiii. 51); and Brunton and Howe claim that it will control the *night-sweats* of phthisis (*St. Bart's Rep.*, xv. 119; *Lancet*, Sept. 1884, p. 408).

Among spasmodic diseases, *tetanus* has been cured by strychnine, contrary to all expectations founded upon the accepted mode of action of the medicine; nevertheless, the method has found few imitators. The same remark is nearly as applicable to *chorea*, and also to *epilepsy;* but in regard to both diseases it may be observed that where the patients are extremely feeble, excitable, and timid this medicine may well form part of the general plan of tonic treatment which is then indicated, and which includes the administration of quinine and iron. A like statement may also be made respecting various local *spasms*, as that of the *œsophagus*, *facial tic*, etc. It is said that *writer's cramp* has been cured by the hypodermic use of strychnine, and the *vomiting of pregnancy* by its internal use. It is alleged that the medicine has the power of arresting the development and preventing the usual effects of *alcoholic intoxication* (Luton, *Bull. de Thérap.*, xcix. 241; cii. 473; Dujardin-Beaumetz, *ibid.*, cvi. 1; *ibid.*, cviii. 179; cxv. 324). These physicians have not feared to use hypodermic injectons of 5 Mgm. (gr. $\frac{1}{12}$) in cases of *delirium tremens* and *mania-à-potu*, without adverting to the fact that the affections in question terminate spontaneously in cure in nearly all uncomplicated instances if treated with exercise and well-seasoned food. Gibson (*Practitioner*, xli. 401) has shown that strychnine is a clinical as well as a physiological antidote to the poisonous effects of opium, as indicated by irregularity or interruption of the breathing. It should be administered hypodermically in the dose of Gm. 0.001 (gr. $\frac{1}{60}$). It is one of the numerous remedies which have seemed to moderate *hay fever*. It has been known to cure facial *neuralgia*, *lead colic*, *dysmenorrhœa*, etc., but its efficacy is too inconstant to inspire confidence. There is one form of neuralgia, *gastralgia*, in which it is often of signal benefit, doubtless more by its power as a bitter tonic than as a nervine. The cases in which it is most useful are those in which the gastralgia is associated with gastrodynia attended by flatulent *dyspepsia*, eructations, and sometimes vomiting of food, along with habitual constipation. In some of these cases strychnine—or, still better, nux vomica—should be combined with antacids and stimulant carminatives. It is, on the whole, best suited to combat the element gastric debility, with whatever symptoms that condition may be associated. Their tonic action upon the intestine renders nux vomica and strychnine appropriate remedies for *constipation* depending upon atony of the bowel. (Compare Bodenhamer, *Med. Record*, xxxv. 372.) But for this purpose it should be prescribed in small doses taken immediately after meals, or should be associated with aloes, rhubarb, and soap, or with the first only, in a pill, which is most conveniently taken at bedtime. A similar mode of action makes it one of the best remedies for the so-called *spasmodic obstruction* of the bowel, which is really, in most cases, constipation with fecal accumulations at one part of the

intestine and flatulent distension at another. *Tympanites* from intestinal debility is favorably influenced by this medicine, especially if associated with lime-water or some antifermentative, as salicylic acid. On the other hand, *chronic diarrhœa* and *dysentery*, affections in which the discharges are apt to be prolonged by the exhausted state of the bowel, are often benefited by nux vomica or strychnine. The latter is alleged to have been found useful in *epidemic cholera*. It is also reported to act as a *vermifuge* and to *arrest sea-sickness*, in the dose of $\frac{1}{40}$ grain every four hours. Finally, it has been used with alleged benefit in various forms of *dyspnœa* depending upon pulmonary and cardiac obstruction, including *emphysema*, *bronchitis*, and, along with digitalis, in cases of *irregular and fatty heart* (Fothergill); in a word, in all those conditions of the heart and lungs marked by positive or by relative debility of these organs.

Brucine appears to act like strychnine upon the spinal cord and the muscles (Brunton). Anæsthetic virtues have been ascribed to a 5 per cent. solution of it applied to the auditory canal (Burnett; Zeiss), the throat, and the nasal passages; but upon the skin it failed to exhibit them. Others have more prudently employed doses of Gm. 0.001 (gr. $\frac{1}{60}$) three times a day in pill. Manassein states that the use of the medicine neutralizes the *craving for alcohol* for the time being (*Lancet*, Oct. 16, 1880). Like other nerve-tonics, strychnine sometimes lessens *insomnia* caused by mental exhaustion.

The first dose of strychnine should not be greater than from Gm. 0.003–0.005 ($\frac{1}{20}$ to $\frac{1}{12}$ grain); as a general rule, it is better to begin with Gm. 0.002 ($\frac{1}{30}$ grain), and cautiously increase the dose until a slight manifestation of its specific effects occurs or until the object of its administration is attained. It is usually prescribed in pills of breadcrumb or of confection of roses, care being taken to mix the mass thoroughly and divide it accurately. A convenient form, which its bitterness alone renders objectionable, is to dissolve Gm. 0.06 (1 grain) of strychnine in Gm. 8 (2 fluidrachms) of rectified spirit with the aid of 2 minims of sulphuric, acetic, or muriatic acid, so that every 10 minims of the solution shall contain Gm. 0.005 (gr. $\frac{1}{12}$) of the salt of strychnine. For hypodermic injection a solution of Gm. 0.26 (4 grains) of sulphate or muriate of strychnine in Gm. 32 (1 fluidounce) of water is used. Each minim contains Gm. 0.0005 ($\frac{1}{120}$ grain) of the salt. Gm. 0.001 (2 minims or $\frac{1}{60}$ grain) of strychnine may be used as a primary dose. In all cases in which strychnine is used the modifying operation of idiosyncrasies and of the existing disease must be regarded.

Treatment of Poisoning by Strychnine.—As in the case of other poisons taken into the stomach, so in poisoning by strychnine free vomiting should be produced by mustard and warm water, or, as has been found successful in more than one case, by the hypodermic injection of Gm. 0.02 ($\frac{1}{3}$ grain) of apomorphine, after which the bowels should be purged with castor oil, croton oil, or a saline laxative. In one instance this use of apomorphine saved the life of a man who had swallowed 20 grains of strychnine sulphate (*Med. News*, lxi. 214). When asphyxia threatens, artificial respiration should be resorted to. As mechanical antidotes which retard the absorption of the poison, lard, sweet oil, and milk have been used with apparent success immediately after the poison was taken and before its spasmodic action had been developed. Animal *charcoal*, and also *tannin*, have been used with the same view. Of the other alleged antidotes, all are more or less sedatives of the nervous system, and therefore antagonists of the spasm produced by the poison. The first of these is the medicine which has been so much employed in the treatment of tetanus, *opium* or *morphine*, and from which, *à priori*, much was to be expected. But experimentally and clinically the expectation has proved to be unfounded. Opium and its salts are useless in strychnine-poisoning, however efficient they may be in relieving the symptoms produced by the alkaloid when its medicinal operation is but slightly exceeded, or in delaying the absorption of the poison, and therefore the manifestation of its symptoms. *Aconitine* and *woorara* are also regarded as physiological antidotes to strychnine, but we are unacquainted with any instances of their use as such in human poisoning. The same remark applies to *prussic acid*. Moreover, the physiological antagonism of woorara and strychnine has been denied by Vulpian, Brown-Séquard, and others. *Camphor*, internally, is said to have arrested the toxical symptoms. There is more evidence in favor of *chloroform*, which unquestionably has in several cases controlled the spasm and apparently prevented death, while in others it has rendered the phenomena of death less distressing (Haynes, *Philada. Med. Times*, xiv. 504). The antagonism shown by experiments upon animals to exist between *chloral* and strychnine is more or less exhibited in cases of poisoning by the latter. Chloral counteracts the spasmodic effects of strychnine, and thus conserves force, while it gains time for the elimination of the poison. In the case of a woman who had taken 40 Cgm. (gr. vj) of strychnine recovery

ultimately took place, and was evidently due to the administration of chloral by the mouth and rectum and hypodermically (Faucon, *Archives gén.*, Jan. 1833, p. 74). Another case, in which the estimated dose of the poison was 5 grains, recovered after the use of chloral hydrate, but apparently in doses quite inadequate to control the action of the strychnine (*Boston Med. and Surg. Jour.*, July 1881, p. 8). Two cases are reported by Moore (*Med. News*, xli. 566), the one illustrating the virtues of strychnine in chloral-poisoning, and the other (in a dog) of chloral in poisoning by strychnine. (On the relations between the two agents see Husemann, etc., *Amer. Jour. Med. Sci.*, Apr. 1882, p. 608.) *Amyl nitrite*, which appears to be more or less antidotal to strychnine in dogs and frogs, does not seem to have been sufficiently tested in poisoning by this substance in man (Hare, *Boston Med. and Surg. Jour.*, Nov. 1884, p. 481). *Potassium bromide* is credited with several striking cures of strychnine-poisoning. In three of them the doses of strychnine were very large and the effects characteristic; but repeated doses of the bromide, varying in their totality from Gm. 5–16 (80 grains to ½ ounce), saved the patients. Experiments on animals demonstrate the power of the bromide to prevent or mitigate strychnine spasms. In several cases the bromide has been associated with chloral (*Med. Record*, xix. 208), but the experiments of Husemann (1880) seem to show that the former medicine was superfluous (*Bull. de Thér.*, xcix. 429). *Calabar bean* and strychnine appear to be truly antagonistic, in that the one counteracts the operation of the other, provided that their doses and the time of their administration be duly adjusted. But there is great danger that death by asphyxia may be escaped only by encountering the risk of death from exhaustion. In two cases which terminated favorably this untoward result was prevented by the use of stimulants internally and externally. In one of these cases Gm. 0.05 (¾ grain) of the extract of physostigma was exhibited three times within an hour, and in the other case Gm. 0.06 (1 grain) in a single dose. These conclusions concerning the efficiency of chloroform, chloral, potassium bromide, and physostigma have been experimentally confirmed by Husemann (1878). *Tobacco* and *nicotine* have been employed experimentally as antidotes to strychnine, and, on the whole, with not unfavorable results. Whether or not they may be so regarded in a physiological sense matters little, provided that they save lives which would otherwise be lost. That tobacco has done so is proved by several recorded cases (*Amer. Jour. Med. Sci.*, Apr. 1857, p. 551; Aug. 1862, p. 172; *Dublin Quart. Jour.*, Aug. 1862, p. 183; *Brit. and For. Med.-Chir. Rev.*, Jan. 1867, p. 243). Possibly it may have acted in part by hastening the elimination of the poison with the urine. The uncertainty and possible danger of these antidotes should exclude them when chloral can be obtained. *Belladonna* and *atropine* have also been suggested as antidotes to strychnine, and a case is recorded in which, atropine having been injected simultaneously, the patient recovered. Gm. 0.01 (⅙ grain) was thus used three times at intervals of ten minutes. In two more recent cases recovery was attributed to the administration of atropine (*Phila. Med. Times*, x. 323).

STYRAX, *U. S.*—Storax.

Styrax præparatus, Br.; *Styrax liquidus*, P. G.; *Balsamum styraeis.—Liquid storax*, E.; *Styrax liquide*, Fr. Cod.; *Flüssiger Storax*, G.; *Estoraque liquido*, Sp.

A balsam prepared from the bark of Liquidambar orientalis, *Miller*, s. L. imberbe, *Aiton*. Bentley and Trimen, *Med. Plants*, 107.

Nat. Ord.—Hamamelaceæ. Balsamifluæ.

Origin.—The tree yielding liquid storax closely resembles the sweet-gum tree of North America (see p. 946), from which it differs in having smooth leaves with obtuse, often three-lobed, and finely serrulate lobes, and in producing smaller heads of fruit. It has been found only in the south-western part of Asia Minor, where it forms forests.

Production.—The extraction of liquid storax was described by Hanbury (1857) from accounts received from S. H. Maltass and Lieut. Robert Campbell. The outer bark is stripped off on one side of the tree, made into bundles, and reserved for the purpose of fumigation. The inner bark is then scraped off with a semicircular or sickle-shaped knife, and thrown into pits until a sufficient quantity has been collected. It is then boiled in water, upon which the resinous matter comes to the surface, and is skimmed off. The boiled bark is next put into hair-sacks and pressed, boiling water being added to assist in the extraction of the resin, or, as it is termed, *yagh—i. e.* oil. According to Maltass, the fresh bark is pressed in strong horsehair bags by means of a wooden lever press, hot water being afterward thrown over the bags, and these subjected to pressure a

second time. Dr. McGrath states that the storax is chiefly collected by a tribe of wandering Turcomans called *Yuruks*, and that the liquid resin, separated from the bark by boiling and pressure, is run into barrels.

Description.—Liquid storax has the consistence of thick honey, and is sticky, opaque, and of a gray color, caused by the water which is diffused through it. By long standing it separates a heavier dark-brown (in thin layers transparent) stratum. When heated it becomes thinner and more transparent, the water separating slowly, and when ignited it burns with a bright sooty flame. It becomes harder by age and on exposure, is heavier than water, and has a strong agreeable odor somewhat resembling that of vanilla. Its taste is pungently balsamic. With the exception of the water and the impurities contained in it, storax dissolves in alcohol, ether, chloroform, and most of the volatile oils. With an equal weight of warm alcohol it yields a turbid gray-brown solution having an acid reaction; when cooled and filtered the solution, on evaporation, yields not less than 70 per cent. of the weight of the balsam in the form of a brown semi-liquid residue, which deposits crystals only after a long time, and which, with the exception of a few flocculeS, is completely soluble in ether and in carbon disulphide (*U. S.*, *P. G.*). It is insoluble in cold petroleum benzin, but dissolves partly in it while hot, the colorless solution depositing crystals of cinnamic acid and cinnamic ethers on cooling. Examined under the microscope, storax is seen to consist of minute globules, intermixed with larger drops of water and with tabular crystals of cinnamic acid, and when left on the object glass feathery crystals of styracin make their appearance.

Styrax præparatus, *Br.*, is storax purified by melting and straining (*F. Cod.*), or by dissolving in rectified spirit (benzene, *P. G.*), filtering, and evaporating the solvent. It has a brown-yellow color, is semi-transparent or transparent in thin layers, and otherwise resembles the crude balsam.

Constituents.—E. Simon (1839) obtained from this balsam styrolene, cinnamic acid, styracin, and two resins. In addition to these, W. von Miller (1876–77) found a little benzoic acid, ethyl cinnamate, and a fragrant compound melting at 65° C. (149° F.), probably ethyl vanillin; in larger proportion was found the alcohol storesin in two modifications—the cinnamic ether of this alcohol and cinnamate of phenylpropyl. *Styrolene* or *cinnamene* has the composition C_8H_8, and is obtained by distilling storax with water. The yield is very variable. It is a colorless, thin liquid, very refractive to light, and of a very fragrant odor and burning taste. It has been artificially obtained by heating acetylene gas, and from ethyl-benzene bromide by heating it with baryta. Its specific gravity is 0.924, and it boils at 146° C. (294.8° F.); but when heated to 200° C. (392° F.) it is rapidly converted into a polymeric compound, *metacinnamene*, which is a colorless, amorphous, tough solid of the specific gravity 1.054, insoluble in alcohol and ether, and reconverted into styrene when distilled. *Cinnamic acid* (see page 1119) may be obtained by treating storax with a solution of sodium carbonate and precipitating the acid by means of hydrochloric acid. The ethers are obtained from storax previously deprived of cinnamic acid by treating it with hot petroleum benzin, on the cooling of which white or colorless needles are deposited which require repeated treatment with hot benzin. *Styracin* melts at 38° C. (100.4° F.), and after prolonged heating congeals to a transparent mass, in which crystals are formed very slowly. It is *styryl (cinnamyl) cinnamate*, $C_9H_9.C_9H_7O_2$, and when in alcoholic solution treated with caustic soda, or when heated with an aqueous solution of soda, is converted into sodium cinnamate and *cinnam-alcohol*, also known as *styryl alcohol* and *styron*, $C_9H_{10}O$. This crystallizes in colorless silky needles, has an agreeable hyacinthine odor, melts at 33° C. (91.4° F.), and boils at 250° C. (482° F.). Styracin and cinnamic acid yield with oxidizing agents oil of bitter almonds and benzoic acid, and when styrol is treated with chromic acid and then boiled with water benzoic acid is obtained. After saponifying storax with an alkali, and subjecting the alcohols to fractional distillation, Laubenheimer (1872) obtained a distillate having the properties of *benzyl alcohol*; this is a colorless liquid of a weak but fragrant odor, having the specific gravity 1.06 and the composition C_7H_8O. *Storesin*, $C_{36}H_{58}O_3$, is amorphous, melts at 168° C. (*β* storesin at 145° C.), and dissolves readily in alcohol, ether, petroleum benzin, and potassa, forming with the latter a crystalline compound. Mylius (1882) prepared *styrogenin*, $C_{26}H_{40}O_3$, from that portion of storax which is soluble in boiling benzin; after treating it with an equal weight of sulphuric acid, boiling with water, and washing with ether, white crystals are left which are easily soluble in chloroform, melt at 350° C., dissolve in cold sulphuric acid, being reprecipitated by water, and yield with warm sulphuric acid a yellowish-red solution, which with water precipitates uncrystallizable resin.

Commercial storax contains from 10 to 20 per cent. of water and from 13 to 18 per cent. of fragments of bark and inorganic impurities (*Pharmacographia*).

Adulterations.—Storax is said to be sometimes adulterated with turpentine. Hager (1874) proposed to detect the adulteration by dissolving the storax in a little warm alcohol and exhausting it with petroleum benzin by agitation. On evaporating the benzin solution the residue should have a bluish opalescence and an agreeable odor, while if turpentine be present the color will be yellowish and the odor of turpentine will be apparent.

Allied Products.—Cortex thymiamatis. This is the bark from which storax has been obtained. It is in brown foliaceous cakes, consisting of thin pieces of bark and having the odor of storax.

Styrax calamita. As now found in the market, it consists of sawdust mixed with liquid storax, and contains numerous minute crystals of styracin. The drug known by this name in ancient times and during the last century was a solid balsamic resin, most likely obtained from Styrax officinale, *Linné*, which is indigenous to Western Asia and South-eastern Europe. This is no longer an article of commerce.

Action and Uses.—The medicinal action and uses of storax are almost identical with those of copaiba, like which it was formerly employed in the treatment of chronic catarrhs, particularly of the lungs, but also to some extent in similar affections of the digestive and urinary organs, and especially in *gonorrhœa*. It has been highly recommended as a dressing for ulcers following *frostbite*. Within a few years its use as a remedy for *scabies* has been revived. As of old, it is mixed with olive oil for this purpose: a mixture of 1 part of storax with 2 or 3 parts of oil is rubbed diligently into the affected parts, and in the course of twelve hours a warm bath with soap is used, after which the skin is again covered with the liniment. This treatment generally suffices for a cure in nearly all of the cases. It is convenient for its cheapness, as well as for its acceptableness, particularly when balsam of Peru is added to the storax in the proportion of about one-fourth. The latter ingredient improves the odor of the mixture. Of 124 cases of itch treated by Unna with styrax frictions, nine are said to have had albuminous urine during or immediately after the treatment, the albumen varying in proportion from one-tenth to one-half. On the successive application of heat and nitric acid the precipitate was apparently albuminous; but the counter-proof of attempting its solution with alcohol, which would have dissolved a possible resinous deposit, does not seem to have been tried. (Compare *Virchow's Archiv*, lxxiv. 424, and Lassar, *ibid.* lxxvii. 558.) The following formula is recommended as more efficient than the mixture described above: R. Liquid storax ℥j; Alcohol f℥ij; Olive oil f℥j.—M. S. For two frictions. The *dose* of storax internally is Gm. 0.60–1.30 (gr. x–xx).

Styracin, or *styrone*, is said to be an antiseptic and deodorizer. When pure it is slightly irritating to raw surfaces, but dissolved in 6 parts of oil or water it is no longer so. 1 part in 12 forms a convenient solution for an antiseptic dressing (*Boston Med. and Surg. Jour.*, Mar. 1880, p. 249).

SUCCI.—Juices.

Sucs végétaux, Fr.; *Pflanzensäfte*, G.

These preparations are made by bruising the fresh drugs, expressing them forcibly, and mixing the expressed juice, with a definite proportion of alcohol for preservation. They must necessarily vary in the amount of their active constituents, and perhaps more so than the dried and carefully-preserved drugs. They have been dismissed from the U. S. P., and tinctures of fresh herbs admitted in place thereof. (See Tincturæ Herbarum Recentium.)

SUCCUS BELLADONNÆ, *Br.*—Juice of Belladonna.

Suc de belladone, Fr.; *Belladonnasaft*, G.

Preparation.—Take of fresh leaves and young branches of Belladonna 7 pounds; Rectified Spirit a sufficiency. Bruise the belladonna in a stone mortar, press out the juice, and to every 3 measures of juice add 1 of the spirit. Set aside for seven days, and filter. Keep it in a cool place.—*Br.*

Uses.—The *dose* of this preparation is Gm. 0.30–1 (♏ v–xv).

SUCCUS CONII, *Br.*—Juice of Conium.

Juice of hemlock, E.; *Suc de grande ciguë*, Fr.; *Schierlingsaft*, G.

Preparation.—Bruise fresh leaves and young branches of Hemlock, press out the juice, and to every 3 measures of juice add 1 of spirit. Set aside the liquid for seven days, and filter. Keep it in a cool place.—*Br.*

Uses.—The *dose* of juice of conium is stated at Gm. 2–4 (ʒss–j), but the characteristic effects of the drug are not manifested in the slightest degree by doses of less than Gm. 8 (ʒij), and ordinarily they are not well marked by less doses than Gm. 16 (½ ounce). Doses of Gm. 32–128 (ʒj–iv), have been given without occasioning alarming symptoms. But in whatever dose the medicine is administered, it should not be increased beyond the point at which it begins to render deglutition and voluntary movement imperfect. This preparation is relatively less powerful in children than in adults.

SUCCUS HYOSCYAMI, *Br.*—Juice of Hyoscyamus.

Suc de jusquiame, Fr.; *Bilsensaft*, G.

Preparation.—Bruise fresh leaves, flowering tops, and young branches of Hyoscyamus in a stone mortar, press out the juice, and to every 3 measures of juice add 1 of spirit. Set aside for seven days, and filter. Keep it in a cool place.—*Br.*

Uses.—The *dose* is from Gm. 2–4 (fʒss–j).

SUCCUS SCOPARII, *Br.*—Juice of Broom.

Suc de genêt à balais, Fr.; *Besenginstersaft*, G.

Preparation.—Bruise fresh Broom-tops in a stone mortar, press out the juice, and to every 3 measures of juice add 1 of spirit. Set aside for seven days and filter. Keep in a cool place.—*Br.*

Uses.—This juice may be prescribed in *doses* of Gm. 4–8 (fʒj–ij).

SUCCUS TARAXACI, *Br.*—Juice of Dandelion.

Suc de pissenlit, Fr.; *Löwenzahnsaft*, G.

Preparation.—Bruise fresh Dandelion-root in a stone mortar, press out the juice, and to every 3 measures of juice add 1 of spirit. Set aside the liquid for seven days, and filter. Keep it in a cool place.—*Br.*

Uses.—This preparation is a convenient form for the administration of dandelion, but it may be surmised that even the small proportion of alcohol which it contains may impair its virtues in those hepatic derangements for which dandelion is a reputed remedy. The *dose* is from Gm. 8–16 (fʒij–iv).

SULPHONAL, *Br. Add.*—Sulphonal.

Sulfonalum, P. G.—*Diethylsulphon-dimethylmethane*, E.; *Sulfonal*, G.

Formula $(CH_3)_2C(SO_2C_2H_5)_2 = C_7H_{16}S_2O_4$. Molecular weight 227.59.

History.—Diethylsulphon-diemethylmethane was first produced in 1886 by E. Baumann, and since 1888 has been manufactured on a large scale and sold under the copyrighted name "sulphonal."

Preparation.—When dry hydrochloric acid gas is led into a mixture of 2 parts of anhydrous ethyl hydrosulphide (mercaptan, C_2H_5SH) and 1 part of anhydrous acetone, heat is slowly developed; the mixture becomes gradually turbid, and finally separates into two distinct layers, the lower being a dilute hydrochloric acid, while the upper is composed of a new compound, known as dithioethyldimethylmethane or mercaptol $(CH_3)_2C(SC_2H_5)_2$, a condensation-product of the interaction between the mercaptan and acetone. Mercaptol may also be obtained by a process patented in Germany, which consists in first treating sodium thiosulphate with ethyl chloride or bromide, whereby sodium ethylthiosulphate is produced; thus, $Na_2S_2O_3 + C_2H_5Cl = NaC_2H_5S_2O_3 + NaCl$: this salt in the presence of water yields acid sodium sulphate and ethyl hydrosulphide or mercaptan: the latter is not separated, but in its nascent state, in the presence of hydrochloric acid, is allowed to react with acetone, condensing to mercaptol. Obtained by either process, mercaptol is an oily liquid, which is purified by washing with water and afterward with dilute soda solution; it is dried by means of calcium chloride and rectified by distillation; it boils at 190°–191° C. (374°–375.8° F.), is highly refractive, insolu-

ble in water, and has a very disagreeable odor. Upon agitating mercaptol with 5 per cent. potassium permanganate solution until the color of the latter remains, oxidation takes place and the mercaptol is converted into sulphonal; thus, $(CH_3)_2C(SC_2H_5)_2 + O_4 = (CH_3)_2C(SO_2C_2H_5)_2$. Sulphonal may be obtained absolutely pure by recrystallization from water or alcohol.

Properties.—Sulphonal occurs as colorless, inodorous, nearly tasteless, prismatic crystals, neutral to test-paper and melting at 125°–126° C. (257°–258.8° F.). It is soluble in 500 parts (*P. G.*) or 450 parts (*Br.*) of cold water, 15 parts of boiling water, 65 parts (*P. G.*) or 50 parts (*Br.*) of cold or 2 parts of boiling alcohol, and in 135 parts of ether. Ignited with free access of air, it burns without leaving a residue. A mixture of sulphonal and powdered wood charcoal heated in a test-tube develops the characteristic disagreeable odor of mercaptan (*P. G.*). If a few grains of sulphonal be mixed with an equal weight of potassium cyanide and heated, the odor of mercaptan is evolved, and when to the solution of the product in water excess of hydrochloric acid and a few drops of solution of ferric chloride are added, a reddish color is developed (*Br.*): the last reaction is due to the formation of ferric sulphocyanate. The odor of mercaptan is also evolved if sulphonal be heated with pyrogallol or gallic acid. Sulphonal is a very stable compound, being unaffected by concentrated acids or alkalies, as well as chlorine or bromine.

Tests.—"A solution of 1 part of sulphonal in 50 parts of boiling water should be free from odor. The aqueous solution, filtered when cold, should not be affected by barium nitrate or silver nitrate solution (absence of sulphuric acid and chlorides). 1 drop of potassium permanganate solution added to 10 Cc. of the above solution should not be decolorized (absence of oxidizable organic impurities)."—*P. G.*

Allied Compounds.—Trional, Diethylsulphon-methylethylmethane, $CH_3.C_2H_5.C(SO_2C_2H_5)_2$. This compound differs from sulphonal, as the formula shows, by the substitution of an ethyl group for a methyl group; it is prepared exactly like sulphonal, except that methyl-ethyl-ketone is used in place of acetone. Trional forms shining, colorless, odorless crystalline plates, which melt at 76° C. (168.8° F.) It is soluble in 300 parts of water at 15° C. (59° F.), and in less hot water; also readily soluble in alcohol and ether.

Tetronal, Diethylsulphon-diethylmethane, $(C_2H_5)_2C(SO_2C_2H_5)_2$. When diethyl-ketone, $(C_2H_5)_2CO$, is used in place of acetone in the process for the manufacture of sulphonal, diethyl-ketone mercaptol, $(C_2H_5)_2C(SC_2H_5)_2$, is produced, and this upon oxidation with potassium permanganate yields tetronal, a compound analogous to sulphonal and trional. It occurs in colorless and odorless shining plates and laminæ, melting at 89° C. (192.2° F.), and soluble in 450 parts of cold and less of boiling water, forming a tasteless solution of neutral reaction. Tetronal is readily soluble in alcohol and ether.

Action and Uses.—When sulphonal was made in 1888 by Kast, he stated that in dogs it produced sleep and disturbed muscular co-ordinations, but in man sleep only, which he declared to be exactly natural sleep, and was prevented by pain, mental excitement, or outward influences. He noted that it was neither anæsthetic nor analgesic. According to him, it did not aggravate the distress of cardiac or aortic disease or affect the composition of the blood (*Centralb. f. Ther.*, vi. 328). Rabbas confirmed these statements, and remarked the slow development of the action of the medicine caused by its imperfect solubility (*ibid.*, p. 330), and the prolonged sleep produced by it. He and other observers, as Cramer and Egasse (*Bull. de Thérap.*, cxvi. 212), stated that it does not disturb the respiration or the circulation, but produces a sort of locomotor ataxia; and Garnier also observed its tendency to cause unsteadiness of the gait and a condition resembling drunkenness, as well as its diuretic action, while others met with instances of vomiting and diarrhœa occasioned by it. Hénocque explained the sluggishness and sopor it produced by its hindering the conversion of arterial into venous blood (*Bull. et Mém. Soc. thérap.*, 1889, p. 23), and, in opposition to Kast, charged it with the destruction of the red blood-disks. Longer experience brought to light certain other untoward effects of the medicine. Thus it was found liable to cause eruptions on the skin, usually of an erythematous nature (*Therap. Gaz.*, xiii. 25; *Practitioner*, xliii. 376); it has produced cyanosis; reduced the patient to extreme weakness and apathy with a pulse of 38, or, again, a frequent pulse; occasioned aphasia (Kirch), hallucinations (Bornemann), or prolonged torpor (*Med. Record*, xxxv. 348), with vomiting of several days' duration (*Therap. Gaz.*, xiii. 247, 288). Griffith has called particular attention to its "unpleasant effects;" its occasional slowly developed or unduly prolonged action; the uncertainty of its dose; its threatening secondary symptoms; and the absolute failure, at times, of its hypnotic action (*Therap. Gaz.*, xiii. 323). Browning has made a similar report, and noticed, like others, priapism as an occasional effect of the medicine (*Med. Record*, xxxvi. 62). Rehm (*Bull.*

de Thér., cxvii. 381) and Hagart (*Lancet*, Oct. 1889, p. 777) have observed decidedly alarming examples of its action. Knoblauch thus summarizes the objections to its use: It causes intoxication, staggering, paresis of the limbs, grinding of the teeth, derangement of speech, vertigo, malaise, vomiting, and diarrhœa; the duration of the sleep it causes cannot be foreseen, nor the appropriate dose for any given case. For these reasons he opines that Marandon was not far wrong when he declared sulphonal a poison and not a medicine (*Ther. Monatsh.*, iii. 501. Compare Folsom, *Boston Med. and Surg. Jour.*, 1890, p. 31.) The duration of the sleep, as well as the other effects of it, is variable. The case is related of a man who after taking a large (but uncertain) dose of sulphonal slept almost continuously for four days, and awaked feeling refreshed and well (*Med. Record*, xxxvi. 560). Again, a man with Bright's disease, cystitis, and repeated attacks of erysipelas of the face took in the course of eleven months Gm. 300 (say ℨx) of sulphonal, not only without injury, but with great advantage (*Therap. Monatsh.*, iii. 459). Still more striking is the case of a man who with suicidal intent swallowed 3 ounces of the compound. Coma succeeded and lasted for six days, but recovery followed (*Jour. Amer. Med. Assoc.*, xvii. 421). A case of death from its use is the following: A feeble, nervous woman, who, after a physical and mental shock, became melancholic and hysterical, took 30 grains of the drug within one and a quarter hours. She slept for twelve hours deeply, and then less so for as many hours more. Excitement followed cyanosis and feeble breathing, although the pulse remained good, and death forty hours after the sulphonal had been taken (*Med. News*, lv. 166). Breslauer has reported five fatal cases due to this medicine (*Lancet*, Apr. 4, 1891); Kobert one (*Centralbl. f. d. Med.*, 1892, p. 185); Reinfuss another (*Therap. Gaz.*, xvi. 318); Geill several in which only the fatal termination was lacking (*ibid*, p. 533), and S. Solis-Cohen three instances of a partial suppression of urine due to the medicine (*Med. News.*, lxiii. 239).

Sulphonal is a hypnotic and sedative of spinal irritation, resembling chloral, but is less apt than it to affect the heart. Owing to its slow solubility its action is gradual, and when the sleep it produces has ended there is apt to remain a dull and sluggish state of body and mind. It is less liable to bring on sleep when there is pain or mental excitement, especially in persons addicted to the use of narcotics. It is held by some (Garnier) to be, as a hypnotic, superior to paraldehyde, urethane, chloral, and hypnone; and Mabon found (*Therap. Gaz.*, xiii. 403) that among the *insane* it produced a "calmer, longer, and more refreshing sleep than any other hypnotic." (See Conolly Norman, *Dublin Jour. Med. Sci.*, Jan. 1889; Flint, *Therap. Gaz.*, xiii. 37; Carpenter, *Med. Record*, xxxv. 239; Cramer, *Med. News*, liii. 240; Landis, *University Med. Mag.*, i. 289; Smith, *Lancet*, Nov. 1889, p. 1051; Sutherland, *ibid.*, p. 1053; Umpfenbach, *Therap. Monatsh.*, iii. 255; Hay, *Amer. Jour. Med. Sci.*, xcviii. 34; Lojacono, *Therap. Gaz.*, xiii. 485; Pachoud and Clairet, *Centralb. f. Ther.*, vii. 469.) Nearly all of the physicians here named agree that it is only in excited states of insanity, whether melancholia, mania, or dementia, that the medicine is an efficient palliative, while Dehio and others have noted serious dangers arising from its continued use (*Centralbl. f. Ther.*, viii. 594). On the other hand, it has been found of little service in the *delirium* of *typhoid fever* and in hectic fever. It has been sometimes employed to allay the excited action of the *heart* in valvular disease of that organ and in *angina pectoris*, but Joachim and others have warned against the danger it involves of lessening the heart's power (*Therap. Monatsh.*, iii. 226). (For further illustrations of the use of sulphonal as a hypnotic see Lauder Brunton, *Therap. Gaz.*, xiv. pp. 623, 628.)

According to Jeffries (*Med. News*, lvi. 275), sulphonal "is able, at times, to suppress promptly choreic motions;" Casarelli claims that the medicine is useful in *diabetes* (*Centralbl. f. Therap.*, viii. 71); and Boetrich that in doses of 7 or 8 grains it controls *night-sweats* (*Therap. Monatsh.*, iii. 123).

The average dose of sulphonal for adults is Gm. 1–1.3 (gr. xv–xx); for children, Gm. 0.20–0.3 (gr. iij–v). It should be given an hour or two before bedtime in hot water, soup, or milk. The dose should not be increased unless the action of the medicine has proved inadequate and after a sufficient interval has elapsed.

Trional and Tetronal are so nearly alike in their action and uses that they may be described together. They are efficient hypnotics when *sleeplessness* results from nervous disease, whether functional or organic, but are less so when it is caused by pain or great mental excitement. When sleep ensues, it generally does so within fifteen or twenty minutes. Some observers assign to these preparations a superiority over sulphonal and chloral, while others have noted no difference in their action. It is, however, stated that when one of the groups has begun to lose its effect by repetition, the substitution of another will renew the original impression. No injurious consequences of either have been

reported. According to Koppers, trional diminishes *night-sweats*. The dose of trional or of tetronal is stated to be Gm. 1–4 (gr. xv–lx). It should generally be given in the evening, and repeated in an hour if the proper effects do not occur.

SULPHUR, *U. S., Br., P. G.*—Sulphur.

Soufre, Fr.; *Schwefel*, G.

Symbol S. Atomicity bivalent, quadrivalent, and sexivalent. Atomic weight 31.98.

Official Forms of Sulphur.—1. Sulphur (Sulfur) sublimatum, *U. S., Br., P. G.;* Flores sulphuris.—Sublimed sulphur, Flowers of sulphur, *E.;* Soufre sublimé, Fleur (Crême) de soufre, *Fr.;* Schwefelblumen, Schwefelblüthe, *G.*—Sulphur sublimed and condensed in powder.

2. Sulphur lotum, *U. S.;* Sulfur depuratum, s. Flores sulfuris loti, *P. G.*—Washed sulphur, *E.;* Soufre lavé, *Fr.;* Gereinigter Schwefel, *G.*—Sublimed sulphur thoroughly washed with water.

3. Sulphur (Sulfur) præcipitatum, *U. S., Br., P. G.;* Lac (Magisterium) sulphuris—Precipitated sulphur, Milk of sulphur, *E.;* Soufre précipité, Magistère (Lait) de soufre, *Fr.;* Schwefelmilch, *G.*

Origin.—Sulphur is a constituent of the volatile oils of mustard, garlic, and asafetida, and of albumen and other proteids. It is found in many mineral waters as hydrogen sulphide and in the form of sulphates, and is widely distributed in the mineral kingdom in combination with metals, forming iron pyrites, FeS_2, galena, PbS, blende, ZnS, black antimony, Sb_2S_3, cinnabar, HgS, and other sulphides, and as sulphate in gypsum, heavy spar, and many other minerals. But sulphur is most abundantly obtained from *native sulphur*, which is found in volcanic countries. Beds of native sulphur have been discovered in California, Nevada, Utah, and other parts of the Western United States, in Mexico, the West Indies, etc.; the chief supply of sulphur, however, comes from Italy, where extensive beds are worked near Latera and Scrofano, and from the provinces of Girgenti, Caltanisetta, Catania, and Palermo in the island of Sicily. Sulphur-beds on the surface of the earth are called *solfatare*, and when they are found underground are known as *solfare*. The latter are the most important, and yield nearly the whole of the commercial sulphur.

Extraction and Purification.—Sulphur is obtained in Sicily by melting it from the mineral in semicircular pits called *calcaroni*, which have a diameter of about 30 feet and a depth of about 8 feet, and are internally covered with a layer of gypsum. The bottom is inclined toward one side, which has an opening, closed during the operation with a thin wall of gypsum. The pit is filled with the mineral, and this is heaped up above so as to form an obtuse cone, the whole being covered first with a layer of powdered sulphur ore, and finally with a stratum of spent ore in powder. Fire is now applied to the heap, and after an hour all openings are closed until, after about nine days, the melted sulphur begins to collect on the floor of the pit. Through a small opening made into the gypsum wall the melted sulphur is removed two or three times a day and run into moistened moulds made of poplar wood, where it solidifies in the form of blunt pyramids, in which condition it enters commerce. The *rough sulphur* thus obtained contains from 3 to 4 parts of earthy impurities, which are removed by distilling the sulphur from iron retorts and conducting the vapors into large brick chambers, where they condense in the form of a fine powder, which is from time to time removed before the condensing-chamber becomes too hot, and constitutes *sublimed sulphur*. If, however, the operation is not interrupted, the brick walls of the chamber become hot enough to melt the sulphur, which is run into wooden moulds. The cylindrical pieces thus obtained enter commerce as *brimstone* or *roll sulphur*.

In Nevada the sulphur ore is placed in upright cast-iron retorts, in shape resembling a blast-furnace; superheated steam is admitted and the pressure raised to about 70 pounds to the square inch; the pressure is slowly reduced to 50 pounds as the melted sulphur flows through a grate into a receiving-pan, where mechanical impurities are allowed to subside, the sulphur being run into large cylindrical moulds, and after cooling broken into irregular lumps before it is refined.

Sulphur is also obtained from pyrites by a process of roasting in heaps or in suitable furnaces built for the purpose, a portion of the sulphur being burned in the operation.

Preparation.—Sublimed Sulphur. The process by which this is procured has been described above. The other official forms of sulphur are prepared as follows:

Washed Sulphur. Sublimed sulphur 100 Gm.; ammonia-water 10 Cc.; water a

sufficient quantity. Pass the sublimed sulphur through a No. 30 sieve, mix it thoroughly with 100 Cc. of water, add 10 Cc. of ammonia-water, and digest for three days, agitating occasionally. Then add 100 Cc. of water, transfer the mixture to a muslin strainer, and wash the sulphur with water until the washings cease to impart a blue color to red litmus-paper. Then allow it to drain, press the residue strongly, dry it rapidly at a moderate heat, and pass it through a No. 30 sieve.—*U. S.* The P. G. orders for 10 parts of sublimed sulphur 7 parts of water and 1 part of ammonia-water, the mixture to be macerated for a day. Prolonged digestion is unnecessary for the removal of the free acid, but it is important that after thorough washing the sulphur be well dried to prevent its slow oxidation.

Precipitated Sulphur. Sublimed sulphur 100 Gm.; lime 50 Gm.; hydrochloric acid, water, each a sufficient quantity. Slake the lime, and make it into a uniform mixture with 500 Cc. of water. Add the sulphur, previously well dried and sifted, mix well, add 1000 Cc. of water, and heat the mixture to boiling over a fire for one hour, stirring constantly and replacing the water lost by evaporation. Then cover the vessel, allow the contents to cool, pour off the clear solution, filter the remainder, and to the united liquids add, gradually, hydrochloric acid previously diluted with an equal volume of water, until the liquid is nearly neutralized, still retaining, however, an alkaline reaction and a yellow color. Collect the precipitate on a strainer, and wash it with water until the washings are tasteless and cease to give an acid reaction with litmus-paper. Then dry it with a gentle heat.—*U. S.*

The British Pharmacopœia uses 5 oz. of sulphur and 3 oz. of slaked lime, but directs the decanted and filtered solution to be mixed with hydrochloric acid until the mixture acquires an acid reaction.

In the processes described calcium thiosulphate and sulphide are first produced, from which, on the addition of an acid, sulphur is precipitated. Both formulas direct too large a quantity of lime, resulting in a corresponding waste of hydrochloric acid, but the second formula employs nearly the theoretical quantity of sulphur. In order to obtain good results it is advisable to dissolve in the lime as much sulphur as can be taken up, the reaction taking place as follows: $3Ca(OH)_2 + 6S_2$ yields $2CaS_5 + CaS_2O_3 + 3H_2O$. Therefore, 168 parts of burned lime or 222 parts of slaked lime require 384 parts of sulphur, or 50 parts of the calcium compounds need respectively 115 and 87 parts of sulphur. It is, however, advisable to employ an excess of sulphur, the undissolved portion of which may be utilized in a subsequent operation; for 1 pound of lime $2\frac{3}{8}$ or $2\frac{1}{2}$ pounds, and for 1 pound of slaked lime $1\frac{1}{8}$ pounds, of sulphur should be used. The resulting liquid has a dark orange-red color. Diluted hydrochloric acid should now be added in a thin stream and with continued stirring, when the calcium pentasulphide will be decomposed, calcium chloride remaining in solution, while sulphur is precipitated and hydrogen sulphide is liberated, which should be carried off through a chimney. This reaction occurs according to the equation $2CaS_5 + 4HCl = 2CaCl_2 + 4S_2 + 2H_2S$. If the acid be added with the precaution that the liquid retains its alkaline reaction, calcium hydrosulphide, $Ca(HS)_2$, will remain in solution, and with it any arsenic which may have been present in the sulphur or in the acid; but in the presence of iron black ferrous sulphide will be precipitated with the sulphur, and impart to it a dark-gray color. The latter impurity may be easily removed by washing first with water, followed by dilute hydrochloric acid, and this again by water.

Operating in this manner, as directed by the U. S. P., the calcium thiosulphate will not be decomposed. The further addition of acid will decompose this compound, sulphur being liberated, together with sulphur dioxide, and the latter, by reacting with the hydrogen sulphide, will liberate an additional quantity of sulphur, with the formation of water. The result of the entire complicated reaction is expressed by the equation $2CaS_5 + CaS_2O_3 + 6HCl = 6S_2 + 3CaCl_2 + 3H_2O$. It will be observed that by acidulating the solution of lime and sulphur, as directed by the British Pharmacopœia, a larger amount of precipitated sulphur is obtained; but it was shown by Fordos and Gélis (1851), and by Berthelot, that that resulting from the thiosulphate is soft and only partially soluble in carbon disulphide. Arsenic, if present in the lime solution, will separate as yellow arsenic sulphide. If the hydrochloric acid is replaced by sulphuric acid, the precipitated sulphur is contaminated with calcium sulphate: it has been proposed to restrict the appellation *lac sulphuris* to this preparation, which is often demanded in Great Britain as milk of sulphur.

Properties.—Sulphur exists in several modifications, and is either *crystalline* and soluble in carbon disulphide, *amorphous* and insoluble in the same liquid, or *soft* or *oily* at

common temperatures, and either soluble or insoluble in this menstruum. When sulphur is fused and kept near the temperature of 90° C. (194° F.), octahedral or rhombic crystals are formed, fusing at 115° C. (239° F.); but if the crust which forms on cooling is broken and the liquid sulphur poured out, the vessel will afterward be filled with long oblique prisms, which melt to a yellowish liquid at 120° C. (248° F.). On gradually increasing the heat to near 180° C. (356° F.) sulphur becomes brown, and ultimately black, opaque, and very viscid. If the heat be continued, the mass liquefies again at 260° C. (500° F.), and at about 450° C. (842° F.) is converted into orange-brown vapors. On agitating sublimed sulphur with carbon disulphide about two-thirds of it are dissolved, while the remainder is amorphous and remains undissolved. The different varieties of sulphur differ also in specific gravity, that of amorphous and soft sulphur being 1.96, of prismatic sulphur 1.98, and of octahedral sulphur 2.05; this last variety is more stable than the other two, which are under various circumstances converted into it. Heated in the air, sulphur ignites at about 150° C. (302° F.), and burns with a blue flame to sulphurous anhydride or sulphur dioxide, SO_2. This gas always contains a small quantity of the trioxide or sulphuric anhydride, SO_3, according to Lunge and Salathé (1883), if the combustion takes place in dry air, the amount being 2.5 or 2.8 per cent., and the quantity being increased in the presence of ferric oxide. The two oxides named are the only oxygen compounds which have been obtained in the isolated state, though several others are known in combination, of which the most important is thiosulphuric acid. (See Sodii Thiosulphas.) The other oxygen compounds of sulphur are as yet only of scientific interest: they are *hyposulphurous* (also called *hydrosulphurous*) (H_2SO_2), *dithionic*, *trithionic*, *tetrathionic*, and *pentathionic acids*, and the last four contain, in combination with a bivalent basylous radical, 6 atoms of oxygen, and respectively 2, 3, 4, and 5 atoms of sulphur. These four acids, when liberated from their salts, are readily decomposed into sulphuric and sulphurous acids, the last three separating also sulphur.

Sulphur combines also with most of the non-metallic and metallic elements, forming sulphides, the most important of which to the pharmacist are the sulphides of antimony, mercury, iron, potassium, ammonium, and hydrogen. When treated at an elevated temperature with volatile and fixed oils, it dissolves, and forms with the fats compounds which were formerly known as *balsams of sulphur*. Sulphur is insoluble in water, but dissolves in hot solutions of the fixed alkalies and alkaline earths, forming sulphides, and is somewhat soluble in hot absolute alcohol, ether, chloroform, oil of turpentine, benzin, and benzene, being deposited on cooling in crystals. Carbon disulphide promptly dissolves a portion of it, but leaves a residue of insoluble sulphur, which may be dissolved by a boiling solution of alkali hydroxide.

Sublimed sulphur is a yellow or somewhat greenish-yellow, slightly gritty powder, which is free from odor and taste, or generally has a slight sulphurous odor and a faint acidulous taste, and has a slight acid reaction to litmus. To heat and solvents it shows the behavior described above.

Washed sulphur has the same appearance and behavior as the preceding, except that it is entirely inodorous and nearly tasteless, and does not change the color of litmus-paper, which properties are demanded by the Br. P. for its sulphur sublimatum.

Precipitated sulphur is a yellowish-white or grayish, very fine powder, free from grittiness and from the odor of hydrogen sulphide, and nearly tasteless. When examined under the microscope it is seen to consist of opaque globules which are free from crystalline matter. It is not altered on exposure to air when kept dry, and on fusion it is converted into ordinary sulphur.

Tests.—Water agitated with washed or precipitated sulphur (*U. S.*), or these varieties of sulphur moistened with water (*P. G.*), should not redden blue litmus-paper; the last is the more delicate test. Pure sulphur should completely evaporate by heat, and when ignited in the air should burn without leaving any fixed residue (clay, gypsum, etc.). The pharmacopœias permit a trace (0.1 to 0.5 per cent.) of fixed residue for sublimed and washed, but none for precipitated, sulphur. The latter, if precipitated by sulphuric acid, is more readily miscible with water than pure precipitated sulphur, and leaves on ignition a large amount of fixed residue. For the detection of this and other fixed impurities the following additional but unnecessary tests may be employed: If precipitated sulphur be boiled with diluted hydrochloric acid, the liquid filtered, and the filtrate divided into two portions, one portion should not be precipitated by test-solution of barium chloride, and the other portion should not be rendered more than slightly turbid by test-solution of ammonium carbonate with excess of water of ammonia (absence of calcium sulphate). When digested successively with water, hydrochloric acid, and water of

ammonia, these liquids, after filtration, should leave no residue on evaporation (absence of alkalies, alkaline earths, or sulphide). Sulphur obtained from pyrites usually contains arsenic, which is most conveniently detected, unless present in very minute quantities, by digesting it with 20 parts (*U. S.*, *P. G.*) of ammonia-water, filtering, and adding hydrochloric acid, when yellow arsenic sulphide will be precipitated; on the further addition of hydrogen sulphide, arsenous acid, if present, will yield a yellow precipitate of arsenic sulphide. While arsenous acid may be present in sublimed and in washed sulphur, it is obvious from the above explanation of the process that precipitated sulphur may be contaminated with the sulphide, but not with the oxide of arsenic. Very minute quantities of this metal are best detected by Marsh's test. Selenium, which is sometimes present in sulphur, is detected by "boiling 0.5 Gm. of the sample with a solution of 0.5 Gm. of potassium cyanide in 5 Cc. of water, and, if after filtration, the clear liquid be acidulated with hydrochloric acid, it should not assume a reddish color, even after standing an hour (absence of selenium)."—*U. S.* Precipitated sulphur frequently has a slight odor of hydrogen sulphide, which is more apparent on being warmed; such sulphur acquires a more or less black color when agitated with a solution of lead acetate; the pharmacopœias give no chemical test, almost complete freedom from odor being sufficient.

Action and Uses.—The use of powdered sulphur for limiting fermentation has come down from a remote period, and it has also long been used for destroying parasitic fungi upon plants, as well as parasitic insects upon plants and animals. Recent experiments appear to show that these effects, as well as others which are usually attributed to sulphur are in reality due to the sulphurous and sulphuric acids with which it is nearly always impregnated or which form by the action of the oxygen of the air upon it. The former, produced by the combustion of sulphur, is habitually used for disinfecting rooms, ships, etc. where infectious or contagious diseases have existed.

In doses of from 20 to 40 grains sulphur occasions soft stools, generally without colic, and the flatus discharged has the odor of hydrogen sulphide. The greater part of the sulphur passes unchanged. When small doses are repeated day after day, the exhalations of the lungs and skin have a sulphurous smell, the linen is sometimes stained yellow by the perspiration, and silver articles worn near the skin are blackened by the formation of silver sulphide. The expired air also, the urine, and the milk contain combinations of sulphur. It has happened, when a course of mercury followed the administration of sulphur, that parts of the skin have been discolored by sulphide of mercury. Sulphur may continue to be used for a long time and in full doses without untoward effects, but, on the other hand, a case has been recorded of a person who took 120 grains of sulphur in wine four or five times a day, and who on the sixth day was seized with nausea, bloody diarrhœa, cramps in the legs, fever, dysury, etc., and for several years suffered from irritable stomach (Giacomini, *Mat. Med.*). There can be little doubt that these peculiar symptoms were occasioned by a great excess of free acids in the sulphur, for those acids have been found to be present in the proportion of from 10 to 30 parts in 10,000 parts of ordinary sublimed sulphur. They are the chief source of the increased proportion of sulphates found in the urine of those who use sulphur medicinally. In another case a man took 1 ounce of sublimed sulphur, and repeated the dose twenty-four hours later. The symptoms comprised prostration, partial insensibility, headache, fever, sulphurous breath, contracted pupils, clammy perspiration, griping, vomiting, purging of bloody mucus, and bloody urine. Recovery took place in a week (Vaughn, *British Med. Jour.*, Nov. 3, 1888). The skin appears to absorb it in some degree, since those who are subjected to frictions with sulphur ointment discharge fetid gas from the bowels. The case is recorded of a man who for dandruff of the scalp used an ointment containing 10 per cent. of sulphur. He suffered from occipital headache, giddiness, faintness, pallor, general debility, cold perspiration, and a small and frequent pulse. On abstaining from the use of the ointment and using hot baths he recovered (*Med. News*, li. 596). Dolan states that he found sulphur in the milk, sweat, and urine of persons taking it, and that it acts as a mild purgative on nursing infants through the mother's milk (*Practitioner*, xxvii. 170).

The most important therapeutic application of sulphur is to the cure of *scabies*. As already stated, it was used for this purpose in ancient times. Within the last generation its efficacy has been greatly enhanced by softening the patient's skin by means of warm baths before the sulphur is applied, and by associating the latter with some substance which, with the aid of friction, mechanically breaks up the burrows of the acari and brings the insects under the poisonous influence of the sulphur. Some writers, even among the most recent, distinctly assert that sulphur is not efficient, *per se*, and can cure

the itch only when the presence of a free or carbonated alkali favors the formation of a sulphide, which is the true agent of the cure, and hence that all sulphurous itch ointments should contain such an alkaline ingredient. Others affirm that the sulphur in an ointment only acts mechanically by breaking up the burrows of the itch insect, while the sulphides destroy its life These writers appear to have overlooked the presence and potency of sulphurous acid in sulphur ointment, as well as to have forgotten the long period in which simple sulphur ointment continued to be an efficient cure for the itch. The greatest dermatologist of the age was not, apparently, of their opinion. Hebra, after referring to the comparative value of several insecticide agents, says of sulphur: "It was found to be equally effectual whether it was used alone or in combination with potassa, soda, or lime." He also distinctly points out the advantage of there being mixed with the sulphur some coarse and insoluble substance to mechanically rupture the burrows of the acarus and permit the true insecticide to reach at once the insect and its eggs. But as many of the substances used for that purpose irritate the skin, causing artificial vesicular and pustular eruptions, those remedies only should be employed which, without irritating the skin, will destroy the itch insect and its ova. In hospitals this precaution may be less imperative than in private practice, but in all cases irritating ointments should be applied to those parts only, and especially the hands and the feet, which are distinctly the seat of the parasitic eruption.

The first compound sulphur ointment was that of Helmerich (1812–13), and consisted of 2 parts of sulphur, 1 of carbonate of potash, and 8 of lard, which was said to cure the itch in eighteen hours when applied by vigorous and repeated friction, aided by warm baths. The method was revived in 1844 by Hebra, whose perfected formula was as follows: R. Flor. sulphuris, Ol. fagi vel cadini, āā ℥vj; Saponis viridis, Adipis, āā Oj; Cretæ, ℥iv.—M. He, however, employed successfully a much simpler preparation, made of equal parts of flowers of sulphur and powdered soap, reduced to a semi-fluid mass with water. These agents effect a cure in two or three days when duly supplemented by warm baths. Hardy reduced the time of treatment to two hours. The patient was first rubbed for half an hour with soft soap, then placed in a warm bath for half an hour while the skin was again thoroughly rubbed, after which he was vigorously anointed with Helmerich's ointment or with one composed of 1 part of potassium carbonate, 2 parts of sublimed sulphur, and 12 parts of lard. The method variously ascribed to Bourguignon and to Vlemingkx consisted in the use of the following lotion: R. Calcis vivæ lb. j; Sulphuris citrini lb. ij. Boil with 20 pints of water until reduction to 12 pints. When cold, filter. The patient is immersed in a warm bath for half an hour, then rubbed with flannel cloths and potash soap, and finally remains for another half hour in the bath. During the third half hour he is again rubbed vigorously with flannel dipped in the solution of calcium sulphide, and passes a fourth half hour in the bath. Any particles of sulphur adhering to the skin may be washed off with cold water. This completes the cure. Behrund, in the Berlin Hospital, uses the following: Sublimed sulphur, 8 parts; liquid tar 8; soft soap 16; lanolin 16; and powdered pumice 5 parts. The objection to these methods consists in the harshness of the application and the artificial eruptions they excite.

Sulphur is useful in other diseases of the skin, and especially in *acne*, *alopecia pityrodes*, *sycosis*, and *tinea versicolor*, and in certain cases of *psoriasis*. In the last-named affection, unless very circumscribed, all sulphurous applications are painful and often aggravate the disease. In tinea versicolor sulphur baths and the internal use of sulphur waters should be conjoined. In the different forms of acne the seat of the eruption should every night be bathed with warm water to soften the skin, after which a paste made with flowers of sulphur and water, or an ointment prepared with equal parts of sulphur, potassium carbonate and simple ointment, should be smeared over the affected part and allowed to remain all night. In the morning it should be thoroughly washed off with soft water, with the addition, if necessary, of bran or Indian corn-meal, but without soap. A simpler but very efficient plan consists in dusting the skin with pure precipitated sulphur every night, after washing it with soft water. Tinea tonsurans, or *trichophyton*, is curable by sulphur ointment after the hair has been closely cropped. Chloasma, or *tinea versicolor*, is sometimes cured by drinking sulphurous mineral waters and by baths of the same, but whether by their local or by their indirect action is not easily determined.

The fumes of burning sulphur (v. Acidum Sulphurosum), conveyed into a wooden chest enclosing all of the patient but his head, have sometimes been used in the treatment, especially of inveterate cases, of cutaneous diseases, such as *eczema*, *psoriasis*, *impetigo*, and *prurigo*, and also for the cure of *rheumatic* and *scrofulous* affections, *paralysis*,

amenorrhœa, etc. The method, however, sometimes gave rise to great cutaneous irritation, syncope, etc., and is now seldom if ever employed. Pliny informs us that sulphur ointment rubbed upon the loins is serviceable in lumbago (lib. xxx. c. l.). This we stated long ago (*Therapeutics*, 4th ed., ii. 484), and also that O'Connor treated *sciatica* and chronic *rheumatism* by applying dry powdered sulphur with friction, followed by the use of flannel bandages (*Lancet*, Mar. 1855, p. 237), and that Geisler employed sulphur ointment in a similar manner (*Jour. f. Phar. u. Toxicol., etc.*, ii. 227). A few years since Fuller, in his work on rheumatism (3d ed. p. 472) states that this mode of using sulphur often subdues pain that has resisted other remedies. Guénau de Mussy, and later on Duchesne and Cowden, resorted to O'Connor's plan with success (*Therap. Gaz.*, xii. 276, 626; Barthol, *Cent. f. Therap.*, vii. 666). Sulphurous baths, both natural and artificial, have always enjoyed a great vogue, especially in the treatment of *rheumatism* and *gout* and of some *cutaneous affections*. For the former thermal waters are to be preferred, and for the latter partial douche baths are more efficacious than general baths, and are more useful in limited than in extensive eruptions. Sulphurous mineral waters generally contain earthy and alkaline sulphates, which render them, when taken internally, more or less laxative and diuretic, and therefore depurative, while the sulphurous acid disengaged from them in the body promotes diaphoresis. (See AQUÆ MINERALES.) Probably by the latter operation sulphur is useful as an internal remedy for chronic rheumatism, especially of the muscles and tendons, but not of the joints. It forms an ingredient of the laxative compound known as the "Chelsea pensioner," thus: ℞. Flowers of sulphur ʒij; Cream of tartar ʒj; Powdered rhubarb ʒij; Guaiacum ʒj; Clarified honey lb. j; one Nutmeg, finely powdered.—M. S. 2 large teaspoonfuls to be taken night and morning, and at bedtime a hot alcoholic draught. A lozenge containing 5 grains of precipitated sulphur and 1 grain of potassium bitartrate is recommended by Garrod for habitual use in *constipation*, etc.

In *chronic coughs* with profuse expectoration the virtues of sulphur are sometimes conspicuous. Its reputation in such affections at one time was so great as to obtain for it the title of *balsamum pulmonum*. It was often used for this purpose in the form of the compound liquorice powder, which is now more generally employed as a mild and efficient laxative. It has been claimed that sulphurous mineral waters are curative of certain cases of phthisis (Candellé, *Bull. de Thérap.*, cii. 305, 366). Undoubtedly, in certain cases they tend to eliminate the bronchitic element of the disease, but nothing more. (Compare Aitken, *Practitioner*, xxxi. 259; Dujardin-Beaumetz, *Bull. et Mém. Soc. thér.*, 1887, p. 200.) The mildness of the laxative operation of sulphur renders it appropriate in *piles;* for this and similar purposes it is often administered with cream of tartar, of each Gm. 4 (1 drachm), mixed with molasses.

Nebulized sulphurous waters are useful as a local application in *granular pharyngitis* and *chronic laryngitis*, and powdered sulphur itself was long ago recommended to be applied by insufflation to the same parts in *diphtheria* and *croup*, but of its efficacy there is not sufficient proof, at least in the latter disease. In the former, however, there is some reason for believing that finely-powdered or precipitated sulphur applied in this manner has had the effect of removing the exudation (Stuart, *Practitioner*, xxii. 248; xxiii. 272; Knaggs, *Therap. Gaz.*, xii. 153, 226; Osborne, *ibid.*, xiii. 357). But the arguments in its favor are more theoretical than clinical. It has been claimed that the fumes of sulphur arrest *whooping cough* (*Therap. Gaz.*, xi. 185). It is said that malarial fevers do not prevail where the air is impregnated with sulphurous emanations (D'Abbadie, *Practitioner*, xxix. 466).

Sulphur is given as a laxative in the *dose* of from Gm. 4–15 (gr. lx–ccl). For other purposes the dose is about Gm. 2 (gr. xxx). It may be administered in milk or molasses or other syrup.

SULPHURIS IODIDUM, *U. S., Br.*—SULPHUR IODIDE.

Sulfur iodatum, Iodurctum sulfuris.—Iodure de soufre, Fr.; *Jodschwefel*, G.

Preparation.—Washed Sulphur 20 Gm.; Iodine 80 Gm. Mix the sulphur and iodine thoroughly by trituration; introduce the mixture into a flask, close the orifice loosely and by means of a water-bath gradually and with occasional agitation apply a heat not exceeding 60° C. (140° F.) until the ingredients combine, which is indicated by the color becoming uniformly dark throughout the mixture. Then increase the heat to the boiling-point of the water, so as to fuse the mass. By inclining the flask unite any iodine which may have sublimed and condensed on the sides of the flask with the

fused mass, and then pour the latter out upon a porcelain plate or other suitable cold surface. After cooling break the product into pieces of suitable size, and keep them in a glass-stoppered bottle in a cool place.—*U. S.*, *Br.*

On warming a mixture of iodine and sulphur the two elements unite, and at a somewhat higher heat melt together. The operation is readily performed in an ordinary vial if this is carefully heated by means of a sand-bath. The use of washed sulphur directed by the U. S. P. is an unnecessary refinement in view of the qualities demanded for sublimed sulphur, the trace of acid present in the latter not affecting the quality of the preparation.

Properties.—Thus prepared, sulphur iodide is a grayish-black mass of a radiated crystalline appearance and with a metallic lustre. It resembles iodine in smell and taste, and on exposure to the air gradually loses iodine. If exposed to a gradually-increased heat, it sublimes, the first portion of the sublimate consisting of iodine, and the portion subsequently obtained containing sulphur; only a minute trace of fixed residue should be left. Sulphur iodide is insoluble in water, but dissolves in about 60 parts of glycerin, and is soluble in carbon disulphide, on the spontaneous evaporation of which at a low temperature iodine crystallizes first, and afterward rhombic pyramids of *sulphuric iodide* are obtained, having the formula SI_6 (Vom Rath, 1860), and on exposure to the air leaving sulphur in the form of a delicate crystalline skeleton (Lamers, 1861). Alcohol, ether, volatile oils, and cold solutions of potassa and of potassium iodide decompose sulphur iodide by dissolving the iodine. A similar decomposition is effected by boiling the sulphur iodide with water, with the vapors of which the iodine passes off, leaving a residue of sulphur amounting to 20 per cent. of the weight of the sulphur iodide employed; this is recommended as a test of purity by the U. S. P.

Composition.—Sulphur and iodine are employed in the proportion of their atomic weights, the compound being regarded as *sulphur subiodide*, S_2I_2. Guthrie (1861) obtained this compound in tabular crystals by acting with sulphur subchloride, S_2Cl_2, upon ethyl iodide, C_2H_5I.

Action and Uses.—Sulphur iodide was originally employed in the treatment of tuberculated *diseases of the skin* in an ointment which contained from 1 part of the iodide in 12 parts to 1 part in 3 parts of lard. It acts as a stimulant or caustic according to the strength of the ointment applied. It is seldom used, chiefly on account of its tendency to become decomposed. (See Ung. Plumbi Iodidi.)

SUMBUL, *U. S.*—Sumbul-root.

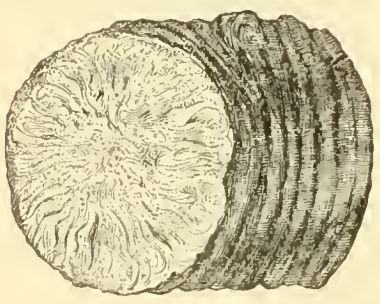
Sumbul radix, Br.; *Racine de sumbul*, Fr.; *Sumbulwurzel*, *Moschuswurzel*, G.

The root of Ferula (Euryangium, *Kauffmann*) Sumbul, *Hooker filius*, s. Sumbulus moschatus, *Reinsch*. Bentley and Trimen, *Med. Plants*, 131.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin.—The sumbul-plant is indigenous to Turkestan, Bucharia, Eastern Siberia, and probably to other parts of Central Asia, and was discovered by Fedschenko (1869) in the mountains of Maghian, south-eastward of Samarkand. It is a perennial growing to the height of 2.4 M. (8 feet), and has large, triangular, tripinnate radical leaves and a few small cauline leaves, the upper ones being reduced to sheathing bracts. The flowers are polygamous, and the fruit is about 12 Mm. (½ inch) long, oblong-oval, dorsally compressed, and when ripe is free from oil-tubes, but in the unripe state has in each mericarp four large dorsal and two small commissural vittæ. The root was sent to Western Russia in 1835 as a substitute for musk, and was afterward used in medicine.

Fig. 297.



Sumbul-root.

Description.—Sumbul-root enters commerce by way of Russia. It is spindle-shaped, simple, about 30 Cm. (12 inches) long, and is met with in transverse segments, varying in diameter from 2–15 Cm. (1 inch to 4 or 6 inches), and in thickness from 2–5 Cm. (¾ inch to 2 inches), occasionally intermixed with pieces scarcely 6 Mm. (¼ inch) in diameter. The root is light, of a spongy texture, annulate in the upper part, and below with longitudinal wrinkles, covered with a thin brown bark, is internally whitish, sprinkled with yellowish-brown resinous dots, and consists of white parenchyma and pale-brownish fibro-vascular bundles, which are easily separated, are irregular-wavy, and more numerous near the bark than in the centre. Sumbul-root breaks with an irregular, farinaceous, and

fibrous fracture, and has a strong, persistent musk-like odor and a bitter balsamic taste.

Constituents.—The ethereal tincture of sumbul-root, on being evaporated and treated with alcohol, leaves waxy matter behind, and on evaporating the alcoholic solution Reinsch's (1848) *sumbul balsam* is obtained, which on being heated in a narrow tube acquires a green afterward blue color, and subsequently yields oily distillates of a yellow, green, and blue color, and containing umbelliferon. When added to sulphuric acid the balsam acquires a purple color, and after having been heated with potassa it yields to a small quantity of water potassium angelicate, the potassium salt of *sumbulamic acid* remaining undissolved. Valerianic acid is probably likewise contained in the resinous extract. Murawjeff (1853) reported having obtained from sumbul-root an alkaloid, *sumbuline*, yielding crystallizable salts. The chemistry of sumbul-root requires further researches.

Allied Root.—In India a root is employed as sumbul-root which, according to Pereira, differs from the Russian root in being of a closer texture, firmer, denser, and of a more yellow tint. Dymock showed it to be the root of Dorema Ammoniacum, which has no musk-like odor.

Uses.—This root first attracted attention in Russia about 1835 as a specific for cholera—how uselessly the history of that disease demonstrates. Afterward its strong musky odor led to its being prescribed in various functional nervous disorders, including *hysteria* and *delirium tremens;* and compounds of it with iron, arsenic, etc. were used in *amenorrhœa* and *chlorosis*, and the benefit due to these metals was attributed to the sumbul associated with them. Its combined resin and essential oil caused it to be employed in mucous profluvia, such as chronic *bronchitis*, *leucorrhœa*, and *gleet*. It is now but little used. The *dose* of the root in powder is Gm. 0.60–1.30 (gr. x–xx). It has also been given in tincture and in syrup.

SUPPOSITORIA.—Suppositories.

Suppositoires, Fr.; *Stuhlzäpfchen*, G.

Suppositories are solid medicinal preparations intended to be introduced into the rectum or vagina, and of such a consistence that they will slowly melt at the temperature of the body or liquefy in the presence of moisture. The material best adapted for the vehicle is undoubtedly butter of cacao, since at ordinary temperatures it is sufficiently firm to be handled, and at the same time has such a low fusing-point that it will slowly but completely liquefy after introduction into the rectum. In addition to this, it is not prone to become rancid, and may be mixed with most medicinal substances commonly employed in this form of medication without having its fusing-point lowered. The volatile oils, camphor, carbolic acid, creosote, and chloral hydrate, exert a marked influence upon the consistence of cacao butter, and liquefy with it at a temperature lower than its fusing-point. But even these substances may be added in small quantities without occasioning unusual trouble in preparing the suppositories; if, however, added in full medicinal doses, the cacao butter may be replaced by about 10 per cent. of spermaceti.

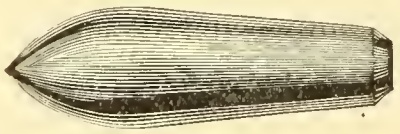
Recently (August, 1893) a change has been suggested by H. S. Wellcome of London in the shape of suppositories and bougies. It being well known that the old cone shape, and even the double cone shape, latterly employed operate considerably against retention of the suppository on account of the peculiar contraction of the sphincter muscles, a modification of the shape has been proposed, so as to allow of the introduction of the bulbous end of the suppository or bougie first, and thus ensure perfect retention by the reflex contraction of the sphincter. No patent or proprietary right being claimed for the improvement in shape, any pharmacist is at liberty to use it, and can procure suitable moulds for the same.

Figs. 298 and 299 show the shape and actual size of the improved bougies and suppositories.

In the selection of the base for suppositories the United States Pharmacopœia very properly follows the French Codex, while the British Pharmacopœia employs a mixture of cacao butter and wax, or curd soap with powdered starch or with starch and glycerite of starch. Suet is also occasionally used in Europe for this purpose. Another vehicle, which is more particularly adapted for vaginal suppositories, is a combination of 3 parts of gelatin, 7 of glycerin, and 1 of alcohol, as proposed by H. B. Brady.

The size of rectal suppositories adopted by the different pharmacopœias varies very much, their weight, according to the United States and British Pharmacopœias, being

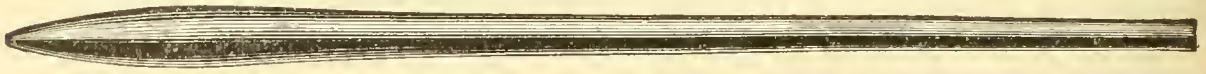
Fig. 298.



The "Wellcome"-shape Suppositories.

15 grains; according to the German Pharmacopœia, 2–3 Gm. (30–45 grains), and according to the French Codex 4, or for children 2, Gm. (60 or 30 grains).

Fig. 299.



The "Wellcome"-shape Bougies.

Preparation.—Suppositories are prepared by the following general formula: "Having weighed out the medicinal ingredient or ingredients, and the quantity of oil of theobroma required according to the kind of suppository to be prepared (see below), mix the medicinal portion (previously brought to a proper consistence, if necessary) with a small quantity of the oil of theobroma, by rubbing them together, and add the mixture to the remainder of the oil of theobroma, previously melted and cooled to the temperature of 35° C. (95° F.). Then mix thoroughly, without applying more heat, and immediately pour the mixture into suitable moulds. The moulds must be thoroughly chilled by being placed on ice or by immersion in ice-cold water, and the inner surface of the moulds should be carefully freed from adhering moisture before the melted mass is poured in.

In the absence of suitable moulds suppositories may be formed by allowing the mixture, prepared as above, to cool, care being taken to keep the ingredients well mixed, and dividing the mass into parts, of a definite weight each, of the proper shape.

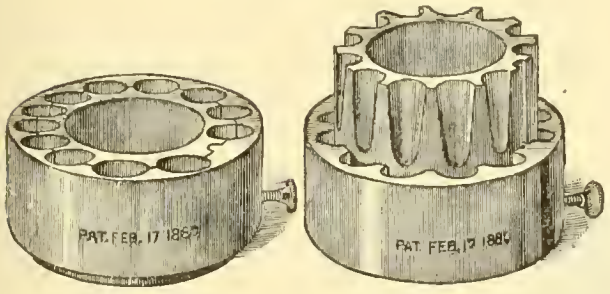
Unless otherwise specified, suppositories should have the following weights and shapes, corresponding to their several uses: *Rectal suppositories* should be cone-shaped, and of a weight of about 1 Gm. *Urethral suppositories* should be pencil-shaped, and of a weight of about 1 Gm. *Vaginal suppositories* should be globular, and of a weight of about 3 Gm."—*U. S.*

These directions are sufficiently minute for the proper preparation of suppositories having cacao butter for their base. The directions of the British Pharmacopœia when other vehicles are used are given below. In making suppositories with gelatin, this material is well soaked in water, and when thoroughly saturated and softened is melted together with the requisite quantity of glycerin, and the fused mass is mixed with the alcohol containing the medicinal substance in solution or suspension. Since tannin forms an insoluble compound with gelatin, drugs owing their virtue to tannin cannot be combined with this vehicle, which is likewise not well adapted for various salts unless the amount of gelatin be somewhat increased.

To obtain suppositories of a uniform shape, they are generally moulded. The simplest mould is made of thin writing-paper folded into the shape of a cone and having the edge secured with a little sealing-wax or paste; after the material has solidified the paper is unrolled. Or the moulds are made of pewter or other suitable metal and suspended in a tray, which is filled with cold water or fragments of ice to thoroughly chill the moulds before the melted mass is poured out. The suppositories will readily congeal, and may be removed by inverting the mould and striking it suddenly on a slab. Moulds have also been made of brass with a number of conical cavities of the desired size and shape, and arranged in such a manner that after the suppositories have congealed the mould may be taken apart either by removing the top portion or the sides, when the suppositories are easily lifted or pushed out by slight pressure. Serviceable suppository moulds may be made by the pharmacist from plaster of Paris, as was suggested by Charles E. Dwight (1872), by pouring the plaster, mixed with water to the consistence of thick cream, into a suitable vessel, and inserting into the soft mass a convenient number of wax suppositories in such a manner that the broad end is near one side, and the suppositories are

immersed only to one-half their diameter. When the plaster is set the wax is removed, the surface is smoothed with a knife, taking care that the edges of each mould be sharp, and small cavities are dug between the depressions. This represents one-half of the mould, the surface of which is well greased,

Fig. 300.



Sée's Suppository Mould.

Fig. 301.

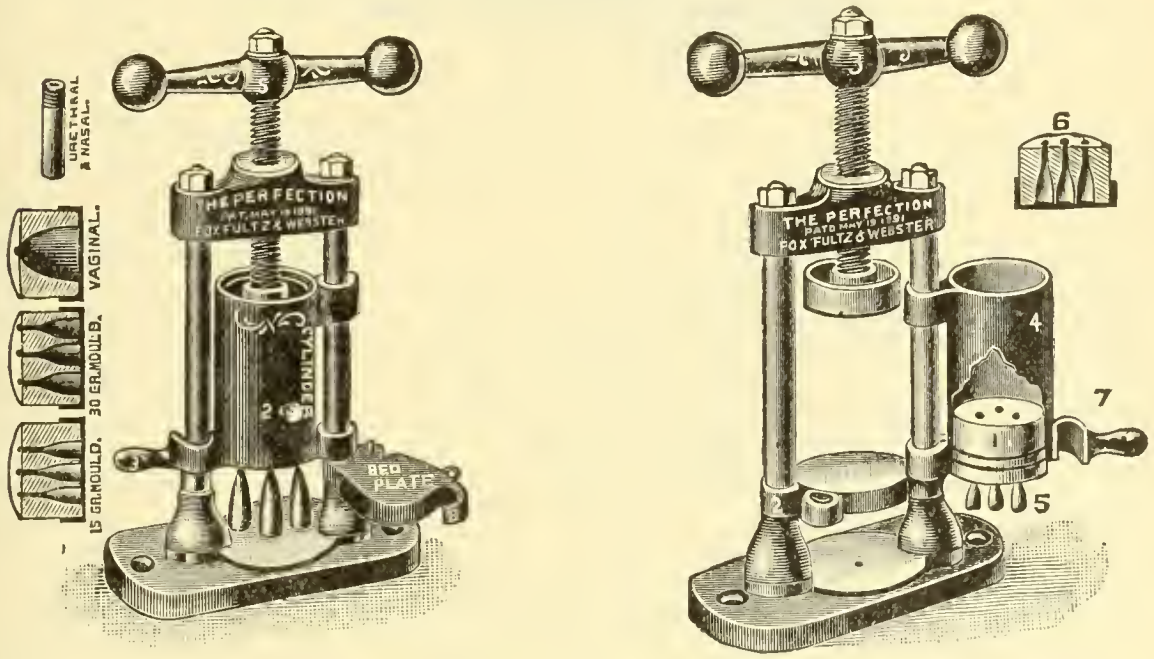
Hinged Suppository Mould.

and after replacing the wax the other half is obtained by pouring mixed plaster upon the greased surface to the depth of an inch or more. When hard the two parts can be easily separated, the edges trimmed off, and each part boiled for about an hour in linseed oil, which will prevent the adhesion of the substance to be moulded. The adhesion of suppositories to metallic moulds sometimes causes inconvenience; it is almost invariably due to the imperfect cleaning or to insufficient chilling of the moulds.

In making suppositories it is of importance that the medicinal ingredients are uniformly mixed with the vehicle, and if not soluble in the latter the rapid congelation of the mix-

Fig. 302.

a., closed. *b.*, open.



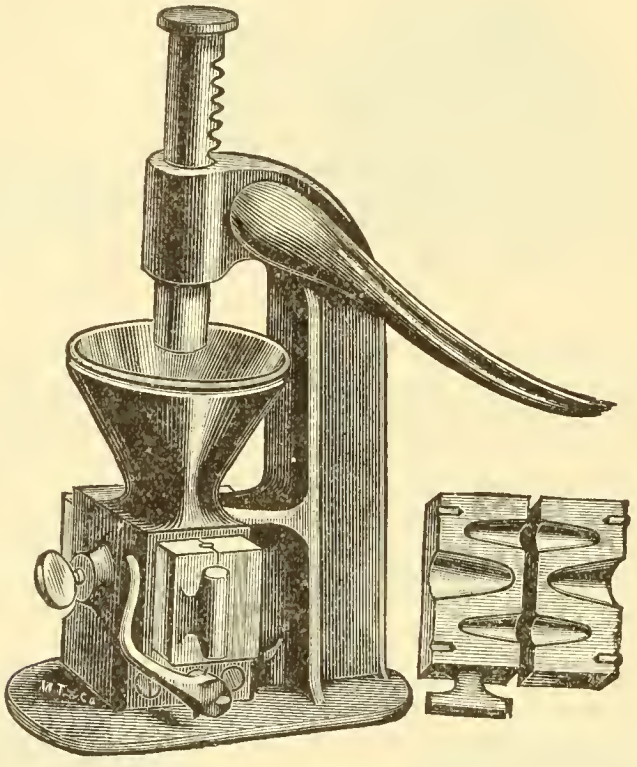
The "Perfection" Suppository Mould.

ture after it has been poured into the moulds is absolutely necessary. The difficulty thus experienced has led many pharmacists to abandon this method and prepare suppositories by a process rendering fusion of the cacao butter unnecessary. This vehicle is either grated or by means of a sharp knife cut into very thin slices, and mixed by trituration, either in a mortar or on a slab, with the other ingredients; in this condition the mass may be easily rolled out, in the same manner as a pill mass, and cut into the requisite number of pieces, each of which is then shaped into a cone with the fingers or a spatula. Several apparatuses have been constructed by means of which the mass, as obtained by mixing the cold ingredients, may be compressed into conical moulds.

Figs. 302 and 303 represent two moulds for making suppositories without the use of heat: by the cold method any possible damage to the ingredients by over-heating, as well as separation of the mixture, is entirely obviated, and, moreover, the suppositories can be dispensed in far less time. Both moulds are extensively used, the "Perfection" possessing the advantage of compressing three rectal suppositories at once.

Special formulas for suppositories are no longer given by the U. S. Pharmacopœia, except in one instance, but the following synopsis explains the composition and manipu-

Fig. 303.



W. T. & Co.'s Cold Compression Mould.

lation for those which were recognized by the U. S. P. 1870; twelve suppositories are made in each case:

Suppositoria.	Medicinal ingredients.	Incorporate with cacao butter.	Add to cacao butter.
Acidi carbolici.	Carbolic acid 12 grains.	60 grains.	108 grains.
Acidi tannici.	Tannin 60 grains.	60 "	60 "
Aloes.	Powd. purif. aloes 60 grains.	60 "	60 "
Asafœtidæ.	Tinct. of asafetida 1 fluidounce; evaporate spontaneously.	60 "	80 "
Belladonnæ.	Alcoh. extract of belladonna 6 grains; water sufficient.	60 "	114 "
Morphiæ.	Morphine sulphate 6 grains.	60 "	114 "
Opii.	Extract of opium 12 grains; water sufficient.	60 "	108 "
Plumbi.	Lead acetate 36 grains.	60 "	84 "
Plumbi et opii.	Lead acetate 36 grains; extract of opium 6 grains; water sufficient.	60 "	80 "

Urethral suppositories are made in precisely the same manner as those intended for use in the rectum or vagina, the chief difference being in the shape, which should be cylindrical and slender, and in the greater stiffness of the vehicle. J. L. Lemberger (1871) made use of the well-known candle-mould, modified merely by making the tubes much smaller; and others have forced the mixture of cacao butter, wax, and medicinal substances through a narrow tube, and cut the cylinders thus obtained into pieces of a suitable length.

SUPPOSITORIA ACIDI CARBOLICI CUM SAPONE, *Br.*—Carbolic Acid Suppositories.

Suppositoires d'acide phénique, Fr.; *Carbolsäure-Stuhlzäpfchen*, G.

Preparation.—Take of Carbolic Acid 12 grains; Curd Soap, in powder, 180 grains; Glycerin of Starch 40 grains or a sufficiency. Mix the ingredients so as to form a paste of suitable consistence. Divide the mass into twelve equal parts, each of which is to be made into a conical or other convenient form for a suppository. Each suppository contains 1 grain of carbolic acid.—*Br.*

Uses.—This suppository is disinfectant and stimulant, and may be used in chronic *dysentery*, *hæmorrhoids*, *cancer*, and other diseases of the *rectum* attended with mucous, purulent, or bloody secretions or with fetor.

SUPPOSITORIA ACIDI TANNICI, *Br.*—Tannic Acid Suppositories.

Suppositoires de tannin, Fr.; *Tannin-Stuhlzäpfchen*, G.

Preparation.—Take of Tannic Acid 36 grains; Oil of Theobroma 144 grains. Rub the tannic acid with 44 grains of the oil of theobroma in a slightly warmed mortar, and add them to the remainder of the oil of theobroma previously melted at a low temperature; mix thoroughly, and pour the mixture while it is fluid into suitable moulds of the capacity of 15 grains; or the fluid mixture may be allowed to cool, and then be divided into twelve equal parts, each of which shall be made into a conical or other convenient form for a suppository.—*Br.*

Suppositoria acidi tannici cum sapone. Take of tannic acid 36 grains; glycerin of starch 30 grains; curd soap, in powder, 100 grains; starch, in powder, a sufficiency. Mix the tannic acid with the glycerin of starch and soap, and add sufficient starch to form a paste of suitable consistence. Divide the mass into twelve equal parts, each of which is to be made into a conical or other convenient form for a suppository.—*Br.*

Uses.—Tannic-acid suppositories are chiefly used to allay rectal or vaginal irritation, diminish local discharges, and constringe the flabby mucous membrane of these parts.

SUPPOSITORIA GLYCERINI, *U. S., Br. Add.*—Glycerin Suppositories.

Suppositoires de glycerin, Fr.; *Glycerin-Stuhlzäpfchen*, G.

Preparation.—Glycerin 60 Gm.; Sodium Carbonate 3 Gm.; Stearic Acid 5 Gm., to make 10 rectal suppositories. Dissolve the sodium carbonate in the glycerin in a capsule on a water-bath; then add the stearic acid, and heat carefully until this is dissolved and the escape of carbon dioxide has ceased. Then pour the melted mass into suitable moulds, remove the suppositories when they are cold, and wrap each in tin-foil. These suppositories should be freshly prepared when required.—*U. S.*

To make 1 dozen glycerin suppositories use glycerin 1111 grains, sodium carbonate 56 grains, and stearic acid 93 grains.

Take of gelatin, cut small, ½ oz.; glycerin, by weight, 2½ ounces; distilled water a sufficiency; place the gelatin in a weighed evaporating-dish with sufficient water to cover it; after allowing it to stand for a minute or two, pour away the excess of water; set aside until the gelatin is quite soft, then add the glycerin. Dissolve over a water-bath, and evaporate until the mixture weighs 1560 grains. Pour the product into suppository moulds holding 30, 60, or 120 grain-measures, or having other capacities as required. Each suppository contains 70 per cent. by weight of glycerin.—*Br.*

The two formulas differ somewhat: the mass made by the U. S. P. formula contains about 20 per cent. more of glycerin than that of the Br. Ph. In the former, sodium stearate is obtained as a result of the reaction between sodium carbonate and stearic acid; thus, $Na_2CO_3.10H_2O + 2HC_{18}H_{35}O_2 = 2NaC_{18}H_{35}O_2 + CO_2 + 11H_2O$. If all the water be expelled, the official mass will weigh about 66.52 Gm. and contain 90 per cent. of glycerin. Each official glycerin suppository will weigh about 6.652 Gm. (102 grains).

Uses.—Suppositories of glycerin can only act mechanically to promote an action of the rectum. In structural diseases of this bowel they are less eligible than liquid or semi-liquid enemas.

SUPPOSITORIA HYDRARGYRI, *Br.*—Mercurial Suppositories.

Suppositoires mercuriels, Fr.; *Mercurial-Stuhlzäpfchen*, G.

Preparation.—Take of Ointment of Mercury 60 grains; Oil of Theobroma 120 grains. Melt the oil of theobroma with sufficient heat, then add the ointment of mercury, and, having mixed them thoroughly, without applying more heat, immediately pour the mixture, before it has congealed, into suitable moulds of the capacity of 15 grains; or, the fluid mixture may be allowed to cool, and then be divided into twelve equal parts, each of which shall be made into a conical or other convenient form for a suppository.—*Br.*

Uses.—These suppositories appear to have been contrived for the purpose of affecting the system with mercury when for any reason it cannot be administered by the mouth.

SUPPOSITORIA MORPHINÆ, *Br.*—Morphine Suppositories.

Suppositoires morphinés, Fr.; *Morphin-Stuhlzäpfchen*, G.

Preparation.—Take of Morphine Hydrochlorate 6 grains; Oil of Theobroma 174 grains. Rub the morphine hydrochlorate with 24 grains of the oil of theobroma in a slightly warmed mortar, and add this to the remainder of the oil previously melted at a low temperature; mix the whole thoroughly, and pour the mixture while it is fluid into suitable moulds of the capacity of 15 grains; or, the fluid mixture may be allowed to cool, and then be divided into twelve equal parts, each of which shall be made into a conical or other convenient form for a suppository, which will contain ½ grain of morphine hydrochlorate.—*Br.*

Suppositoria morphinæ cum sapone. Take of morphine hydrochlorate 6 grains; glycerin of starch 30 grains; curd soap, in powder, 100 grains; starch, in powder, a sufficiency. Mix the morphine hydrochlorate with the glycerin of starch and soap, and add sufficient starch to form a paste of suitable consistence. Divide the mass into twelve equal parts, each of which is to be made into a conical or other convenient form for a suppository.—*Br.*

Uses.—Each of these suppositories contains Gm. 0.03 (½ grain) of morphine hydrochlorate, which is quite too large a dose for ordinary use.

SUPPOSITORIA PLUMBI COMPOSITA, *Br.*—Compound Lead Suppositories.

Suppositoires de plomb opiacés, Fr.; *Stuhlzäpfchen von Opium und Bleizucker*, G.

Preparation.—Take of Lead Acetate 36 grains; Opium, in powder, 12 grains; Oil of Theobroma 132 grains. Rub the lead acetate and opium with 42 grains of the oil of theobroma in a slightly warmed mortar, and add them to the remainder of the oil previously melted at a low temperature; mix the whole thoroughly and pour the mixture while it is fluid into suitable moulds of the capacity of 15 grains; or, the fluid mixture may be allowed to cool, and then be divided into twelve equal parts, each of which shall be made into a conical or other convenient form for a suppository.—*Br.*

Uses.—The combined astringent, soporific, and anodyne qualities of these suppositories render them appropriate in many affections of the *rectum*, *vagina*, and *uterus* attended with altered secretion and pain, such as *leucorrhœa*, *diarrhœa*, *dysentery*, *cancer*, etc.

SYMPHYTUM.—Comfrey-root.

Radix symphyti, Radix consolidæ majoris.—Consoude, Fr.; *Schwarzwurz, Beinwurz*, G.

The root of Symphytum officinale, *Linné.*

Nat. Ord.—Boraginaceæ.

Origin.—Comfrey is a European perennial growing on the banks of streams and in meadows, and now found in similar places in the United States, where it has escaped from gardens. It is a coarse-looking plant, with a bristly stem .5–1 M. (20 to 40 inches) in height, and with lance-ovate or lanceolate alternate and rough leaves, which are narrowed into a winged petiole. The flowers are in racemose cymes, have a five-toothed calyx and a tubular bell-shaped yellowish white or purplish corolla, with spreading teeth and linear scales closing the throat, and produce four smooth, glossy, brown-black akenes. The flowers appear in June. The root is collected in autumn or early in spring, and yields about 20 per cent. of air-dry drug.

Description.—Comfrey-root is fleshy, 15–20 Cm. (6 or 8 inches) long, about 25 Mm. (an inch) thick above, several-headed, tapering, and with few branches. After drying it is deeply wrinkled longitudinally, often bent, of a purplish-black color externally, and breaks readily with an even somewhat waxy fracture, or in damp weather is rather tough. The bark is about one-eighth the diameter of the root, and has a thick black, corky layer, the inner bark being whitish. The meditullium consists of broad medullary rays and narrow wood-wedges, and is of a whitish color, or when old brownish. Comfrey-root is inodorous, and has a mucilaginous, sweetish, and faintly astringent taste.

Constituents.—The most important principle contained in comfrey-root appears to be the large quantity of *mucilage*. The root contains also sugar, a little tannin, and a few starch-granules, but acquires with iodine only a brown, not a blue, color. Plisson (1829) isolated from the root a small quantity of *asparagin*.

Uses.—Comfrey-root is both demulcent and astringent, and was esteemed in ancient

times for hastening the cure of bruises and the cicatrization of wounds; hence its name, *consolida*. A popular method in France of treating *fissures of the nipple* is to apply a hollow section of the fresh root over the sore organ. A decoction of it is prescribed in *hæmoptysis*, *hæmaturia*, *metrorrhagia*, *diarrhœa*, and *dysentery*. It is made with Gm. 8–16 in Gm. 500 (℥ij–iv in Oj) of water.

SYRUPI.—Syrups.

Sirops, Fr.; *Sirupe*, G.

Syrups are concentrated solutions of sugar in water or in aqueous or very slightly alcoholic solutions of medicinal substances. In a few instances vinegar or dilute acetic acid is the solvent, and in Europe certain syrups are made with wine. Syrup made of sugar and water is called *simple syrup;* all others are distinguished as *medicated syrups*, and these may be again classified into *simple* and *compound medicated syrups*, in accordance with the number of drugs represented by them.

Preparation.—In preparing syrups only the best refined sugar should be employed, which is free from impurities, and when dissolved in water is less prone to fermentation than partially-refined sugar. Most pharmacopœias direct the syrups to be prepared with the aid of heat. The necessary quantity of sugar is mixed with the liquid, a moderate heat is applied to the mixture, and this is frequently stirred until the sugar is dissolved, when the heat is raised to the boiling-point, and the syrup is strained for the purpose of removing dust and other accidental impurities that may have been contained in the sugar and albumen, which is coagulated by heat from some aqueous infusions of drugs. After straining, the U. S. Pharmacopœia directs the volume of simple syrup to be adjusted by passing a sufficient quantity of water through the strainer. In following these directions literally the syrup may become too much diluted through the use of a large-sized strainer, which, with the vessel in which the syrup was made, would retain considerable of the latter; the strainer should therefore be as small as possible, and water equal to only about one-half the weight to be made up should be used until the vessel and strainer have been thoroughly rinsed with it, when more water may be added. All undue dilution may be avoided by ascertaining the volume of the syrup previous to straining, and afterward rinsing the vessel and strainer only with sufficient water to make up the difference. The German Pharmacopœia very properly directs the adjustment of the weight to be made *before* the syrup is strained or filtered.

With three exceptions, all syrups of the U. S. P. are directed to be made by dissolving the sugar in the proper liquid without heat, with the view of avoiding the evaporation of volatile ingredients and the inverting influence of hot acid liquids upon the cane-sugar. L. Orynski (1871) proposed to extend this process to all syrups, and the method has been found by R. Hunstock (1875) and others not only much easier and more economical than the process involving the use of heat, but likewise to yield syrups which, as a rule, are less liable to ferment. This latter quality may probably be directly referred to the avoidance of heat, since the continued application of heat is known to produce changes in the sugar resulting in the formation of glucose. Simple syrup, made by dissolving the sugar at the boiling-point very soon after it has been prepared, reduces alkaline solutions of copper, showing the formation of grape-sugar, while simple syrup made from the same sugar, but without heat, forms grape-sugar more slowly. This so-called *cold process* for preparing syrups therefore deserves the attention of pharmacists. The menstruum is in all cases prepared as directed by the Pharmacopœia; the requisite quantity of sugar is then introduced into a conical percolator, the lower orifice of which is closed with a cork, and into the neck of which a piece of loose sponge or cotton, previously moistened, is introduced. The liquid is now poured into the percolator, and the whole set aside in a moderate temperature until the sugar has been partially dissolved and melted down to about one-half of its original volume, when the cork may be removed and the syrup allowed to drop; it should be perfectly clear and transparent, or the turbid portion returned to the percolator. If the sugar is not all dissolved when the liquid has passed, this is to be again percolated through the sugar. With proper management a repetition of the process will be rarely required. Syrups prepared in this manner with perfect emulsions will be opaque. If made with aqueous infusions of drugs, such syrups will contain the soluble albuminous principles, and probably not be quite as unchangeable as those prepared with the aid of heat; but if the drug had been exhausted by an

alcoholic liquid, as directed by the U. S. P. for most of the syrups to which these remarks apply, albumen is not present.

If heat is employed, as directed by the pharmacopœias for most syrups, the loss occasioned by evaporation should be rectified by the addition of water. This is easily accomplished by taking the weight of the vessel with its contents before and after boiling, and adding enough water to compensate for the loss occasioned by heating. If clarification by means of white of egg should be necessary, this is best added to the cold aqueous liquid. Paper-pulp may be used for the same purpose.

The preparation of the aqueous liquid used for dissolving the sugar is of great importance. The pharmacopœias have very properly discarded the exhaustion of the crude drugs by boiling them with water, since thereby starch and other principles are dissolved which easily undergo chemical changes, and interfere with the stability of the syrups. The United States Pharmacopœia has, for the same reasons, abandoned the employment of hot water in exhausting the drugs. The most stable medicated syrups are obtained if the drug is treated with cold water, diluted alcohol, or alcohol, as the case may be, either by maceration or preferably by percolation. For this part of the process all the precautions are required which have been pointed out in another place (see pp. 639–643). The percolate is concentrated, and, if necessary, deprived of alcohol, particular care being required to prevent the evaporation of volatile principles and the change of others by the influence of an elevated temperature. Filtration of the concentrated liquid is usually required, and it should be borne in mind that it is much easier to pass a concentrated aqueous infusion of a drug or an aqueous solution of an alcoholic extract through a filter than to perform the same operation with a syrup.

The proper proportion of sugar to menstruum ensures the stability of the syrup. Should the sugar be deficient in quantity, it could not efficiently protect the other organic principles contained in the syrup, and it would be liable to ferment. On the other hand, if too much sugar be employed, the excess would crystallize after cooling, and dispose an additional quantity to separate in a like manner, thus leaving the syrup weaker in sugar than it should be, and subject to similar alterations as if an insufficient quantity of sugar had been used. The proper proportion of sugar is a little less than twice the weight of water, or 35 parts of water to 65 parts of sugar. For colder climates a little more water may be employed; the German Pharmacopœia directs 40 parts of water to 60 parts of sugar. If the liquid contains already much organic matter in solution or if it is partially alcoholic, a correspondingly smaller amount of sugar will be required.

A process was recommended by Isaac Davis (1878) in which the principle adopted by Orynski is still further extended. Mr. Davis proposed to make the medicated syrups by percolating the powdered drugs with simple syrup prepared by the cold process.

(For remarks on the preparation of *fruit-syrups* see Syrupus Mori and Syr. Rubi Idæi.)

Preservation.—The finished syrups should be introduced into dry bottles, so as to avoid diluting them with water; if bottled while warm, condensation of aqueous vapors in the neck of the bottle will cause dilution of the upper stratum and disposition to fermentation, unless the syrup be thoroughly mixed after cooling. Properly prepared, syrups may generally be kept unaltered, even in partially filled bottles, at the ordinary temperatures, but it is best to keep them in a place where the temperature will not vary materially between about 15° and 20° C. (59° and 68° F.). The addition of small quantities of spirit of ether, Hoffmann's anodyne, potassium chlorate, and more recently of salicylic acid, has been recommended for the purpose of preserving syrups; but all these additions are more or less objectionable, and generally unnecessary if, in the exhaustion of the drug, heat is avoided.

Restoration.—When fermentation sets in, the carbon dioxide disengaged causes the syrups to assume a frothy appearance, and a vinous odor is noticed. As soon as these signs make their appearance the syrup should be heated to boiling, strained, and afterward properly preserved. The medicinally active principles will rarely have undergone any alteration, except in the case of syrups of acacia and of almond; but syrups which owe their virtues wholly or in part to volatile principles, or in which fermentation has proceeded beyond the incipient stage, cannot be thus restored without being impaired in their properties. For syrups prone to fermentation the employment of glycerin in place of a corresponding quantity of liquid and sugar has been recommended.

Properties.—Syrups should be perfectly transparent, with the few exceptions noted below. When heated to boiling they have the density indicated by 30° B. = 1.26,

F. Cod. At 15° C. (59° F.) the density of simple syrup is 1.317 (*U. S.*), 1.32 (*F. Cod.*), 1.330 (*Br.*), and most of the medicated syrups have about the same specific gravity. The employment of magnesium carbonate in the preparation of syrups renders them unfit for being dispensed with salts of morphine, strychnine, or other poisonous alkaloids. (See AQUÆ MEDICATÆ, p. 246.)

SYRUPUS, *U. S., Br.*—SYRUP.

Syrupus simplex, P. G.; *Syrupus sacchari*, F. Cod.; *Syr. albus.—Simple syrup*, E.; *Sirop de sucre, Sirop simple*, Fr.; *Weisser Sirup*, G.

Preparation.—Sugar, in coarse powder, 850 Gm.; Distilled Water a sufficient quantity; to make 1000 Cc. Dissolve the sugar, with the aid of heat, in 450 Cc. of distilled water, raise the temperature to the boiling-point, strain the liquid, and pass enough distilled water through the strainer to make the product, when cold, measure 1000 Cc. Mix thoroughly.—*U. S.*

Syrup may also be prepared in the following manner: Into the neck of a percolator or funnel of suitable size fit a tapering piece of coarse, well-cleaned sponge, not too tightly, and in such a manner that the upper end of the sponge be about half an inch within the outlet-tube or stem. Place the sugar in the apparatus, make its surface level without shaking or jarring, then carefully pour on 450 Cc. of distilled water, and regulate the flow of the liquid, if necessary, so that it will pass out in rapid drops. Return the first portions of the percolate until it runs through clear, and, when all the liquid has passed, follow it by distilled water, added in portions, so that all the sugar may be dissolved, and the product measure 1000 Cc. Mix thoroughly.—*U. S.* To make 1 gallon of simple syrup dissolve 7 lbs. 1½ av. oz. of sugar in 61 fluidounces of distilled water, and when cold add sufficient distilled water to bring the volume to 1 gallon.

The official syrup thus prepared has the specific gravity 1.317, and contains 64.54 per cent. of sugar. The British Pharmacopœia orders 5 pounds of sugar and sufficient distilled water to make 7½ pounds of syrup, which contains 66.667 per cent. of sugar, and is stated to have the density of 1.330. The French Codex orders 64.286 per cent. of sugar, and gives the density 1.32.

Pharmaceutical Uses.—Simple syrup is used in the preparation of certain confections, mixtures, and syrups, and as an excipient in several pill masses.

Uses.—Syrup—or "simple syrup," as it was formerly and more definitely called—is a most important member of the Pharmacopœia, not only because it preserves medicines associated with it from undergoing change, but because it renders them more acceptable to the palate and mitigates their action upon the alimentary canal. It should, however, not be used in large doses nor for a long time together, lest it impair the appetite and digestion. It may be employed as a protective for superficial *burns* and *abrasions*.

SYRUPUS ACACIÆ, *U. S.*—SYRUP OF GUM-ARABIC.

Syrupus gummosus.—Sirop de gomme, Fr.; *Gummisirup*, G.

Preparation.—Mucilage of Acacia, recently prepared, 25 Cc.; Syrup 75 Cc.; to make 100 Cc. Mix them. This syrup should be freshly made when required for use. —*U. S.*

This is the formula of the P. G. 1872, from the revised edition of which this syrup has been dismissed. While it is desirable to prepare this syrup extemporaneously, it should be remembered that mucilage of acacia which is not preserved by sugar is readily altered on exposure, and likely to induce decomposition when used in mixtures; it is therefore important that the mucilage be of good quality.

The formula of the French Codex is similar to the following, which is the formula of the U. S. P. 1870: Dissolve 2 troyounces of gum-arabic in 8 fluidounces of water, without heat; then, having added 14 troyounces of sugar, dissolve it with a gentle heat and strain.

Uses.—Syrup of gum-arabic is chiefly used to aid in suspending more active substances in mixtures and impart an agreeable flavor to them, as a demulcent in catarrhal affections of the *throat* and *larynx*, and as a palatable addition to drinking water.

SYRUPUS ACIDI CITRICI, *U. S.*—SYRUP OF CITRIC ACID.

Sirop d'acide citrique, Sirop de limon, Fr.; *Citronsäuresirup*, G.

Preparation.—Citric Acid 10 Gm.; Water 10 Cc.; Spirit of Lemon 10 Cc.; Syrup

a sufficient quantity; to make 1000 Cc. Dissolve the citric acid in the water, and mix the solution with 500 Cc. of syrup. Then add the spirit of lemon, and lastly enough syrup to make the product measure 1000 Cc. Mix thoroughly.—*U. S.*

To make a quart of syrup of citric acid will require 144 grains of citric acid, 2½ fluidrachms each of water and spirit of lemon, and sufficient syrup to bring the volume of the finished product up to 32 fluidounces.

Uses.—This syrup is used as a flavoring ingredient chiefly. It is intended as a substitute for lemon syrup made from the recent fruit, for which, however, it is by no means an equivalent.

SYRUPUS ACIDI HYDRIODICI, *U. S.*—Syrup of Hydriodic Acid.

Sirop d'acide iodhydrique, Fr.; *Jodwasserstoffsirup*, G.

A syrupy liquid containing about 1 per cent. by weight of absolute hydriodic acid, (HI, molecular weight 127.53), or about 1.3 Gm. in 100 Cc.

Preparation.—Potassium Iodide 13 Gm.; Potassium Hypophosphite 1 Gm.; Tartaric Acid 12 Gm.; Water 15 Cc.; Diluted Alcohol, Syrup, each, a sufficient quantity to make 1000 Gm. Dissolve the two potassium salts in the water, and the tartaric acid in 25 Cc. of diluted alcohol. Mix the two solutions in a vial, shake it thoroughly, and place it in ice-water for half an hour, occasionally shaking. Then filter the mixture through a small, rapidly-acting, white filter, and carefully wash the vial, and filter with diluted alcohol until the filtrate ceases to produce more than a faint cloudiness when a drop or two is allowed to fall into silver nitrate test-solution. Reduce the filtrate, by evaporation in a tared capsule on a water-bath, to 50 Gm., and mix it, when cold, with enough syrup to make the product weigh 1000 Gm.—*U. S.*

To make 1 pint of syrup of hydriodic acid use 125 grains of potassium iodide, 9.5 grains of potassium hypophosphite, 114 grains of tartaric acid, 2½ fluidrachms of water, ½ fluidounce of diluted alcohol, and syrup a sufficient quantity; the dilute solution of hydriodic acid must be evaporated to 480 grains, and then sufficient syrup added to bring the volume up to 16 fluidounces.

The present official formula is much simpler than that of 1880, and at the same time yields a more permanent preparation, the addition of a small quantity (0.1 per cent. by weight) of potassium hypophosphite tending to improve the stability of the syrup. Though we have no proof that the potassium hypophosphite remains unaffected by the tartaric acid, the Pharmacopœia assumes such to be the case, and directs a quantity of potassium iodide and tartaric acid sufficient to yield 10 Gm. of hydriodic acid, according to the following equation: $KI + H_2C_4H_4O_6 = HI + KHC_4H_4O_6$. The acid potassium tartrate, being insoluble in cold diluted alcohol, is precipitated, while the acid remains in solution, and is obtained by filtration and subsequent washing of the precipitate with diluted alcohol. 1000 Gm. of the finished syrup will measure very nearly 762 Cc., or about 25¾ fluidounces, and contains in each Cc. about 0.013 Gm., or in each fluidrachm about ¾ grain of hydriodic acid.

Properties.—This syrup is described as "a transparent, colorless, or not more than pale straw-colored liquid, odorless, having a sweet and acidulous taste"; spec. grav. about 1.313 at 15° C. (59° F.). If a small portion of the syrup be mixed with a little starch solution and a few drops of chlorine-water then added, the liquid will acquire a deep-blue color.—*U. S.* Sugar will in a measure, but not completely, prevent the oxidation of the acid and the liberation of iodine; hence a pale straw-color of the otherwise colorless syrup is permitted.

Tests.—"Gelatinized starch added to the syrup should not impart to it more than a faint bluish tint (limit of free iodine). Test-solution of silver nitrate produces a pale-yellow precipitate which is nearly insoluble in water of ammonia. If 32 (31.88) Gm. of the syrup be exactly neutralized by ammonia-water, and then mixed with 2 drops of potassium chromate test-solution, it should require about 25 Cc. of decinormal silver nitrate solution to produce a permanent red tint of silver chromate (corresponding to about 1 per cent. of absolute hydriodic acid)."—*U. S.*

Uses.—As was mentioned under Hydriodic Acid, the virtues of that compound are chiefly of a local stimulant and caustic nature: the evidence of its utility as an internal medicine are, in our judgment, too slender to entitle it to an officinal position in the comparatively stable form of a syrup. The *dose* of the syrup is stated to be Gm. 4 (fʒj), largely diluted. It has been given in chronic *bronchitis*, chronic *malarial poisoning*, etc. It appears to be a superfluous addition to the Pharmacopœia.

SYRUPUS ALLII, *U. S.*—Syrup of Garlic.

Sirop d'ail, Fr.; *Knoblauchsirup*, G.

Preparation.—Fresh Garlic, sliced and bruised, 200 Gm.; Sugar 800 Gm.; Diluted Acetic Acid a sufficient quantity; to make 1000 Cc. Macerate the garlic with 300 Cc. of diluted acetic acid during four days, and express the liquid, avoiding the use of metallic utensils. Then mix the residue with 200 Cc. more of diluted acetic acid, and again express. Mix the expressed liquids and filter. Pour the filtrate upon the sugar contained in a suitable vessel, and stir or agitate until the sugar is dissolved. Lastly, add enough diluted acetic acid to make the product measure 1000 Cc., and mix thoroughly. Keep the syrup in well-stoppered, completely-filled bottles in a cool place.—*U. S.*

Syrup of garlic may also be prepared in the following manner: Prepare a percolator or funnel in the manner described under Syrupus. Pour the filtrate obtained as directed in the preceding formula upon the sugar, return the first portions of the percolate, until it runs through clear, and, when all the liquid has passed follow it by diluted acetic acid until the product measures 1000 Cc. Mix thoroughly.—*U. S.*

To make 1 quart of syrup of garlic prepare 14 fluidounces of an acetous infusion by treating 6¾ av. ozs. of fresh garlic with dilute acetic acid a sufficient quantity; add 26½ av. ozs. of sugar, and finally enough diluted acetic acid to bring the volume up to 32 fluidounces.

Thus prepared, syrup of garlic is somewhat opalescent and has the odor of the drug in a marked degree.

Uses.—This is the form in which garlic is generally employed internally. It is very commonly used in subacute and chronic *catarrhs* of the respiratory passages in children and infants, and particularly in the decline of *whooping cough*. The *dose* is about Gm. 4 (ʒj).

SYRUPUS ALTHÆÆ, *U. S., P. G.*—Syrup of Althæa.

Syrup of marshmallow, E.; *Sirop de guimauve*, Fr.; *Eibischsaft*, G.

Preparation.—Althæa, cut into small pieces, 50 Gm.; Alcohol 30 Cc.; Glycerin 100 Cc.; Sugar 700 Gm.; Water a sufficient quantity; to make 1000 Cc. Wash the althæa with cold water, then macerate it with 400 Cc. of water, previously mixed with the alcohol, during one hour, stirring frequently, and strain without expressing. In the strained liquid dissolve the sugar by agitation, without heat, add the glycerin, and enough water to make the product measure 1000 Cc., and mix thoroughly.

Keep the syrup in well-stoppered, completely filled bottles in a cool place. This preparation does not keep well. Unless in constant demand, it should be freshly made when required.—*U. S.*

This is the formula of the P. G., with the marshmallow-root somewhat increased, and the addition of glycerin equal to one-tenth of the total volume of finished product, whereby it is intended to improve the stability of the syrup. Cold water must be used for maceration to avoid dissolving the starch, but the duration of maceration may very properly be prolonged for one or two hours.

The syrup has a yellowish color and a slight agreeable odor.

To prepare ½ pint of syrup of marshmallow macerate 195 grains of washed althæa-root for one or two hours, stirring occasionally, in a mixture of 3½ fluidounces of cold water and 2 fluidrachms of alcohol; strain without expression, and in the strained liquid dissolve 6 av. ozs. of sugar, finally adding 7 fluidrachms of glycerin and sufficient water to bring the volume up to 8 fluidounces.

Uses.—This syrup is universally employed in France to sweeten ptisans used in sore throat and inflammations of the air-passages.

SYRUPUS AMYGDALÆ, *U. S.*—Syrup of Almond.

Syrupus amygdalarum, P. G.; *Syr. emulsivus*, *Sirop d'amande*, *Sirop d'orgeat*, Fr.; *Mandelsirup*, G.

Preparation.—Sweet Almond 140 Gm.; Bitter Almond 40 Gm.; Sugar 200 Gm.; Orange-flower Water 100 Cc.; Water 130 Cc.; Syrup, a sufficient quantity; to make 1000 Cc. Having blanched the almonds, rub them in a mortar to a very fine paste, adding during the trituration 30 Cc. of water and 100 Gm. of sugar. Mix the paste

thoroughly with the orange-flower water and 200 Cc. of syrup; strain with strong expression, and add 100 Cc. of water to the dregs and express again. To the strained liquid add the remainder of the sugar, dissolve it by agitation without heat, and add enough syrup to make the product measure 1000 Cc. Keep the syrup in well-stoppered, filled bottles in a cool place.—*U. S.*

To make 1 quart of syrup of almond prepare a paste of 4¾ av. ozs. of sweet and 600 grains of bitter almond (blanched), with 1 fluidounce of water and 3¼ av. ozs. of sugar; mix well with 6 fluidounces of syrup and 3 fluidounces of orange-flower water, and strain. To the residue add 2¼ fluidounces of water, and express again. To the strained liquid add 3¼ av. ozs. of sugar and sufficient syrup to bring the volume up to 32 fluidounces.

This formula is modified after that of the French Codex, but endeavors to avoid heat by dissolving the sugar by agitation or percolation. The syrup is whitish and opaque, and in order to obtain it free from dark color the integuments of the seeds must be completely removed, for which purpose the almonds are for a few minutes steeped in warm water.

Uses.—Almond or orgeat syrup is an agreeable addition to expectorant and diuretic mixtures, and is possibly a feeble sedative of mild forms of febrile and nervous disorder through the minute proportion of hydrocyanic acid it contains. It is much used, mixed with water, in irritation of the *urinary passages*.

SYRUPUS AURANTII, *U. S.*, *Br.*—Syrup of Orange.

Syrupus aurantii corticis, P. G.—*Syrup of orange-peel*, E.; *Sirop d'écorce d'orange amère*, Fr.; *Pomeranzenschalensirup*, G.

Preparation.—Sweet Orange-peel, taken from the fresh fruit, 50 Gm.; Precipitated Calcium Phosphate 50 Gm.; Sugar 700 Gm.; Alcohol, Water, each, a sufficient quantity; to make 1000 Cc. Introduce the sweet orange-peel (which should be as free as possible from the white inner layer, and cut into small shreds) into a flask, and add 80 Cc. of alcohol. Stopper the flask loosely with a cork, apply the heat of a water-bath until the alcohol boils, and maintain it boiling during five minutes, with repeated agitation. Then stopper the flask well and set it aside to cool. Filter off the liquid, and wash the filter and contents with alcohol until the filtrate measures 100 Cc. Mix the precipitated calcium phosphate in a mortar with 150 Gm. of sugar, and add the tincture under constant trituration; to the resulting pasty mass add 300 Cc. of water, triturating constantly, transfer the whole to a filter, and return the first portions of the filtrate, if necessary, until it runs through clear. In the filtrate dissolve the remainder of the sugar, and add enough water, through the filter, until the product measures 1000 Cc. Mix thoroughly.—*U. S.*

As tincture of fresh orange-peel, if made with deodorized alcohol, will retain its original pure flavor, it will prove very convenient to keep on hand a concentrated tincture made according to the above directions, and each pint of which will represent 3650 grains of the fresh orange-peel.

To make 1 quart of syrup of orange mix 3 fluidounces and 96 minims of the concentrated tincture of orange-peel with 1½ av. ozs. of calcium phosphate and 5 av. ozs. of sugar; add with constant trituration 9½ fluidounces of water and filter; in the clear filtrate dissolve 18½ av. ozs. of sugar, and add enough water to bring the volume up to 32 fluidounces.

Tincture of orange-peel 1 fluidounce; syrup 7 fluidounces. Mix.—*Br.*

The corresponding syrups of the French and German Pharmacopœias are made with bitter orange-peel, which, according to the former authority, is exhausted with alcohol of 6 per cent., and, according to the latter, with white wine; in the tincture thus obtained the sugar is dissolved. The U. S. P. makes the syrup from fresh sweet orange-peel, the volatile oil of which, together with some coloring matter, is dissolved by maceration with alcohol and expression; this tincture is treated in a manner similar to the volatile oils in the preparation of medicated waters (see page 247). Syrup of orange has a yellowish color and an agreeable odor and taste.

Uses.—This syrup is merely an agreeable flavoring ingredient of medicinal mixtures. Its more decided taste, as compared with that of lemon and other official syrups, constitutes its special advantage.

SYRUPUS AURANTII FLORUM, *U. S.*—Syrup of Orange-flowers.

Syrupus aurantii floris, Br.—*Sirop de fleur d'oranger*, Fr.; *Pomeranzenblüthensirup*, G.

Preparation.—Sugar 850 Gm.; Orange-flower Water, a sufficient quantity; to make 1000 Cc. Dissolve the sugar in 450 Cc. of orange-flower water by agitation, without heat, add enough orange-flower water to make the product measure 1000 Cc., and mix thoroughly.—*U. S.*

Syrup of Orange-flowers may also be prepared in the following manner: Prepare a percolator or funnel in the manner described under Syrup. Pour 450 Cc. of orange-flower water upon the sugar, return the first portions of the percolate until it runs through clear, and, when all the liquid has passed, follow it by orange-flower water until the product measures 1000 Cc. Mix thoroughly.—*U. S.*

To make 1 quart of syrup of orange-flowers dissolve 28¾ av. ozs. of sugar in 14½ fluidounces of orange-flower water, and add sufficient of the latter to bring the volume of the solution up to 32 fluidounces.

Dissolve 3 pounds of refined sugar in 16 fluidounces of distilled water with the aid of heat; strain, and when nearly cold add 8 fluidounces of orange-flower water and sufficient distilled water to make the product weigh 4½ pounds.—*Br.*

Uses.—Syrup of orange-flowers is a pleasant flavoring agent, with a possibility of exercising a slight sedative influence upon morbidly sensitive persons, since one-third of it consists of orange-flower water.

SYRUPUS CALCII LACTOPHOSPHATIS, *U. S.*—Syrup of Calcium Lactophosphate.

Sirop de lactophosphate (phospho-lactate) de chaux, Fr.; *Calciumphospholactatsirup*, G.

Preparation.—Precipitated Calcium Carbonate 25 Gm.; Lactic Acid 60 Cc.; Phosphoric Acid 36 Cc.; Orange-flower Water 25 Cc.; Sugar 700 Gm.; Water a sufficient quantity; to make 1000 Cc. To the lactic acid, mixed with 100 Cc. of water and contained in a capacious mortar, gradually add the calcium carbonate, in portions, until it is dissolved. Then add the phosphoric acid, and triturate until the precipitate at first formed has disappeared. Add 150 Cc. of water, and filter, rinsing the mortar with 75 Cc. of water, and passing the rinsings through the filter. To the mixed filtrates add the orange-flower water, and, having added the sugar, dissolve it by agitation without heat, and strain. Lastly, pass enough water through the strainer to make the product measure 1000 Cc., and mix thoroughly.—*U. S.*

To make 1 quart of syrup of calcium lactophosphate dissolve 366 grains of precipitated calcium carbonate in 15½ fluidrachms of lactic acid diluted with 26 fluidrachms of water; add 1 fluidounce and 72 minims of phosphoric acid, and triturate until perfect solution is effected. Now add 38 fluidrachms of water, filter, and wash filter with 19 fluidrachms of water; to the filtrate add 6 fluidrachms of orange-flower water and 23½ av. ozs. of sugar. Shake until dissolved, strain, and add sufficient water through the strainer to bring the volume up to 32 fluidounces.

The present Pharmacopœia formula is a great improvement over that of 1880: calcium carbonate is readily dissolved by the diluted lactic acid, and upon the addition of phosphoric acid calcium phosphate is formed, which is held in solution by the lactic acid and excess of phosphoric acid present. Each Cc. of the finished syrup contains the equivalent of 0.02584 Gm., or each fluidrachm the equivalent of 1.48 grains, of tricalcium phosphate ($Ca_3(PO_4)_2$).

The formula of the French Codex (1884) is as follows: Dissolve 12.5 Gm. of calcium phosphate in sufficient (14 Gm.) of concentrated lactic acid and 340 Gm. of water; 630 Gm. of sugar are dissolved in the liquid, and 10 Gm. of essence of lemon added. Replacing the lactic acid by a sufficient quantity of hydrochloric acid, *sirop de chlorhydrophosphate de chaux* is obtained. *Sirop de phosphate acide de chaux* is made in the same manner, using sufficient phosphoric acid for dissolving the calcium salt.

Uses.—Not the least evidence exists that this preparation is endowed with medicinal virtues. It is intended especially to act as a reconstituent, but the proportion of lime contained in it is so minute that its action, of any sort, must be quite illusory. Moreover, as the greater part of the compound consists of sugar, it tends to produce or to prolong the gastric fermentation that exists in cases which require the use of true reconstituents. The *dose* of this preparation is at the option of the prescriber, from a teaspoonful to a wine-glassful, diluted.

SYRUPUS CALCIS, *U. S.*—Syrup of Lime.

Liquor calcis saccharatus, Br.; *Syrupus calcariæ.—Saccharated solution of lime*, E.; *Sirop de chaux*, Fr.; *Kalksirup*, G.

Preparation.—Lime 65 Gm.; Sugar 400 Gm.; Water a sufficient quantity; to make 1000 Cc. Triturate the lime and sugar thoroughly in a mortar, so as to form a homogeneous powder; then add the mixture to 500 Cc. of boiling water, contained in a bright copper or tinned iron vessel; boil for five minutes, constantly stirring, and then strain. Let the strained liquid stand for twenty-four hours, decant the clear portion, add to it enough water to make the product measure 1000 Cc., and mix thoroughly. Keep the syrup in well-stoppered bottles.—*U. S.*

To make 1 quart of syrup of lime use 2 av. ozs. of lime, 13½ av. ozs. of sugar, and 16 fluidounces of boiling water; after straining and decanting the clear liquid add enough water to bring the volume up to 32 fluidounces.

Take of slaked lime 1 ounce; refined sugar, in powder, 2 ounces; distilled water 1 pint. Mix the lime and the sugar by trituration in a mortar. Transfer the mixture to a bottle containing the water, and, having closed this with a cork, shake it occasionally for a few hours. Finally, separate the clear solution with a siphon, avoiding unnecessary exposure to the air, and keep it in a well-stoppered bottle.—*Br.*

Water containing sugar dissolves a larger quantity of lime than pure water. Peligot ascertained the solubility for 100 parts of sugar in solutions of 40 per cent. to be 26.57 parts; 20 per cent., only 23.15 parts; and in solutions of 5 per cent., only 18.06 parts of lime. According to these observations, the first formula must yield a preparation very much stronger in lime than that of the Br. P. Cane-sugar boiled with a strong solution of an alkali is gradually turned brown, while weak alkaline liquids have very little effect upon it (Hochstetter, 1843); and a concentrated solution of cane-sugar may be boiled with lime for a long time before decomposition commences (Dubrunfaut, Soubeiran).

This preparation is a thin, syrupy, colorless liquid, and has a bitter alkaline and somewhat sweet taste and an alkaline reaction. On exposure to air it absorbs carbon dioxide, and must therefore be preserved in well-stoppered bottles. Prepared according to the Br. P., it has the specific gravity 1.052, and 460.2 grains (1 fluidounce) require for neutralization 254 grain-measures of volumetric solution of oxalic acid, which corresponds to 7.11 grains of lime in 1 fluidounce (Imperial), or 1.546 per cent. of CaO.

The strength of the official syrup is uncertain; it is unfortunate that the U. S. Pharmacopœia has not fixed the proportion of lime to be contained in the finished product.

Uses.—The benefits which the lime in this preparation is fitted to produce are more or less prevented by the associated sugar. For all useful purposes pure lime-water is to be preferred. In Germany it has been recommended in *poisoning* by certain acids, as *carbolic* and *oxalic* acids. Its *dose* is not fixed, but may be stated at a teaspoonful or more, diluted.

SYRUPUS CHLORAL, *Br.*—Syrup of Chloral.

Sirop de chloral, Fr.; *Chloralhydratsirup*, G.

Preparation.—Take of Chloral Hydrate 80 grains; Distilled Water 1½ fluidrachms; Simple Syrup a sufficiency. Dissolve the chloral hydrate in the water, and add the syrup until the mixed product measures a fluidounce.—*Br.*

The syrup of the F. Cod. contains only 5 per cent. of chloral hydrate, and is flavored with spirit of peppermint.

Uses.—This preparation is a convenient vehicle for the administration of chloral in definite doses. Each fluidrachm of it contains 10 grains of chloral hydrate. The ordinary *dose* is Gm. 2–4 (f℥ss–j).

SYRUPUS FERRI IODIDI, *U. S., Br.*—Syrup of Ferrous Iodide.

Syrupus ferri iodati, P. G.; *Syrup of iodide of iron*, E.; *Sirop d'iodure de fer*, Fr.; *Eisenjodürsirup*, G.

A syrupy liquid, containing 10 per cent. by weight of ferrous iodide (FeI_2; molecular weight 308.94) or about 13.4 Gm. in 100 Cc.

Preparation.—Iron, in the form of fine bright wire and cut into small pieces, 25 Gm.; Iodine 83 Gm.; Syrup, Distilled Water, each, a sufficient quantity; to make 1000

Gm. Introduce the iron into a flask of thin glass having a capacity of about 500 Cc.; add to it 150 Cc. of distilled water, and afterward the iodine. Shake the mixture occasionally, checking the reaction, if necessary, by the affusion of cold water, and, when the solution has acquired a greenish color and has lost the odor of iodine, heat it to boiling. Then filter it through a strong, double, rapidly-acting filter placed in a funnel, the stem of which dips below the surface of 600 Gm. of syrup contained in a tared flask. When the liquid has run through, wash the flask and filter with a mixture of 25 Cc. each of syrup and distilled water, previously raised to near 100° C. (212° F.); then withdraw the funnel, add enough syrup to make the product weigh 1000 Gm., and mix thoroughly. Keep the syrup in small, well-stoppered, and completely filled bottles in a place accessible to daylight.—*U. S.*

To make 1 quart of syrup of ferrous iodide use 493 grains of iron wire, $3\frac{3}{4}$ av. ozs. of iodine, and $6\frac{1}{2}$ fluidounces of distilled water: filter the pale-green solution of ferrous iodide into 20 fluidounces of syrup, wash the filter with 2 fluidounces of a mixture of equal volumes of syrup and distilled water, and finally add sufficient syrup to bring the volume of the finished product up to 32 fluidounces.

On bringing iodine together with an excess of iron in the presence of water, ferrous iodide is formed and dissolves with a pale-green color. This compound has the formula FeI_2, and contains very nearly 82 per cent. of iodine. The aqueous solution, which should not be filtered until it has a pale-green color entirely free from any brown tint, is prone to change, but when protected by sugar, as proposed by Frederking (1839) and preserved with some precautions, it keeps unaltered. The details of the process given above are very similar to those of the British and German Pharmacopœias, both authorities directing the solution of ferrous iodide to be filtered into syrup, in which it sinks, owing to its greater density, and is thus perfectly protected against the oxidizing influence of the air. The strength of this syrup varies in the different pharmacopœias, that of the French Codex being much weaker than the others: 1 part of iodine (= 1.2 + part of ferrous iodide) is represented by about 12.2 (*U. S.*), 21.5 (*Br.*), 24.4 (*P. G.*), and 244 (*F. Cod.*) parts of the syrup; or 1000 parts of the syrup contain 83 (*U. S.*), 46.5 (*Br.*), 41 (*P. G.*), and 4.10 (*F. Cod.*) parts of iodine.

Properties.—Syrup of ferrous iodide is transparent, pale-green, nearly inodorous, and has a sweet, strongly ferruginous taste and a slightly acid (neutral, *U. S.*) reaction. It shows the behavior of solutions of ferrous salts (see page 744), and the addition of a little bromine-water liberates iodine, which has to solvents and to starch the behavior described on page 888. On exposure to the air the color of the syrup slowly changes to yellow and afterward to brown, the change of color proceeding from the exposed surface downward. Diffused daylight seems to somewhat accelerate the decomposition, but exposure to the direct sunlight entirely prevents the change, or, if it has taken place, restores the original color, and finally renders the syrup colorless. The effects of oxidation become manifest first by the production of ferric compound, and soon afterward by the liberation of iodine, recognized by the blue color produced with starch-paste. Numerous suggestions have been made with a view of preventing the discoloration of the syrup, such as the use of deoxidizing agents, bright iron wire, etc.; but the best results seem to have been obtained by using glucose in place of one-half of the simple syrup. G. H. C. Klie exposed syrup thus prepared in half-filled pint bottles to diffused daylight for months, without noting any apparent change. The specific gravity of the official syrup is about 1.353 at 15° C. (59° F.); each Cc. contains about 0.134 Gm., or each teaspoonful (fluidrachm) about 7.81 + grains, of ferrous iodide. On adding a few drops of potassium ferricyanide solution to the syrup a blue precipitate will be produced.

Syrups of the density of the above official syrups are not easily affected by exposure to the air, and we have known them to be kept in half-filled vials for months without apparent change. But if, from want of attention to the details of the process, the syrup should become colored from iodine, we prefer to restore it by addition of bright iron wire and exposure to sunlight, in preference to using a thiosulphate or other deoxidizing agents, which have been recommended for this purpose.

Should the iron used in preparing the solution of ferrous iodide be contaminated with other metals, these are likely to be dissolved. We have occasionally observed the syrup to contain a minute quantity of copper. On evaporating the syrup with due care to dryness, a yellowish-white powder is obtained, which is again soluble in water, yielding a slightly turbid solution (see page 731).

Tests.—Syrup of ferrous iodide should not impart a blue tinge to gelatinized starch (absence of free iodine, *U. S.*), but after the addition of a few drops of chlorine-water a

deep blue color will be developed. "If 1.55 Gm. (1.5447 Gm.) of the syrup and 10 Cc. of water be introduced into a flask, and the liquid mixed successively with 11 Cc. of decinormal silver nitrate solution, and 5 Cc. each of diluted nitric acid and ferric ammonium sulphate test-solution, it should not require more than about 1 Cc. of decinormal potassium sulphocyanate solution to produce a reddish-brown tint, which persists after shaking (corresponding to about 10 per cent. of ferrous iodide)."—*U. S.* This test is intended to show the exact quantity of decinormal silver nitrate solution necessary to precipitate completely the prescribed quantity of syrup; each Cc. of the silver solution corresponds to 0.015447 Gm. of ferrous iodide, as shown by the equation $FeI_2(308.94) + 2AgNO_3(339.10) = 2AgI(468.38) + Fe(NO_3)_2(179.66)$. The excess of silver nitrate solution added is ascertained by residual titration with potassium sulphocyanate in the presence of ferric alum; after all iodine has been precipitated as silver iodide, the remaining silver nitrate is thrown down as white sulphocyanate, and then the reddish-brown color of ferric sulphocyanate becomes permanent.

The syrup of the French Codex is flavored with orange-flower water and contains gum; the solution of ferrous iodide is filtered, afterward mixed with syrup, and finally protected from the light.

Allied Preparations.—Syrupus ferri bromidi, *U. S.* 1880.—Syrup of ferrous bromide.—This syrup should contain 10 per cent. by weight of ferrous bromide, and may be prepared by adding 3 av. ozs. of bromine to 8 fluidounces of distilled water contained in a flask, and then gradually adding 1¼ av. ozs. of bright fine iron wire cut into small pieces; the iron should be added a little at a time, and the reaction allowed to subside before each new addition. When the solution has become pale-green and free from all reddish tint, it may be filtered, and the flask and filter well washed with 3½ fluidounces of distilled water; after the addition of 24 av. ozs. of sugar the mixture is well stirred and heated to the boiling-point and strained. To the syrup, when cool, enough distilled water is added to bring the weight of finished product up to 40 av. ozs. (about 28 fluidounces). If no bromine is lost during the operation, the syrup will contain about 63 grains of ferrous bromide in each fluidounce, or very nearly 8 grains in each teaspoonful.

Syrupus ferri citro-iodidi, N. F., Syrup of citro-iodide of iron, Tasteless syrup of iodide of iron.—Mix 200 grains of finely-cut bright iron wire with 4 fluidounces of distilled water in a flask; add 267 grains of iodine, and set aside until a clear pale-green solution is obtained; heat to boiling and filter. To the filtrate add 620 grains of potassium citrate and 133 grains of iodine, and set aside until the liquid has assumed a deep-green color; pour it upon 10 troyounces of sugar contained in a bottle, shake until solution is complete, and add enough distilled water to bring the volume up to 16 fluidounces. Each fluidrachm contains an amount of iron corresponding to about 3.6 grains of ferric iodide.

Uses.—In the treatment of *scrofula*, especially of the glandular form, in those numerous cases in which *anæmia* is owing to scrofula, tuberculosis, or syphilis, and in chronic affections of the *skin*, chronic *rheumatism*, *amenorrhœa* from exhaustion, *leucorrhœa*, etc., this compound was at one time greatly in vogue. It is now thought very probable that its alleged virtues in the greater number of those diseases depended more upon the iron than upon the iodine in its composition. It has the disadvantage of being the least agreeable in its taste of all the officinal preparations of iron. It may be given in *doses* of Gm. 0.50–2.50 (gtt. x–xl) after meals. It should be largely diluted with water, and taken through a tube to prevent its injuring the teeth. As an additional precaution the mouth should be rinsed with water after each dose.

SYRUPUS FERRI PHOSPHATIS, *Br.*—Syrup of Phosphate of Iron.

Sirop de phosphate de fer, Fr.; *Eisenphosphatsirup*, G.

Preparation.—Take of Granulated Ferrous Sulphate 224 grains; Sodium Phosphate 200 grains; Sodium Bicarbonate 56 grains; Concentrated Phosphoric Acid 1¼ fluidounces; Refined Sugar 8 ounces; Distilled Water 8 fluidounces. Dissolve the ferrous sulphate in 4 ounces of boiling water, and the sodium phosphate in a similar quantity of cold water; mix the solutions, add the sodium bicarbonate dissolved in a little water, and, after careful stirring, transfer the precipitate to a calico filter, and wash it with distilled water till the filtrate ceases to be affected by barium chloride. Mix the residue on the filter in a mortar with the phosphoric acid. As soon as the precipitate is dissolved, filter the solution, add water and the sugar, and dissolve without heat. The product should measure exactly 12 fluidounces, any water which may be necessary beyond that introduced with the precipitate or with the sugar being added to form the stated bulk.—*Br.*

Ferrous sulphate and sodium phosphate react on each other, forming ferrous phosphate and sodium sulphate, the resulting free sulphuric acid, which would keep a portion of

the ferrous phosphate in solution, being nearly neutralized with sodium bicarbonate. After washing, the precipitate is dissolved in phosphoric acid, and this solution is converted into syrup, which is therefore presumed to contain acid ferrous phosphate. But during the washing the originally white precipitate has turned blue from the formation of ferroso-ferric phosphate, and this oxidation continues to some extent in the syrup, notwithstanding the protective influence of the sugar. The change produced in the color of the syrup on exposure is thus accounted for. The syrup has the density 1.305, and 1 fluidrachm contains the equivalent of about 1 grain of anhydrous ferrous phosphate.

Allied Syrups.—Syrup of Pyrophosphate of Iron is made by dissolving 10 parts of the official pyrophosphate of iron in 20 parts of water, and adding 970 parts of simple syrup (*F. Cod.*). The syrup contains 1 per cent. of the salt, and has a green color.

Numerous other formulas for syrup containing phosphate of iron in solution have been proposed, in some of which the free phosphoric acid has been wholly or partly replaced by hydrochloric acid, resulting in the formation of ferric chloride. H. W. Jones (1875) showed that a more satisfactory syrup is obtained by preparing the ferrous phosphate from iron and phosphoric acid; and E. B. Shuttleworth (1876) proposed the following formula: 38 grains of clean iron filings or fine iron wire are dissolved in a mixture of 6 fluidrachms each of water and phosphoric acid spec. grav. 1.5; the solution is filtered as soon as the iron is dissolved and mixed with 8½ fluidounces of simple syrup. Thus prepared, it is free from ferric salt, but otherwise represents the official syrup, and contains 1 grain of phosphate in the fluidrachm.

Syrupus phosphatum compositus, or Chemical Food. This was proposed by Edward Parrish (1857), whose formula is as follows: 600 grains of ferrous sulphate and 720 grains of sodium phosphate are separately dissolved in boiling water, the solutions mixed, and the precipitate thoroughly washed; 720 grains of calcium phosphate are dissolved in 4 ounces of hot water with the aid of hydrochloric acid; the solution is precipitated by ammonia and the precipitate well washed. The recently-obtained phosphates are dissolved in 1200 grains of glacial phosphoric acid previously dissolved in water; 40 grains of sodium carbonate and 60 grains of potassium carbonate are added to the solution, and if a precipitate should form it is redissolved by sufficient hydrochloric, or, preferably, by phosphoric, acid. The solution is now diluted with water to 20 fluidounces; 120 grains of powdered cochineal and 36 troyounces of sugar are added, and when the latter is dissolved the syrup is strained and flavored with 10 minims of oil of orange. Each teaspoonful is stated to contain about 1 grain of ferrous phosphate, 2½ grains of calcium phosphate, and smaller proportions of sodium and potassium phosphates. E. C. Saunders (1876), however, showed that a syrup thus prepared cannot contain the amounts of phosphates stated, and proposed to dissolve 240 grains of fine iron wire in 3 ounces (avoirdupois) of tribasic phosphoric acid spec. grav. 1.75 and 4 ounces of water; 923 grains of recently-slaked lime in 9½ ounces of phosphoric acid and 14 ounces of water; and 54 grains of crystallized sodium carbonate and 72 grains of potassium carbonate in ½ ounce of the phosphoric acid and 1 ounce of water. The three solutions are mixed and diluted with water to the measure of 28 fluidounces; the mixture, with 52 ounces of sugar and 85 grains of powdered cochineal, is made into a syrup, and this is flavored with 2 fluidounces of orange-flower water and diluted with water to 64 fluidounces.

Uses.—This is a convenient and mild preparation of iron, which is assumed to have a special influence upon the nervous system. The *dose* is Gm. 4 (1 fluidrachm). Other non-officinal syrups have been devised, such as those above described, which, besides phosphorus and iron, contain lime, soda, and potassa, or else quinine and strychnine. The latter are the most efficient. They have the disadvantage in many cases, however, of confining the bowels.

SYRUPUS FERRI PROTOCHLORIDI, *N. F.*—Syrup of Ferrous Chloride.

Syrupus ferri subchloridi, Br. Add.; *Syrup of proto- (sub-) chloride of iron*, E.; *Sirop de chlorure de fer*, Fr.; *Eisenchlorürsirup*, G.

Preparation.—Solution of Ferrous Chloride (see below) 384 minims; Glycerin 2 fluidounces; Orange-flower Water 2 fluidounces; Syrup, enough to make 16 fluidounces. Mix thoroughly.—*N. F.*

Mix 2 fluidounces of hydrochloric acid with 1 ounce of water in a flask, add 300 grains of iron wire, and heat gently until action ceases; add 10 grains of citric acid, and filter the solution into 10 fluidounces of syrup; wash filter with ½ ounce of water, and add sufficient syrup to form 1 pint (Imperial) of the mixed fluid.—*Br. Add.*

Both syrups are of a light-green color, but differ greatly in strength. The N. F. syrup contains 1 grain of ferrous chloride in each fluidrachm, and the British syrup about 3½ grains.

Allied Preparation.—Liquor ferri protochloridi, *N. F.*—Solution of ferrous chloride.—Take of iron, in the form of fine, bright, and finely-cut wire, 1130 grains; hydrochloric acid 10 troyounces; glycerin 4 fluidounces; dilute hypophosphorous acid 60 minims; distilled water enough to make 16 fluidounces. To the iron, contained in a flask, add 6 fluidounces of distilled water and the hydrochloric acid, and apply a gentle heat until effervescence ceases. Then raise the liquid to boiling; keep it at this temperature for a short time, so that the iron may be brought into solution as far as possible; filter the solution through a pellet of absorbent cotton placed in the neck of a funnel, and wash the cotton with a little distilled water. Evaporate the filtrate over a boiling water-bath until crystals begin to form and the escaping vapors cease to redden, or only slightly affect, moistened blue litmus-paper. Now add the glycerin and the hypophosphorous acid; continue the heat, if necessary, until a perfect solution is obtained; then transfer the liquid to a graduated bottle, allow it to cool, and add enough distilled water to make 16 fluidounces. Each fluidrachm represents about 20 grains of ferrous chloride.

SYRUPUS FERRI, QUININÆ ET STRYCHNINÆ PHOSPHATUM, *U. S.*—Syrup of the Phosphates of Iron, Quinine, and Strychnine.

Syrupus ferri phosphorici cum chinino et strychnino, Syrupus Eatoni.—Sirop tonique d'Eaton, Fr.; *Eaton's Sirup*, G.

Preparation.—Soluble Ferric Phosphate 20 Gm.; Quinine Sulphate 30 Gm.; Strychnine 0.2 Gm.; Phosphoric Acid 48 Cc.; Glycerin 100 Cc.; Water 50 Cc.; Syrup a sufficient quantity; to make 1000 Cc. Heat the soluble ferric phosphate with the water in a porcelain capsule, until it is dissolved. Then add the phosphoric acid, the quinine sulphate, and the strychnine, and stir until solution is effected. Filter the liquid into the glycerin contained in a graduated bottle, add enough syrup to make up the volume to 1000 Cc., and mix thoroughly. Lastly, strain if necessary.—*U. S.*

This syrup is known as *Eaton's syrup*. In the original formula freshly-precipitated ferrous phosphate was dissolved in phosphoric acid, and subsequently became oxidized on exposure to ferric salt. The phosphate of iron now employed is the pharmacopœial scaled sodio-ferric citro-phosphate.

To make 1 quart of the official syrup dissolve 286 grains of soluble ferric phosphate in $1\frac{3}{4}$ fluidounces of water previously heated; add 1 fluidounce and 280 minims of phosphoric acid, and dissolve in the acid mixture 430 grains of quinine sulphate and 3 grains of strychnine; filter the solution into $3\frac{1}{4}$ fluidounces of glycerin, and add sufficient syrup to bring the volume up to 32 fluidounces.

The preparation of the syrup by the present official formula presents no difficulties, and we have found the syrup to keep admirably well, darkening but slightly during two months' exposure on the store-shelf. Each Cc. of the finished syrup represents 0.02 Gm. soluble ferric phosphate, 0.03 Gm. quinine sulphate, and 0.0002 Gm. strychnine, or each teaspoonful about $1\frac{1}{8}$ grains of the iron salt, $1\frac{3}{4}$ grains quinine sulphate, and $\frac{1}{85}$ grain of strychnine.

Uses.—The association of iron, quinine, and strychnine is a very valuable one, but it is not judicious to make use of a preparation in which their proportion to one another is invariable, nor of one whose solid bulk is mainly sugar. Moreover, the present preparation is very liable to undergo changes that impair its qualities. *Dose*, Gm. 4–8 (1 or 2 teaspoonfuls).

SYRUPUS HEMIDESMI, *Br.*—Syrup of Hemidesmus.

Sirop de hemidesmus, Fr.; *Hemidesmussirup*, G.

Preparation.—Take of Hemidesmus-root, bruised, 4 ounces; Refined Sugar 28 ounces; boiling Distilled Water 1 pint (Imperial). Infuse the hemidesmus in the water, in a covered vessel, for four hours, and strain. Set it by till the sediment subsides; then decant the clear liquor, add the sugar, and dissolve by means of a gentle heat. The product should weigh 2 pounds 10 ounces, and should have the specific gravity 1.335. —*Br.*

Uses.—The syrup of Indian sarsaparilla probably possesses no definite or peculiar medicinal virtues; it is used chiefly as a flavoring agent.

SYRUPUS HYPOPHOSPHITUM, *U. S.*—Syrup of Hypophosphites.

Syrupus calcii hypophosphitis compositus.—Sirop d'hypophosphite de chaux composée, Fr.; *Hypophosphitsirup*, G.

Preparation.—Calcium Hypophosphite 15 Gm.; Potassium Hypophosphite 15 Gm.;

Sodium Hypophosphite 15 Gm.; Diluted Hypophosphorous Acid 2 Gm.; Sugar 500 Gm.; Spirit of Lemon 5 Cc.; Water a sufficient quantity; to make 1000 Cc. Triturate the hypophosphites with 450 Cc. of water, until they are dissolved; add the spirit of lemon and the hypophosphorous acid and filter the liquid. In the filtrate dissolve the sugar by agitation, without heat, and add enough water, through the filter, to make the product measure 1000 Cc. Strain, if necessary.—*U. S.*

Syrup of hypophosphites may also be prepared in the following manner: Prepare a percolator or funnel in the manner described under SYRUPUS. Pour the filtrate obtained as directed in the preceding formula upon the sugar, return the first portions of the percolate, until it runs through clear, and when all the liquid has passed follow it by water, until the product measures 1000 Cc. Mix thoroughly.—*U. S.*

To make 1 quart of the official syrup of hypophosphites use 660 grains of calcium hypophosphite, 220 grains each of potassium and sodium hypophosphite, 16 av. ozs. and 330 grains of sugar, 1 fluidrachm of spirit of lemon, 28 minims of diluted hypophosphorous acid, and 15 fluidounces of water. Each Cc. contains 0.075 Gm., or each teaspoonful nearly 4.3 grains of the combined hypophosphites, three-fifths of the weight being calcium salt.

Uses.—As we have elsewhere insisted, there is no ground for believing in the efficiency of the pharmaceutical hypophosphites. The dose of this preparation has been stated at Gm. 2–4 (f℥ss–j), but no reason appears why more or less than this would not be quite as efficient.

SYRUPUS HYPOPHOSPHITUM CUM FERRO, *U. S.*—SYRUP OF HYPOPHOSPHITES WITH IRON.

Preparation.—Ferrous Lactate 10 Gm.; Potassium Citrate 10 Gm.; Syrup of Hypophosphites a sufficient quantity; to make 1000 Cc. Rub the ferrous lactate and potassium citrate with a small quantity of the syrup, gradually added, until they are dissolved. Then strain, and add enough syrup of hypophosphites to make the product measure 1000 Cc. Mix thoroughly.—*U. S.*

Each fluidounce of this syrup contains, besides the hypophosphites mentioned in the preceding formula, 4.564 grains each of ferrous lactate and potassium citrate.

This and the preceding syrup have been in use since 1857, but were admitted into the Pharmacopœia for the first time in 1880. Formerly ferrous hypophosphite was used, but this salt has been replaced in the above formula by the lactate. In preparing both syrups heat should be avoided, and they should be kept in well-stoppered bottles to lessen the chances of gradual oxidation.

Uses.—The remarks made on the analogous preparation immediately preceding apply to this one also. Whatever virtues it possesses are due to the iron it contains. *Dose*, Gm. 2–4 (f℥ss–j).

SYRUPUS IPECACUANHÆ, *U. S., P. G.*—SYRUP OF IPECAC.

Sirop d' ipécacuanha, Fr.; *Ipecacuanhasirup*, G.

Preparation.—Fluid Extract of Ipecac 70 Cc.; Acetic Acid 10 Cc.; Glycerin 100 Cc.; Sugar 700 Gm.; Water a sufficient quantity; to make 1000 Cc. Dilute the fluid extract of ipecac with 300 Cc. of water to which the acetic acid had previously been added, and mix them thoroughly by shaking. Then filter, and pass enough water through the filter to obtain 500 Cc. of filtrate. To this add the glycerin; dissolve the sugar in the liquid, and add enough water to make the product measure 1000 Cc. Mix thoroughly, and strain if necessary.—*U. S.*

Syrup of ipecac may also be prepared in the following manner: Prepare a percolator or funnel in the manner described under SYRUPUS. Mix the filtrate obtained as directed in the preceding formula with the glycerin, pour the mixture upon the sugar, return the first portions of the percolate until it runs through clear, and when all the liquid has passed follow it by water until the product measures 1000 Cc. Mix thoroughly.—*U. S.*

To make 1 quart of syrup of ipecac add 18 fluidrachms of fluid extract of ipecac to a mixture of 9½ fluidounces of water and 150 minims of acetic acid; shake well, filter, and wash filter with sufficient water to obtain 1 pint of filtrate. To this add 3¾ fluidounces of glycerin, 23½ av. ozs. of sugar, and sufficient water to bring the volume up to 32 fluidounces.

As formerly prepared, syrup of ipecac was apt to deposit flocculi after standing some days, and was likely to sour in warm weather. The present official formula aims at obtaining a perfect aqueous solution of the active virtues of ipecac by treating the fluid extract with very dilute acetic acid; the addition of 10 per cent., by volume, of glycerin will prevent subsequent changes in the syrup. Each Cc. represents the activity of 0.070 Gm. of ipecac, or each teaspoonful (ʒj) equals about 4 grains.

The syrup of the German Pharmacopœia represents 1 per cent. of its weight of ipecacuanha-root, and that of the French Codex 1 per cent. of extract of ipecacuanha.

Uses.—This syrup is used chiefly as an emetic for infants, and as an expectorant in cases of acute *laryngitis* and *bronchitis*. For the former purpose the dose is Gm. 2–4, (fʒss–j) repeated every ten minutes until it operates; and for the latter it may be given to infants and children in doses of Gm. 0.30–1.30 (gtt. v–xx), and to adults in double these quantities. It forms a very useful ingredient of expectorant mixtures in the diseases named.

SYRUPUS KRAMERIÆ, *U. S.*—Syrup of Krameria.

Syrupus ratanhæ.—Syrup of rhatany, E.; *Sirop de ratanhia*, Fr.; *Ratanhiasirup*, G.

Preparation.—Fluid Extract of Krameria 450 Cc.; Syrup 550 Cc.; to make 1000 Cc. Mix them.—*U. S.*

Each fluidounce of the official syrup contains 216 minims of fluid extract of rhatany, or 27 minims in each teaspoonful (fluidrachm).

Syrupus iodo-tannicus (see also p. 889). Guilliermond recommends extract of rhatany for this syrup, which may be made by dissolving 2 grains of iodine, with a little alcohol, in 200 grains of syrupus krameriæ (*U. S. P.*), and adding 800 grains of simple syrup.

Uses.—Syrup of rhatany is chiefly used as a medicine for infants and children affected with diarrhœa independent of organic or inflammatory disease, and is usually associated in mixtures with chalk and other antacids and astringents. The *dose* for a child a year or two old is Gm. 2–4 (fʒss-j).

SYRUPUS LACTUCARII, *U. S.*—Syrup of Lactucarium.

Sirop de lactucarium, Fr.; *Lactucariumsirup*, G.

Preparation.—Tincture of Lactucarium 100 Cc.; Precipitated Calcium Phosphate 50 Gm.; Sugar 750 Gm.; Water a sufficient quantity; to make 1000 Cc. Triturate the precipitated calcium phosphate and 150 Gm. of the sugar in a mortar with the tincture of lactucarium gradually added, and afterward with 300 Cc. of water, added in small portions at a time. Filter the mixture, dissolve the remainder of the sugar in the filtrate, and pass enough water through the filter to make the product measure 1000 Cc. Mix thoroughly.—*U. S.*

Syrup of Lactucarium may also be prepared in the following manner: Prepare a percolator or funnel in the manner described under Syrupus. Pour the filtrate obtained as directed in the preceding formula upon the sugar, return the first portions of the percolate until it runs through clear, and when all the liquid has passed follow it by water, until the product measures 1000 Cc. Mix thoroughly.—*U. S.*

To make 1 quart of syrup of lactucarium triturate 2 av. ozs. of calcium phosphate and 5 av. ozs. of sugar with 26 fluidrachms of tincture of lactucarium, and afterward with 9½ fluidounces of water, gradually added; filter, add 20 av. ozs. of sugar and sufficient water through the filter, to bring the volume of syrup up to 32 fluidounces.

Since lactucarium is freed from its caoutchouc-like constituent in the preparation of the tincture, the above formula will yield a perfectly clear syrup, which contains the active virtues of 0.050 Gm. of lactucarium in each Cc., or of about 3 grains in each teaspoonful (fluidrachm).

Sirop de lactucarium opiacé, *Fr. Cod.*, contains in each tablespoonful 0.005 Gm. ($\frac{1}{14}$ grain) of extract of opium and 0.01 Gm. ($\frac{1}{7}$ grain) of alcoholic extract of lactucarium.

Uses.—It is very doubtful whether this preparation possesses any hypnotic powers at all. It may be used as a *placebo* for mothers in certain cases of infantile disorder, in the *dose* of Gm. 4 (fʒj). The addition of opium to the syrup of lactucarium by the French Codex implies a confession of the inefficacy of the latter ingredient.

SYRUPUS LIMONIS, *Br.*—Syrup of Lemon.

Syrupus succi citri.—Sirop de suc de limon (*de citron*), Fr.; *Citronensirup*, G.

Preparation.—Fresh Lemon-peel 2 av. ozs.; Lemon-juice, strained, 1 pint (Imperial); Refined Sugar 36 av. ozs. Heat the lemon-juice to the boiling-point, and, having put it into a covered vessel with the lemon-peel, let them stand until they are cold; then filter and dissolve the sugar in the filtrate with the aid of heat. The product should weigh 3½ pounds, and its specific gravity be about 1.340.—*Br.*

The U. S. Ph. 1880 formula was nearly identical with the above, except that more sugar and more lemon-peel were directed. 3½ pounds of the British syrup will measure very nearly 42 Imperial (or 41 U. S.) fluidounces.

Uses.—This syrup is hardly medicinal. It is used habitually with water as a beverage, and thus forms a pleasant and suitable drink in febrile affections generally, especially when mixed with carbonic-acid water.

SYRUPUS MORI, *Br.*—Syrup of Mulberries.

Syrupus mororum.—Sirop de mûre, Fr.; *Maulbeersaft*, G.

Preparation.—Take of Mulberry-juice 1 pint (Imperial); Refined Sugar 2¼ pounds; Rectified Spirit 2½ fluidounces. Heat the mulberry-juice to the boiling-point, and when it has cooled filter it. Dissolve the sugar in the filtered liquid with a gentle heat, and add the spirit. The product should weigh 3 pounds 6 ounces, and should have the specific gravity 1.33.—*Br.*

This and all other syrups of acid fruit-juices should be prepared only in porcelain or well-enamelled iron vessels. The heating of the juice to the boiling-point has for its object the removal of the albumen.

The fruit-syrups of the French Codex and of the German Pharmacopœia, with the exception of lemon syrup, are made with the fermented juice. (See Syrupus Rubi Idæi.)

Uses.—In this country syrups made from currants, raspberries, and strawberries are as commonly used as mulberry syrup and mulberry wine are in England. Mulberry syrup has no therapeutic virtues which are not possessed by the other syrups mentioned.

SYRUPUS PAPAVERIS, *Br., P. G.*—Syrup of Poppies.

Syrupus capitum papaveris, Syrupus diacodii.—Sirop de pavot blanc, Fr.; *Beruhigungssaft*, G.

Preparation.—Take of Poppy-capsules, dried, freed from the seeds, and coarsely powdered, 36 ounces; Rectified Spirit 16 fluidounces; Refined Sugar 4 pounds; Boiling Distilled Water a sufficiency. Mix the poppy-capsules with 4 pints of the water and infuse for twenty-four hours, stirring them frequently; then pack them in a percolator, and, adding more of the water, allow the liquor slowly to pass until about 2 gallons have been collected or the poppies are exhausted. Evaporate the liquor by a water-bath, until it is reduced to 3 pints (Imperial). When quite cold, add the spirit, let the mixture stand for twelve hours, and filter. Distil off the spirit, evaporate the remaining liquor to 2 pints, and then add the sugar. The product should weigh 6½ pounds, and should have the specific gravity 1.330.—*Br.*

The concentrated infusion of poppy contains much mucilage, which is precipitated by the alcohol. This syrup is less liable to ferment than if prepared from an infusion not subjected to the treatment with alcohol, and is nearly six times stronger in poppy-capsules than that of the P. G. The syrup was formerly often prepared from the hot infusion of poppy-capsules, St. John's bread, and liquorice-root. On account of the variable composition of poppy-capsules the French Codex directs this syrup to be prepared by dissolving 1 part of alcoholic extract of poppy in 3 parts of alcohol, and mixing with 96 parts of syrup. *Sirop diacode* is a solution of ½ grain, and *sirop d'opium* a solution of 2 grains, of extract of opium in 1000 grains of simple syrup; *syrupus opiatus* (P. G. 1872) contained 1 grain of the extract of opium in the same amount of syrup.

Uses.—The variable proportion of opium in poppy-capsules renders this preparation uncertain in its effects, and therefore capable of doing serious injury to young children, the class of persons it is intended for especially. It is far better to add a definite proportion of a liquid preparation of opium or of morphine to syrup of acacia, of marshmallow, or of wild-cherry if a weak anodyne or narcotic action is required. The *dose* of this syrup is stated to be Gm. 2 (fʒss) for young children.

SYRUPUS PICIS LIQUIDÆ, *U. S.*—Syrup of Tar.

Syrupus piceus.—Sirop de goudron, Fr.; *Theersirup*, G.

Preparation.—Tar 75 Gm.; Cold Water 150 Cc.; Boiling Distilled Water 400 Cc.; Glycerin 100 Cc.; Sugar 800 Gm.; Distilled Water a sufficient quantity; to make 1000 Cc. Mix the tar intimately with about 100 Gm. of white sand, pour on the cold water, and stir frequently during twelve hours; then pour off the water and throw it away. Pour the boiling distilled water upon the residue, stir well and frequently during fifteen minutes, add the glycerin, and set the vessel aside for twenty-four hours, occasionally stirring. Decant the clear solution and filter. Dissolve the sugar in the filtrate with the aid of a gentle heat; allow the liquid to cool, then strain it, and pass enough distilled water through the strainer to make the product measure 1000 Cc. Mix thoroughly.—*U. S.*

To make 1 quart of tar syrup mix 2½ av. ozs. of tar with 3¼ av. ozs. of white sand, and wash well during twelve hours with 6 ounces of cold water; after decantation pour 13 ounces of boiling distilled water upon the residue, stir well for fifteen minutes, add 3¼ fluidounces of glycerin, and set aside for twenty-four hours, stirring occasionally. Decant and filter, and in the filtrate dissolve 26½ av. ozs. of sugar, and add sufficient water to bring the volume up to 32 fluidounces.

This formula is very similar to that of the French Codex of 1866. The tar is first treated with water for the purpose of removing most of the acetic acid present, and this infusion is rejected. The various soluble constituents of tar are then extracted by hot water, as directed above, or by one of the methods described on page 1255: in the tar-water thus obtained the sugar is dissolved by agitation or by percolation. Thus prepared, the syrup is of a yellowish-color, has the odor of tar, a slightly bitter taste and an acid reaction, and when rendered alkaline becomes brown.

Syrupus picis iodatus, *Sirop de goudron iodé*, is much employed in France, and contains $\frac{1}{10}$ per cent. of iodine. 1 grain of iodine dissolved in a little alcohol is added, with agitation, to 1000 grains of syrup of tar; the color of iodine will disappear in a few days, when the iodized syrup has about the same color as tar syrup.

Uses.—It may be questioned whether the sugar in this preparation of tar-water does not impair the activity of the medicine, and partly so by retarding its absorption. The dose may be stated at Gm. 16–64 (f℥ss–ij), according to the age of the patient and the tolerance of his stomach.

SYRUPUS PRUNI VIRGINIANÆ, *U. S.*—Syrup of Wild Cherry.

Sirop d'écorce de cérisier, Fr.; *Wildkirschenrindensirup*, G.

Preparation.—Wild Cherry, in No. 20 powder, 150 Gm.; Sugar 700 Gm.; Glycerin 150 Cc.; Water a sufficient quantity to make 1000 Cc. Mix the glycerin with 300 Cc. of water. Moisten the wild cherry with a sufficient quantity of the liquid, and macerate for twenty-four hours in a closed vessel; then pack it firmly in a cylindrical percolator, and pour on the remainder of the menstruum. When the liquid has disappeared from the surface, follow it by water, until the percolate measures 450 Cc. Dissolve the sugar in the liquid by agitation, without heat, strain, and pass enough water through the strainer to make the product measure 1000 Cc. Mix thoroughly.—*U. S.*

Syrup of Wild Cherry may also be prepared in the following manner: Prepare a percolator or funnel in the manner described under Syrupus. Pour the filtrate obtained as directed in the preceding formula upon the sugar, return the first portions of the percolate until it runs through clear, and, when all the liquid has passed, follow it by water, until the product measures 1000 Cc. Mix thoroughly.—*U. S.*

To make 1 quart of syrup of wild cherry bark use 5 av. oz. of the ground bark, a mixture of 4¾ fluidounces of glycerin and 9½ fluidounces of water, and 23¼ av. ozs. of sugar.

The treatment of wild cherry bark with cold water results in the production of hydrocyanic acid and oil of bitter almonds (see page 1320), which, together with the bitter and astringent principles, are contained in the syrup, which has a rich brownish-red color and a pleasant taste. A formula for this preparation was proposed by Procter and Turnpenny in 1842, and the substitution of glycerin for a portion of the sugar was first suggested by C. Schnabel (1874) for the purpose of preventing fermentation.

Enough menstruum should be added to the powder to thoroughly moisten it, and the vessel be kept tightly closed to prevent loss of hydrocyanic acid: a No. 20 powder being

rather coarse, the mixture must be very firmly packed and the percolation be allowed to go on in slow drops, so as to ensure exhaustion of the bark. The present syrup contains less sugar, but fully three times as much glycerin as that made after the Pharmacopœia of 1880; it keeps well.

Uses.—Syrup of wild cherry has no peculiar medicinal virtues, but is a very agreeable flavoring addition to mixtures. It is often added to them under the impression that it may aid in appeasing cough. The *dose* is Gm. 4 (f℥j) or more.

SYRUPUS RHAMNI CATHARTICÆ, *P. G.*—Syrup of Buckthorn.

Syrupus rhamni, Br. 1867; *Syrupus spinæ cervinæ.—Sirop de nerprun*, Fr.; *Kreuzdornbeerensirup*, G.

Preparation.—Fresh buckthorn-berries are mashed and allowed to ferment at 20° C. (68° F.) in a covered vessel, until 2 volumes of the filtered liquid mix clear with 1 volume of alcohol: the juice is then expressed, and in it sugar is dissolved in the proportion of 13 parts for every 7 parts by weight of juice.—*P. G.*

Evaporate 4 pints of buckthorn-juice to 2½ pints, add ¾ ounce each of sliced ginger and bruised pimento, digest at a gentle heat for four hours, and strain. When cold add 6 fluidounces of rectified spirit; let the mixture stand for two days, then decant off the clear liquid, and in this dissolve 5 pounds (or a sufficiency) of sugar with a gentle heat, so as to make the specific gravity 1.320.—*Br.* 1867.

Uses.—In Europe syrup of buckthorn is generally used as a purgative for children in the *dose* of Gm. 4 (f℥j).

SYRUPUS RHEI, *U. S., Br., P. G.*—Syrup of Rhubarb.

Sirop de rhubarbe, Fr.; *Rhabarbersaft*, G.

Preparation.—Fluid Extract of Rhubarb 100 Cc.; Spirit of Cinnamon 4 Cc.; Potassium Carbonate 10 Gm.; Glycerin 50 Cc.; Water 50 Cc.; Syrup a sufficient quantity; to make 1000 Cc. Mix the spirit of cinnamon with the fluid extract of rhubarb, and add to it the potassium carbonate dissolved in the water. Then add the glycerin, and lastly enough syrup to make the product measure 1000 Cc. Mix thoroughly.—*U. S.*

To make 1 quart of syrup of rhubarb use 3 fluidounces and 96 minims of fluid extract of rhubarb, 60 minims of spirit of cinnamon, 146 grains of potassium carbonate, and 1 fluidounce and 288 minims each of glycerin and water.

Take of rhubarb-root, in No. 20 powder, coriander-fruit, in No. 20 powder, each 2 ounces; refined sugar 24 ounces; rectified spirit 8 fluidounces; distilled water 24 fluidounces. Mix the rhubarb and coriander; pack them in a percolator; pass the spirit and water previously mixed slowly through them; evaporate the liquid that has thus passed until it is reduced to 14 fluidounces, and in this, after it has been filtered, dissolve the sugar with the aid of heat. The product should weigh nearly 2½ pounds.—*Br.*

We consider the present official formula a decided improvement over that of 1880, but fail to see any necessity for the glycerin and water, as just as good and permanent a syrup can be made without them, the alkali carbonate being dissolved in a small quantity of syrup. The U. S. Ph. syrup of rhubarb is nearly twice as strong as that of the British and German Pharmacopœias, both of the latter representing only 5 per cent. by weight of rhubarb.

The present syrup is of a deep brown-red color, and is transparent in thin layers; the presence of alkali renders it unfit for combination with various salts, which are precipitated thereby. The syrup of the Br. P. is of a deep-brown color and somewhat opaque, and of a similar appearance was the syrup of rhubarb as prepared by the U. S. P. 1870 by mixing 3 fluidounces of fluid extract of rhubarb with 29 fluidounces of simple syrup.

Uses.—The simple syrup of rhubarb is seldom used, but it may be given as a purgative to infants in the *dose* of Gm. 4 (f℥j).

SYRUPUS RHEI AROMATICUS, *U. S.*—Aromatic Syrup of Rhubarb.

Spiced syrup of rhubarb, E.; *Sirop de rhubarbe aromatique*, Fr.; *Gewürzter Rhabarbersaft*, G.

Preparation.—Aromatic Tincture of Rhubarb 150 Cc.; Syrup 850 Cc.; to make 1000 Cc. Mix the aromatic tincture of rhubarb with the syrup.—*U. S.*

To make 1 quart of aromatic syrup of rhubarb mix 4¾ fluidounces of aromatic tincture of rhubarb with 27¼ fluidounces of syrup.

The syrup is of about the same strength as that of the Pharmacopœia of 1870, which directed 1 part by measure of the tincture to 6 parts by measure of simple syrup; it has an agreeable odor, a spicy and bitterish but pleasant taste, and is somewhat opaque in appearance.

Uses.—This preparation is in universal use as a purgative for children in *diarrhœa* attended with flatulence and colic. The *dose* is Gm. 4 (fʒj).

SYRUPUS RHŒADOS, *Br.*—Syrup of Red Poppy.

Sirop de coquelicot, de pavot rouge, Fr.; *Klatschrosensaft*, G.

Preparation.—Take of fresh Red Poppy-petals 13 ounces; Refined Sugar 2¼ pounds; Distilled Water 1 pint (Imperial) or a sufficiency; Rectified Spirit 2½ fluidounces. Add the petals gradually to the water heated in a water-bath, frequently stirring, and afterward, the vessel being removed, infuse for twelve hours. Then press out the liquor, strain, add the sugar, and dissolve by means of heat. When nearly cold add the spirit and as much distilled water as may be necessary to make up for loss in the process, so that the product shall weigh 3 pounds 10 ounces. It should have the specific gravity 1.33.—*Br.*

The addition of alcohol to the finished syrup is designed to counteract its tendency to fermentation. The syrup is of a deep-red color.

Uses.—The syrup of red poppy is an opiate preparation of uncertain strength, and, being used only for coloring mixtures, it appears to be superfluous. The *dose* is Gm. 4 (fʒj).

SYRUPUS ROSÆ, *U. S.*—Syrup of Rose.

Syrupus rosæ gallicæ, Br.; *Syrupus rosarum rubrarum.—Syrup of red rose*, E.; *Sirop de roses rouges*, Fr.; *Rosensirup*, G.

Preparation.—Fluid Extract of Rose 125 Cc.; Syrup 875 Cc.; to make 1000 Cc. Mix them.—*U. S.*

Take of dried red rose-petals 2 ounces; refined sugar 30 ounces; boiling distilled water 1 pint. Infuse the petals in the water for two hours; squeeze through calico, heat the liquor to the boiling-point, and filter. Dissolve the sugar in the liquor by means of heat. The product should weigh 2 pounds 14 ounces, and should have the specific gravity. 1.335.—*Br.*

The syrup is of a fine red color and has an agreeable somewhat astringent taste. Each fluidounce contains 1 fluidrachm of the fluid extract of red rose-petals.

Uses.—It is used almost exclusively for giving an agreeable color and flavor to other syrups and to mixtures. *Dose*, Gm. 4 (fʒj).

SYRUPUS RUBI, *U. S.*—Syrup of Rubus.

Syrup of blackberry-bark, E.; *Sirop d'écorce de ronce*, Fr.; *Brombeerrindensirup*, G.

Preparation.—Fluid Extract of Rubus 250 Cc.; Syrup 750 Cc.; to make 1000 Cc. Mix them.—*U. S.*

This syrup has a deep reddish-brown color and a strongly astringent taste. Each fluidounce contains 2 fluidrachms of the fluid extract.

Uses.—As a remedy for slight *diarrhœa* independent of irritants in the intestine and of inflammatory conditions of that organ syrup of blackberry-root is a convenient astringent. But the syrup is generally less appropriate than the decoction. Its *dose* is Gm. 4–8 (fʒj–ij).

SYRUPUS RUBI IDÆI, *U. S., P. G.*—Syrup of Raspberry.

Sirop de framboise, Fr.; *Himbeersaft*, G.

Preparation.—Reduce the raspberries to a pulp, and let this stand, at a temperature of about 20° C. (68° F.), until a small portion of the filtered juice mixes clear with half its volume of alcohol. Then separate the juice by pressing, set it aside in a cool place until the liquid portion has become clear, and filter. To every 40 parts by weight of the filtrate (which should not be allowed to remain unprotected by sugar more than about two hours) add 60 parts of sugar, heat the mixture to boiling, avoiding the use of tinned

vessels, and strain. Keep the product in well-stoppered bottles in a cool and dark place. —*U. S.*

This process is identical with that of the Germ. Pharm., except that the latter directs 65 parts of sugar for every 35 parts of filtered juice. Some care is necessary that the temperature during the fermentation of the fruit-pulp do not exceed that prescribed.

The new French Codex directs the fresh fruit to be expressed and the juice to be fermented at a temperature of 12° to 15° C. (54–59° F.), fermentation to be arrested as soon as the liquid will readily pass through a filter; otherwise the flavor will be much impaired. Other fruit-juices are prepared in precisely the same manner. The juice of ripe raspberries ferments readily, and the fermentation is completed in a few hours or a day, according to the temperature. The formation of mould and acetic fermentation impair the flavor; the progress of fermentation should therefore be closely watched, and the expressed juice should be rapidly filtered and at once converted into syrup. Fruit-syrups contain 59.3 (*Br.*), 60 (*U. S.*), 63.7 (*F. Cod.*), and 65 (*P. G.*) per cent. of sugar.

Properties.—Raspberry syrup has a bright-red color, a very agreeable fruit odor, a pleasant acidulous taste, and a distinct acid reaction. When agitated with amylic alcohol, ether, or chloroform, these liquids should not become colored. On being rendered alkaline the syrup becomes dark-blue or dingy violet-colored, and when treated with basic lead acetate a dingy-blue or blue-green precipitate is produced, the filtrate being colorless or nearly so. When strongly acidulated with cold nitric acid the red color is not changed to yellow. These reactions serve to distinguish raspberry syrup from imitations colored with aniline red or with other coloring matters of vegetable origin.

Allied Preparations.—Syrupus cerasorum, *P. G.*—Cherry syrup, *E.*; Sirop de cérise, *Fr.*; Kirschsirup, *G.*—The juice of black cherries is fermented in the presence of the bruised seeds, and further treated as stated above.

Syrupus cydoniæ (quince syrup), Syr. fragariæ (strawberry syrup), Syr. granati (pomegranate syrup), and others are prepared in a similar manner, the ripe fruits being used. (See also Syr. Mori and Syr. Rhamni.)

Acetum rubi idæi.—Raspberry vinegar, *E.*; Vinaigre framboise, *Fr.*; Himbeeressig, *G.*—Mix equal parts of syrup of raspberry and of vinegar.—*F. Cod.* Raspberry syrup 1 part, pure vinegar 2 parts.—*P. G.* 1872. Other fruit-vinegars may be made in the same manner.

Aqua rubi idæi.—Raspberry-water, *E.*; Eau de framboise, *Fr.*; Himbeerwasser, *G.*—Distil 2 parts of water from 1 part of the press-cake left on clarifying raspberry-juice as described above.—*P. G.* 1872. It has an agreeable fruit odor. *Strawberry-water* is made in the same manner; it is sometimes used as a cosmetic.

Uses.—This syrup has no special medicinal virtues. It forms an agreeable flavoring addition to mixtures, and with water a pleasant drink in febrile affections. The same remark applies to the allied preparations.

SYRUPUS SARSAPARILLÆ COMPOSITUS, *U. S.*—Compound Syrup of Sarsaparilla.

Syrupus sudorificus.—Sirop de salsepareille composé, Sirop sudorifique, Fr.; *Zusammengesetzter Sarsaparillsirup*, G.

Preparation.—Fluid Extract of Sarsaparilla 200 Cc.; Fluid Extract of Glycyrrhiza 15 Cc.; Fluid Extract of Senna 15 Cc.; Sugar 650 Gm.; Oil of Sassafras 0.1 Cc.; Oil of Anise, 0.1 Cc.; Oil of Gaultheria 0.1 Cc.; Water, a sufficient quantity; to make 1000 Cc. Add the oils (equivalent to 2 drops each) to the mixed fluid extracts and shake the liquid thoroughly. Then add enough water to make up the volume to 600 Cc., and mix well. Set the mixture aside for one hour, then filter it. In the filtrate dissolve the sugar with the aid of a gentle heat, allow the liquid to cool, strain, and add enough water through the strainer to make the product measure 1000 Cc. Mix thoroughly.—*U. S.*

To make 1 quart of compound syrup of sarsaparilla mix 2 drops each of oils of gaultheria, anise, and sassafras with ½ fluidounce each of fluid extracts of senna and glycyrrhiza, and 6⅔ fluidounces of fluid extract of sarsaparilla; add sufficient water to make 19 fluidounces, and after filtration dissolve 21⅔ av. ozs. of sugar in the filtrate, and add enough water to bring the volume up to 32 fluidounces.

The present official formula differs materially from that of 1880 in the omission of guaiacum-wood and pale rose-petals, and the substitution of aromatic oils for the respective drugs; the process is much simpler than the former, and the preparation no doubt equally efficient; but we think an increase in the quantity of sugar to 750 Gm. would

improve the keeping qualities of the syrup, during hot weather particularly, as the alcohol derived from the fluid extracts is less than 8 per cent. of the total volume of the syrup.

The syrup of the French Codex is made by hot infusion of sarsaparilla, borage-flowers, pale rose, senna, and anise; it is known as *sirop de Cuisinier*. Under the names of *sirop de Laffecteur* and *rob Boyveau-Laffecteur* a similar but more complex preparation has been in use in France; more than thirty drugs entered into its composition.

Uses.—Compound syrup of sarsaparilla has been extensively used in the treatment of constitutional *syphilis*, but there is no evidence whatever to prove its efficiency when given alone. For this reason, probably, it is omitted from the British and German Pharmacopœias. It is a convenient vehicle for the administration of iodide of potassium. Corrosive sublimate, which is sometimes added to it, is converted by it into calomel. The *dose* is Gm. 16 (f℥ss), diluted, several times a day.

SYRUPUS SCILLÆ, *U. S., Br.*—Syrup of Squill.

Syrupus aceti scillæ.—Sirop de scille, Fr.; *Meerzwiebelsirup*, G.

Preparation.—Vinegar of Squill 450 Cc.; Sugar 800 Gm.; Water a sufficient quantity; to make 1000 Cc. Heat the vinegar of squill to the boiling-point in a glass or porcelain vessel, and filter the liquid while it is hot. In the hot filtrate dissolve the sugar by agitation, without further heating, strain, and when the strained liquid is cold add enough water through the strainer to make the product measure 1000 Cc. Mix thoroughly.—*U. S.*

To make 1 quart of syrup of squill use 14½ fluidounces of vinegar of squill and 27 av. ozs. of sugar, finally adding sufficient water to bring the volume of the solution up to 32 fluidounces.

The formula directs the removal of the albumen in the manner suggested in preceding editions of this work, and a perfectly clear syrup is thus obtained. The sugar may be dissolved with the aid of heat, but percolation is to be preferred. The use of metallic vessels should be avoided. The syrup of the Br. P. is much denser than the above; it is made from an Imperial pint (20 fluidounces) of the vinegar and 40 oz. av. of sugar, and has a specific gravity of about 1.345.

Uses.—This syrup is an adequate representative of squill—at least in its action upon the bronchial mucous membrane. It is much used in the treatment of *laryngeal* and *bronchial catarrhs*, both for promoting the resolution of such affections, and in children, when used in appropriate doses, for producing emesis, and thereby expelling accumulated secretions from the air-passages. It is habitually associated with syrup of ipecacuanha or syrup of senega, according to the nature of the case. The *dose*, as an expectorant, is Gm. 2–4 (f℥ss–j), and in the latter quantity it is emetic when repeated at short intervals.

SYRUPUS SCILLÆ COMPOSITUS, *U. S.*—Compound Syrup of Squill.

Sirop de scille composé, Fr.; *Zusammengesetzter Meerzwiebelsirup*, G.

Preparation.—Fluid Extract of Squill 80 Cc.; Fluid Extract of Senega 80 Cc.; Antimony and Potassium Tartrate 2 Gm.; Precipitated Calcium Phosphate 10 Gm.; Sugar 750 Gm.; Water a sufficient quantity; to make 1000 Cc. Mix the fluid extracts, evaporate them, on a water-bath, in a tared capsule, to 100 Gm., and mix the residue with 400 Cc. of water. When the mixture is cold, incorporate with it, intimately, the precipitated calcium phosphate, filter, and add to the filtrate the antimony and potassium tartrate, dissolved in 25 Cc. of hot water. In this liquid dissolve the sugar by agitation, without heat, strain, and add enough water through the strainer to make the product measure 1000 Cc. Mix thoroughly.—*U. S.*

Compound Syrup of Squill may also be prepared in the following manner: Prepare a percolator or funnel in the manner described under Syrupus. Pour the filtrate, obtained as directed in the preceding formula, and mixed with the solution of antimony and potassium tartrate, upon the sugar, return the first portions of the percolate, until it runs through clear, and, when all the liquid has passed, follow it by water, until the product measures 1000 Cc. Mix thoroughly.—*U. S.*

To make 1 quart of compound syrup of squill mix 20½ fluidrachms each of fluid extracts of squill and senega, evaporate to 3 av. ozs., and add 14 fluidounces of water. When cold incorporate 150 grains of calcium phosphate and filter; to the filtrate add 29½ grains of tartar emetic, dissolved in 1 ounce of hot water. In the mixed liquid dis-

solve 25 av. ozs. of sugar, and add enough water to bring the volume of the syrup up to 32 fluidounces.

After the evaporation of the alcohol in the official process considerable insoluble matter (pectin compounds) is apt to separate, which it is intended to remove by aid of calcium phosphate; if necessary the liquid should be returned to the filter until it runs clear, and the solution of tartar emetic should not be added until a clear filtrate has been obtained. The finished syrup contains a little less than $\frac{1}{8}$ grain of tartar emetic in each fluidrachm, and if carefully prepared it will keep well.

This syrup is known as *hive syrup* and *croup syrup*, and is an official substitute for *Coxe's hive syrup*, which was made by boiling the drugs in water and preserving the liquid by honey.

Uses.—The union of squill, senega, and tartar emetic in this preparation renders it expectorant, diaphoretic, emetic, and, in full doses, purgative also. It was originally devised for the treatment of "croup," or "hives," whence its popular name, "hive syrup." It is not appropriate, however, for membranous croup, but only for the affection which is properly called *spasmodic laryngitis*, and which it relieves mainly by its nauseant, and therefore antispasmodic, action. Care must be taken in employing it not to allow its sedative operation to proceed too far. It may be prescribed in this affection in *doses* of Gm. 0.60–2 (♏x–xxx), repeated at intervals of ten minutes or until its nauseant or emetic operation is developed. In acute *bronchitis* with scanty secretion it should be administered in similar doses, but at longer intervals, so as to keep within the limits both of nausea and vomiting.

SYRUPUS SENEGÆ, *U. S., P. G.*—Syrup of Senega.

Sirop de polygala, Fr.; *Senegasirup*, G.

Preparation.—Fluid Extract of Senega 200 Cc.; Ammonia-water 5 Cc.; Sugar 700 Gm.; Water a sufficient quantity; to make 1000 Cc. Mix the fluid extract of senega with 300 Cc. of water and with the ammonia-water, and set the mixture aside for a few hours. Then filter, and pass enough water through the filter to obtain 550 Cc. In the filtrate dissolve the sugar by agitation, without heat, strain, and add enough water through the strainer to make the product measure 1000 Cc. Mix thoroughly.—*U. S.*

Syrup of Senega may also be prepared in the following manner: Prepare a percolator or funnel in the manner described under Syrupus. Pour the filtrate, obtained as directed in the preceding formula, upon the sugar, return the first portion of the percolate until it runs through clear, and, when all the liquid has passed, follow it by water until the product measures 1000 Cc. Mix thoroughly.—*U. S.*

To make 1 quart of syrup of senega mix 6 fluidounces and 192 minims of fluid extract of senega with $9\frac{1}{2}$ fluidounces of water and 75 minims of ammonia-water; filter and wash the filter with enough water to obtain $17\frac{1}{2}$ fluidounces of filtrate. Dissolve $23\frac{1}{2}$ av. ozs. of sugar in the liquid, and add enough water to bring the volume of the syrup up to 32 fluidounces.

As formerly prepared from a tincture of senega, the separation of pectin compounds occasioned difficulty in filtration, which is now (since 1883) avoided by keeping the gelatinous matters in solution by the aid of ammonia, a portion of which is already contained in the pharmacopœial fluid extract. The syrup has a brown color and a decidedly acrid taste; it should be free from ammoniacal odor. 100 parts of syrup contain about 16 (*U. S.*), 4 (*P. G.*), or 2.5 (*F. Cod.*) parts of senega.

Uses.—The syrup of senega is a very useful medicine in subacute and chronic *bronchitis* and *laryngitis* in the *dose* of Gm. 4–8 (f℥j–ij).

SYRUPUS SENNÆ, *U. S., Br., P. G.*—Syrup of Senna.

Sirop de séné, Fr.; *Sennasirup*, G.

Preparation.—Senna (Alexandria), bruised, 250 Gm.; Oil of Coriander 5 Cc.; Alcohol 150 Cc.; Sugar 700 Gm.; Water a sufficient quantity; to make 1000 Cc. To the senna add 700 Cc. of boiling water, and digest, at a temperature not exceeding 60° C. (140° F.), during twenty-four hours. Then express the liquid, and pass enough water through the dregs to obtain 600 Cc. of liquid. Strain this, and when it is cold mix it with the alcohol, in which the oil of coriander had previously been dissolved. Set it aside until the precipitate has subsided, then pour off the clear liquid, filter the remainder, and pass enough water through the filter to obtain 550 Cc. In this dissolve the sugar

by agitation, without heat, strain, and add enough water through the strainer to make the product measure 1000 Cc. Mix thoroughly.—*U. S.*

To make 1 quart of syrup of senna digest 8¼ av. ozs. of bruised senna with 24 fluidounces of boiling water for twenty-four hours at a temperature not above 60° C., express, and wash the residue with sufficient water to obtain 20 fluidounces. Strain, and when cold add 75 minims of oil of coriander dissolved in 5 fluidounces of alcohol. After twenty-four hours decant the clear liquid, filter the remainder, and pass enough water through the filter to obtain 17½ fluidounces, in which dissolve 23½ av. ozs. of sugar. Finally, add enough water to make the volume 32 fluidounces.

This formula is modelled after that of the British Pharmacopœia; by a similar process 16 oz. av. of senna are made to yield 16 fluidounces of concentrated and filtered infusion, including 3 fluidounces of rectified spirit and 3 minims of oil of coriander, and in this liquid 24 ounces of sugar are dissolved. This syrup weighs 42 ounces, and its specific gravity is about 1.310.

Senna Syrup, *P. G.*, is only about one-fourth the strength of that of the U. S. P., and is flavored with fennel.

Syrupus sennæ cum manna, *P. G.*, is made by mixing equal parts of syrup of senna and syrup of manna (see p. 1019).

The prolonged digestion for twenty-four hours appears unnecessary, and liable to dissolve an increased quantity of inert matter. Senna yields its cathartic principle to water quite readily, and we think that ten or twelve hours' digestion should be sufficient, the residue to be washed with hot water after expression. The alcohol is intended to remove gummy matter, and some time must be allowed for precipitation. The finished syrup is of very dark color, almost black, and possesses the characteristic odor and taste of senna.

Uses.—This is a mild and efficient cathartic for children in the *dose* of from Gm. 4–16 (f℥j–iv).

SYRUPUS TOLUTANUS, *U. S., Br.*—Syrup of Tolu.

Syrop de baume de Tolu, Sirop balsamique, Fr.; *Tolubalsamsirup*, G.

Preparation.—Balsam of Tolu 10 Gm.; Precipitated Calcium Phosphate 50 Gm.; Sugar 850 Gm.; Alcohol 50 Cc.; Water a sufficient quantity; to make 1000 Cc. Dissolve the balsam of Tolu in the alcohol, in a small flask or bottle, with the aid of a gentle heat. Mix the precipitated calcium phosphate with 150 Gm. of the sugar in a mortar, thoroughly incorporate with it the solution of the balsam, and set the mortar aside in a moderately warm place until the alcohol has evaporated. Then triturate the residue well with 500 Cc. of water, gradually added, and filter the mixture through a wetted filter, returning the first portions of the filtrate until it runs through clear. To the filtrate, heated to a temperature of about 60° C. (140° F.), add the remainder of the sugar, and dissolve it by agitation. Then allow the syrup to cool, strain it, and pass enough water through the filter and strainer to make the product measure 1000 Cc. Mix thoroughly.—*U. S.*

Syrup of Tolu may also be made in the following manner: Prepare a percolator or funnel in the manner described under Syrupus. Pour the filtrate, obtained as directed in the preceding formula, upon the sugar, return the first portions of the percolate until it runs through clear, and, when all the liquid has passed, follow it by water until the product measures 1000 Cc. Mix thoroughly.—*U. S.*

To make 1 quart of syrup of Tolu dissolve 146 grains of balsam of Tolu in 12½ fluidrachms of alcohol; incorporate the solution with a mixture of 1¾ av. ozs. of calcium phosphate and 5 av. ozs. of sugar, and allow the alcohol to evaporate. Gradually add 16 fluidounces of water, mix well, and filter; in the clear filtrate dissolve 28¼ av. ozs. of sugar, and add sufficient water to bring the volume of syrup up to 32 fluidounces.

Take of balsam of Tolu 1¼ ounces; refined sugar 2 pounds; distilled water 1 pint or a sufficiency. Boil the balsam in the water for half an hour in a tightly-covered vessel, stirring occasionally. Then remove from the fire, and add distilled water, if necessary, so that the liquid shall measure 16 ounces. Filter the solution when cold, add the sugar, and dissolve with the aid of a steam- or water-bath. The product should weigh 3 pounds, and should have the specific gravity 1.33.—*Br.*

We can see no advantage in driving off the alcohol from the solution of Tolu balsam, nor any objection to retaining it: in our experience the flavor and aroma of the syrup are much improved by allowing the alcohol to remain, no doubt because more of the

balsamic principles are kept in solution along with some resin. The short time of contact of cold water with the finely-divided balsam of Tolu will scarcely dissolve much of the odorous principles (ethers and oil), whereas the presence of 10 per cent. of alcohol will materially increase their solubility: if the alcohol be allowed to remain, the quantity of sugar in the official formula should be reduced to 800 Gm.

SYRUPUS BALSAMI PERUVIANI, S. SYRUPUS BALSAMICUS. Digest 1 part of balsam of Peru in 11 parts of water; decant and filter when cold, and dissolve 18 parts of sugar in 10 parts of the filtrate.—*P. G.* 1872.

Uses.—The medicinal virtues of this preparation are exceedingly feeble, if indeed it possess any. But its agreeable flavor renders it an eligible associate of other and less palatable syrups, especially such as are used in bronchial catarrhs. *Dose*, Gm. 4 (f℥j).

SYRUPUS ZINGIBERIS, *U. S., Br.*—SYRUP OF GINGER.

Sirop de gingembre, Fr.; *Ingwersirup*, G.

Preparation.—Fluid Extract of Ginger 30 Cc.; Precipitated Calcium Phosphate 15 Gm.; Sugar 850 Gm.; Water a sufficient quantity; to make 1000 Cc. Triturate the fluid extract of ginger with the precipitated calcium phosphate, and expose the mixture in a warm place until the alcohol has evaporated. Then triturate the residue with 450 Cc. of water and filter. In the filtrate dissolve the sugar by agitation, without heat, strain, and pass enough water through the filter to make the product measure 1000 Cc. Mix thoroughly.—*U. S.*

Syrup of Ginger may also be prepared in the following manner: Prepare a percolator or funnel in the manner described under SYRUPUS. Pour the filtrate, obtained as directed in the preceding formula, upon the sugar, return the first portions of the percolate until it runs through clear, and, when all the liquid has passed, follow it by water until the product measures 1000 Cc. Mix thoroughly.—*U. S.*

To make 1 quart of syrup of ginger mix 1 ounce of fluid extract of ginger with ½ av. oz. of calcium phosphate, and when the alcohol has evaporated add 14½ fluidounces of water; in the clear filtrate dissolve 28¼ av. ozs. of sugar, and add sufficient water to bring the volume of syrup up to 32 fluidounces.

As in the case of syrup of orange-peel, there can be no possible objection to the presence of alcohol in the finished syrup. We should prefer to add 20 Cc. of alcohol to the fluid extract, triturate the mixture well with 30 Gm. of calcium phosphate, gradually add 450 Cc. of water, and set the mixture aside for six or eight hours with frequent agitation; then filter, and wash the filter with water, so as to obtain 500 Cc. of clear filtrate, in which dissolve 800 Gm. of sugar, adding sufficient water finally to make 1000 Cc. of syrup. Thus prepared, syrup of ginger has a yellowish color, and possesses a much stronger aroma and characteristic pungency than if made strictly according to the official formula.

The Pharmacopœia of 1870 used magnesium carbonate for diffusing the fluid extract preceding the treatment with water; a syrup was thus obtained which was transparent and had the odor of ginger, but contained magnesia in solution, and had but little pungency. The syrup of the Br. P. is milky; it is made by mixing strong tincture of ginger 6 fluidrachms with syrup 19 fluidounces.

Uses.—Syrup of ginger is chiefly employed as a flavoring ingredient of mixtures, but is most suitable as an addition to those which are intended to relieve *colic* by causing an expulsion of flatus. *Dose*, Gm. 4 (f℥j) or more.

TABACUM, *U. S.*—TOBACCO; LEAF TOBACCO.

Tabaci folia, Br.; *Folia nicotianæ*, P. G.—*Nicotiane*, *Tabac*, Fr. Cod.; *Tabak*, G.; *Tabaco*, Sp.

The commercial, dried leaves of Nicotiana Tabacum, *Linné*. Bentley and Trimen, *Med Plants*, 191.

Nat. Ord.—Solanaceæ.

Origin.—The tobacco-plant is indigenous to tropical America, but the country which originally produced it cannot now be ascertained, since tobacco is now unknown in the wild state. The seeds were sent to Spain in 1518 by Fra Romano Pane, and reached France in 1560 from Lisbon through the French ambassador, Jean Nicot. The cultivation of tobacco was commenced in Holland in 1615, soon afterward in England, and about fifty years later in the Palatinate. About the same period, or a little earlier, it appears

to have been introduced into China. At present tobacco is very extensively cultivated in most temperate and subtropical countries. During 1875 there were over 559,000 acres of land planted in the United States, yielding 367,000,000 pounds of tobacco. The annual production of tobacco in all countries has been estimated at about 3,000,000 tons.

N. TABACUM attains a height of 1.2–1.8 M. (4 or 6 feet), has a stout, viscidly hairy stem, shortly-stalked sessile amplexicaul and alternate leaves, and terminal panicles of dull-pink or reddish flowers, consisting of a tubular, bell-shaped, five-toothed calyx, a funnel-shaped corolla about 5 Cm. (2 inches) long, with spreading, five-lobed border and five stamens and a conical ovary. The capsule is about 25 Mm. (1 inch) long, opens by two valves, is two-celled, and contains a large number of minute, somewhat reniform, pale-brown seeds. Nicotiana macrophylla, *Lehmann*, Nic. fruticosa, *Linné*, Nic. petiolata, *Agardh*, and others, are now regarded as varieties of the above species.

Nic. repanda, *Willdenow*, is cultivated in Cuba; Nic. persica, *Lindley*, yields the Shiraz or Persian tobacco; and Nic. rustica, *Linné*, is the species which is chiefly cultivated in Turkey and India. The last-named species is about 1.2 M. (4 feet) high, has oval or ovate entire leaves on petioles about 38 Mm. (1½ inches) long, and produces greenish-yellow flowers nearly 25 Mm. (1 inch) long. According to Thiselton Dyer, Latakia tobacco is prepared from the flowering panicles and capsules of N. Tabacum, and owes its peculiar flavor to the smoke of the wood of Pinus halepensis, *Aiton*, to which it is exposed.

Cultivation.—The plant requires a deep, rich soil, which must be annually well manured; the seeds are sown in beds, and when the young plants are 15 to 20 Cm. high they are transplanted to the tobacco-fields, and during their growth carefully freed from the larvæ of insects. The flowering tops and branches are broken off before the flowers expand, and when the leaves are fully matured, which takes place about the month of September, the plants are cut, allowed to wilt in the sun, and afterward cured by being hung up in a drying-house and exposed to the heat of a fire. The leaves at first become wet, or "sweat," and in the course of several weeks are dried, after which they are stripped from the stems, assorted, gathered up into small parcels, and then are packed into large boxes or hogsheads.

Description.—Tobacco-leaves are from 15–50 Cm. (6 to 20 inches) long and from 5–15 Cm. (2 to 6 inches) wide, oval or ovate-lanceolate, sometimes rather obovate in form, pointed and acute at the apex, and with an entire margin. In the fresh state they are rather thick, green, and covered with viscid hairs and with small sessile glands; after drying they are thinner, lighter or darker brown, or mottled with different shades of brown and friable. The leaves have a thick, prominent midrib, branching under acute angles into lateral veins, which are curved near the margin. The odor of tobacco is peculiar and heavy, and its taste disagreeable, bitter, and acrid.

Constituents.—Tobacco contains a large amount of salts, consisting of sulphates, nitrates, chlorides, phosphates, and malates of potassium, calcium, ammonium, and nicotine, and yields from 14 to 18.5 per cent. of ash. Larger amounts have been obtained, sometimes as much as 25 to 27 per cent.—a result which is probably due in some cases to dust adhering to the viscid glands, as was suggested by B. F. Creighton (1876). The other constituents of tobacco are albumen, resin, extractive, gum, citric acid (Goupil), nicotianin, and nicotine. *Nicotianin* was discovered by Hermbstädt on distilling tobacco with water; it separates from the distillate in the form of white foliaceous crystals, which have an odor resembling that of tobacco-smoke and a warm and bitterish aromatic taste (Posselt and Reimann, 1828). Landerer (1835) obtained nicotianin from the dried, but not from the fresh, leaves. Barral (1845) stated that it contains 7.12 per cent. of nitrogen.

Nicotine or *nicotia* is the poisonous principle of tobacco, and was discovered by Posselt and Reimann (1828). It may be prepared by exhausting bruised tobacco with acidulated water, concentrating the infusion, adding an excess of potassa, and agitating with ether, which dissolves the alkaloid, and on the addition of powdered oxalic acid nicotine oxalate, which is insoluble in ether, is separated (Schloesing); or, the ether is evaporated, the liquid neutralized with oxalic acid, evaporated to dryness, and the residue exhausted with boiling alcohol, which dissolves nicotine oxalate (Ortigosa). On evaporating the solution to a syrupy consistence and agitating it with potassa and ether, an ethereal liquid is obtained, which on fractional distillation yields the alkaloid. This is a colorless oily liquid, having at 15° C. (59° F.) the spec. grav. 1.0111, and remaining liquid at —10° C. (14° F.). It has an unpleasant, and when heated a pungent, acrid, tobacco-like odor, a burning taste, and a strongly alkaline reaction. Exposed to air and light, it

rapidly acquires a brown color and is partly converted into a resinous compound. It boils near 250° C. (482° F.), but distils at a lower temperature, always leaving a residue. Its composition is $C_{10}H_{14}N_2$ (mol. weight 161.72). It absorbs water from the air, dissolves readily in water, and is separated from this solution by caustic potassa. Alcohol and ether dissolve it in all proportions, and it yields with acids neutral and acid salts, of which the former crystallize with difficulty and are mostly soluble in weak alcohol, but insoluble in ether. The alkaloid acquires a wine-red color with strong sulphuric acid, and on heating the mixture is charred. Chlorine gas colors it deep-red or red-brown. When heated with a little hydrochloric acid a violet color is produced, which on the further addition of nitric acid changes to yellowish-red. The double salts with mercuric and platinic chloride are sparingly soluble in cold water. Dried tobacco-leaves contain from 2 to 8, and occasionally as high as 11, per cent. of nicotine. The alkaloid is present in all parts of the green plant, as well as in the dried leaves, and according to Kissling (1882), also in tobacco-smoke, which owes its toxic action mainly to this alkaloid. Instead of nicotine, H. Vohl and H. Eulenburg (1871), found chiefly *collidine*, with *pyridine*, *picoline*, and other bases of the same series (see page 1109), besides ammonia and traces of ethylamine; and, in passing the vapors through potassa solution, hydrocyanic, hydrosulphuric, acetic, formic, butyric, valerianic, carbolic, and probably other acids were retained.

Pharmaceutical Products.—Oleum tabaci, Oil of tobacco (*U. S.* 1870), is prepared by dry distillation of coarsely-powdered tobacco, and is a brown-black tar-like liquid of a strong and very peculiar empyreumatic odor. Unverdorben (1826) recognized in it the presence of an alkaloid, which on being boiled with diluted sulphuric acid yields, among other products, *odorine* or *picoline;* it is not unlikely that others of the ternary bases contained in animal oil (see page 1109) may likewise be present in this tarry product. Zeise (1843) demonstrated the presence of butyric acid, ammonia, paraffin, empyreumatic resin, and a pale-yellow oil of the formula $C_{11}H_{22}O_2$, which boils at 195° C. (383° F.). Melsens (1843) proved the presence of nicotine in the tarry matter separating in tobacco-pipes, and it is most likely present in the empyreumatic oil.

Unguentum tabaci, Tobacco ointment (*U. S.* 1870). The aqueous extract from ½ oz. av. of powdered tobacco is mixed with 8 oz. av. of lard.

Vinum tabaci, Wine of tobacco (*U. S.* 1870). Exhaust 120 grains of tobacco with 4 fluid-ounces of sherry wine.

Action and Uses.—The essential effects of tobacco are best illustrated by the action of nicotine employed experimentally. The following summary represents the effects of doses of nicotine varying from $\frac{1}{32}$ to $\frac{1}{16}$ grain, taken in water: The minutest doses occasion a burning sensation in the tongue, a hot, acrid feeling in the fauces, and a sense of rawness throughout the œsophagus. Salivation is abundant. Small doses produce a sense of heat in the stomach, chest, and head, and even in the fingers, with some excitement of the nervous system; larger ones cause heaviness, giddiness, torpor, sleepiness, indistinct vision, with sensitiveness of the eye to light, imperfect hearing, laborious and oppressed breathing, and dryness of the throat. The former contract, the latter dilate, the pupils. In forty minutes after the larger doses a sense of great debility is perceived, the head droops, the pulse-rate falls, the face grows pale, the features are relaxed, the limbs seem paralyzed, the hands and feet are cold, the coldness advances gradually toward the trunk, and faintness ends in loss of consciousness. The disorder of the digestive organs manifests itself by eructations, nausea, and even vomiting, the abdomen becomes distended, and an urgent desire is felt to go to stool; wind is discharged, the stools may be profuse and watery, and urine is voided copiously. The nervous system, after the debilitating influence of the poison has developed itself, shows its condition by muscular spasm, which begins with tremulousness of the extremities, and gradually involves the whole muscular system, including the respiratory muscles, so that the breathing is oppressed, gasping, and incomplete. This enumeration of effects is sufficient to prove that nicotine acts primarily upon the spinal and sympathetic nervous systems rather than upon the brain. It may cause death by direct paralysis of the heart, or more indirectly by paralysis of the respiratory muscles, producing asphyxia. But it also impairs the function of the blood as a carrier of oxygen. The blood examined during life of a person under the full influence of tobacco is of a dark color, and presents a striking disaggregation of the red corpuscles, which are also less regularly circular than natural, and have jagged or crenated edges. The white corpuscles are likewise broken up. As the poisonous operation passes off, however, the blood regains its normal character. The action of tobacco itself is so nearly identical with that of nicotine as to render unnecessary a detailed account of it in this place. It, however, is mainly exhibited in muscular relaxation and collapse. In some cases "lethargy" and "insensibility" are mentioned, but the condition is

not that of cerebral oppression so much as of cerebral exhaustion. Briert has reported the case of a woman who consumed large quantities of tobacco by smoking, chewing, and snuffing. Finally, she fell into a condition in which the graver of the above symptoms were present, and in which she died (Blatin, *La Nicotine et le Tabac*, 1870, a work in which this subject is copiously illustrated). The case of Count de Bocarmé, who, in 1851, with his wife as an accomplice, killed her brother with nicotine prepared by themselves, is famous in judicial annals. In 1884 a case apparently of suicide by this poison terminated very rapidly (*Centralbl. f. d. g. Therap.*, iii. 328). We have elsewhere cited numerous cases of tobacco-poisoning; others have been collected by Hare (*Physiol. and Pathol. Effects of Tobacco*, 1885), by Giacchi (*Therap. Monatsh.*, iii. 178), and a very striking case of fatal acute poisoning by Richardson (*Asclepiad*, 1889). Within a few years past the habit of smoking cigarettes, especially by the young, has multiplied the number of cases of chronic tobacco-poisoning beyond all precedent. Among the symptoms especially prominent in certain cases of tobacco-poisoning, either caused by a single excessive dose or by inordinate indulgence in smoking or chewing tobacco, may be mentioned: a rapid followed by a very slow pulse, hiccough, and cold perspiration, dilated pupils, profuse diuresis, convulsions without loss of consciousness, sometimes cataleptic and sometimes hysterical, and great numbness as well as impaired motor power of the limbs and of the tongue (*e. g.* case in *Amer. Jour. of Med. Sci.*, Jan. 1882, p. 306). As in the case of other medicines directly affecting the nervous system, the habitual use of tobacco deprives it of many of its graver effects, especially if the general health is not reduced below its normal standard.

The cases of serious illness produced by the emanations of tobacco, and by its application even to the unbroken skin, are innumerable, and many instances of fatal poisoning by tobacco are recorded, some of them being due to its having been swallowed purposely or accidentally, some to its use medicinally in an enema, and some to its application to eruptions on the skin. The fatal dose of tobacco internally, and generally by enema, has varied from the maximum of an ounce or two to a minimum of 15 grains. It was generally administered in decoction or infusion. Nicotine stands next to prussic acid in the rapidity and energy of its poisonous action, but the minimum fatal dose of it is unknown.

Although the use of tobacco as an external remedy is no longer common, its efficacy is sufficiently well established in several diseases. It has been applied to the treatment of *scabies* in man, and long was used, and perhaps still is, for the same disease in domestic animals, but the risk of producing toxical symptoms when the skin is broken has probably led to its disuse. The same remark applies to other cutaneous eruptions. The bruised fresh leaves of the tobacco-plant have been found a local palliative in *urticaria*, *gout*, and *rheumatism*, and the fumes of tobacco have been applied with advantage in the last two disorders. Snuffing has been employed with success in the cure of *nasal polypus*, for the relief of chronic *ophthalmia* and catarrh of the *frontal sinuses*, and in tropical countries for destroying the *worm* which sometimes breeds in the antrum Highmorianum and the adjacent parts.

Internally, the smoke of tobacco inhaled is a palliative of nervous *cough* produced by tickling in the larynx or trachea, and has put an end to an attack of *spasmodic laryngitis* in the same manner as other nauseants and cardiac sedatives. A plaster made with strong snuff and tallow is a popular remedy in the same disorder, and has been applied in *laryngismus stridulus*. Obstinate *hiccough* has been arrested by swallowing tobacco-smoke, and *dislocations* of the lower jaw and of various joints have been remedied while the patient was relaxed by tobacco-fumes.

The relaxing, nauseating, and purgative operation of tobacco has been successfully employed to overcome *obstruction of the bowel* by fecal accumulations. When the usual purgative agents have failed, tobacco cataplasms or enemas (even of tobacco-smoke) may be cautiously employed. It is not certain that *internal hernia* and *intussusception* have not been relieved by this treatment, but the accurate diagnosis of intestinal obstructions is very difficult, and care must be taken not to exhaust the patient by heroic measures while a reasonable hope remains that nature will suffice for the cure. It is quite erroneous to suppose that these intestinal obstructions are overcome by relaxing muscular spasm: the only rational explanation of the utility of tobacco, and of various other medicines of the same class, is that by lowering the heart's action they tend to diminish the vascular congestion of the strangulated organ. In *lead colic*, in which tonic spasm probably does exist, tobacco may act as a true antispasmodic, but in this affection it is seldom used.

The powerful relaxing influence of tobacco led naturally to its use in the treatment of *tetanus*, and the list is long of the cases in which its infusion was given by enema. More recently nicotine was administered in this disease by the mouth or the rectum. It is, as might be expected, a surer remedy in the idiopathic than in the traumatic form of the disease. Tobacco has generally been prescribed in tetanus in an infusion made with 1.30 Gm. (20 grains) of the drug to Gm. 250 (½ pint) of water, and nicotine in the dose of a fraction of a drop, increased until its specific effects are developed. The same means as in tetanus have been employed in several cases of *strychnine-poisoning*; but, according to Haynes, nicotine and strychnine are in no degree antagonistic poisons (*Phil. Med. Times*, vii. 363). It does not follow, however, that at a certain stage of strychnine-poisoning nicotine may not tend to control the spinal spasms. (See STRYCHNINÆ SULPHAS.) The power of tobacco-smoke to arrest or palliate paroxysms of *asthma* is well established. There is reason to believe that it is quite as efficient as lobelia, with which it is almost identical in operation. *Ascarides* of the rectum, and even *lumbricoid* worms, have been expelled after the injection into the rectum of tobacco-smoke or of tobacco infusion. It is alleged to be an antidote to poisoning by *mushrooms*, but upon insufficient grounds.

Tobacco may be given as an emetic in the *dose* of Gm. 0.30 (gr. v–vj), but it is rarely prescribed in this form. The infusion, wine, and ointment are no longer officinal. Fresh tobacco-leaves, which are sometimes used as a topical application, are much feebler in their action than the cured leaves, and those especially which have undergone fermentation in their manufacture. The dose of nicotine has been stated at Gm. 0.01–0.06 (gr. ⅙–j), but some authorities recommend that the primary dose should not exceed Gm. 0.001 (gr. $\frac{1}{60}$). For hypodermic injection a solution has been proposed containing Gm. 0.001 (gr. $\frac{1}{60}$) in every 5 drops. Of this solution the primary dose should not exceed Gm. 0.0005 ($\frac{1}{120}$ grain). Nicotine should never be used internally if other preparations of tobacco can be procured.

TAMARINDUS, *U. S., Br.*—TAMARIND.

Pulpa tamarindorum cruda, P. G.; *Fructus tamarindorum.*—*Tamarinier* (*pulpe*), F. Cod.; *Tamarin*, Fr.; *Tamarindenmus*, G.; *Tamarindo*, Sp.

The preserved fruit of Tamarindus indica, *Linné*, s. T. officinalis, *Hooker*. Bentley and Trimen, *Med. Plants*, 92.

Nat. Ord.—Leguminosæ. Cæsalpineæ.

Origin.—The tamarind tree, 18–24 M. (60 to 80 feet) high, is indigenous to India and throughout tropical Africa, and has been introduced into all tropical countries. It has alternate abruptly pinnate evergreen leaves, with from ten to eighteen pairs of oval-oblong, at the base unequal, veined leaflets, and produces few-flowered terminal and lateral racemes. The fragrant flowers have a four-lobed calyx, the upper lobe being broad and two-toothed; the corolla is white, afterward yellow, red-veined, and consists of three elliptical petals, which are longer than the calyx; occasionally two more petals, linear and minute, are present; the nine or ten stamens are monadelphous, but only three or four have anthers; the ovary is stalked and has a long style. The fruit is an indehiscent usually curved legume, about 15 Cm. (6 inches) long and nearly 25 Mm. (1 inch) broad. The West Indian tree bears a fruit which is only about three times longer than broad, and was formerly regarded as a distinct species, T. occidentalis, *Gaertner*. The fruit has a thin, fragile, pale-brownish shell (pericarp), and underneath this there are found on each side three tough fibrous somewhat branching veins running from the base to the apex. Next follows an

FIG. 304.

Tamarindus indica, *Linné*: flowering branch, pod, and pod with shell removed.

acidulous pulp, and this adheres to a tough membrane which encloses from three to ten cavities, each of which contains a single flat somewhat quadrangular and polished brown seed.

Preparation.—Before tamarinds enter commerce the shell is removed, and the inner portion is in India pressed together into a mass to which sometimes sugar is added. In Upper Egypt it is formed into cakes which are dried in the sun, and in the West Indies hot syrup is poured over the pulpy mass. The fresh leaves and flowers have an acidulous taste, and are used in tropical countries for the preparation of cooling drinks.

Description.—As seen in our commerce, tamarinds form a reddish-brown soft mass in which the interior portion of the fruit is more or less broken. They have a fruit-like odor and an acidulous and sweet taste. *East Indian tamarinds* are tougher and darker in color and have a less sweet taste. *Egyptian tamarinds* appear in hard, flattish, circular cakes, about 15 Cm. (6 inches) in diameter, of a brown-black color externally, and frequently mouldy. The last two varieties are rarely met with in American commerce. On leaving the clean blade of an iron spatula for thirty minutes in contact with tamarinds, it should not become covered with a coating of copper.

Constituents.—Vauquelin ascertained tamarinds to contain sugar, tartaric, citric, and a little malic acid, pectin, and mucilaginous matter. The acids are mostly present as potassium compounds. Acetic acid has likewise been found in tamarinds; it probably results from the fermentation of the sugar. Tannin is not present, except in the testa of the seeds. C. Mueller (1882) found in East Indian tamarinds very little malic acid; citric acid varied between 6 and 4 per cent., tartaric acid between 5.3 and 8.8 per cent., potassium bitartrate between 4.7 and 6 per cent., the insoluble matter of the pulp between 12 and 20 per cent., and the seeds between 1.5 and 38 (average 13.9) per cent.

Pharmaceutical Uses.—Tamarinds are employed in the preparation of Confectio sennæ, *U. S.*, *Br.*, being freed from vegetable tissues by means of water and straining.

Pulpa tamarindorum depurata, *P. G.*, is made by softening East Indian tamarinds with sufficient boiling water, straining the mass through a hair sieve, evaporating the strained portion to the consistence of an extract, and incorporating with 5 parts of it 1 part of powdered sugar.

Conserva tamarindi, *F. Cod.* Tamarind-pulp 2 parts; powdered sugar 5 parts, water sufficient for 8 parts.

Tamar indien is a confection of senna flavored with anise and oil of lemon.

Action and Uses.—Tamarinds are mentioned by the Arabian medical writers as antibilious and useful in correcting nausea, quenching thirst, and allaying febrile excitement, and also as being efficient in healing aphthous sores. They are still used for similar purposes, and especially to prepare a cooling drink in *febrile diseases*. They should be mixed with hot water, and the strained liquid allowed to cool. An ounce of tamarind-pulp boiled with a pint of milk produces a whey which also forms an agreeable drink in fevers. Although reputed to impair the purgative action of senna, they are habitually used along with that cathartic in magistral preparations, as well as in the officinal confection of senna.

TANACETUM, *U. S.*—Tansy.

Summitates tanaceti.—*Tanaisie*, F. Cod.; *Herbe aux vers*, Fr.; *Rainfarn, Wurmkraut*, G.; *Tanaceto*, Sp.

The leaves and tops of Tanacetum vulgare, *Linné*, s. Chrysanthemum Tanacetum, *Karsch.*

Nat. Ord.—Compositæ, Senecionideæ.

Origin and Description.—Tansy is a perennial herb indigenous to Europe and Central Asia and naturalized in many parts of North America, where it grows in old fields, along roadsides, and in the neighborhood of river-banks. The stout and fibrous many-headed root sends up a cluster of nearly simple stems which are .9–1.2 M. (3 or 4 feet) high, roundish-angular, and frequently purplish at the base. The leaves are alternate, shortly petiolate or sessile, from 12–25 Cm. (5 to 10 inches) long and nearly half as wide, smooth, dark-green, dotted with oil-glands, bipinnately divided, and the segments rounded, incised, or coarsely serrate. The flowers are in a dense terminal corymb, have an imbricate involucre with numerous brown-margined scales, a convex naked receptacle, and numerous yellow florets, with the marginal ones pistillate and three-toothed, but not ligulate. The akenes are obovate, about five-ribbed, and terminate with a crown-like pappus. The plant commences to bloom in July, and should be collected while flowering; on drying the loss in weight is from 80 to 85 per cent. It has a strong, rather unpleas-

ant odor, and an aromatic, pungent, and bitter taste. A variety, Tan. crispum, with twice-pinnatifid and curled leaves, is frequently cultivated, and is known as *double tansy*.

Constituents.—Among the ordinary constituents of tansy, Peschier and Frommherz found mucilage, sugar, albumen, fixed oil, resin, tannin, coloring matter, and malic acid, with which Peschier's *tanacetic acid* is probably identical. The bitter principle was isolated by Leroy (1845) by a process similar to that for digitalin. This *tanacetin* is described as being yellowish-white, granular, inodorous, fusible, soluble in ether, less freely soluble in alcohol, and sparingly soluble in water. Leppig (1882) gives for it the formula $C_{11}H_{16}O_4$, and found it to be present chiefly in the flowers; sulphuric acid colors it yellow, then brown, red-brown, and blood-red, the margin becoming blue. The most important constituent of tansy is its volatile oil, of which the fresh flowering herb yields ¼ to ⅓ per cent. of its weight. *Oil of tansy*, *Oleum tanaceti*, is an oxygenated oil of neutral or slightly acid reaction, varies in density between 0.92 and 0.95, and has either a yellow or green color. According to Geoffroy, the herb grown in dry places yields a green-colored volatile oil, but if grown in moist localities the oil is yellow. Oil of tansy has a camphoraceous aromatic odor and a bitterish pungent taste, deviates polarized light to the left, is readily soluble in alcohol, dissolves iodine without explosive action, and is readily oxidized on being heated with nitric acid. Bruylants (1877) found in it 1 per cent. of a terpene, $C_{10}H_{16}$, boiling near 160° C. (320° F.), and a small quantity of an acid and a neutral resin, while the greater portion consists of the aldehyde, $C_{10}H_{16}O$, mixed with about 20 per cent. of the alcohol, $C_{10}H_{18}O$.

Allied Plant.—Tanacetum Balsamita, *Linné*, s. Pyrethrum Tanacetum, *De Candolle*, Balsamita suaveolens, *Persoon*.—Costmary, *E.*; Balsamite, *Fr.*; Frauenminze, *G.*—This is a perennial herb of Southern Europe, with undivided serrate, oval-oblong, petiolate leaves, and discoid, yellow, hemispherical flower-heads in terminal corymbs. It has a strong aromatic odor and bitter taste, and is employed like tansy, and recognized as such by the French Codex.

Action and Uses.—2½ drachms of the oil occasioned loss of consciousness, convulsions, foaming at the mouth, dilated pupils, and frequent pulse, followed by recovery. (*Therap. Gaz.*, ix. 342. Compare *Med. Record*, xxxvi. 342.) In fatal cases death is usually caused by coma and asphyxia. In a case of fatal poisoning by a decoction of the herb death took place by paralysis of the muscles of deglutition, respiration, and voluntary motion. Instead of these nervous symptoms, an infusion of tansy caused vomiting, purging, severe abdominal pain, and death in collapse, without previous impairment of intelligence (*Phila. Med. Times*, xi. 346). In another case it was attended with convulsions, and followed the taking of a teaspoonful of oil of tansy in an hour and a quarter. In a fatal case following a dose of 11 drachms of oil of tansy no congestion of the brain was found, but the heart was full of black blood and the lungs were shrunken and crepitous. The stomach was not inflamed (Jewett, *Boston Med. and Surg. Jour.*, March, 1880, p. 327).

The fatal poisonous dose of oil of tansy is undetermined; very grave symptoms have been produced by Gm. 2 (f℥ss), and even by a dose of Gm. 1–1.30 (gtt. xv–xx).

Tansy was used in the Middle Ages and subsequently as a remedy for *amenorrhœa*, *worms*, and *dropsy*, and, although it is no longer regarded as of equal potency with other medicines in these diseases, its efficacy cannot be reasonably questioned. Its tonic and stimulant virtues resemble those of absinth, but there can be little doubt that it causes a vascular congestion of the abdominal organs, increasing the secretion of urine and promoting the menstrual discharge. It is largely employed in domestic practice, especially in rural districts, to promote or restore *menstruation*, and sometimes with a criminal intention as an abortifacient, but, so far as appears, unsuccessfully. Its fruit is held by some to be as efficient as chenopodium in the destruction and expulsion of lumbricoid *worms*, and the bruised leaves have been applied to the abdomen for the same purpose. In this manner, and also in vinous and spirituous infusion, tansy has been in vogue as a topical application for *bruises*, *sprains*, *muscular rheumatism*, chronic *ulcers*, etc. Internally, it affords relief in flatulent *colic*, and is not without efficacy in *hysterical* disorders.

The *dose* of the powder of the fruit of tansy is Gm. 0.60–3 (gr. x–xl) and of the flowers from Gm. 1.30–8 (gr. xx–cxx). An infusion may be prepared with Gm. 16–32 (℥ss–j) of the seeds, or with Gm. 32–64 in Gm. 500 (℥j in Oj) of boiling water, and prescribed in doses of Gm. 32–64 (f℥j–ij). The oil may be given in doses of Gm. 0.05–0.25 (gtt. j–iv) or more.

TARAXACUM, *U. S.*—Taraxacum (Dandelion).

Taraxaci radix, Br.; *Radix taraxaci*, P. A.—*Dandelion-root*, E.; *Pissenlit, Dent de lion, Couronne de moine*, Fr.; *Löwenzahn, Pfaffenröhrchen*, G.; *Diente de leon*, Sp.

The root, gathered in the autumn (*U. S., Br., P. A.*), of Taraxacum officinale, *Weber* (T. Dens-leonis, *Desfontaines*, T. vulgare, *Schrank*, Leontodon Taraxacum, *Linné*). Woodville, *Med. Bot.*, plate 3; Bentley and Trimen, *Med. Plants*, 159.

Nat. Ord.—Compositæ, Cichoriaceæ.

Origin.—Dandelion is a perennial acaulescent herb, with a tuft of spreading short-stalked radical leaves, which are about 20 Cm. (8 inches) long, obovate-oblong, acute, and on the margin runcinately and coarsely serrate. The flower-heads are terminal upon the hollow scapes, about 38 Mm. (1½ inches) in diameter, and have an erect imbricate involucre and numerous ligulate, yellow, and five-toothed florets. The akene is compressed, obovate-oblong, and terminated by a silky-hairy, spreading pappus raised upon a long stalk. The plant grows in waste places, pastures, and on roadsides, and is met with in most countries of the northern hemisphere. Collected in spring and dried, the root loses from 80 to 85 per cent. in weight, but if collected in autumn the loss on drying ranges from 70 to 75 per cent.

Fig. 305.

Transverse section of Taraxacum-root.

Description.—The root is from 15–30–40 Cm. (6 to 12 or 16 inches) long, nearly cylindrical, 12–25 Mm. (½ to 1 inch) thick, crowned with several short thickish heads above and furnished with few branches below. Fresh, it is light yellowish-brown and fleshy; when dry, brown or dark-brown, much wrinkled longitudinally; internally, it is white with a yellowish centre. It is inodorous and has a bitter taste. It is hygroscopic, and in damp weather rather flexible, but when dry breaks with a short fracture, showing the pale-yellow porous wood surrounded by a dark-brown cambium-line and a thick white bark, with concentric circles of milk-vessels of a brownish color, and separated by layers of thin-walled and axially elongated parenchyma. The meditullium has no medullary rays, and consists mainly of ducts varying in diameter and more or less interspersed with thin-walled, elongated cells.

After frost and early in the spring, particularly when grown in a rich soil, the root contains much sugar and levulin; during the spring and summer the milk-juice becomes thicker and the bitter taste increases; the root is therefore directed to be collected in the autumn. The early spring root yields a sweetish-bitter extract. Bentley regards the root collected about July as most efficient. The Austrian Pharmacopœia directs also the leaves, *Folia taraxaci*, collected in the spring, for use in the preparation of the extract; for the same purpose the German Pharmacopœia orders *Radix taraxaci cum herba* collected before flowering.

Constituents.—The bitter principle, *taraxacin*, was obtained by Polex (1839) in a crystalline state by treating the milk-juice with boiling water and evaporating. Kromayer (1864) left the aqueous solution in contact with animal charcoal, from which afterward alcohol dissolved the bitter principle, requiring treatment with lead acetate and sulphuretted hydrogen to free it from various principles; it was obtained as an amorphous bitter mass. The milk-juice contains also *resin* and *taraxacerin*, $C_8H_{16}O$, which is insoluble in water, crystallizes from hot alcohol, and when in an alcoholic solution has an acrid taste. The dry root yields from 5 to 7 per cent. of ash.

Dandelion-root collected in October yielded to Dragendorff (1870) 24 per cent. of inulin and a little sugar, but when collected in March only 1.74 per cent. of inulin was found, and about 18 per cent. each of uncrystallizable sugar and *levulin*, the latter being intermediate between inulin and sugar in having the composition of inulin, but being of a sweet taste, soluble in cold water, and without influence on polarized light. Frickhinger (1840) and T. and H. Smith (1849) proved that the mannit, which is sometimes found in notable quantities in the extract, does not pre-exist in the root, and that, on the contrary, it is a product resulting from fermentation.

The presence of fermentable sugar has been noticed by most investigators, and Dragendorff's observations confirm the results previously obtained by Frickhinger, Widemann, and Overbeck (1827), that the sugar predominates in the spring root, and inulin in the root collected in autumn. It seems to follow therefrom that the extract and other preparations made from the expressed juice or by treating the autumn root with cold water should be more efficacious and less loaded with inert matters (sugar, etc.) than those obtained from the spring root. Old extract of taraxacum sometimes contains granular

crystals of calcium lactate (Ludwig, 1861); the lactic acid is probably produced from *inosit*, which, according to Marmé (1864), exists in the leaves and stalks of dandelion, but is not found in the root.

Allied Drug.—Cichorium Intybus, *Linné*, indigenous to Europe and the Levant, is naturalized in fields and along roadsides in North America westward to Minnesota, and is largely cultivated in some parts of Europe. The root of the wild-grown plant soon becomes woody, but cultivated it remains fleshy and has a thicker bark. It resembles dandelion-root, but it is of a rather lighter color, and upon transverse section shows the white bark-tissue radially striate from the milk-vessels, and the yellowish finely porous wood marked by fine medullary rays. About 4,000,000 pounds of this root, usually cut into short pieces, are annually imported from Europe. The bitter principle of chicory has not been isolated. The cultivated root, from which, collected in July, Dragendorff obtained 36 per cent. of inulin, has been recommended as a source of alcohol, which is said to be easily obtainable in a state of purity and possessed of a pleasant aromatic taste. According to Nietzki (1876), the flowers contain a crystalline glucoside insoluble in ether, dissolving in alkalies with a yellow color.

Chicory-root (Succory, *E.*; Chicorée sauvage, *Fr.*; Cichorie, *G.*) is not unfrequently substituted for dandelion-root in the preparation of extract and fluid extract. While the roots of the two plants, notwithstanding their resemblance, may be distinguished from each other without difficulty (see above), no reliable tests are known by which their pharmaceutical preparations may be distinguished. It is therefore best for pharmacists to prepare them from the properly-selected drug.

Besides the root of the wild plant, the French Codex recognizes also *chickory-leaves*, of which the radical ones are oblong, more or less runcinate or lyrate and acute, while the cauline leaves are lanceolate, the upper ones clasping, toothed or entire. They contain a bitter principle, sugar, albuminoids and salts. The young leaves are slightly bitter. When cultivated and protected from the light the leaves are yellow, and are used as salad in France under the name of *barbe de capucin*.

Cichorium Endivia, *Linné*, a native of the Levant, is cultivated for its bitterish leaves, known as endive, *E.*; Scarole, *Fr.*; Endivie, *G.*

Medical Action and Uses.—The first distinct mention of dandelion is by Arabian medical writers, who state it to be a very efficacious deobstruent and purifier of the blood. At the close of the last century it was greatly in vogue as a remedy for chronic affections of the liver and bowels, for renal calculus, some cutaneous diseases, etc. Its diuretic qualities are recognized in its popular names, pissenlit, lectiminga, etc. Rutherford and Vignal concluded from their experiments that taraxacum is a very feeble hepatic stimulant. It is employed, now, as formerly, in cases of *hepatic congestion* due to or associated with *atonic dyspepsia* and *constipation*. It has been regarded as useful in pulmonary *consumption*—possibly, if at all, by its action upon the stomach and bowels, and indirectly upon the liver.

Dandelion is frequently administered in decoction, of which the *dose* is from Gm. 64–128 (2 to 4 fluidounces). It is apt to ferment. The extract is of little use. The fluid extract and the juice are probably its most active forms.

Chicory is thought to increase the appetite, promote the digestion, and stimulate the liver—in a word, to operate very nearly as dandelion is supposed to act. Its excessive use is alleged to occasion venous congestion of the abdominal organs, the brain, and the organs of the senses. In this manner it has been accused of causing amaurosis. The fresh young plant is generally eaten, like endive, as a salad in the spring season, as a "purifier of the blood"—*i. e.* as a promoter of the secretions of the liver, bowels, and kidneys. Even from ancient times it has been recommended in cases for which dandelion is commonly used, including those of *feeble digestion* with flatulence, constipation, and light-colored stools—a condition erroneously supposed to denote torpor of the liver. It is alleged to have cured *intermittent* fevers which quinine failed to arrest, especially when engorgement of the liver and spleen was present, with general dropsy. It is also asserted to have been useful in chronic diseases of the *skin*, particularly in those of a gouty origin. Chicory-root dried, roasted, and reduced to a coarse powder has a close resemblance to ground coffee, and is extensively used for mixing with the latter or for fraudulently adulterating it. To those who are not aware that the proper flavor of coffee depends upon its aromatic volatile oil, and who measure its strength by its bitterness, the substitution of chicory can cause no disappointment or injury. It is probable that an infusion of chicory taken at meals as a substitute for coffee would be preferable to the latter on the score of health, and it is still more probable that pure water would be more wholesome than either; but such facts furnish no reason why the public should be deluded into believing that in drinking an infusion of chicory they are using a true substitute for coffee.

TAXUS.—Yew.

If commun, Fr.; *Eibe*, G.; *Tejo*, Sp.

Taxus baccata, *Linné*. Bentley and Trimen, *Med. Plants*, 253.
Nat. Ord.—Coniferæ.

Origin and Description.—The yew is an evergreen shrub, or more frequently a tree of very slow growth, but attaining a height of 9–12 M. (30 or 40 feet). It is indigenous to Asia from Siberia southward to the Himalaya Mountains, and westward to Syria, Northern Africa, and the greater part of Europe. It has been introduced as an ornamental tree into North America, and is naturalized to some extent. The tree has a red-brown bark, numerous and spreading (or in one variety fastigiate) branches, and closely placed, nearly sessile, and two-ranked or crowded leaves, which are linear, entire, flat, somewhat curved, acute, glossy-green above, pale-green beneath, and about 25 Mm. (1 inch) long. The fruit or berry consists of a globular-ovate, acutish or blunt, black-brown seed, surrounded by a fleshy cup-shaped scarlet-red arillus, which is open at the top, and at the base furnished with two or three rows of small scales. The young branches with the leaves attached and the fruit have been employed medicinally. The former have an unpleasant terebinthinaceous odor and a disagreeable bitter and acrid taste. The taste of the fleshy part of the berry is sweetish and not unpleasant, but the seed is bitter.

Constituents.—The leaves were examined by Peretti (1828) and Righini (1837), who, besides the common principles, found in them volatile oil, tannin, and an amorphous bitter principle. Lucas (1843) isolated the latter in the form of an amorphous bitter powder which is sparingly soluble in water, but freely soluble in dilute acids, in alcohol, and ether. The salts of this *taxine* are uncrystallizable, and are precipitated by tannin and by alkalies. Marmé (1876) obtained the alkaloid in a crystalline condition from the leaves and in small proportion from the seeds; besides the solvents mentioned before, it is soluble also in chloroform, benzene, and carbon disulphide, is precipitated by all group reagents of the alkaloids except the chlorides of mercury, gold, and platinum and potassium platino-cyanide, and is colored purplish-red by sulphuric acid, but dissolves without coloration in other acids, and has poisonous properties. Amato and Capparelli prepared from the leaves a crystalline, nitrogenated, colorless compound, *milossin*, which is insoluble in water, and a volatile alkaloid which has a peculiar musty odor and is colored green by sulphuric acid and potassium chromate, the color changing to violet on warming. The air-dry leaves yield 5.5 per cent. of ash (Roth, 1876). The red coloring matter of the arillus is soluble in alcohol and ether, but insoluble in water.

Allied Plants.—The American yew, Taxus canadensis, *Willdenow*, is regarded by Gray as a low, straggling variety of the above species; its leaves are mucronate, and have a revolute or subrevolute margin. The yew of the Pacific coast, Taxus brevifolia, *Nuttall*, is a tree growing in Oregon to the height of 15 M. (50 feet), but is smaller in California. The Irish yew, T. hibernica, *Mack*, has a yellow fruit. T. nucifera, *Kämpfer*, indigenous to Japan, has a green fruit, the fleshy portion of which is astringent and pungent, while the seed is sweet and oily.

Action and Uses.—The effects which are produced by yew on man vary materially in different cases, and, in general, the larger the dose of the poison the less definite and various are the symptoms. When they are fully developed they comprise irritation of the stomach and bowels, with vomiting, and sometimes purging, difficult urination, pallor, giddiness, prostration, coldness, spasm, or partial paralysis, irregular and feeble action of the heart, and death by coma or by syncope. The latter mode of death occurs most frequently when the dose of the poison is very large, and then the phenomena of nervous irritation and exhaustion and the gastric disturbance may be very trifling, the patient dying by rapid asthenia or by absolute syncope. In the case of a young woman who took the leaves of yew as an abortive, death occurred without convulsion, and her countenance was as natural as in sleep. In another case eleven persons partook of a decoction of yew; some of them were seized with giddiness, confusion of sight, pain in the head, nausea, and vomiting, and then fell asleep; but two of them died within an hour without pain or convulsion. The fatal dose varies greatly; a decoction of from 2 to 5 ounces has destroyed life.

A jelly prepared from the berries of yew has been employed in the treatment of chronic catarrh of the *bronchia* and the *urinary passages*, and the leaves have been recommended in *scurvy*, *epilepsy*, and other spasmodic affections, and been used by the vulgar as an *emmenagogue*, and especially as an abortive. The efficiency of yew in these conditions

is far from proven, and among the numerous cases in which it has been employed to provoke abortion several have resulted fatally to the mother, but in none was the fœtus expelled. The leaves have been prescribed in doses of from Gm. 0.06–0.30 (gr. j–v), or in a decoction or infusion made with from Gm. 0.50–1 in Gm. 120 (gr. viij–xvj in f℥iv) of water.

In *poisoning* by this substance the stomach should be speedily evacuated, after which milk may be given in small quantities to allay the irritation, and alcoholic liquids in stimulant doses.

TEPHROSIA.—Goat's Rue.

Turkey pea, Hoary pea, Devil's shoestring, E.; *Tephrosie*, Fr., G.

Tephrosia (Galega, *Linné*) virginiana, *Persoon*. Meehan, *Native Flowers*, i. 81.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin and Description.—This species is an herbaceous perennial growing in sandy soil in Canada and the United States westward to the Mississippi. Its root is many-headed and divided into several nearly horizontal branches, which are about 12 Mm. (½ inch) in diameter, 30–60 Cm. (1 to 2 feet) long, somewhat beset with fibres, rather tough and flexible, externally brown-gray and internally whitish. The stems are about 60 Cm. (2 feet) high, nearly simple, more or less woolly, and have numerous alternate, oddly-pinnate leaves, with about ten pairs of oblong, mucronate, shortly-stalked, straight-veined, and silky-villous, pale-green leaflets. The flowers are in terminal and axillary racemes, white, rose-colored, and red, and produce a curved silky legume.

The root, and occasionally the herb, have been employed; the root is without odor and has a bitterish and somewhat acrid taste.

Constituents.—The principles to which the properties of goat's rue may be due are unknown.

Allied Plants.—Tephrosia apollinea, *De Candolle*. The leaflets have occasionally been used as a substitute for, or for the adulteration of, senna-leaves (see p. 1441).

T. toxicaria, *Persoon*, is indigenous to Africa and naturalized in tropical America. It has deep-red flowers and a poisonous root.

T. purpurea and T. spinosa, *Persoon*, indigenous to India, have bitter roots, which are employed for their tonic properties.

T. leptostachya, *De Candolle*, is a native of Senegambia. Its root and leaves are regarded as possessing purgative properties.

Action and Uses.—The root as well as the leaves of the native tephrosia is said to be laxative, tonic, and *vermifuge*. For the last-named purpose a decoction of the root has been used. It may be prepared by boiling Gm. 32 in Gm. 500 (℥j in Oj) of water, to the reduction of one-half. *Dose*, Gm. 16–32 (f℥ss–j). It has also been reported to be useful in the treatment of *typhoid fever*, but, as it was not given alone, its value in this disease cannot be estimated.

TEREBENUM, *U. S.*—Terebene.

Terebène, Fr.; *Tereben*, G.

Formula $C_{10}H_{16}$. Molecular weight 135.7.

A liquid consisting chiefly of pinene, and containing not more than very small proportions of terpinene and dipentene. Terebene should be kept in well-stoppered bottles in a cool place, protected from light.—*U. S.*

Preparation.—By repeatedly treating oil of turpentine with concentrated sulphuric acid or phosphoric anhydride it is rendered optically inactive. After purification this constitutes the so-called terebene. As a working formula Hirsch proposes the following method: Mix 1000 parts of oil of turpentine with 25 parts of sulphuric acid in one portion, and agitate thoroughly. When the heat generated has moderated to 70° C., add the same quantity of acid as before, and repeat this a number of times, taking care that the temperature does not rise too high. Shake the mixture at intervals for a short time, and put it aside for twenty-four hours. Remove the oil and wash it with solution of soda to remove all trace of acidity, and distil the oil in a brisk current of steam. The distillate thus obtained should be optically inactive, and if such is not the case the product should again be treated with sulphuric acid in the proportion of 5 to 100, the further procedure being as mentioned above. The inactive liquid finally obtained is a mixture of terebene with various hydrocarbons, from which terebene is obtained pure by fractional distillation, the portion boiling above 160° C. (320° F.) being rejected. According to Riban, it can be further purified by distilling over metallic sodium.

Properties.—Hirsch states that pure terebene is crystalline, while Riban describes his terebene as a liquid having the boiling-point at 155°–156° C. (311°–312.8° F.). For medicinal use it is not necessary that this body be absolutely pure, and further the Pharmacopœia only demands that the portion boiling above 160° C. be absent, as it gives the boiling-point 156° to 160° C. (312° to 320° F.). The Pharmacopœia describes terebene as a colorless or slightly yellowish thin liquid, with a rather agreeable thyme-like odor and an aromatic somewhat terebinthinate taste. At 15° C. (59° F.) its spec. grav. is 0.862, corresponding with the specific gravity found by Riban. Slightly soluble in water, it dissolves, however, in an equal volume of alcohol, glacial acetic acid, or carbon disulphide. On exposure to air terebene becomes resinified and acquires an acid reaction. "In its chemical properties it resembles oil of turpentine. Terebene should possess its characteristic agreeable odor, should not redden moist blue litmus-paper (absence of acids), and should not have more than a very slight action on polarized light (limit of unaltered oil of turpentine). When evaporated, it should not leave more than a very slight residue (absence of more than traces of resinous matters)."—*U. S.* H. Wyatt (1892) gives the following test for the freshness of terebene: 15 minims of terebene are by means of a pipette brought below the surface of an ounce of the following mixture: potassium iodide 20 gr., compound tragacanth powder 60 gr., boiling water to make 8 oz.; allow to cool before using. The test should be made in a stoppered bottle to allow shaking. Old terebene will color the liquid blue within one hour, while good terebene will cause no change in twelve hours' time.

Action and Uses.—Terebene has been employed with striking success as a substitute for carbolic acid in the antiseptic dressing of *wounds, ulcers, burns*, etc. It thoroughly deodorizes the secretions and protects the surface to which it is applied from the contact of the air. It is supposed, like carbolic acid, to destroy morbid germs, since it deprives vaccine virus of its activity. It has been applied pure, and also in the proportion of 1 part to 6 of olive oil. Internally it has been used, like other terebinthinates, in the treatment of *bronchitis* and various mucous profluvia. The dose is stated to be from 5 to 20 drops three times a day.

TEREBINTHINA, *U. S.*, *P. G.*—Turpentine.

Thus americanum, Br.; *Terebinthina communis.—Crude turpentine*, E.; *Térébinthine commune, T. de Bordeaux*, Fr. Cod.; *Gemeiner Terpentin*, G.; *Trementina commune*, Sp.

The concrete (semi-fluid, *P. G.*) oleoresin obtained from Pinus palustris, *Miller*, and other species of Pinus. Bentley and Trimen, *Med. Plants*, 256–259.

TEREBINTHINA CANADENSIS, *U. S.*, *Br.*—Canada Turpentine.

Balsamum canadense.—Canada balsam, Balsam of fir, E.; *Térébinthine du Canada, Baume de Canada*, Fr.; *Canadischer Terpentin*, G.; *Trementina de Canada*, Sp.

The liquid oleoresin obtained from Abies (Pinus, *Linné*, s. Picea, *Loud*) balsamea, *Miller*. Michaux, *N. Amer. Sylva*, iii. t. 150; Bentley and Trimen, *Med. Plants*, 263.

Nat. Ord.—Coniferæ.

Origin.—The different species of pine and fir form resin-ducts in the bark or wood, in which liquid oleoresins secrete. Most of these oleoresins exude to some extent spontaneously, but the various turpentines of commerce are obtained by wounding the trees. Many species secrete the oleoresin in such small quantities that it is not collected. The turpentines recognized in the U. S. and British Pharmacopœias are furnished by the following species:

Pinus australis, *Michaux*, s. P. palustris, *Miller*. This is the *broom pine* or *swamp pine* of the United States, where it is very abundant from Southern Virginia to Florida, not extending more than about 100 miles from the coast. Its leaves are 25–38 Cm. (10 to 15 inches) long, crowded near the ends of the branches, and in tufts of threes, surrounded by long, ragged sheaths. The cones are nearly cylindrical, about as long as the leaves, and have the scales furnished with a short spine. This species yields nearly all the turpentine and rosin in the United States.

Pinus Tæda, *Linné*, grows in barren, sandy soil near the coast from Virginia to Florida, and is known as *loblolly* or *old-field pine*. The leaves are 20–25 Cm. (8 or 10 inches) long, in fascicles of threes, and surrounded by elongated, subentire sheaths. The cones are ovate-oblong, about one-half the size of the leaves, and have the scales tipped with a stout inflexed spine.

Abies balsamea, *Marshall*, is the *balsam fir* or *balm-of-Gilead fir* of Canada and the Northern United States. It attains a height of about 15 M. (50 feet), has numerous solitary leaves, which are about 2 Cm. ($\frac{4}{5}$ inch) long, linear, flat, obtuse, and glaucous-silvery beneath, and produces cylindrical bluish cones 7–10 Cm. (3 or 4 inches) long, and with scales tipped by a short spine.

Abies Fraseri, *Pursh*, resembles the last species, but has the cones only about 5 Cm. (2 inches) in length, and the upper part of their sharp-pointed scales much projecting and recurved. It grows from New England to North Carolina, principally in the mountains, and may be used for collecting *balsam of fir*.

Collection.—Common Turpentine. In the United States turpentine is chiefly obtained in North Carolina, and more recently it has been procured from South Carolina and Georgia. During the autumn and winter the pine trees are *boxed*, one to four excavations being made, by means of an axe, through the bark into the sapwood, commencing about 15–20 Cm. (6 or 8 inches) above the roots. The bottom of these *boxes* is about 12 Cm. (5 inches) below the lower and 20–25 Cm. (8 or 10 inches) below the upper lip, and their capacity varies from 4 to 8 pints. A few days after the boxes have been cut the bark is removed above the box to the height of about 3 feet, and some of the wood is scraped off or *hacked*, the hacks being made in the shape of the letter L. The oleoresin or *crude turpentine* begins to flow about the middle of March, runs best during July and August, and slackens again in September and October. The boxes are from time to time emptied by means of a peculiarly-constructed spoon or ladle, called turpentine-dipper, and the turpentine is at once transferred into rudely-constructed barrels, and usually used for distilling the oil. The trees are slightly scraped every eight or ten days, and the scraping or hacking is continued until finally ladders have to be employed. The flow of the first year is the best, called *virgin dip*, and yields about 6 gallons of oil per barrel and the so-called "window-glass rosin." *Yellow dip* is the exudation of the second and subsequent years, yields about 4 gallons of oil per barrel, and furnishes the medium grades of rosin. The turpentine which hardens upon the tree is termed *scrapings*, yields about 2 gallons of oil per barrel, and leaves a very dark-colored nearly black rosin. (See I. Zacharias, *Amer. Jour. Phar.*, 1877, 543, and Dr. T. F. Wood, *New Remedies*, 1880, 289.)

Canada Turpentine is largely collected in the province of Quebec, Canada, the balsam-gatherers, with their whole families, encamping in the woods for two months each year. The turpentine is secreted in vesicles formed in the bark, each of which requires to be pierced by the sharp-pointed iron tube attached to a can, when the balsam flows into the vessel. The average yield of each tree is about 8 ounces, and a man with the aid of two children may gather about 1 gallon during the day. The trees require two or three years' rest before they are tapped again, and the yield is then always less than the first time. The largest crop ever gathered in the Laurentine Mountains of Quebec in one year was 5000 gallons. (See Wm. Saunders, *Proceedings Amer. Phar. Assoc.*, 1877, p. 337.)

Fig. 306.

Instrument for collecting balsam of fir.

Description.—Turpentine is a yellowish or brownish-yellow, viscid liquid, which, when it exudes, is transparent, but soon becomes opaque from a crystalline deposit, is rendered thinner and clear by a moderate heat, and has an agreeable terebinthinate odor and a pungent, bitterish, and acrid taste. In this condition turpentine is recognized by the pharmacopœias of continental Europe, but in the United States and in Great Britain the oleoresin which has concreted on the trees is official, and is generally kept under the name of *white turpentine*, and in England is known as *common frankincense*. It is identical with the granular sediment deposited from liquid turpentine, and is found in irregular yellowish-white, more or less tough masses, which contain fragments of bark and wood, are brittle in the cold, breaking with a crummy fracture, and are more tenacious, or even semi-liquid, in warm weather. It contains from 12 to 16 per cent. of volatile oil, on the loss of which by exposure it becomes firm and friable.

Canada Turpentine is a yellowish or faintly greenish, perfectly transparent, and occasionally somewhat fluorescent, viscid liquid, having a similar but more agreeable odor and taste than the preceding. On exposure it acquires a slightly darker tint and dries into a transparent, pale-yellow mass. It is completely soluble in chloroform, benzene, ether, and warm amylic alcohol, but incompletely in carbon disulphide, glacial acetic acid, acetone, and absolute alcohol (*Pharmacographia*).

Substitutions.—Common turpentine is not liable to adulterations, but a fictitious Canada turpentine has occasionally been sold under the name of *Oregon balsam of fir*, which was made by dissolving rosin in oil of turpentine and flavoring the solution by the

addition of a little oil of wormwood. A liquid pale-yellow turpentine may be procured by puncturing the vesicle of the bark of Abies (Pinus, *Douglas*) Menziesii, *Lindley*, the *balsam pine* of the Pacific coast. The sample in our possession slowly deposited white granular matter, and became rather opaque and solid.

Other Turpentines.—European Turpentine closely resembles American turpentine, and is obtained in Russia from Pinus sylvestris, *Linné;* in Germany, from the same species and from P. rotundata, *Link;* in Austria, from P. Laricio, *Poiret;* and in South-western Europe, from P. Pinaster, *Solander*, s. P. maritima, *Poiret* (Bentley and Trimen, *Med. Plants*, 256, 257). The turpentine is secreted in the sap-wood, and is obtained in a manner similar to that in which the American turpentine is procured. The concrete French or *Bordeaux turpentine* is known in European commerce as *galliput*, and resembles white turpentine. In Mexico turpentine is procured from Pinus Teocotl, *Schlechtendal.*

Strassburg Turpentine, *Terebinthina argentoratensis* (Terebinthine d'Alsace, T. de Vosges, T. de Strasbourg, *Fr. Cod.*; Trementina de abeto, *Sp.*), is procured, like Canada balsam, which it resembles, by puncturing the vesicles of the bark of Abies (Pinus, *Lamarck*) pectinata, *De Candolle*, s. Pinus Picea, *Linné*, P. Abies, *Duroi*, Abies alba, *Miller*, A. excelsa, *Link* (Silver fir, *E.;* Sapin, *Fr.;* Weisstanne, Edeltanne, *G.*; Bentley and Trimen, *Med. Plants*, 262). It is collected in the Vosges, and has an agreeable odor, somewhat resembling that of lemon.

Venice Turpentine, *Terebinthina laricini, s. laricis, s. veneta* (Terebenthine de Venise, *Fr. Cod.;* Trementina de Venecia, *Sp.*), is procured in Tyrol and Switzerland from Larix europæa, *De Candolle* (L. decidua, *Miller*, Pinus Larix, *Linné;* Bentley and Trimen, *Med. Plants*, 260). (See Laricis Cortex.) The oleoresin is secreted in the heart-wood, and is obtained by boring a hole into the trunk to the centre and dipping the liquid out as it accumulates. It is a nearly transparent or slightly opaque and somewhat fluorescent thick liquid, of a terebinthinate odor, a bitter and aromatic taste, and a yellowish or greenish-yellow color. It is freely soluble in alcohol, amyl alcohol, acetone, and glacial acetic acid, and does not become hard when mixed with magnesia. The article usually sold here under this name is an artificial product. 59,366 pounds of Venice turpentine were imported in 1878; the average is about 48,000 pounds.

Hungarian Turpentine, *Balsamum hungaricum*, exudes from Pinus Pumilio, *Haenke*, after cutting off the tops of the branches in the spring. It is thin, transparent, yellowish, and has an aromatic odor and warm taste.

Constituents.—All turpentines consist of a volatile oil having the composition $C_{10}H_{16}$ (see Oleum Terebinthinæ) and of resin, which is left behind on distilling the oil, and then constitutes rosin. (See Resina.) The transparent turpentines, according to Maly, are solutions of *abietic anhydride* in the volatile oil, and on exposure to a moist atmosphere gradually become turbid and opaque from the crystallization of *abietic acid.* But the resin contained in those turpentines which do not become opaque on exposure must necessarily be different. Hot water agitated with turpentine acquires an acid reaction from the presence of formic, and probably also of succinic, acid, and the alcoholic solution of turpentine has a strong acid reaction.

Other Products of Pines.—Turiones (Gemmæ) Pini.—Pine-shoots, *E.;* Bourgeons de pin (sapin), *Fr.;* Fichtensprossen, *G.*—The young shoots of P. sylvestris, collected when about 5 Cm. (2 inches) long, are glutinous from an oleoresinous exudation, and have an agreeable terebinthinate odor and a bitter, resinous, and rather acrid taste.

Oleum pini foliorum.—Pine-leaf oil, Fir-wool oil, *E.;* Essence de feuilles de pin, *Fr.;* Kiefernadelöl, Waldwollöl, *G.*—The leaves of the different species of pine by pounding are converted into a fibrous substance known as *Fichtenwolle* (*fir-wool*), and when distilled with water yield a volatile oil which differs from the volatile oil obtained from the resin of the same species. It is of a green-yellow color, is limpid, has an agreeable terebinthinate and somewhat lavender-like odor, and is soluble in about seven times its volume of alcohol sp. gr. 0.838. The volatile oil is recognized as Oleum Pini sylvestris, *Br.*

Oleum templinum is distilled from the shoots of Pinus Pumilio, and is known in Germany as *Krummholzöl* and *Latschenöl.* It is colorless or yellowish-green, and of an agreeable somewhat terebinthinate odor. The volatile oils of Pinus sabiniana, *Douglas*, and of other species of pine indigenous to California resemble these products.

Allied Oleoresins.—Terebinthina Chia, s. Cypria, *Chian turpentine*, is the turpentine of ancient authors. It is obtained from incisions made in the bark of Pistacia Terebinthus, *Linné* (nat. ord. Anacardiaceæ; Bentley and Trimen, *Med. Plants*, 69). This species is a small tree found in the basin of the Mediterranean and eastward in Asia. The oleoresin is greenish-yellow or brownish, transparent, has a terebinthinate and somewhat fennel-like odor and a mild bitterish taste, and hardens to a transparent resin.

Balsamum gileadense (see p. 1069).

Caranna is a soft oleoresin of a greenish-brown or brownish-green color coming from Central and South America, and obtained from Icica Caranna, *Kunth*, and other trees of the nat. ord. Burseraceæ. It has an agreeable balsamic odor and a bitterish taste.

Tacamahaca is referred by the French Codex to Icica heptaphylla, *Aublet*, but in different sections of tropical America appears to be also produced from I. (Postium) Tacamahaca, *Kunth*, Bursera (Elaphium, *Jacquin*) tomentosa, *Triana*, and other trees. It is brown or yellowish, translucent, internally glossy, bitter, and somewhat aromatic, particularly on burning. The exudations of Calophyllum Tacamahaca, *Willdenow*, and Cal. inophyllum, *Linné* (nat. ord. Guttiferæ), indigenous to India and the islands of the Indian Ocean, have been used under the same name. Their odor bears a resemblance to lavender and fenugreek. The seeds of the last-named species contain from 50 to 60 per cent. of fixed oil, known in Indian commerce as *bitter oil* or *wcandee;* it is butyraceous, green, aromatic, and is in great repute for rheumatic complaints.

Anime. South American anime is probably derived from some species of the nat. ord. Burseraceæ, though it has been referred to Hymenæa Courbaril, *Linné* (nat. ord. Leguminosæ). It is in yellowish-white or brownish, rather opaque pieces, which soften between the teeth and have an odor resembling that of olibanum. East Indian anime is reddish and yellowish, friable, of a waxy lustre, and has a somewhat fennel-like odor.

Pharmaceutical Products.—Tinctura pini composita.—Compound tincture of pine-shoots, *E.:* Teinture de sapin composée, *Fr.:* Holztinktur, *G.*—Macerate for eight days young pine-shoots 3 parts, guaiac-wood 2 parts, sassafras-root and juniper-berries, each 1 part, in alcohol (sp. gr. 0.892) 36 parts; express and filter.—*P. G.* 1872.

Syrup of Pine-Shoots, *E.:* Sirop de bourgeons de pin, *Fr.*—Macerate for twelve hours 100 parts of young pine-shoots with an equal weight of alcohol; add 1000 parts of hot water, digest for six hours, express, filter, and dissolve 180 parts of sugar in every 100 parts of the filtrate.—*F. Cod.*

Uses.—Turpentine is seldom or never used in medicine, as its virtues depend entirely upon its volatile oil (see Ol. Terebinthinæ), which is separately employed. In ancient times it was prescribed chiefly as a stimulant in *amenorrhœa*, as a diuretic, as a remedy for catarrhal affections of the *urino-genital* organs and of the *lungs*, and in *ulceration of the bowels*, *hæmorrhoids*, and *rheumatism*. Externally, it was applied in the treatment of *itch* and of numerous chronic *diseases of the skin*, and its vapor, at a high temperature, as a bath in *chronic rheumatism*. The *dose* of turpentine may be stated at from Gm. 1.30–4 (20 to 60 grains).

Under the name of Canada balsam, balsam of fir, and even under the deceptive title of balm of Gilead, Canada turpentine has been used, especially in the treatment of chronic *bronchitis*, as well as for the purposes to which other turpentines are applied. It is destitute of the special qualities of the true balsams, since it does not contain benzoic acid.

The resin of tacamahaca was formerly used in fumigations for *rheumatism* and in plasters for that affection, *sprains*, and other local disorders requiring stimulation or mechanical support. It was also given internally, associated with amber, cloves, nutmeg, etc. Pine-shoots and pine-leaf oils are popular remedies for the same class of affections. The former are sometimes used in hot baths.

Chian Turpentine was introduced as a remedy for *uterine cancer* in 1880 by Prof. Clay of Birmingham, Eng. It was given internally, and in a maximum dose of 25 grains. Its effects were thus described: "It appears to act upon the periphery of the growth with great vigor, causing the speedy disappearance of what is usually termed the cancerous infiltration. . . . . It appears to dissolve the cancer-cells, ... and the firmer structures gradually gain a comparatively normal condition. . . . . It is a most efficient anodyne" (*Lancet*, Mar. 27 and Oct. 2, 1880). On the other hand, Dr. Henry Morris (*Lancet*, Dec. 4, 1880) declared that the drug did not exercise a favorable influence over a single symptom of cancer, and that as a cure it was utterly valueless. To the latter opinion all experts in the matter have rallied, although, in 1887, Mr. Clay renewed his original claims in favor of the medicine.

Oleum templinum has been used, like other terebinthinates, in chronic affections of the mucous membranes; and in like manner the wood and shoots of P. Pumilio have been employed to impregnate baths and the air breathed by patients affected with pulmonary complaints. The oil is credited with having expelled a tape-worm (*Therap. Gaz.*, ix. 287).

TERPINI HYDRAS, *U. S.*—Terpin Hydrate.

Terpinum hydratum, P. G.—*Terpinhydrat*, G.

Formula $C_{10}H_{18}(OH)_2 + H_2O$. Molecular weight 189.59.

The hydrate of the diatomic alcohol terpin. Terpin hydrate should be kept in well-stoppered bottles.—*U. S.*

Preparation.—The formation of terpin hydrate depends on the oxidation of turpentine with nitric acid in the presence of ethyl or methyl alcohol. It is formed also if oil of turpentine remains in contact with water for a long time. Wriggers (1846) obtained it by mixing 8 parts of oil of turpentine, 2 parts of nitric acid of spec. grav. 1.25–1.30, and 1 part of alcohol (80 per cent.), and permitting it to stand for some time. The process of Deville (1849) is only a slight modification of the above, while in the method of Tilden (1878) methyl alcohol is substituted for the ethyl alcohol. The latter method is, in outline, as follows: A mixture of 2½ volumes of oil of turpentine, and 1 volume each of methyl alcohol and nitric acid (spec. grav. 1.400) is allowed to stand in a flask for two days, and then transferred to a dish, and a small quantity of methyl alcohol added every second day. The crystals which form in each process are separated and purified by crystallizing from alcohol. The yield of terpin hydrate depends on the nature of the oil of turpentine, the American and French oils yielding it very readily, while the terpenes of boiling-point 176° C. (348.8° F.) yield none.

Properties.—Terpin hydrate forms colorless, lustrous, rhombic prisms, nearly odorless, and having a slightly aromatic and somewhat bitter taste, permanent in the air, soluble, at 15° C. (59° F.), in about 250 parts of water and in 10 parts of alcohol, in 32 parts of boiling water and in 2 parts of boiling alcohol; also soluble in about 100 parts of ether, 200 parts of chloroform, or 1 part of boiling glacial acetic acid. Terpin hydrate melts at 116° to 117° C. (240.8° to 242.6° F.), with the loss of water, and, at the temperature of the water-bath sublimes in fine needles. When heated in a flask adapted for distillation it first loses water. At 258° C. (496.4° F.) anhydrous terpin distils over without decomposition, soon solidifying to a crystalline, hygroscopic mass, which melts at 102° to 105° C. (215.6° to 221° F.) When strongly heated on platinum-foil it burns with a bright, smoky flame, leaving no residue. Terpin hydrate is dissolved by sulphuric acid with an orange-yellow color. If to its hot, aqueous solution a few drops of sulphuric acid be added, the liquid becomes turbid and develops a strongly aromatic odor. Terpin hydrate should not have the odor of turpentine, and its hot, aqueous solution should not redden blue litmus-paper (absence of adhering acid).—*U. S., P. G.*

Action and Uses.—Terpine, or hydrated oil of turpentine, was announced in 1883 by Lepine as a remedy in chronic *nephritis* through its direct action upon the kidneys, and in chronic *bronchitis* through a similar action upon the bronchia (*Bull. de Thérap.*, cviii. 33). The latter statement has been amply confirmed, among others, by Murrell (*Edinb. Med. Jour.*, xxxi. 684) and Cammann (*Med. Record*, xxxii. 476), proving that the action of the medicine resembles that of balsams, especially upon the bronchial and urinary mucous membranes. It gives a characteristic odor to the urine. If the dose be excessive or if the medicine be too long continued, it may occasion strangury (*Brit. Med. Jour.*, Jan. 29, 1887), just as Lepine, in his experiments upon dogs, found it to cause albuminuria, and even bloody urine. It is true that this effect need not occur if the medicine is cautiously employed. According to Penzoldt (*Lehrbuch d. klin. Arzneibehandlung*, 1889, p. 148), it is of peculiar value in chronic affections of the *heart* and *kidneys*, especially in chronic nephritis and degeneration of the heart-muscle with albuminuria and extensive œdema: and yet even under the prescribed conditions it sometimes fails. In such cases caution must be observed lest the kidneys become congested. Lazarus claims for the medicine a remarkable efficacy in *whooping cough*, at least as a palliative (*Ther. Monatsh.*, iv. 118). It has also been recommended in *hay fever* and for the prevention and expulsion of *flatus*. Terpine may be given in doses of Gm. 0.12–0.18 (gr. ij–iij) three times a day, in lozenges or in emulsion. Bayland recommends the following formula: R. Terpine hydrate, grs. xxiv; Glycerin, q. s. ut fit solut.; Syrup of lactucarium, ad f℥j.—M. S. A teaspoonful every three hours (*Record*, xxxii. 420).

Terpinol is said to be of little value in disorders of the urinary tract, but very efficient in diseases of the respiratory tubes. It is largely eliminated through the lungs, and but little through the kidneys. It may be given in capsules, each containing 2 grains, to the number of from six to twelve a day, or in pills made with sodium benzoate and sugar.

TEUCRIUM.—Germander.

Herba mari veri.—Herb mastich, Cat thyme. E.; *Germandrée maritime*, Fr.; *Gamander, Katzengamander, Amberkraut*, G.; *Maro cortesso*, Sp.

Teucrium Marum, *Linné.*

Nat. Ord.—Labiatæ, Ajugoideæ.

Description.—Of the numerous species of the genus Teucrium which are occasionally employed in medicine, nearly all are indigenous to Europe. The genus is characterized by its flowers, which have the lower lip elongated and the upper lip short and deeply divided, the four stamens projecting from the cleft. All are aromatic and more or less bitter. The above-named species is shrubby, about 30 Cm. (10 inches) high, and much branched. The leaves are about 8 Mm. (⅓ inch) long, petiolate, oval or lance-ovate, with the margin entire and revolute, and whitish tomentose beneath. The rose-red flowers are single in the axils of the bracts, forming a one-sided, spike-like raceme. The odor is strongly camphoraceous, the taste pungent and bitter.

Allied Plants.—Teucrium canadense, *Linné*.—Woodsage, *E.*—It is downy or hairy, of a grayish-green color, and about 60 Cm. (2 feet) high. The leaves are about 5 Cm. (2 inches) long, short-stalked, lance-ovate, rounded at the base and serrate on the margin. The pale-purple flowers are in whorls of about six, and form a terminal spike.

T. Scordium, *Linné*; Herba scordii.—Water germander. *E.*—Germandrée aquatique, *Fr.*; Lachenknoblauch, *G.*; Escordio, *Sp.*—It is about 30 Cm. (12 inches) high, has sessile, lance-oblong, serrate, and soft hairy leaves about 38 Mm. (1½ inches) long, and rose-colored flowers in whorls of two to four. In the fresh state it has an alliaceous odor.

T. Polium, *Linné*.—Polymountain, *E.*; Polium, *Fr.*; Bergpoley, *G.*; Zamarilla, *Sp.*—The leaves are 12 Mm. (½ inch) long, tomentose, sessile, lance-linear, obtuse, crenate, and strongly revolute on the margin. The flowers are white. The allied T. montanum, *Linné*, has yellowish flowers.

T. Chamædrys, *Linné*.—Chamædrys.—Petit-chêne, *Fr. Cod.*; Camedrios, *Sp.*—It is low, suffruticose, and branching. The leaves are about 25 Mm. (1-inch) long, petiolate, hairy, ovate or obovate, obtuse, cuneate at base, and crenately serrate. The flowers are purplish-red.

Ajuga (teucrium, *Linné*) Chamæpitys, *Schreber*.—Ground pine, *E.*; Chamæpitys ivette, *F. Cod.*; Günsel, Feldcypresse, *G.*; Pinillo olorroso, *Sp.*—A small hairy annual with axillary flowers, having the yellow corolla dotted with purple; the lower leaves are lanceolate, the upper ones three-cleft with linear lobes; the odor is rosemary-like.

Ajuga (Teucrium, *Linné*) Iva, *Schreber*.—French ground pine, *E.*; Ivette musquée, *F. Cod.*; Bisamgünsel, *G.*—It resembles the preceding, but has linear, somewhat toothed, woolly leaves, red flowers, and a musk-like odor. This and the preceding two species are official in the French Codex.

Ajuga reptans and A. pyramidalis, *Linné*, are small perennials with obovate crenate radical leaves and blue flowers, are slightly aromatic and somewhat bitter, and are known in Europe as *bugle* and *mountain bugle*.

Constituents.—These species owe their virtues to volatile oil, to a small quantity of bitter principle, and to tannin.

Action and Uses.—The numerous species of Teucrium appear to possess similar qualities in different degrees, and among them T. marum, or germander, has enjoyed the greatest reputation. It is described as tonic, stimulant, diaphoretic, diuretic, and emmenagogue, and has been used in *scrofula*, *chlorosis*, chronic *bronchitis*, *leucorrhœa*, *amenorrhœa*, *dropsy*, *chronic*, *gout*, etc.—in a word, in various affections requiring a stimulant and tonic treatment. A snuff made from its powder has been employed to cure *nasal polypi*. *T. scordium* was formerly used in the treatment of chronic simple and syphilitic eruptions of the skin and mucous membranes, and, like some other aromatic stimulants, for the relief of dyspeptic ailments, *hæmorrhoids*, and *pruritus ani*. In the latter affections it is applied locally as well as given internally. Teucrium is administered in powder in the dose of Gm. 2–2.30 (gr. xxx–xl), or in an infusion made with Gm. 16–32 in Gm. 500 (℥ss–℥j in℥j) of water.

THALLINÆ SULPHAS.—Thalline Sulphate.

Thallinum sulfuricum, P. G.—*Thalline*, E., Fr.; *Thallin*, *Thallinsulfat*, G.

Formula $2C_9H_{10}N(OCH_3).H_2SO_4 + 2H_2O$. Molecular weight 459.06.

Preparation.—The base thalline, which is the methyl ether of tetrahydro-paraoxyquinoline, and its salts were discovered by Skraup in 1884, and is prepared from *paraquinanisol* by treatment with tin and hydrochloric acid. This last-named compound is an oily base, and is obtained by heating to about 145° C. (293° F.) a mixture of paramidoanisol, paranitranisol (or another nitro-compound), glycerin, and sulphuric acid. The base thalline forms thick white prisms, which are freely soluble in alcohol, ether, and benzene, but dissolve sparingly in benzin and water. The sulphate, which has become known by the name of the base, thalline, is formed by dissolving the latter in dilute sulphuric acid and crystallizing or granulating.

Properties.—Thalline sulphate is usually seen in the form of a white or whitish granular crystalline powder, which is permanent in the air, and has a slight anise-like

odor and a nauseous, bitter, saline, and pungent taste, becoming more agreeable and aromatic in dilute solutions. The salt is freely soluble in hot water, sparingly soluble in chloroform and in ether, and requires for solution 7 parts of cold water and 100 parts of alcohol, the solutions becoming darker on exposure to light. A solution of the salt in 10,000 parts of water acquires an emerald-green color on the addition of a little ferric chloride or other oxidizing agent, the color being not altered by sulphuric acid, but changed to purplish, reddish, or yellow by reducing agents. The solution of thalline is colored deep red on being heated with fuming nitric acid; it is not affected by tannin or mercuric chloride, but yields a yellow precipitate with picric acid, and alkalies separate from it the base in oily drops, becoming crystalline and having a coumarin-like odor.

Allied Salts.—Thalline Tartrate closely resembles the sulphate in appearance and taste, but is much less soluble in water, requiring at 15° C. (59° F.) at least 10 parts for solution.

Kairin. This name was given to two compounds prepared synthetically by Fischer in 1882, and designated more particularly as kairin A and kairin M. The former is the hydrochloride of oxyquinoline ethyl tetrahydride, $C_9H_{10}(C_2H_5)NO.HCl$, and is also known as ethyl kairin. It was the first substitute for quinine synthetically prepared, and was obtained from α-oxyquinoline by treatment with tin and hydrochloric acid, and subsequently with ethyl iodide. It occurs in colorless, odorless prismatic crystals, soluble in 6 parts of water or 20 parts of alcohol. Kairin M is the hydrochloride of oxyquinoline methyl tetrahydride, $C_9H_{10}(CH_3)NO.HCl$, and is prepared like the preceding compound, except that methyl iodide is used in place of ethyl iodide. When simply kairin is mentioned ethyl kairin is always understood.

Kairolin A and Kairolin M are the acid sulphates of ethyl- and methylquinolinetetrahydride, respectively.

Action and Uses.—According to Brouardel and Loye, thalline deteriorates the hæmoglobin of the blood, converting it into methæmoglobin, and thereby diminishing its oxidizing power. Huchard, while he failed to detect the latter product, observed a great reduction in the oxyhæmoglobin, in consequence of which guinea-pigs employed in his experiments perished as if they were anæmiated. He also found that thalline was rapidly eliminated in the urine, and, indeed, in all the secretions (*Bull. et Mém. de la Soc. de Thérap.*, Avril, 1885, p. 46). The experiments of Beyer (*Amer. Jour. of Med. Sci.*, Apr., 1886, p. 386) on the frog and terrapin proved that "repeated thallinization of the heart is followed by a peculiar shrinkage of the organ, during which it presents the dark color of thallinized blood;" that, as had already been shown, "it reduces the temperature by diminishing heat-production and increasing heat-radiation; and that "its influence upon the blood-corpuscles is sufficient to condemn it" as a medicine. Ehrlich's experiments on animals (*Centralbl. f. Med.*, v. 114) show that thalline may produce fatty degeneration, gland-necrosis, and papillary infarction of the kidneys. Kreis attributed to it germicide properties (*Ther. Gaz.*, xi. 414).

In man, thalline produces a fall of temperature which is nearly always attended with profuse sweating; it reaches the minimum in from one to three hours, and recovers its former height in from four to five hours, but sometimes more rapidly, and in that case chilliness is experienced. Yet not unusually both chill and sweat are wanting. The rise and subsequent fall of temperature are more rapid than are caused by antipyrine, but less so than kairin occasions; yet it maintains the maximum longer than either of these preparations (Mengazzini; Anseroff). After its completed action the temperature is apt to rise higher than at first. The pulse-rate and force subside simultaneously, even to the production of syncope that may be fatal. According to Welt, a watery diarrhœa is frequently produced by thalline, and vomiting in about 7 per cent. of the cases (*Deutsch. Arch. f. klin. Med.*, Dec. 3, 1885; Weinstein, *Centralb. f. Med.*, iv. 446). The repeated administration of medicinal doses now and then occasions a papular erythema, especially of the limbs. Some clinical observations of Dr. Griffith on the use of thalline point to its sometimes causing profuse sweating in phthisis. Twice in thirty-eight cases of this disease and in acute febrile affections a decided depression of strength occurred, which "indicated that it must be given with great care to debilitated subjects" (*Med. News*, xlviii. 370). Jaccoud maintained, but we believe without adequate evidence, that the reduction of temperature produced by thalline is limited to the surface of the body; and he adds that this peripheral cooling does not benefit, but rather weakens (*Archives gén.*, Dec. 1885, p. 796). According to Martin's experiments (*Therap. Gaz.*, xi. 295), it reduces fever by increasing heat-dissipation, while its influence on heat-production varies, even with the same dose.

Thalline is unquestionably an antipyretic, probably the most certain and powerful of its class, and for that reason calls for the condemnation which was pronounced upon it by Jaksch in Vienna, who first brought the preparation into notice. "Drugs," he said,

"which are only antipyretics are of very little use" (*Times and Gaz.*, Dec. 1884, p. 797). In this sentence Prof. Nothnagel concurred, protesting against the indiscriminate use of "antipyretics," as if fever were a substantial disease, and not the outcome of necessary chemical and physiological changes in the tissue-elements. We have long inculcated the opinion he thus expressed: "Fever is not a symptom to be removed in every case. According to my conviction, which is also that of many other investigators, it is a very beneficial phenomenon—one of those processes of reaction which one must look upon as compensatory. . . . . Although we may succeed in lowering the temperature, we do not shorten the duration of an acute fever by a single day. . . . . In general, a temperature that does not exceed 104° F. does not injure the patient." In relapsing fever the temperature often rises to 105° F., and even to 106° F., without in the least disturbing the mind, and the patient recovers—exhausted indeed, but not otherwise injured. Jaksch claimed for thalline that it provoked neither vomiting, cyanosis, nor collapse, and that only occasionally did it produce sweating and rigors. Now that this judgment is known to be too favorable, we may all the more readily accept his further conclusions, confirmed by later observers. He confessed that the medicine neither shortens nor radically modifies febrile affections, including intermittent fever, acute articular rheumatism, measles, puerperal septicæmia, pneumonia, erysipelas, and tuberculosis. "Fever, indeed, it suppressed, but all the rest remained unchanged" (*Wiener med. Wochensch.*, No. 48, 1884). Hallopeau pronounced a similar judgment in the matter (*Bull. et. Mém. Soc. de Thérap.*, 1885, p. 57). Maragliano's observations confirm the conclusions already stated. He found that in non-febrile states the temperature was but slightly affected by thalline; that in these, as in febrile states, it occasioned a decided loss of heat; that during its action the excretion of urea and the elimination of carbonic acid are diminished; and that it also lessens the absorption of oxygen by the blood in the lungs (*Zeitschr. f. k. Med.*, 1886, x. 462). Minot, like many others, admitted that while it promoted the comfort of the patient, it did not affect the course or issue of the disease (*Trans. Assoc. Amer. Phys.*, ii. 77). Weinstein, like others, observed the collapse produced sometimes by thalline, and held it to be an unsafe medicine in the greater number of febrile diseases (*Centralb. f. Ther.*, iv. 447). In one case it occasioned death (*ibid.*, p. 256). Kohts noticed this tendency, especially in children (*ibid.*, p. 402). Without further examples of the poisonous operation of thalline, suffice it to add that Falk says it has earned, along with kairin, a place among the obsolete medicines, and that Robin pronounced it both dangerous and useless (*Therap. Monatsh.*, iv. 211).

Thalline salts, the sulphate or the tartrate, may be prescribed in doses of from Gm. 0.25–0.75 (4 to 12 grains), or in hourly doses of about Gm. 0.03–0.05 (½ gr.). They may be administered in powder, contained in wafers, or in solution. They are said to act perfectly through the rectum. Hypodermically, they do not produce abscess or otherwise irritate the tissues.

In 1882, Prof. Filehne of Erlangen announced that the newly-discovered kairin muriate reduced the temperature of fever to the normal degree without occasioning any of the unpleasant effects of other antipyretics. Other observers have more or less confirmed or modified these statements. In 1884, v. Halla, reviewing the clinical history of kairin, drew conclusions unfavorable to its use as a medicine; and Dujardin-Beaumetz in 1886 declared that "it ought to be banished from use as dangerous, because it produces its antithermic effects by profoundly impairing the vital constituents of the blood" (*Les nouveaux Remèdes*, p. 127). It, moreover, occasioned severe chills and even epileptiform spasms. Elsewhere the reports concerning this medicine agree, more or less, with the above in essential particulars (compare Shattuck, *Boston Med. and Surg. Jour.*, Nov. 1883, p. 415; Draper, *ibid.*, p. 417; Crook, *Med. News*, xliv. 326), and especially that the medicine is an efficient antipyretic; but none of them prove it to bear the marks of a true remedy, curing disease "*cito, tuto, et jucunde*."

Filehne recommended that the primary dose of kairin should not exceed Gm. 0.25 (4 or 5 grains); that it should be repeated and increased at intervals of two or three hours, according to its influence on the temperature, to Gm. 0.50–1 (8 or 15 grains); and that when the desired subsidence is obtained the dose should be gradually reduced. It is most conveniently administered in wafers or capsules to avoid its bitter saline taste and its acrid impression on the fauces.

THAPSIA.—Thapsia.

Thapsie, Fr. Cod.; *Faux fenouil*, Fr.; *Thapsie*, G.; *Tapsia*, Sp.

Thapsia garganica, *Linné*.

Nat. Ord.—Umbelliferæ, Orthospermæ.

Origin and Description.—This plant is a perennial herb of Northern Africa and Southern Europe, and has a smooth, thick, and hollow stem; smooth, shining, twice or thrice-pinnate leaves, with large sheaths and lance-linear, acute, often two- or three-lobed leaflets; and pale-yellow flowers in large compound umbels. The root is usually employed. It is about 60 Cm. (2 feet) long, about 5 Cm. (2 inches) thick, gradually tapering, somewhat branched, brownish-gray externally and internally whitish. When fresh it contains a white acrid juice. It is nearly inodorous and has a biting, acrid taste.

The closely-allied Th. Sylphium, *Viviani*, of Northern Africa, is, like the Narthex Sylphium, *Oersted*, regarded as a mere variety of the preceding plant, which is by some believed to be identical with the Sylphium cyrenaicum of the ancients.

Constituents.—The acrid properties are due to a resin which is neutral and free from nitrogen, crystallizes in needles, and is soluble in hot alcohol, in ether, and in carbon disulphide. Canzoneri (1883) found in the resinous extract also an octoic acid, $C_8H_{16}O_2$, closely related to caprylic acid, and *thapsic acid*, $C_{16}H_{30}O_4$, which is scaly, melts near 124° C. (255° F.), and is nearly insoluble in water, benzene, and carbon disulphide.

Pharmaceutical Uses.—Resina thapsiæ. Exhaust the bark of the root with alcohol and evaporate to a soft extract.—*F. Cod.*

Thapsia Plaster contains 7 per cent. of the resin, combined with yellow wax, colophony, and turpentine.—*F. Cod.*

Action and Uses.—Galen, Dioscorides, and the Arabians agree in describing the powdered root and juice of thapsia as being irritating to the skin, and, when taken internally, as emetic and purgative. The juice and ointments and plasters prepared with it were used as stimulants and counter-irritants for the relief of *rheumatic* and other local *pains* and to lessen *dyspnœa*. About 1868 some attempts were made to revive its use in the form of the resin extracted from the root. Applied in a plaster, the skin became inflamed, with intolerable itching, and a copious vesicular eruption ensued. If the application was not prolonged, this eruption speedily dried up, but in the contrary case the vesicles became confluent, broke, and exposed an ulcerated and suppurating surface, which on healing left scars resembling those of small-pox. On delicate skins its operation was extremely severe. It is stated that the men employed in preparing extract of thapsia on a large scale were affected with fever and swelling of the hands and face, and from time to time were obliged to suspend their work. A case is also related in which the application of a plaster of thapsia resin to the chest was followed in about twelve hours by severe strangury and violent itching about the genitals and anus. A similar example has been related by Douglass (*Med. Record*, xxxvii. 96). In the Therapeutical Society of Paris all the leading members of that body condemned thapsia plasters as unnecessary, and as sometimes dangerous (*Bull. et Mém. Soc. thér.*, Avr. 1882, p. 101). It does not appear that its therapeutic operation differs in any wise from that of other counter-irritants, such as croton oil, euphorbium, mezereon, and tartar emetic, but it may be added to the number of such agents for occasional use. The resin may be mixed with diachylon in the form of a plaster, or ordinary adhesive plaster may be coated with an alcoholic solution of the resin and applied to the skin.

THEA.—Tea.

Thé, Fr. Cod.; *Thee*, G.; *Té. Té de China*, Sp.

The leaves of Thea chinensis, *Sims* (Camellia Thea, *Link*, C. theifera, *Griffith*). Bentley and Trimen, *Med. Plants*, 34.

Nat. Ord.—Ternstrœmiaceæ (Camelliaceæ).

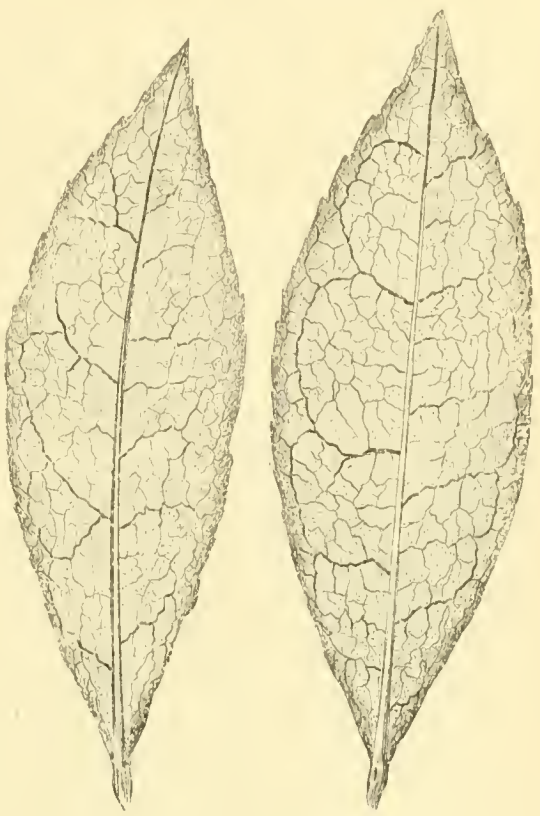
Origin.—Tea is obtained from a shrub which is indigenous to China and probably to other parts of Southern and South-eastern Asia, and has been cultivated in India, China, and Japan from a very early period. The varieties produced by long cultivation were formerly regarded as distinct species, and described as Thea Bohea, T. viridis, T. stricta, etc. The plant has been successfully introduced in several parts of the United States. It bears white axillary flowers and roundish-triangular, three-celled, and three-seeded capsules. The seeds are subglobular, somewhat flattened, of the size of a cherry-stone, glossy-brown, yellow at the hilum, and have a brittle testa, a short radicle, and unequal thick plano-convex cotyledons.

Preparation.—After the leaves have been gathered they are either rapidly dried, when they change to a dull-green color (*green tea*), or they are allowed to wilt, and are

subsequently kept for some time in heaps, when they acquire a dark color (*black tea*). Both varieties are subjected to various manipulations, such as rolling upon a table, heating over a fire, etc., and are sometimes flavored by being left in contact with the flowers of the orange, fragrant olive, jessamin, and others. Hyson, Young Hyson, Gunpowder, and Imperial are some of the best-known brands of green tea, and Souchong, Oolong, and Pekoe are black teas.

Description.—Tea is met with in commerce in the form of little cylinders or rolls, into which the leaves have been twisted during the manipulation of rolling, and in some varieties these leaves have again been formed into balls of different sizes. Tea-leaves after having been softened in water and unfolded are found to be from 25–75 Mm. (1 to 3 inches) long, varying between oblong-ovate and oblanceolate in shape, short-stalked, pointed at both ends or blunt, sometimes emarginate at the apex and irregularly toothed at the margin. They have a prominent midrib, the lateral branches of which are curved upward near the margin. Tea has an agreeable odor, which varies, however, in the different varieties; its taste is pleasantly astringent and bitterish. The green color is not unfrequently heightened or imparted to tea by a mixture of Prussian blue and gypsum.

Fig. 307.



Tea-leaves: natural size.

Constituents.—Tea contains 1 to 2, or sometimes 4, per cent. of *theine*, which was discovered by Oudry (1827), and by Mulder and Jobst (1838) proved to be identical with caffeine (see page 361). It may be obtained by sublimation on carefully heating powdered tea-leaves, or, according to Cazeneuve and Caillot (1877), by macerating in a water-bath and drying a mixture of 1 part of cut tea-leaves, 4 of water, and 1 of slaked lime; the residue is exhausted with chloroform; this is distilled off, and the greenish mass treated with boiling water; the solution is passed through a moist filter, and on cooling and concentrating yields the alkaloid. Mulder obtained from tea between 13 and 18 per cent. of tannin, which, according to Peligot, is peculiar, and, according to Stenhouse, differs from gallo-tannic acid, and is accompanied by a little gallic acid. Rochleder (1848), on the contrary, found a small quantity of tannin identical with that of nutgalls, and a smaller proportion of *boheic acid*, $C_{11}H_{20}O_{12}$, which is amorphous, deliquescent, freely soluble in water and alcohol, and is colored brown, but not precipitated, by ferric chloride. Peligot found tea-leaves to contain pectin. Mulder obtained about 3 per cent. of albumen, 2 to nearly 4 per cent. of wax and resin, aside from the chlorophyll, and between 0.6 and 1 per cent. of volatile oil, which necessarily must vary with the variety of tea yielding it; it is of a lemon-yellow color, has a strong aromatic odor and taste, and congeals readily. Tea yields between 4 and 6 per cent. of ash, about two-thirds of which is soluble in water; but on extracting tea-leaves with water, one-half to three-fourths or more of the mineral constituents enter the infusion. The ash contains from 38 to 48 per cent. of potassa and from 11 to 26 per cent. of phosphoric acid. The nitrogen of the leaves varies between 4 and 7 per cent. R. Weyrich (1872), found it impossible to determine chemically the value of tea; the best results were obtained from determining the phosphoric acid, which was always present in largest proportion in the best qualities, but varies greatly in the different varieties, green tea yielding 11.6 to 13.3 per cent., black tea 13.1 to 17.3 per cent., yellow tea 18.5 to 25 per cent., etc.

By expression tea-seeds yield about 35 per cent. of comestible oil, which resembles olive oil, is of a yellow color, has the spec. grav. 0.927, becomes turbid below 5° C. (41° F.), and congeals at about — 60° C. (21° F.); it consists of olein and stearin.

Allied Plants.—Thea (Camellia, *Linné*) japonica, *Baillon*, s. Thea Camellia, *Hoffmann*. The seeds of this well-known ornamental shrub are regarded as poisonous in Japan. Katzuyama (1878) isolated from them tannin, acrid soft fixed oil, and *camellin*, which is nearly insoluble in

cold water and ether, is freely soluble in water, turns yellow by alkalies, and red by sulphuric acid containing nitric acid, and appears to be a glucoside.

Camellia oleifera, *Abel* (Thea oleosa, *Loureiro*), and Cam. drupifera, *Loureiro*. The seeds, like tea-seeds, yield bland fixed oils, that of the last species having an agreeable odor.

Action and Uses.—The most familiar effect of tea is its power of inducing a cheerfulness of disposition and a lively flow of ideas, without that tendency to mental and physical torpor which follows the exhilaration caused by alcohol. The familiar line of Cowper, "The cups that cheer, but not inebriate," describes its usual mode of action. There can be no doubt that, like its congeners, tea diminishes the need of food even while it quickens the activity of the nervous system. In this way, probably, it has become the favorite drink of women, whose sedentary lives impede the activity of tissue-waste, without lessening the craving peculiar to their sex for lively conversation. Tea imparts to them the mental activity which their ordinary occupations restrain. It also tends to banish the drowsiness which their monotonous labor induces. Many men have been great tea-drinkers, but they were chiefly of the class addicted to prolonged mental labor, particularly at night, and they found in it not only the power of resisting sleep, but often the inspiration of bright ideas. It is evident that these effects, which are notorious and familiar, must be attributed to the direct stimulation of the brain, and by no means to the restriction of tissue-change, which is too often regarded as the prime, and indeed the sole, effect of tea. The latter is, undoubtedly, a real result of tea-drinking, but it is not that for which tea is so universally employed. It has been alleged that persons employed in tasting tea for commercial purposes are liable to lose their health and grow morbidly nervous, their bowels become constipated, and the urine and the proportion of urea in it suffer diminution (Morton, *Monthly Abstract*, Jan. 1880, p. 54; Smerinoff, *Bull. de Thérap.*, cxiv. 375). It is affirmed as positively, on the other hand, that none of these alleged effects occur, so far as relates to derangement of the nervous system and the general health (Dana, *Medical Record*, xvii. 85). But the former statement is the more correct. It has been confirmed, among others, by Bullard (*Boston Med. and Surg. Jour.*, April, 1886, p. 314; Sept. 1887, p. 217). He charges to the abuse of tea ringing in the ears, headache, tremor, nervousness, neuralgia, exhaustion of mind and body, hysteria, irregularity and palpitation of the heart, dyspnœa, dyspepsia, and constipation. Even delirium has been attributed to the chewing of tea (*Jour. Amer. Med. Soc.*, vi. 658).

In comparing the physiological effects of theine and caffeine upon the excretions, it has been found by some experimenters that the former does not affect the elimination of carbonic acid, while the latter diminishes it, as well as the discharge of urea, uric acid, and water, in a larger proportion than theine. Caffeine also is said to increase the watery constituent of the urine, while theine diminishes it. However this may be, it is a matter of familiar observation that the effects of tea and coffee upon the system are by no means identical; for while coffee causes wakefulness as well as tea, in the former case it is rather a pleasing insomnia, not unlike that occasioned by small doses of opium, tranquil for the most part, and filled with pleasing reveries; while tea, on the other hand, induces in one who endeavors in vain to sleep after its use a state of tension of the nervous system which is in the highest degree distressing. Upon almost every one coffee acts as a stimulant which is more or less cordial, flushing the face and rendering the pulse fuller, but such effects never follow the use of tea as direct consequences. It is seldom that a single indulgence in strong coffee induces that nervous agitation and tremulousness and impaired muscular power which are ordinary effects of strong tea; and, unless we are greatly mistaken, gastralgia and other neuralgic affections are much more frequent among tea-drinkers than coffee-drinkers. It is very true that some of these apparent differences may be explained by the fact that tea is generally taken with only a small modicum of cream or milk, while coffee is as commonly used with a large proportion of one or both. Indeed, in France, where coffee is the universal breakfast drink, it is always mixed with a great excess of milk, and it is used pure and in small quantity, chiefly after dinner, when the presence of food in the stomach retards its absorption and modifies its action. It is, however, customary for those who have mental or bodily work to perform before breakfast to take a cup of "black coffee" immediately on leaving bed.

It has been already objected that theine and caffeine do not fully represent the sources from which they are respectively obtained. The identity of these alkaloids in their physiological action does not imply a similar identity in tea and coffee. As little should we be entitled to infer that all alcoholic drinks produce identical effects because they all contain alcohol as their chief constituent. It is just as certain that tea and coffee differ in their action upon the human system as that Rhenish or Bordeaux wine acts very dif-

ferently from whisky or brandy, although in all of these liquors the common cause of their effects is alcohol. Moreover, not only are theine and caffeine physiologically identical, but so are guaranine, cocaine, and theobromine with them and with one another; and yet the operations of guarana, coca, and theobroma are different from one another, and from those of tea and coffee in important particulars. It is unquestionably a fact of the highest possible interest that all of these vegetable products, which are used by different and remote nations, should contain identical proximate principles; but while we thus are led to admire the universality of physiological laws, we should not lose sight of the peculiarities which distinguish these important articles of human food from one another.

Dr. Squibb has insisted on the identity of action of the fluid extracts of tea and coca, although the former is two and a half times stronger than the latter. Hence theine would be a more eligible medicine than cocaine (*Ephemeris*, 1884). Dr. Mays confirmed the possession of analgesic virtues by theine (*Med. News*, xlvii. 652; *Trans. Coll. Phys. Philad.*, 1886, p. 365) both experimentally and clinically, especially in controlling pain due to central causes. In this respect he held that it differs from cocaine, which is more efficient in topical pains. He found that its anodyne influence is usually of from twelve to twenty-four hours' duration, even in cases of severe pain. It has been used hypodermically in doses of from $\frac{1}{4}$ to $\frac{1}{2}$ grain by Bauduy for the relief of neuralgia (*Practitioner*, xliv. 48).

Among the Chinese, we are told, tea is held to be "cooling, peptic, exhilarating, stimulating, both laxative and astringent, diuretic, emmenagogue, and, in large concentrated doses, emetic. It is applied in a wash to the eyes, ulcers, and wounds of all kinds, but its excessive use as a drink renders people thin, anæmic, and weak-sighted. Tea is taken by Chinese scholars and laborers to stave off the cravings of hunger until a convenient season arrives." The Chinese also prescribe tea, acidulated with vinegar, in *diarrhœa*, and give it as an antidote to the poisonous action of *tartar emetic* and *corrosive sublimate*. The small proportion of tannic acid contained in tea renders it too feeble a remedy in such cases if stronger ones can be procured, but its stimulant and exhilarant action adapts it to be used in the treatment of *poisoning by opium*. A cup of hot tea is a familiar domestic remedy for the relief of nausea and oppression after too full a meal; to produce diaphoresis at the commencement of slight attacks of *muscular rheumatism*, *pulmonary catarrh*, or *sore throat*; and to banish the sense of fatigue and muscular soreness produced by excessive exertion, particularly when it is seasoned with some alcohol. It is one of the best remedies for *nervous headache*, and when cold or acidulated with lemon-juice is a most refreshing drink in the midsummer heats which produce excessive perspiration. It moderates also the copious *sweats* of hectic conditions. A strong infusion of green tea has been employed by injection in *gonorrhœa*, *leucorrhœa*, and *gleet*, and as a wash in *conjunctivitis*, as a gargle in *sore throat*, etc. In China it is often used for certain of these purposes as a fine powder mixed with water, or in decoction rather than in infusion; and doubtless in these forms its operation is more energetic.

Theine may be given hypodermically. The primary dose is about Gm. 0.02 (gr. $\frac{1}{3}$). It should be repeated at intervals according to its effects.

THEOBROMA.—Cacao.

Semen (*s. Fabæ*) *cacao.*—*Cacao*, F. Cod., Sp.; *Fèves du Mexique*, Fr.; *Kakaobohnen*, G.

The seeds of Theobroma Cacao, *Linné*. Bentley and Trimen, *Med. Plants*, 38.

Nat. Ord.—Sterculiaceæ, Buettnerieæ.

Origin.—The cacao (often incorrectly called *cocoa*) or *chocolate tree* is indigenous to Brazil and other parts of tropical America northward to Mexico, and is largely cultivated throughout the tropics. It is about 12 M. (40 feet) high, has alternate, oblong-lanceolate or lance-ovate, acute and entire leaves, and produces pale-pink, five-petalled flowers in clusters from the axils of old leaf-scars. The fruit is about 15 Cm. (6 inches) long, pear-shaped, with an elongated nipple-shaped apex, ten-furrowed and while unripe five-celled, and contains numerous seeds imbedded in a sweet pulpy mass.

Preparation.—Cacao-seeds are prepared for use by removing them from the fruit and simply drying them, in which case they retain their astringent and bitter taste; or they are subjected to a sweating process by enclosing them in a box or burying them in the ground for two or three days, whereby they lose much of their astringency and bitterness, and change in color; the best cured cacao is kept in heaps covered with plantain or other green leaves, for about a week before it is finally dried. The seeds of Th. bico-

lor, *Humboldt*, Th. guayanensis, *Willdenow*, Th. sylvestre, *Martius*, Th. ovatifolium, *Sessé*, and other species are stated to be collected, prepared, and mixed with the seeds of the cacao; but, according to Karsten, these uncultivated species do not furnish any commercial cacao. The seeds of Herrania albiflora, *Goudot*, and several other species appear to have the properties of cacao, and are used like the latter in the mountain-districts of South America under the name of *cacao cimarrona*, but they are only of about the size of a pea and do not enter commerce.

Description.—The seeds are 15–25 Mm. ($\frac{3}{5}$ to 1 inch) long, ovate or oblong, somewhat flattened, and vary in color, according to the manner in which they have been prepared, from brown-red to brown or grayish-brown. A prominent raphe runs along one edge of the seed from one end to the other, uniting the hilum and chalaza, and is divided at the latter into many branching nerves. The testa is thin, papery, and fragile. The embryo has the shape of the seed, and consists of a small conical radicle and two large oily cotyledons, which are strongly ribbed upon their face, and by the projecting folds of the inner seed-coat are divided from the back into numerous small irregular lobes, so that they readily break into many angular pieces. The odor of cacao-seeds is slight, but on warming is agreeably aromatic; their taste is oily, aromatic, and bitterish.

Constituents.—The quantitative analyses by Lampadius, Tuchen (1857), and A. Mitscherlich (1859) vary greatly in their results. Lampadius found the seeds to yield about 12 per cent. of husks or shells and about 88 per cent. of kernels, and the latter to contain about 53 per cent of fat. Mitscherlich obtained from the seeds nearly 50 per cent. of fat, 14 to 18 per cent. of starch, 13 to 18 per cent. of proteids, 1.2 to 1.5 per cent. of theobromine, 3.5 per cent. of ash, and 0.6 per cent. of sugar. Tuchen found also about 3 per cent. of gluten, and isolated between 4.5 and 6.6 per cent. of *cacao-red*. The latter is soluble in water and alcohol, precipitated by lead acetate, and is generated in the seeds during the sweating process; it appears to be combined with a proteid, and when pure has a carmine-red color, does not change the color of litmus, and is insoluble in litmus and fixed oils. *Oil of theobroma* is described on page 1161. The odorous principle of cacao appears to be somewhat volatile, but has not been isolated. *Theobromine*, $C_7H_8N_4O_2$ (molecular weight 179.75), was discovered by Woskresensky (1841), and was found by Bley (1842) to be present also in small proportion in cacao-shells. The alkaloid is obtained from the infusion of cacao by precipitating it with lead acetate, removing the excess of lead by hydrogen sulphide, evaporating and exhausting the residue with boiling alcohol, from which the alkaloid separates in minute colorless or white bitter crystals which are sparingly soluble in cold water, alcohol, and ether, and require for solution 55 parts of boiling water, 47 parts of boiling alcohol, and 600 parts of boiling ether. The alkaloid sublimes without decomposition at 290° C. (554° F.), and has a neutral reaction, but yields with acids crystallizable salts which are decomposed by water. Strecker converted theobromine into caffeine by heating the silver compound of the former with methyl iodide to 100° C. (212° F.). From Trojanowsky's researches (1875) it appears that the ash of the kernel is usually a little below 3 per cent., and should not materially exceed that amount; starch was found to vary between 2.23 and 6.65 per cent., the fat from 39.3 to 52.05 per cent., and the theobromine from 1.205 to 4.652 per cent., while the shells alone yielded from 0.866 to 4.540 per cent. of the alkaloid.

Uses.—Cacao-seeds are employed for preparing butter of cacao (p. 1161) by expressing them between heated iron plates. The press-cake, ground either by itself or with starchy substances, is sold as *cocoa*. The seeds, ground together, while warm, with about their own weight of sugar, constitute *chocolate*. This is usually flavored with about $\frac{1}{2}$ per cent. of cinnamon or other aromatics, and occasionally various amylaceous or mucilaginous substances are added to it.

The following preparations are occasionally used:

Chocolata simplicior.—Simple chocolate, *E.*; Chocolate de santé, *Fr.*—3000 parts each of Caraccas and Marañon cacao are well cleaned, torrefied, deprived of the shells, and the remaining kernels reduced in a heated mortar to a paste, which is well mixed with 5000 parts of sugar and 30 parts of powdered cinnamon, and transferred to a hot slab, where it is worked with a roller until uniformly mixed; the mass is now transferred to sheet-tin moulds, the surface rendered smooth by heating, and, after cooling, the cakes are wrapped in tin-foil.

Chocolata cum ferro.—Iron chocolate, *E.*; Chocolat ferrugineux, *Fr.*—Mix 10 parts of ferric oxide with 990 parts of simple chocolate.

Chocolata cum vanilla. Vanilla 4 parts; sugar 36 parts; chocolate without cinnamon 1000 parts.

Chocolata cum cetraria.—Iceland moss chocolate, *E.;* Chocolat au lichen d'Islande, *Fr.*—Mix 100 parts of saccharated powdered Iceland-moss jelly (see page 441) with 1000 parts of simple chocolate.

Chocolata cum salep.—Salep chocolate, *E.;* Chocolat au salep. *Fr.*—Incorporate 30 parts of powdered salep with 1000 parts of simple chocolate.

Preparations analogous to the latter are made by substituting powdered tapioca, sago, or arrowroot for the salep, and the aromatics are often varied by replacing the cinnamon wholly or in part with powdered cloves, mace, nutmeg, cardamom, or vanilla sugar. Chocolate has also been medicated by incorporating with 1000 parts of simple chocolate 30 parts of powdered catechu, or 60 parts of guarana or powdered cinchona, or 100 parts of calcined magnesia, etc. Chocolate has been proposed as a pleasant vehicle in the preparation of lozenges containing santonin, etc.

Action and Uses.—The dietetic uses of chocolate do not require any detailed notice in this place. Prepared with water or milk, it is employed as a substitute for coffee in Southern Europe, South America, Mexico, and the West Indies, and to a less degree in other civilized countries. It is difficult to discern in it, when thus used, any of the stimulating qualities which belong to the theobromine it contains. It is to be preferred to the other agents mentioned when a nutritive rather than an excitant operation is desired; and hence it is familiarly employed during convalescence from acute diseases, and as a substitute for tea or coffee in the diet of persons whose nervous system is liable to be deranged by them. Chocolate prepared with milk, and seasoned by the addition of a modicum of coffee, is less stimulating than the latter and more palatable than chocolate alone.

According to Gram (*Therap. Monatsh.*, iv. 10), theobromine is absorbed with difficulty, but when absorbed it is powerfully diuretic through a direct action upon the kidneys. It does not affect the heart. The sodium salicylate of theobromine is readily absorbed, and is also diuretic. It has no poisonous action, and may be given in doses of Gm. 1 (gr. xv) five to six times a day. These conclusions have been confirmed by several observers (Schroeder, *Therap. Monatsh.*, iv. 374; Kouindjy-Pomerantz, (*Bull. de Thérap.*, cxix. 112), and especially by Koritzschoner (*Therap. Monatsh.*, iv. 559), who also made use of the compound of theobromine, soda, and salicylic acid known as "Diuretin." In no case did the medicine produce any sensible change in the circulation.

Diuretin, as above stated, is supposed to owe its diuretic virtue to the theobromine it contains in a larger proportion than caffeine. It does not depress the heart, and most observers claim that it does not irritate the kidneys. It is said to increase the discharge of urine sixfold. The testimony in its favor as a remedy for *dropsy*, especially for cardiac dropsy, is almost unanimous. (Compare *Therap. Gaz.*, xv. 560; xvi. 67 and 164; *Amer. Jour. Med. Sci.*, ciii. 75; cv. 481; *Univers. Med. Mag.*, v. 737.) Frank states that although the specific gravity of the urine may decline even to 1010 under its use, yet the total amount of solids discharged is not increased, and also that, contrary to the general belief, it does irritate the kidneys (*Amer. Jour. Med. Sci.*, civ. 338). Dr. Keyes is disposed to attribute to the use of 10 grains of diuretin, every four hours during two days previous to operations on the bladder, the immunity of his patients from *urinary fever* (*Med. News*, lix. 505). Diuretin is usually given in doses of Gm. 1 (gr. xv) three or four times a day in sweetened mint-water, but these doses may be doubled without danger. See also page 1481.

THERIACA, *Br.*—Treacle.

Syrupus fuscus, Sacchari fæx, Syrupus communis, s. hollandicus.—Molasses, E.; *Mélasses, Pyromel*, Fr.; *Melasse, Brauner Sirup*, G.

The uncrystallized residue of the refining of sugar.—*Br.*

Origin and Properties.—The manner in which molasses is obtained is described on page 1394. That variety procured in the preparation of raw sugar is in the United States usually designated as *West India molasses*, while that drained from refined sugar is knows as *sugar-house molasses*. Both kinds closely resemble each other, except that the former is of a lighter color and has a different somewhat empyreumatic flavor. Molasses is a brown, thick, fermentable uncrystallizable syrup of a very sweet taste and having a specific gravity of about 1.40. It contains about 75 per cent. of solid matter, of which from 5 to 7 per cent. are salts. The molasses of beet-root sugar, according to Landolt (1868), contains 56 to 64 per cent. of sugar and about 20 per cent. of oxalate, tartrate, and malate of potassium.

Uses.—Molasses—or treacle, as it is called in England—is rather a food than a medicine. Apart from its pharmaceutical uses, it is seldom employed medicinally except as an ingredient of the common domestic enema, which consists usually of a pint of warm water to which a wine-glassful or more of molasses and a heaped tablespoonful of salt have been added. It is also a popular remedy for superficial *burns*, which it protects as well as oil and various other agents which act chiefly by excluding the air.

THUJA.—Thuja (Arbor Vitæ).

Thuya, Arbre de vie, Fr.; *Lebensbaum*, G.

The small branches of Thuja occidentalis, *Linné*.

Nat. Ord.—Coniferæ.

Origin.—The arbor vitæ, also called *white cedar*, is a tree with spreading branches, attaining under favorable circumstances a height of 15 M. (50 feet). It grows in cedar swamps in Canada and the northern section of the United States, and is met with southward along the Alleghanies and westward to Wisconsin. It has been introduced into Europe as an ornamental tree.

Description.—The branchlets are dark-green and rather glossy above, dull pale-green beneath, two-edged, and flat from the appressed scale-like leaves, which are placed in four rows, closely imbricate, 3–4 Mm. ($\frac{1}{8}$ to $\frac{1}{6}$ inch) long, rhombic-ovate, obtusely pointed, and bear upon the back near the apex an elevated roundish gland; the leaves forming the edges of the branchlets are folded in the centre, compressed, boat-shaped, when young with a small gland beneath the apex, the older ones glandless. The odor is strongly balsamic and the taste pungently aromatic, camphoraceous, and bitter.

The allied Thuja orientalis, *Linné*, which is indigenous to Asia, is sometimes cultivated as an ornamental tree. It is distinguished from the preceding by the erect branches and by the absence of glands and the grooved back of the leaves. The Western species, Thuja gigantea, *Nuttall*, grows from Northern California northward, and attains a height of 36 M. (120 feet).

Constituents.—The volatile *oil of arbor vitæ* was examined by Bonastre (1825) and Schweizer (1844). Hübschmann (1846) obtained about 1 per cent. of the weight of the branchlets. The volatile oil is colorless or greenish-yellow, has the density 0.925, and is a mixture of two oxygenated oils boiling near 195° and 205° C. (383° and 400° F.); it is readily soluble in alcohol, and when treated with potassa or with sulphuric acid acquires a black color. Kawalier (1854–58) obtained from arbor vitæ, in addition to the volatile oil, a gelatinous compound, sugar, two resins, tannin, pinipicrin, and thujin. *Pinipicrin*, $C_{22}H_{36}O_{11}$, was discovered by Kawalier (1853) in the leaves and bark of Pinus sylvestris. It is a yellow bitter powder which becomes soft at 55° C. (131° F.), fuses to a transparent liquid at 100° C. (212° F.), is not precipitated by lead salts, dissolves in water, alcohol, and spirit of ether, is insoluble in pure ether, and when boiled with diluted acids is split into sugar and *ericinol*. *Thujin*, $C_{20}H_{22}O_{12}$, crystallizes in small lemon-yellow tables, has an astringent taste, dissolves readily in alcohol and hot water, acquires with alkalies a deep-yellow and red-brown, and with ferric chloride a dark-green color, and is precipitated by lead acetate and subacetate. When heated with dilute hydrochloric acid it is converted into sugar and *thujigenin*, $C_{14}H_{12}O_7$, and *thujetin*, $C_{14}H_{14}O_8$, both of which are almost insoluble in cold water, and when in alcoholic solution acquire a handsome blue-green color with ammonia. Thujin, boiled with barium hydroxide, yields sugar and *thujetic acid*, $C_{28}H_{22}O_{13}$, which is insoluble in water. These compounds are probably related to *quercitrin* and its derivatives.

Pharmaceutical Preparation.—Tinctura thujæ. Tincture of arbor vitæ. 5 parts of the fresh small branches of arbor vitæ are bruised, and macerated with 6 parts of alcohol for eight days; the liquid is expressed and filtered.—*P. G.* 1872. The tincture is of a greenish-yellow color.

Action and Uses.—Arbor vitæ somewhat resembles savine in its qualities, and particularly by irritating the skin when the fresh leaves or an ointment made from them is applied to it. Like savine, it has been found useful in repressing the fungous granulations of *ulcers*, in removing *warts*, and in an ointment as a palliative of chronic *rheumatism*. Some have even gone so far as to attribute to it the cure of *cancerous* ulcers both of external parts and of the uterus, even when administered internally alone (*Med. News*, xlv. 185). The published reports, however, rather denote cases of simple ulcers aggravated by improper applications as those which have been benefited by this medicine. Both internally and topically it is alleged to be an effectual remedy for *venereal warts*

(*Bull. de. Soc. Thérap.*, June, 1886). Internally, it has been given with alleged benefit in *amenorrhœa* and *pulmonary catarrh*, and for destroying *worms*. For these several purposes the distilled oil has been found efficient. This oil is a stimulant of the heart and spinal marrow, and, given to animals in poisonous doses, it occasions tonic and clonic convulsions (Strahmann, *Thérap. Gaz.*, ix. 827). It has been applied to reduce various neoplasmic *growths* and correct the fetor of discharges (*Ther. Gaz.*, xii. 422). Boerhaave used a distilled water of the leaves in *dropsy*. A fluid extract and a saturated tincture have been given in *doses* of Gm. 4 (1 fluidrachm) several times a day, and applied topically on compresses and to the uterus on a tampon. An ointment made with the leaves or with the volatile oil has been used in rheumatism.

THUS AMERICANA, *Br.*—Common Frankincense.

The concrete turpentine of Pinus Tæda, *Linné*. (See Terebinthina.)

Uses.—This turpentine may be used for the various purposes to which other turpentines are adapted. In England it forms a constituent of the official pitch plaster, under the name of common frankincense.

THYMOL, *U. S., Br., F. Cod.*—Thymol.

Thymolum, P. G.; *Acidum thymicum.—Thymol*, E., Fr., G.; *Thymic acid*, E.; *Acide thymique*, Fr.; *Thymiansäure*, G.

Formula $C_{10}H_{13}OH$. Molecular weight 149.66.

Origin.—Thymol is a phenol occurring in the volatile oils of Thymus vulgaris, *Linné*, Monarda punctata, *Linné*, Carum Ajowan, *De Candolle*, and very likely in other volatile oils of the natural orders Labiatæ and Umbelliferæ.

Preparation.—Oil of thyme is subjected to fractional distillation. That portion which distils at a temperature above 200° C. (392° F.) is separately collected, and is agitated with solution of soda, the solution of sodium thymol separated from the thymene, and the thymol liberated by hydrochloric acid; after it has crystallized it is pressed between bibulous paper and recrystallized from alcohol. This is Lallemand's process (1853), which may be modified so as to distil off only the hydrocarbons at a temperature not exceeding 180° C. (356° F.), and treating the residue in the still with soda solution as stated. By a similar process thymol is obtained from the volatile oils of Monarda and of Ptychotis.

Properties.—Thymol crystallizes in thin, colorless, rhombic scales or is seen in commerce in large translucent crystals of the spec. grav. 1.069 at 15° C. (59° F.). It melts between 50° and 52° C. (122°–125.6° F.) (*U. S., P. G.*) to a colorless liquid lighter than water, retains its fluid condition often for a long time, and boils near 230° C. (446° F.). It has an aromatic thyme-like odor and a warm, pungent but scarcely caustic taste. It dissolves sparingly in water, requiring at 15° C. 1100 (*P. G.*) or 1200 (*U. S.*) parts for solution, but is soluble in half its weight of alcohol, ether, and chloroform, in 2 parts of soda solution sp. gr. 1.16, and freely in benzene, benzin, carbon disulphide, glacial acetic acid, and fixed and volatile oils. It forms with soda a crystallizable and readily soluble compound, and does not change the color of solution of ferric chloride. Symes (1879) ascertained that on being triturated with one-half to ten times its weight of camphor a colorless syrupy liquid is obtained; it also liquefies when triturated with its own weight of menthol or chloral. According to Gerrard, the strongest aqueous solution of thymol available is 1 in 1000, and a solution of 4 grains of it in a fluidounce of alcohol is miscible with water without becoming turbid; 3 grains of thymol are dissolved by 1 grain of caustic soda and 1¼ grains of caustic potassa. Solid fats, when heated, are excellent solvents of thymol. A solution of 1 part of thymol in 100 parts of warm glycerin remains clear. Thymol is also soluble in 4 parts of cold sulphuric acid; the solution has a yellowish color, and on being gently heated becomes rose-red. On pouring this solution into 10 volumes of water, digesting the mixture with an excess of lead carbonate, and filtering, the liquid becomes violet-blue on the addition of ferric chloride. This reaction is due to *thymolsulphonic acid*, $HC_{10}H_{13}SO_4$, discovered by Lallemand (1853). Hammersten and Robert (1881) give the following as the most delicate test by which one-millionth part of thymol may still be detected: Mix the liquid with one-half of its volume of glacial acetic acid, then with at least an equal volume of sulphuric acid, and warm gently, when a bright reddish-violet color is produced which is not destroyed by boiling. According to Hirschsohn (1881), a solution of thymol in 60,000 parts of water is rendered turbid by bromine-water, but according to Hammarsten the precipitate is not crystalline like tri-

bromophenol. If a very small crystal of thymol be dissolved in 1 Cc. of glacial acetic acid, and then 6 drops of sulphuric acid and 1 drop of nitric acid be added, the liquid will assume a deep bluish-green color.

Composition.—Thymol is the phenol of cymene, and its composition is shown by the formula $C_6H_3.C_3H_7.CH_3.OH$. Widman (1882) has succeeded in preparing it synthetically from cuminol (see page 560) by converting this into nitrocuminol, acting upon this with phosphorus pentachloride, when nitrocymylene chloride, $C_{10}H_{11}(NO_2)Cl_2$, is formed, and treating this with nascent hydrogen, first at a low temperature, afterward with the aid of heat, to obtain cymidin, $C_{10}H_{13}.NH_2$. A dilute solution of cymidin sulphate is treated with potassium nitrite and finally distilled, when thymol is obtained, having the melting-point 44° C. (111.2° F.), which is the same as found by Lallemand and Stenhouse for thymol from the oils of thyme and of ptychotis. Widman prepared nitrosothymol from artificial thymol; the product from both fused between 160° and 162° C. (320°–323.6° F.).

Tests.—Thymol should be volatilized by the heat of a water-bath without leaving any residue (inorganic and non-volatile organic compounds). Its saturated aqueous solution should have a neutral reaction, and should not acquire a darker color on the addition of a drop of test-solution of ferric chloride (carbolic acid, various phenols, etc.). If 1 Gm. of thymol be heated in a test-tube, in a water-bath, with 5 Cc. of a 10 per cent. solution of sodium hydroxide, a clear, colorless, or very slightly reddish solution should be obtained, which becomes darker on standing, but without the separation of oily drops (absence of thymene or lævogyrate pinene, $C_{10}H_{16}$). If to this solution a few drops of chloroform be added and the mixture agitated, a violet color will be produced.

Derivative Compound.—Thymacetin, $CH_3.C_3H_7.C_6H_2.OC_2H_5.NH.C_2H_3O$; mol. weight 134.51, occupies the same relation to thymol as phenacetin does to phenol (carbolic acid), and is prepared in an analogous manner. It occurs as a white crystalline powder but sparingly soluble in water.

Action and Uses.—Thymol is comparatively harmless when administered internally, not disturbing digestion, although it arrests gastric fermentation. It is ten times less poisonous than carbolic acid, and hence may be used even in equal quantities with a very inferior risk. Some persons find its taste and smell as repulsive as those of carbolic acid, but the greater number claim for it an agreeable aromatic odor and flavor. When taken largely by sensitive persons it causes ringing in the ears, and even deep somnolence, and collapse.

The applications of thymol in medicine and *surgery* are identical with those of carbolic acid, to which it appears to be very little inferior for all the purposes to which the latter is applied. It has over this acid the great advantage of possessing an agreeable instead of a very offensive odor, and of not being an irritant or corrosive, and therefore of not causing pain. An objection has been made to it that in summer it tends to attract flies to the injured parts. Among surgeons who have expressed a favorable judgment of its antiseptic qualities is Mr. Spencer Wells, who in a series of *ovariotomy* operations gave it the preference over carbolic acid. He used a solution of 1 : 1000 for spray, irrigation, sponges, instruments, and all other antiseptic purposes. It has been employed to correct the *fetor* of suppurating *burns* and *gangrenous wounds* and *ulcers*. Indeed, it has been found to be an excellent anodyne for recent burns in a solution of 1 : 1000 of water. Where sloughs exist it causes them to separate more rapidly than usual, leaving more healthy granulations and a better cicatrix than after carbolic acid. A solution of 1 : 3000 was found an efficient lotion in a case of violent *stomatitis* and in seven cases of *diphtheria*, in which it was injected into the nostrils and throat. A similar solution atomized is of great benefit in *fetid bronchitis*. Its agreeable taste and smell adapt it especially to the last-named purpose. In chronic *coryza* and *ozæna* (Seiss, *Med. News*, i. 370), *conjunctivitis*, and *otorrhœa*, in *gonorrhœa*, and in all mucous fluxes it has been used with advantage, both in simple watery solution and with the addition of boracic acid. In obstetrical practice when the *lochia* are offensive, and in cases of fetid urine or vaginal *leucorrhœa*, and even when the discharge is due to *cancer of the uterus*, *vagina*, or *bladder*, not only is the fetor neutralized, but the inflamed and ulcerated tissues are favorably modified. It is a very efficient and agreeable *deodorizer* for the hands of surgeons and obstetricians. In lesions of the vagina and other accessible parts a lotion should be used several times a day, and cotton saturated with thymolized glycerin may be left in contact with the diseased structure. For these different purposes the solution should vary in strength from 1 : 1000 to 1 : 4000 (Seyferth).

Injected into dead bodies, it preserves them from decomposition; applied pure to *warts*, it causes them to shrivel and disappear. In *skin diseases* it has been found useful in the same cases for which tar has so long proved to be the best topical remedy—that is to say, in *psoriasis* and chronic *eczema*, but especially in the former—and it has the advantage over tar of not staining the bed- and body-clothing. It is recommended to apply it in an ointment consisting of 1 ounce of soft paraffin and from Gm. 0.30–2 (5 to 30 grains) of thymol, or in a lotion consisting of thymol Gm. 0.30 (5 grains), rectified spirit and glycerin each 1 ounce, water to make 8 ounces. In "ringworm" Morris advises as a lotion thymol ʒss; chloroform ʒij; olive oil ʒvj (*Practitioner*, xxvi. 362). It is claimed by Campi to be a tæniacide and tæniafuge. He gave from 1½–5 drachms a day in divided doses, and followed them with castor oil. During the action of the medicine he administered diffusible stimulants to counteract its depressing effects (*Med. News*, xl. 459). Martini claims for the stearoptene a special virtue due to its insolubility in the secretions of the digestive canal, because it thereby acts moderately and on the whole intestinal mucous membrane. He regards it as a valuable agent in the treatment of various forms of *diarrhœa* and *dysentery*, including that of *typhoid fever* (*Med. Record*, xxxii. 149). Dr. H. P. Henry thinks that it favorably influences the latter disease. He gave it in pill with soap, and in the dose of Gm. 0.13–0.16 (2 or 2½ grains) every six hours (*Trans. Assoc. Amer. Phys.*, iii. 346). It probably acts favorably by stimulating the intestinal ulcers and by preventing an accumulation of intestinal gas. Equally good effects have been derived from its use in the diarrhœa of tubercular *phthisis* (Bruen, *Ther. Gaz.*, xii. 105; Philipowicz, *Med. News*, liv. 128). Sauter ranked thymol as an antiseptic below salicylic acid (*Centralbl. f. Ther.*, vi. 376). Its power of limiting fermentation has been thought by Bufalini (*Med. News*, li. 660) to assist the operation of a continued proteid diet in the treatment of *diabetes*. As a substitute for the antiseptic surgical dressing prepared with carbolic acid a solution is recommended as follows: Thymol 1 Gm., alcohol 10, glycerin 30, water 1000 Gm. This solution has no corrosive action on instruments immersed in it; it causes, however, a lively sensation of burning, accompanied with redness of the skin, but not with anæsthesia, nor does it produce desquamation of the epidermis. Neither does it, like carbolic acid, give rise to constitutional symptoms, nor occasion as much discharge from wounds as carbolic acid does. As a substitute for carbolic acid in the antiseptic method of dressing wounds, its effects are reported to be excellent. After forty-one out of fifty-nine operations the secretion was serous in only eight and purulent in two; in the remainder there was absolutely no secretion. Many of these operations involved large surfaces or were for diseased joints, etc. According to Ranke, the results obtained with thymol (antiseptically considered) are as good as those with carbolic acid, while the former presents these advantages: that the secretion of wounds treated by it is much less, and their rate of healing much quicker. Moreover, it produces no bad effects upon the system at large, and does not irritate the parts to which it is applied in solution (*Medical Times and Gazette*, March, 1878).

Thymacetin has been used in doses of Gm. 0.25–1 (5 to 15 grains) for the relief of some cases of neuralgic headache. Its action is very like that of phenacetin.

TILIA.—Linden-flowers.

Flores tiliæ, P. G.—*Tilleul* (*Fleurs*), F. Cod.; *Lindenblüthen*, G.; *Tilo*, Sp.

The inflorescence of different species of Tilia.

Nat. Ord.—Tiliaceæ.

Origin.—The different species of linden, which are also known as *lime tree*, *white-wood*, and *bass-wood*, are stately trees from 12–30 M. (40 to 100 feet) high, and have a soft white wood, a fibrous bark, and alternate petiolate, heart-shaped, serrate leaves, frequently with a more or less oblique base. The wood yields a very light charcoal.

Tilia ulmifolia, *Scopoli* (T. parvifolia, *Ehrhart*, T. microphylla, *Ventenat*). The leaves are pale-green on the lower surface and pubescent in the angles of the veins, otherwise smooth; the cymes are about seven-flowered.

Tilia platyphyllos, *Scopoli* (T. grandifolia, *Ehrhart*, T. pauciflora, *Hayne*). The leaves are larger and softly pubescent beneath; the cymes are about three-flowered. This, with the preceding species, constitutes Tilia europæa, *Linné*, and is occasionally cultivated as an ornamental tree.

Tilia americana, *Linné*. It has thickish and smooth (T. glabra, *Ventenat*) or underneath softly pubescent and frequently thin (T. pubescens, *Aiton*) leaves; the cymes are

mostly many-flowered. The smooth form grows in Canada and the United States, the pubescent variety from Maryland southward.

TILIA HETEROPHYLLA, *Ventenat* (T. alba, *Michaux*, T. laxiflora, *Pursh*). It is found from the mountains of Pennsylvania along the Ohio and Mississippi and southward, and has the leaves bright-green and smooth above and silvery-whitened beneath. It resembles the South European Tilia argentea, *Desfontaines*, which, however, has the leaves on shorter petioles.

Description.—Linden-flowers grow in axillary cymes, and have the peduncle partly united to the midrib of a leaf-like, linear, or oblong-lanceolate greenish-yellow bract. The flowers of each cyme vary in the different species from three to about thirty in number, and have a five-parted calyx and five whitish or yellowish, lanceolate or oblong, usually notched petals. The numerous stamens are hypogynous, slightly united in the first two species by the base of their filaments into about five groups, or in the other species with the base of a petal-like scale placed opposite each petal. The ovary is five-celled, has a style with a five-lobed stigma, and produces a globular, nut-like, one-celled capsule containing one or two seeds. Linden-flowers have an agreeable and (when dry) feeble odor and a sweetish and mucilaginous taste. American linden-flowers and their bracts are larger than the European, and the petals have a somewhat horn-like appearance.

Constituents.—From the analyses made by Marggraf, Brossat, Buchner, Siller, Winckler, and others it appears that linden-flowers contain mucilaginous or pectinaceous principles, sugar, a little tannin, fat, malates, and other salts. The odorous principle is a colorless or yellowish, sweetish, light, and fragrant volatile oil, which is readily soluble in alcohol and dissolves iodine without giving off vapors. Herberger and Winckler obtained between $\frac{1}{2\,0}$ and $\frac{1}{1\,0}$ per cent.

Pharmaceutical Preparation.—AQUA TILIÆ, Linden-flower water. Distil 1 part of linden-flowers and sufficient water until 4 parts (10 parts, *P. G.* 1872) of distillate are obtained.—*F. Cod.*

Allied Plants.—CORCHORUS CAPSULARIS, C. OLITORIUS, *Linné*, and several other species are annual herbs of India, where they are cultivated for their bast-fibres, which are known in commerce as *gunny* and *jute*: the fibre yields from 1 to 2 per cent. of ash. The second species is also employed as a potherb.

Uses.—On the continent of Europe linden-flowers, buds, and leaves are among the most generally used of domestic remedies, in the form of an infusion, to palliate *painful indigestion*, *nervousness*, *nervous headache*, and even mild forms of *hysteria*. For these purposes it is taken either cold or warm, according to circumstances, but in the latter way to dissipate commencing *catarrhs of the respiratory passages* and *diarrhœa* occasioned by cold. The flowers are also used in warm general baths to allay nervous irritability, or a strong infusion of them is administered by enema for similar purposes. The American species is probably quite as operative as the European, and both depend for whatever virtues they possess upon their combined lenitive and stimulant qualities. The agreeable smell and taste of the infusion render it acceptable to the sick and appropriate as a vehicle for more active medicines. The infusion is usually made with the flowers, Gm. 2–4 to Gm. 500 (gr. xxx–lx in Oj) of water.

TINCTURÆ.—TINCTURES.

Teintures, Alcoolés, Fr.; *Tinkturen*, G.; *Tinturas, Alcoholados*, Sp.

Tinctures are solutions of medicinal non-volatile or only partially volatile substances in liquids other than water and glycerin. Solutions of volatile substances in water are known as *medicated waters*, and similar solutions in alcohol as *spirits*. The menstrua employed in the preparation of tinctures are alcohols of different strengths, spirit of ether or spirit of nitrous ether, and aromatic spirit of ammonia or ammoniated alcohol. According to the menstruum employed, tinctures are distinguished as *ammoniated*, *ethereal*, and *alcoholic*, and that class of tinctures in the preparation of which diluted alcohol or a still weaker spirit has been used is sometimes designated as *hydro-alcoholic*. By far the greatest number of tinctures are made with an alcoholic menstruum. The employment of spirit of nitrous ether in tinctures is confined to a few unofficial preparations.

Alcoholic Menstruum.—Most tinctures of the United States Pharmacopœia are prepared with diluted alcohol, of the British Pharmacopœia with proof spirit, and of the

French and German Pharmacopœias with alcohol of about 60 per cent., or of specific gravities 0.912 and 0.894. While it is desirable to keep the alcoholic strength of tinctures as low as possible, it is evidently improbable that one and the same menstruum should be equally well adapted for the preservation of liquid preparations of drugs having the most varied composition; and that improvements in this respect are needed is shown by the unsightly deposits occurring in some and the change into gelatinous masses observed in other tinctures. In most cases these obvious changes are prevented by the employment of a stronger alcoholic menstruum.

Strength.—The British Pharmacopœia, as a rule, prepares tinctures in such a manner that 1 Imperial pint (20 fluidounces) represents 2½ oz. av. of the drug, or 1 part of the drug is used for 8 measured parts of the finished tincture; the U. S. P. directs tinctures to be made in the proportion of 5, 10, 15, and 20 grammes of the air-dried drug to every 100 Cc. of finished product; of these four classes 56 tinctures are officially recognized, and in addition 15 formulas are given for tinctures with varying proportions of drugs. The French and German Pharmacopœias prepare their tinctures almost without exception in such a manner that 1 part of the drug is represented by about 5 or 10 parts (by weight) of the tincture, either 5 or 10 parts of the menstruum being used for extracting 1 part of the drug by maceration. Prepared in this manner, the actual weight of the tincture is equal to that of the menstruum and of the soluble matter combined, so that the strength is only approximately as 1 in 5 or 10.

It is to be regretted that the tinctures of the different pharmacopœias, or at least those prepared from potent drugs, are not of the same composition, as will be seen from the following table, in which no account is taken of the difference in the density of the menstruum:

100 parts of tincture of—	Represent parts of the active drug—				100 parts of tincture of—	Represent parts of the active drug—			
	By weight.			By measure.		By weight.			By measure.
	U. S. P.	F. Cod.	P. G.	Br. P.		U. S. P.	F. Cod.	P. G.	Br. P.
Aconitum (leaves)	. .	20			Gentiana (* compound)	*10	20	20	*7.5
" (root)	35	20	10	12.5	Hyoscyamus	15	20	. .	12.5
Aloes	10	20		2.5	Iodine	7	7.7	9.1	2.5
Arnica (flowers)	20	20	10		Kino	10	20	. .	10
" (root)	10	. .	. .	5	Krameria	20	20	20	12.5
Asafetida	20	20		12.5	Lobelia	20	20	10	12.5
Belladonna	15	20	. .	5	Moschus	5	10	2	
Calumba	10	20	. .	12.5	Myrrha	20	20	20	12.5
Cannabis ind. (herb)	25	20			Opium	10	13	10	7.5
" (extract)	. .	. .	. .	5	Physostigma	15	20		
Cantharides	5	10	10	1.25	Pyrethrum	20	20	. .	20
Capsicum	5	. .	10	3.75	Quassia	10	20	. .	3.75
Catechu (* with cinnamon)	*10	20	20	*12.5	Rheum	10	20	. .	10
Cinchona	20	20	20	20	Scilla	15	20	20	12.5
Colchicum (seed)	15	20	10	12.5	Stramonium (* leaves)	15	*20	. .	12.5
Conium (fruit)	. .	. .	. .	12.5	Valeriana	20	20	20	12.5
" (leaves)	. .	20			Veratrum album	. .	20	10	
Digitalis	15	20	. .	12.5	" viride	40	. .	. .	20
Galla	20	20	20	12.5	Zingiber	20	20	20	12.5

Preparation.—Tinctures of resins, oleoresins, balsams, and of most gum-resins and extractive drugs are best prepared by maceration. Nearly all other drugs are conveniently extracted by percolation, which process is fully described on pages 639, etc., and if the process is properly conducted the drug will be practically exhausted long before the requisite amount of tincture has been obtained. The chief objections that can be raised against this process are, that the manipulation must vary with the nature of the drug, and that a certain amount of alcohol will be retained in the powder. The former is of no weight with the pharmacist, who recognizes his duty of intimately acquainting himself with the characteristics and peculiarities of each drug passing through his hands; and the second objection will be of little moment if weaker menstrua are gradually and judiciously employed, as indicated on page 643.

The British Pharmacopœia avoids the second objection by expressing the contents of the percolator as soon as the requisite quantity of menstruum has been used. In most of its formulas the preparation of a pint (Imperial) of tincture is directed, and the following explains the manipulations which have been adopted: Macerate the material for forty-

eight hours in 15 fluidounces of the menstruum in a closed vessel, agitating occasionally; then transfer to a percolator, and when the fluid ceases to pass continue the percolation with the remaining 5 ounces of the menstruum. Afterward subject the contents of the percolator to pressure, filter the product, mix the liquids, and add sufficient menstruum to make 1 pint.

The German Pharmacopœia prepares all tinctures by maceration. The drugs, either coarsely powdered or cut into thin slices, and the menstruum are introduced into a bottle, which should be only partly filled, so as to permit the frequent agitation of the contents: after macerating in a shady place at about 15° C. (59° F.) for a week, the liquid is decanted and the residue subjected to pressure; the liquids thus obtained are mixed, set aside for a day or two, and then filtered, care being taken to prevent the evaporation of alcohol. The liquid which remains absorbed in the drug is not replaced.

The French Codex directs its tinctures to be made by maceration or by displacement. For the latter process the directions are similar to those of the United States Pharmacopœia, except that the powder is ordered to be of medium fineness and is not moistened previous to its introduction into the percolator.

Ethereal Tinctures—Éthérolés, *F. Cod.*—are not recognized by the U. S. P., and only one has been admitted by the Br. P. (lobelia) and by the P. G. (valeriana), both using spirit of ether for the menstruum. For eight ethereal tinctures of the French Codex a menstruum containing more ether is used; it is designated Ether à 0.758, and is prepared by mixing 3 parts of alcohol with 7 parts of ether spec. grav. 0.724. These tinctures are prepared by maceration or displacement, provision being made to prevent evaporation of the ether.

Preservation.—All tinctures should be perfect solutions, and to retain them entirely transparent the evaporation of the volatile portions should be prevented. Tinctures are best kept in well-stoppered bottles, in a room where the temperature is not subject to great variations, and where they are not exposed to the direct sunlight. The size of the bottles should be adapted to the quantities of the tincture that are likely to be used within a reasonable length of time.

TINCTURÆ HERBARUM RECENTIUM, *U. S.*—Tinctures of Fresh Herbs.

Alcoolaturæ, F. Cod.; *Alcoolatures*, Fr.; *Tinkturen von frischen Pflanzen*, G.

Tinctures made from fresh herbs were, to some extent, prepared more than two hundred years ago, but were more prominently introduced by Hahnemann, and are extensively employed in homœopathic practice. They have attracted more or less attention in Europe since about 1817, when Schrader (*Buchner's Repertorium*, iii. 20) made a number of investigations, and recommended such tinctures prepared from the fresh juice and twice its weight of alcohol. A similar method was subsequently advocated by Béral and by Deschamps, while Soubeiran suggested the use of the fresh plants and their maceration with strong alcohol in definite proportions. This method was adopted in the French Codex of 1866, and has been retained in that of 1884. Tinctures made from fresh herbs have been retained in the new U. S. Pharmacopœia, which, however, gives only a general formula.

Preparation.—"These tinctures, when not otherwise directed, are to be prepared by the following formula: Take of the fresh herb, bruised or crushed, 500 Gm.; alcohol 1000 Cc. Macerate the herb with the alcohol for fourteen days; then express the liquid and filter."—*U. S.*

This is essentially the formula for preparing the third class of tinctures of the Homœopathic Pharmacopœia. The French Codex directs equal parts of the fresh drug and of 90 per cent. alcohol, the maceration to be continued for ten days; in this manner alcoolatures are prepared from aconite-leaves and root, arnica-flowers, belladonna-leaves and root, bryony, colchicum-flowers and root, conium-leaves, digitalis-leaves, drosera (entire plant), eucalyptus-leaves, hyoscyamus-leaves, pulsatilla (flowering herb), spilanthes-flowers, and stramonium-leaves.

It is evident that these preparations must vary in strength at least to the same extent as juices (see p. 1534), and that they are of doubtful utility, except perhaps for such drugs which, like the leaves of Rhus Toxicodendron, owe their virtues to very volatile uncombined principles.

TINCTURA ACONITI, *U. S., Br., P. G.*—Tincture of Aconite.

Tinctura aconiti radicis, P. A.—*Tincture of aconite-root*, E.; *Teinture de racine d'aconit*, Fr.; *Eisenhuttinktur*, G.

Preparation.—Aconite, in No. 60 powder, 350 Gm.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix alcohol and water in the proportion of 700 Cc. of alcohol to 300 Cc. of water. Having moistened the powder with 200 Cc. of menstruum, macerate for twenty-four hours; then pack it firmly in a cylindrical glass percolator, and gradually pour menstruum upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of aconite use 11 av. ozs. and 300 grains of powdered aconite-root and moisten with 6 fluidounces of the menstruum (alcohol 7 volumes, water 3 volumes).

Aconite-root 2½ oz. av., alcohol (sp. gr. 0.838) sufficient to make 1 Imperial pint (20 fluidounces).—*Br.*

Aconite-root 20 parts, alcohol (sp. gr. 0.912) 100 parts.—*F. Cod.*

Aconite-root 10 parts, alcohol (sp. gr. 0.894) 100 parts.—*P. G.*

The selection of efficient root and its careful percolation are of the utmost importance. The tincture is of a yellowish-brown color, and on the addition of water becomes milky from the precipitation of resin. Formerly *tincture of aconite-leaves* (2 troyounces to 1 pint of diluted alcohol) was official; it was much weaker than the present tincture, and could be given in larger doses.

Fleming's Tincture of Aconite is still prescribed by some physicians; it is prepared by carefully percolating 10 troyounces of powdered aconite-root with sufficient alcohol to obtain 15 fluidounces of tincture. Since the introduction of the very efficient official fluid extract of aconite there seems no longer to be any necessity for this tincture.

Uses.—The medicinal and poisonous actions of aconite have been discussed elsewhere. The tincture is the preparation most frequently employed in medicine. The *dose* is Gm. 0.06–0.30 (♏j–v).

TINCTURA ALOES, *U. S., Br.*—Tincture of Aloes.

Teinture d'aloès, Fr.; *Aloetinktur*, G.; *Tintura de Acibar*, Sp.

Preparation.—Purified Aloes, in No. 40 powder, 100 Gm.; Liquorice-root, in No. 40 powder, 200 Gm.; Diluted Alcohol, a sufficient quantity; to make 1000 Cc. Mix the powders, and, having moistened the mixture with 80 Cc. of diluted alcohol, macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of aloes use 3 av. ozs. and 148 grains of purified aloes and 6 av. ozs. and 296 grains of powdered liquorice-root and moisten the mixed powders with 2½ fluidounces of the menstruum (diluted alcohol).

The formulas of other pharmacopœias require—Socotrine aloes ½ ounce, extract of liquorice 1½ ounces (av.), proof spirit sufficient for 1 pint (Imperial).—*Br.* Aloes 1 part, alcohol (sp. gr. 0.912) 5 parts.—*F. Cod.* Aloes 1 part, alcohol (sp. gr. 0.832) 5 parts.—*P. G.*

The tincture has a dark blackish-brown color and a very bitter taste.

Uses.—This preparation is rarely used as a purgative, for which purpose not less than Gm. 16 (½ an ounce) of it would be necessary. As a laxative Gm. 4–8 (fʒj–ij) may be taken after food. It has been applied topically as a dressing for indolent *ulcers*, *excoriations*, *bed-sores*, *fissures*, and *cutaneous eruptions*. It enters into various preparations of old repute for their virtues in such affections—*e. g.* Turlington's balsam, friars' balsam, etc.—and has more recently been employed for similar purposes with glycerin, by evaporating from 4 to 8 parts of the tincture of aloes, and then gradually adding 30 parts of glycerin.

TINCTURA ALOES ET MYRRHÆ, *U. S.*—Tincture of Aloes and Myrrh.

Elixir proprietatis Paracelsi.—Elixir de propriété, Fr.; *Aloëelixir*, G.

Preparation.—Purified Aloes, 100 Gm.; Myrrh 100 Gm.; Liquorice-root, in No. 40 powder, 100 Gm.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc.. Mix alcohol and water in the proportion of 750 Cc. of alcohol to 250 Cc. of water. Having mixed

the aloes, myrrh, and liquorice-root, reduce them to a No. 40 powder. Moisten the powder with 60 Cc. of the menstruum, and macerate for twenty-four hours; then pack it moderately in a cylindrical percolator, and gradually pour menstruum upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of aloes and myrrh use 3 av. ozs. and 148 grains each of purified aloes, myrrh, and liquorice-root, and moisten the mixed powders with 2 fluidounces of the menstruum (alcohol 3 volumes, water 1 volume).

This preparation has been dropped from the other pharmacopœias; that of the P. G. 1872 was four-fifths of the above strength, and contained also 4 per cent. of saffron and 8 per cent. of diluted sulphuric acid sp. gr. 1.115.

The color of this tincture is deep reddish-brown; if prepared with saffron, it is of a rich orange-brown. It is precipitated by water.

In this connection should be mentioned the following preparation, which has long enjoyed considerable reputation on the continent of Europe:

Tinctura aloes composita, *P. G.;* Elixir ad longam vitam, Elixir suedicum.—Compound tincture of aloes, Swedish bitters, *E.;* Elixir de longue vie, Elixir suédois, *Fr.;* Lebenselixir, *G.*—Aloes 6 parts, and gentian, rhubarb, zedoary, and saffron, each 1 part, are macerated for a week with 200 parts of alcohol sp. gr. 0.894; the tincture is expressed and filtered.—*P. G.* The formula of the French Codex reduces the aloes to 4 parts, the other ingredients to ½ part, and adds ½ part each of agaric and of confection of opium.

Uses.—As a purgative capable of especially stimulating the pelvic organs this preparation has been employed under the name of *Elixir proprietatis* ever since it was invented by Paracelsus, and also as peculiarly fitting for *constipation* in females when associated with *amenorrhœa* or irregular menstruation. But this state is commonly a result of general atony, and can only be radically cured by remedies addressed to the general system. The *dose* is Gm. 4–8 (ʒj–ij).

TINCTURA ARNICÆ FLORUM, *U. S.*—Tincture of Arnica-flowers.

Tinctura arnicæ, P. G.—*Teinture de fleur d'arnica*, Fr.; *Arnikatinktur*, G.

Preparation.—Arnica-flowers, in No. 20 powder, 200 Gm.; Diluted Alcohol a sufficient quantity; to make 1000 Cc. Pack the powder firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of arnica-flowers use 6 av. ozs. and 296 grains of powdered arnica-flowers.

Arnica-flowers 20 parts, alcohol (sp. grav. .912) 100 parts.—*F. Cod.*

Arnica-flowers 10 parts, alcohol (sp. grav. .894) 100 parts.—*P. G.*

The first formula yields a yellowish-brown tincture of a darker tint than the other two and that of the U. S. P. 1870, a less alcoholic menstruum being now employed, which extracts more of the extractive matter, but probably less of the resinous and oily constituents. The present tincture becomes less opalescent with water than one prepared with a stronger alcoholic menstruum.

Uses.—In Germany tincture of arnica is universally employed as the sovereign domestic remedy for *wounds*, *bruises*, and all manner of *local pains*, which it benefits through the alcohol as well as by the essential oil that it contains. It is applied diluted with water as a lotion or upon compresses; it is not often prescribed internally, but may be given in *doses* of Gm. 0.60–4 (gtt. x–lx).

TINCTURA ARNICÆ RADICIS, *U. S.*—Tincture of Arnica-root.

Tinctura arnicæ, Br.; *Teinture de racine d'arnica*, Fr.; *Arnikawurzeltinktur*, G.

Preparation.—Arnica-root, in No. 40 powder, 100 Gm.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix alcohol and water in the proportion of 650 Cc. of alcohol to 350 Cc. of water. Moisten the powder with 150 Cc. of the menstruum and macerate for twenty-four hours; then pack it moderately in a cylindrical percolator, and gradually pour menstruum upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of arnica-root use 3 av. ozs. and 148 grains of powdered arnica-root, and moisten the same with 4½ fluidounces of the menstruum (alcohol 65 volumes, water 35 volumes).

Arnica-root 1 oz. av., alcohol (sp. gr. 0.838) sufficient to make 1 Imperial pint (20 fluidounces).—*Br.*

The first formula yields a darker-colored tincture than that of the B. P., due not merely to the larger amount of drug used, but on account of the reduced alcoholic strength of the menstruum, which is nearly the same as that used for the fluid extract.

Uses.—The German Pharmacopœia does not contain any tincture of arnica-root, and it is difficult to understand why the American should be so encumbered. The *dose* may be stated as about the same as that of the tincture of the flowers.

TINCTURA ASAFŒTIDÆ, *U. S., Br.*—Tincture of Asafetida.

Tinctura asæ fœtidæ, P. G.— *Teinture d'asafœtida*, Fr.; *Asanttinktur*, G.

Preparation.—Asafetida, bruised, 200 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Mix the asafetida with 800 Cc. of alcohol, and macerate for seven days in a closed vessel; then filter through paper, adding, through the filter, enough alcohol to make the tincture measure 1000 Cc.—*U. S.*

To make 1 quart of tincture of asafetida macerate 6 av. ozs. and 296 grains of bruised asafetida with 26 fluidounces of alcohol for a week, and after filtration wash the filter with sufficient menstruum to bring the volume up to 32 fluidounces.

The proportions of other pharmacopœias are—Asafœtida 2½ oz. av., rectified spirit sufficient for 1 pint (Imperial).—*Br.* Asafœtida 1 part, alcohol 5 parts.—*F. Cod., P. G.*

The tincture nearly agrees with those of the French and German Pharmacopœias. It has a yellowish brown-red color and is rendered milky on the addition of water.

Tinctura ætherea asafœtidæ (*Tinctura etere de asafétida*, Sp.). Asafetida 2 parts, ether 7 parts, alcohol 3 parts.—*F. Cod.*

Uses.—Owing to its repulsive taste, tincture of asafetida is seldom given by the mouth, although the *dose* is commonly stated to be from Gm. 2–4 (f℥ss–j). It is more convenient and useful in an enema, with water alone or with other appropriate adjuncts, for the relief of intestinal *flatulence* and for obtaining the influence of the drug in *hysterical* attacks. From Gm. 16–32 (f℥ss–j) may be used in this manner.

TINCTURA AURANTII AMARI, *U. S., P. A.*—Tincture of Bitter Orange-peel.

Tinctura aurantii, Br.; P. G.—*Tincture of orange-peel* E.; *Teinture d'orange amère*, Fr.; *Pomeranzentinktur*, G,

Preparation.—Bitter Orange-peel, in No. 30 powder, 200 Gm.: Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix alcohol and water in the proportion of 600 Cc. of alcohol to 400 Cc. of water. Moisten the powder with 200 Cc. of the menstruum and macerate for twenty-four hours; then pack it moderately in a cylindrical percolator, and gradually pour menstruum upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of bitter orange-peel use 6 av. ozs. and 296 grains of powdered bitter orange-peel, and moisten with 6 fluidounces of menstruum (alcohol 6 volumes, water 4 volumes).

Other pharmacopœias direct: Bitter orange-peel 2 ounces (av.), proof spirit sufficient for 1 pint (Imperial).—*Br.* Bitter orange-peel 1 part; macerated with 5 parts of alcohol spec. grav. 0.863.—*F. Cod.* (spec. grav. 0.894, *P. G.*).

Uses.—Tincture of bitter orange-peel is employed almost exclusively as a flavoring ingredient of mixtures. The *dose* is Gm. 4–8 (f℥j–ij).

TINCTURA AURANTII DULCIS, *U. S.*—Tincture of Sweet Orange-peel.

Teinture d'orange douce, Fr.; *Apfelsinenschaalentinktur*, G.

Preparation.—Sweet Orange-peel, taken from the fresh fruit, 200 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Mix the orange-peel (which should be as free as possible from the inner white layer), previously cut into small pieces, with 800 Cc. of alcohol, and macerate for twenty-four hours; then pack it moderately in a conical percolator, and gradually pour alcohol upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of sweet orange-peel macerate 6 av. ozs. and 296 grains of fine cut fresh sweet orange-peel (deprived of the inner white layer) with 26 fluidounces of alcohol, and finally percolate with sufficient menstruum to make 32 fluidounces.

By careful grating the yellow rind of fresh oranges is easily removed, and at once obtained in a suitable condition for preparing the tincture, which has a yellow color and a very agreeable odor.

TINCTURA AURANTII RECENTIS, *Br.*—Tincture of Fresh Orange-peel.

Preparation.—Take of Bitter Orange, Rectified Spirit, each a sufficiency. Carefully cut from the orange the colored part of the rind in thin slices, and macerate 6 ounces of this in 18 fl. oz. of the spirit for a week, with frequent agitation. Then pour off the liquid, press the dregs, mix the liquid products, and filter; finally, add sufficient spirit to make 1 pint (Imperial).—*Br.*

Uses.—The tincture of fresh orange-peel contains a larger proportion of the volatile oil and has a more agreeable flavor than that made from the dry rind of the bitter orange. The *dose* is Gm. 4–8 (ʒi–ij).

TINCTURA BELLADONNÆ FOLIORUM, *U. S.*—Tincture of Belladonna-leaves.

Tinctura belladonnæ, U. S. 1880, Br., P. A.—*Tincture of belladonna*, E.; *Teinture de belladone*, Fr.; *Belladonnatinktur*, G.

Preparation.—Belladonna-leaves, in No. 60 powder, 150 Gm.; Diluted Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 200 Cc. of diluted alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of belladonna use 5 av. ozs. of powdered belladonna-leaves, and moisten with 6½ fluidounces of menstruum (diluted alcohol).

The proportions directed by other pharmacopœias are—Belladonna-leaves 1 ounce (av.), proof spirit sufficient for 1 pint (Imperial).—*Br.* Belladonna-leaves 1 part, alcohol (sp. gr. 0.912) 5 parts.—*F. Cod.*

This tincture differs very little in strength from that of the U. S. P. 1880. The color is greenish-brown or brown-green, according to the strength of the alcohol.

Tinctura ætherea belladonnæ. Belladonna-leaves 2 parts, ether 7 parts, alcohol 3 parts.—*F. Cod.*

Uses.—The *dose* of this tincture is about Gm. 0.50 (♏vij), representing 1 grain of the leaves.

TINCTURA BENZOINI, *U. S.*—Tincture of Benzoin.

Tinctura benzoës, P. G.—*Teinture de benjoin*, Fr.; *Benzoëtinktur*, G.; *Tinctura de benjui*, Sp.

Preparation.—Benzoin, in moderately coarse powder, 200 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Mix the powder with 800 Cc. of alcohol, and macerate for seven days in a closed vessel; then filter through paper, adding, through the filter, enough alcohol to make the tincture measure 1000 Cc.—*U. S.*

To make 1 quart of tincture of benzoin macerate 6 av. ozs. and 296 grains of coarsely powdered benzoin with 26 fluidounces of alcohol for seven days and filter; finally wash the filter with sufficient alcohol to obtain 32 fluidounces.

Macerate benzoin 1 part in alcohol 5 parts.—*F. Cod.*, *P. G.*

The tincture is brownish-red, and yields with water a milky mixture having an acid reaction.

Lac virginis—Virgin's milk, *E.;* Lait virginal, *Fr.;* Jungfernmilch, *G.*—is a cosmetic preparation consisting of tincture of benzoin 1 part and rose-water from 20 to 100 parts.

Uses.—The tincture of benzoin was formerly in more general use than at present, both internally and externally. By the former method it was employed in chronic mucous profluvia of the *bronchial* and *urinary organs*, and even in chronic *diarrhœa* and *dysentery;* in the same cases, in short, for which copaiba has more recently been recommended. As a local application by means of the atomizer it may sometimes be administered with benefit in chronic *laryngeal* and *bronchial catarrh*. Externally, it is useful both as a stimulant and a protective for *ulcers*, and even for slight fresh *wounds*. But it is more applicable to irritable and indolent sores, as *bed-sores*, ulcers tending to gangrene, *sore nipples*, *chapped hands* and *lips*, and to slight lesions of the same sort about the *anus*. Mixed with water or rose-water, it may be used to remove *freckles* and slight papular

and other *eruptions*, as well as to preserve the freshness and suppleness of the skin. It is the medicinal ingredient of the usual forms of court plaster, and too often renders this preparation irritating rather than healing. The *dose* of tincture of benzoin is Gm. 2–4 (f℥ss–j).

TINCTURA BENZOINI COMPOSITA, *U. S., Br.*—Compound Tincture of Benzoin.

Tinctura balsamica, F. Cod.; *Balsamum commendatoris, Elixir traumaticum.—Teinture balsamique, Baume du commandeur de Permes*, Fr.; *Persischer Wundbalsam*, G.

Preparation.—Benzoin, in coarse powder, 120 Gm.; Purified Aloes, in coarse powder, 20 Gm.; Storax 80 Gm.; Balsam of Tolu 40 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Mix the benzoin, aloes, storax, and balsam of Tolu with 800 Cc. of alcohol, and digest the mixture, at a temperature not exceeding 65° C. (149° F.), for two hours in a closed vessel; then filter through paper, adding, through the filter, enough alcohol to make the tincture measure 1000 Cc.—*U. S.*

To make 1 quart of compound tincture of benzoin macerate for seven days in 26 fluidounces of alcohol 4 av. ozs. and 152 grains of benzoin, 309 grains of purified aloes, 2 av. ozs. and 359 grains of storax, and 1 av. oz. and 180 grains of balsam of Tolu and filter; finally wash the filter with sufficient alcohol to make 32 fluidounces.

Take of benzoin, in coarse powder, 2 ounces; prepared storax 1½ ounces; balsam of Tolu ½ ounce (av.); Socotrine aloes 160 grains; rectified spirit sufficient for 1 pint (Imperial). Macerate for seven days and filter.—*Br.*

St. Johnswort 2 parts; angelica-root, myrrh, olibanum, and aloes, of each 1 part; balsam of Tolu and benzoin, of each 6 parts; alcohol (spec. grav. 0.863) 72 parts.—*F. Cod.*

The older pharmacopœias had still more complicated formulas.

The tincture is intended to take the place of numerous preparations formerly employed, as *Wade's*, *Vervain's*, *Saint Victor's*, *Jesuits'*, *Friars'*, *Turlington's*, *Persian*, and *Swedish balsam*. It is of a deep red-brown color, and yields with water a reddish-white opaque mixture having an acid reaction.

Uses.—The uses of the compound tincture are essentially the same as those of the simple tincture of benzoin, but the former is in most cases the more efficient of the two. Especially is this true of its use in affections of the air-passages and lesions of the skin. For such ailments it was for centuries in high repute under various names, as friars' balsam, Turlington's balsam, etc., until it was displaced by the influence of doctrinal principles in therapeutics. Those who considered the cure of disease of more consequence than the justification of a doctrine adhered to its use, and the medicine survived the theory. It is needless to particularize all the cases in which this preparation may be beneficially used; they are, as already stated, those mentioned under the head of the simple tincture. The *dose* is Gm. 2–4 (f℥ss–j).

The compound is far more efficient than the simple tincture as an application to the various ulcerative lesions mentioned in the article upon that preparation, and especially to *bed-sores*. After cleansing and drying the sore it should be thoroughly covered with the tincture, over which should be laid two thicknesses of fresh cotton wadding extending far beyond the sore, and the whole supported by a broad bandage. The application is for a short time painful, but it should be removed at intervals of two or more days, care being taken at each dressing to remove any dead tissue that is loose (Woodman).

TINCTURA BRYONIÆ, *U. S.*—Tincture of Bryonia.

Teinture de bryone blanche, Fr.; *Zaunrübentinktur*, G.

Preparation.—Bryonia, recently dried and in No. 40 powder, 100 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 100 Cc. of alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour alcohol upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of bryony use 3 av. ozs. and 148 grains of powdered bryony-root, and moisten with 3¼ fluidounces of the menstruum (alcohol).

This tincture is not recognized by the other pharmacopœias; it has a brown-yellow color, is destitute of any characteristic odor, and has a somewhat bitter taste. Since bryony does not grow in North America, it will be difficult to comply with the pharmacopœial directions of using the "recently-dried" root. The bitter principle, bryonin, is soluble in water: hence diluted alcohol would seem to be an equally effective menstruum.

Uses.—This drastic purgative may be prescribed in *doses* of Gm. 1–4 (♏xv–lx).

TINCTURA BUCHU, *Br.*—Tincture of Buchu.

Teinture de buchu, Fr.; *Buchutinktur*, G.

Preparation.—Take of Buchu-leaves, in No. 20 powder, 2½ ounces (av.); Proof Spirit 1 pint (Imperial). Prepare the tincture by maceration, as described under Tincturæ.—*Br.* Buchu 1 part, alcohol (sp. gr. 0.836) 5 parts.—*F. Cod.*

The first tincture has a greenish-brown, the second a brownish-green, color; both have the odor and taste of the drug.

Uses.—A medicine intended to allay irritated conditions of the urinary passages should seldom be prepared with alcohol, or if it is so it should be administered in a large proportion of water. The convenience of dispensing buchu under certain circumstances may justify this preparation, but on purely therapeutical grounds it is ineligible. The *dose* of the tincture is Gm. 4–8 (fʒj–ʒij).

TINCTURA CALENDULÆ, *U. S.*—Tincture of Calendula.

Tincture of marigold, E.; *Teinture de souci*, Fr.; *Calendulatinktur*, G.

Preparation.—Calendula, in No. 20 powder, 200 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 200 Cc. of alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour alcohol upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of calendula use 6 av. ozs. and 296 grains of powdered calendula, and moisten with 6½ fluidounces of menstruum (alcohol).

This, like Tinctura bryoniæ, is not recognized by other pharmacopœias. It should be remembered that the Pharmacopœia defines calendula to be the fresh flowering herb, and that two cultivated species of Tagetes are likewise popularly known as marigold (see page 377). The intention seems to be that calendula, freshly gathered, should be at once dried, powdered, and converted into tincture.

Uses.—Considering the deobstruent virtues attributed to calendula, alcohol does not appear to be an appropriate vehicle for its administration. The tincture, however, is convenient as an application to *sprains*, *bruises*, etc.

TINCTURA CALUMBÆ, *U. S., Br.*—Tincture of Calumba.

Tinctura colombo.—Teinture de colombo, Fr.; *Kolombotinktur*, G.

Preparation.—Calumba, in No. 20 powder, 100 Gm.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix alcohol and water in the proportion of 600 Cc. of alcohol to 400 Cc. of water, and, having moistened the powder with 100 Cc. of the mixture, macerate for twenty-four hours; then pack it in a cylindrical percolator, and gradually pour menstruum upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of calumba use 3 av. ozs. and 148 grains of powdered calumba, and moisten with 3¼ fluidounces of menstruum (alcohol 2 volumes, water 1 volume).

Columbo 2½ oz. av., proof spirit sufficient for 1 pint (Imperial).—*Br.* Colombo 1 part, alcohol (sp. grav. 0.912) 5 parts.—*F. Cod.*

The tincture has a brown-yellow color, and is much less prone to unsightly precipitation than that of a former pharmacopœia, which was made with diluted alcohol.

Uses.—This tincture possesses all the virtues of calumba, and may be given for the same purposes as that medicine. It is chiefly employed as a stomachic tonic during convalescence from acute diseases and in *feeble states of digestion* from other causes. It may also be added to bitter infusions where a special stimulant action is desired. The *dose* is Gm. 4–8 (fʒj–ij).

TINCTURA CANNABIS INDICÆ, *U. S., Br.*—Tincture of Indian Cannabis.

Tincture of hemp (*Indian hemp*), E.; *Teinture de chanvre de l'Inde*, Fr.; *Indischhanftinktur*, G.

Preparation.—Indian Cannabis, in No. 40 powder, 150 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 150 Cc. of alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour alcohol upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of Indian hemp use 5 av. ozs. of powdered Indian cannabis, and moisten with 5 fluidounces of menstruum (alcohol).

The tincture of the French Codex is apparently of the same strength, but is made with alcohol spec. grav. 0.912, which is too weak a menstruum. The present official formula is nearly identical with that of 1880, the preparation being about one-third as strong as that of the B. P. Good Indian cannabis yields about 12½ per cent. of alcoholic extract; the tincture will therefore contain about 137 grains of extract in the pint. The Pharmacopœia of 1870 ordered 360 grains of extract to the pint.

Extract of Indian hemp 1 oz. av., rectified spirit 1 pint.—*Br.*

Uses.—The tincture of Indian hemp may be employed for the same purposes as the extract of that plant, but is ineligible on account of the precipitation of its resin by water. The primary *dose* is about Gm. 1.30 (♏xx). The variable strength of different specimens of the tincture has occasioned abnormal effects on changing one for another (*Times and Gaz.*, June, 1885, p. 817). It is prudent to begin with a minimum dose and very gradually increase it.

TINCTURA CANTHARIDIS, *U. S., Br., F. Cod.*—Tincture of Cantharides.

Tinctura cantharidum, P. G., P. A.—*Teinture de cantharides*, Fr.; *Spanischfliegentinktur*, G.

Preparation.—Cantharides, in No. 60 powder, 50 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 30 Cc. of alcohol, and pack it firmly in a cylindrical percolator; then gradually pour alcohol upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of cantharides use 1 av. oz. and 293 grains of powdered cantharides, and moisten with 1 fluidounce of menstruum (alcohol).

The proportions directed by other pharmacopœias are—Cantharides ¼ oz. av., proof spirit 1 pint (Imperial).—*Br.* Cantharides 1 part, alcohol 10 parts.—*F. Cod., P. G.*

The tincture has the burning taste and the peculiar odor of cantharides. Made with alcohol, it is of a greenish-yellow color; but diluted alcohol dissolves the dark extractive matter and yields a brown-yellow tincture. The tincture of the U. S. P. 1880 represented in the fluidounce 18.7 grains (the present one 22.8 grains) of cantharides.

Uses.—This preparation is convenient for use in the comparatively rare cases in which cantharides are internally administered. It may be prescribed in doses of Gm. 0.30–1.30 (♏v–xx) and upward until vesical irritation is produced; even smaller doses, such as a drop every hour, may be preferable to larger doses at longer intervals, particularly when the kidneys are diseased. Tincture of cantharides should be administered largely diluted in a mucilaginous vehicle. The external uses of this preparation include numerous cases in which a more prolonged and sustained irritation, amounting sometimes to rubefaction, is required than can be obtained by more active irritants. Although sometimes applied in liniments to the whole surface of the body, it is manifestly less appropriate to such a purpose than stimulants which act more promptly and for a shorter time; its proper use is as a substitutive stimulant in local *torpor, congestions, inflammations*, and *pains*, in *neuralgia* of certain nerves, *alopecia, frost-bite, fistulous ulcers*, etc. The following liniment is used in alopecia: ℞. Cologne-water fʒj; Tincture of Cantharides fʒiss; Tinctures of Rosemary and Lavender, each 10 drops. The scalp should be gently rubbed every day with this lotion, applied on a sponge or piece of flannel.

TINCTURA CAPSICI, *U. S., Br., P. G.*—Tincture of Capsicum.

Teinture de piment des jardins, Fr.; *Spanischpfeffertinktur*, G.

Preparation.—Capsicum, in No. 30 powder, 50 Gm.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix alcohol and water in the proportion of 950 Cc. of alcohol to 50 Cc. of water, and, having moistened the powder with 40 Cc. of the mixture, pack it firmly in a cylindrical percolator; then gradually pour menstruum upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of capsicum use 1 av. oz. and 293 grains of powdered capsicum, and moisten with 1½ fluidounces of menstruum (alcohol 19 volumes, water 1 volume).

Other pharmacopœias direct—Capsicum ¾ ounce (av.), rectified spirit sufficient for 1 pint (Imperial).—*Br.* Capsicum 1 part, alcohol 10 parts.—*P. G.*

The tincture has a light reddish-orange color and the fiery taste of capsicum. Made according to the U. S. P. 1880, a fluidounce of it contained 19 grains (the present tincture 22.8 grains) of capsicum.

Uses.—This tincture can be used for most of the purposes for which capsicum has been recommended, and especially as an addition to gargles, rubefacient liniments, and mixtures intended to stimulate the stomach exhausted by alcoholic excesses. It may be prescribed in *doses* of Gm. 4–8 (f℥j–ij), appropriately diluted.

TINCTURA CARDAMOMI, *U. S.*—Tincture of Cardamom.

Teinture de cardamome, Fr.; *Kardamomentinktur*, G.

Preparation.—Cardamom, in No. 30 powder, 100 Gm.; Diluted Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 100 Cc. of diluted alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of cardamom use 3 av. ozs. and 148 grains of powdered cardamom, and moisten with 3¼ fluidounces of menstruum (diluted alcohol).

It is of a brown-yellow color, and has the aromatic odor and spicy taste of cardamom.

Uses.—The simple is much less used than the compound tincture of cardamom. It may, however, be prescribed as a carminative in the *dose* of Gm. 4–8 (f℥j–ij).

TINCTURA CARDAMOMI COMPOSITA, *U. S., Br.*—Compound Tincture of Cardamom.

Teinture de cardamome composée, Fr.; *Zusammengesetzte Kardamomentinktur*, G.

Preparation.—Cardamom 20 Gm.; Cinnamon 20 Gm.; Caraway 10 Gm.; Cochineal 5 Gm.; Glycerin 50 Cc.; Diluted Alcohol a sufficient quantity; to make 1000 Cc. Mix the cardamom, cinnamon, caraway, and cochineal, and reduce them to a moderately coarse (No. 40) powder. Having moistened the powder with 25 Cc. of diluted alcohol, pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 950 Cc. of tincture are obtained; then add the glycerin, and mix them.—*U. S.*

To make 1 quart of compound tincture of cardamom use 292 grains each of cardamom and cinnamon, 146 grains of caraway, and 73 grains of cochineal; reduce to No. 40 powder, moisten with 7 fluidrachms of diluted alcohol, and percolate with diluted alcohol until 30⅜ fluidounces of tincture have been obtained, to which add 13 fluidrachms of glycerin.

Cardamom-seed, freed from the pericarps, and caraway-fruit, each ¼ ounce; raisins, freed from their seeds, 2 ounces; cinnamon-bark ½ ounce (av.); cochineal 55 grains; proof spirit sufficient for 1 pint (Imperial).—*Br.*

Both tinctures have a red color, due to cochineal, and are of an agreeable aromatic odor and taste.

Uses.—This tincture, on account of its brilliant color and carminative properties, is when mixed with sweetened hot water, a favorite remedy for flatulent *colic*. It is a customary addition to mixtures intended to relieve similar affections. The *dose* is Gm. 4–8 (f℥–ij).

TINCTURA CASCARILLÆ, *Br., P. A.*—Tincture of Cascarilla.

Teinture de cascarille, Fr.; *Kaskarilltinktur*, G.

Preparation.—Take of Cascarilla-bark 2½ oz. av.; proof spirit 1 pint (Imperial). Macerate and finish the tincture by the process described under Tincturæ.—*Br.* Cascarilla 1 part, alcohol (sp. grav. 0.863) 5 parts.—*F. Cod.*

The tincture has a reddish-brown color.

Uses.—Although not generally used in this country, it is not unworthy of being employed in cases requiring a tonic and stimulant operation. It is especially useful in *dyspeptic* gastro-intestinal derangements due to atony, and is beneficially associated in these affections and others with compound tincture of cinchona. The *dose* is from Gm. 2–8 (f℥ss–ij).

TINCTURA CASTOREI, *F. Cod., P. A.*—Tincture of Castor.

Teinture de castoreum, F.; *Bibergeiltinktur*, G.

Preparation.—Take of Castor, in coarse powder, 1 oz. av.; Rectified Spirit 1 pint. Macerate for seven days in a closed vessel, with occasional agitation; strain, press, filter, and add sufficient rectified spirit to make 1 pint (Imperial).—*Br.* 1867.

Macerate 1 part of castor in 10 parts of alcohol (sp. grav. 0.863).—*F. Cod.*, (sp. grav. 0.832, *P. G.* 1882).

The tincture has a deep reddish-brown color, is rendered opalescent by water, and with a larger quantity of water becomes milky, of a dingy brownish-white color, deposits red-brown resinous matter, and on standing becomes nearly colorless and almost transparent; on the addition of excess of ammonia the resin remains undissolved (see page 422).

Tinctura ætherea castorei (Tinctura etereo de castoreo, *Sp.*). Castor 1 part, ether (sp. gr. .724) 7 parts, alcohol 3 parts.—*F. Cod.*

Uses.—Tincture of castor is seldom employed, but in the obligatory variation of medicines used in the treatment of *hysterical disorders* it may occasionally find its place, particularly in enemas. The latter method is peculiarly appropriate when an hysterical attack occurs about the *menstrual period*, with symptoms of utero-ovarian irritation and flatulent distension of the bowels. The ataxic state of *low fevers* may be treated in the same manner, but with less prospect of doing good than by the use of asafetida, valerian, opium, or simply alcohol. *Dose*, from Gm. 2–8 (fʒss–ij).

TINCTURA CATECHU COMPOSITA, *U. S.*—Compound Tincture of Catechu.

Tinctura catechu, Br., P. G.—*Teinture de cachou*, Fr.; *Katechutinktur*, G.

Preparation.—Catechu, in No. 40 powder, 100 Gm.; Cassia Cinnamon, in No. 40 powder, 50 Gm.; Diluted Alcohol a sufficient quantity; to make 1000 Cc. Mix the powders, and, without moistening, pack the mixture firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of catechu use 3 av. ozs. and 148 grains of catechu and 1 av. oz. and 293 grains of cassia-bark.

The formulas of other pharmacopœias direct—Pale catechu 2½ oz. av., cinnamon-bark 1 ounce av., proof spirit sufficient for 1 pint (Imperial).—*Br.* Catechu 1 part, alcohol (sp. grav. 0.912 or 0.894) 5 parts.—*F. Cod.*, *P. G.*, *P. A.*

The tincture has a dark red-brown color, a strongly astringent taste, and an acid reaction; it does not become milky on the addition of water, produces with ferric salts green-black precipitates, and when heated with potassium dichromate becomes brownish-red.

Uses.—Compound tincture of catechu is used internally, chiefly for the purpose of diminishing *diarrhœa*. When the latter affection is acute, the tincture is generally administered in chalk mixture; when chronic, it is often given with port wine. Externally, it is useful as a dressing for indolent *ulcers* of soft tissues, and particularly of the *nipples* and *anus*. Diluted with water, it may be injected into the *rectum* or *vagina* in chronic *fluxes* of those organs. The *dose* is Gm. 2–8 (fʒss–ij).

TINCTURA CHIRATÆ, *U. S., Br.*—Tincture of Chirata.

Tincture of chiretta, E.; *Teinture de chirette*, Fr.; *Chirettatinktur*, G.

Preparation.—Chirata, in No. 40 powder, 100 Gm.; Alcohol, water, each a sufficient quantity; to make 1000 Cc. Mix alcohol and water in the proportion of 650 Cc. of alcohol to 350 Cc. of water. Having moistened the powder with 100 Cc. of the menstruum, macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour menstruum upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of chirata use 3 av. ozs. and 148 grains of chirata, powdered, and moisten with 3¼ fluidounces of menstruum (alcohol 65 volumes, water 35 volumes).

Chiretta, cut small and bruised, 2½ oz. av.; proof spirit 1 pint (Imperial). Prepare the tincture by the process described under Tincturæ.—*Br.*

Uses.—The medicinal qualities of this preparation are closely analogous to those of columbo. It is but little used in this country. *Dose*, Gm. 2–8 (fʒss–ij).

TINCTURA CHLOROFORMI COMPOSITA, *Br.*—Compound Tincture of Chloroform.

Preparation.—Take of Chloroform 2 fluidounces; Rectified Spirit 8 fluidounces; Compound Tincture of Cardamom 10 fluidounces. Mix.—*Br.*

Tinctura chloroformi et morphinæ, *Br.* Dissolve morphine hydrochlorate 8 grains and oil of peppermint 4 minims in rectified spirit 1 fluidounce, and add chloroform 1 fluidounce and ether 2 fluidrachms. Mix liquid extract of liquorice and treacle, each 1 fluidounce, with syrup 3 fluidounces, add this to the above solution; then add diluted hydrocyanic acid ½ fluidounce, and sufficient syrup to make 8 fluidounces.—*Br.*

Allied Preparation.—Mistura chloroformi et opii, N. F.; Mixture of chloroform and opium, Chloroform anodyne. Triturate 240 grains of purified extract of glycyrrhiza with ½ fluidrachm of water and 1 fluidounce of simple syrup; add 128 minims of fluid extract of belladonna-root, 2¾ fluidounces of deodorized tincture of opium, and 1 fluidounce of tincture of capsicum, previously mixed together. Then mix 2 fluidounces of purified chloroform, 16 minims of oil of peppermint, and 2 fluidounces each of tincture of Indian cannabis and tincture of quillaja, and add them to the previous mixture. Finally add enough syrup to make 16 fluidounces, and mix the whole thoroughly together. This mixture should be shaken whenever it is dispensed.

Uses.—This preparation is convenient for administering chloroform as a liquid internally. The *dose* is Gm. 1.30–2.60 (♏xx–xl). It is chiefly used for allaying flatulent, biliary, and renal *colics*, but has also been employed in *delirium tremens* and in *mania-à-potu*.

TINCTURA CIMICIFUGÆ, *U. S.*, *Br.*—Tincture of Cimicifuga.

Tincture of black snakeroot, E.; *Teinture d'actée à grappes*, F.; *Cimicifugatinktur*, G.

Preparation.—Cimicifuga, in No. 60 powder, 200 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 150 Cc. of alcohol, macerate for twenty-four hours, pack firmly in a cylindrical percolator, and with alcohol obtain 1000 Cc. of tincture.—*U. S.*

To make 1 quart of tincture of cimicifuga use 6 av. ozs. and 296 grains of cimicifuga and moisten with 5 fluidounces of menstruum (alcohol).

Cimicifuga in No. 40 powder 2½ oz.; proof spirit sufficient for 20 fl. oz.—*Br.*

Uses.—The tincture of cimicifuga seems to be an unnecessary medicine, since the fluid extract contains all the virtues of the drug in a smaller proportion of alcohol. *Dose*, Gm. 4–12 (f℥j–iij).

TINCTURA CINCHONÆ, *U. S.*, *Br.*—Tincture of Cinchona.

Tinctura cinchonæ flavæ, F. Cod.; *Tinctura chinæ*, P. G.—*Tincture of yellow cinchona*, E.;. *Teinture de quinquina jaune*, Fr.; *Chinatinktur*, G.; *Tintura de quina*, Sp.

Preparation.—Yellow Cinchona, in No. 60 powder, 200 Gm.; Glycerin 75 Cc.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix the glycerin with 675 Cc. of alcohol and 250 Cc. of water, and, having moistened the powder with 200 Cc. of the mixture, macerate for twenty-four hours; then pack it firmly in a cylindrical glass percolator, and gradually pour on the remainder of the mixture. When the liquid has disappeared from the surface, gradually pour on more of the mixture of alcohol and water, using the same proportions as before, and continue the percolation until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of cinchona use 6 av. ozs. and 296 grains of yellow cinchona, and moisten with 6½ fluidounces of the menstruum, glycerin 2½ fluidounces, alcohol 21½ fluidounces, and water 8 fluidounces; continue percolation subsequently with a mixture of alcohol 3 volumes, water 1 volume.

Other pharmacopœias employ—Red cinchona 4 ounces av., proof spirit sufficient for 1 pint (Imperial).—*Br.* Yellow cinchona 1 part, alcohol (sp. grav. 0.912) 5 parts—*F. Cod.* Cinchona containing 3½ per cent. of alkaloids 1 part, alcohol (sp. grav. 0.894) 5 parts.—*P. G.*

The tincture has a red-brown color, and, if not sufficiently strong in alcohol, deposits a sediment of cinchonic red containing kinates of the alkaloids. Mr. A. B. Taylor (1865) found a menstruum composed of 2 measures of alcohol and 1 measure each of water and glycerin capable of preventing this precipitation for several months. The present U. S. P. uses alcohol and water nearly in the same proportion as before, and adds a slightly increased quantity of glycerin.

Uses.—Tincture of cinchona is seldom given alone, but is generally used as an addition to tonic mixtures, infusions, etc., and especially for modifying the taste of solutions of quinine. But for these and all other purposes the compound tincture is preferable. *Dose*, Gm. 4–8 (f℥j–ij).

TINCTURA CINCHONÆ COMPOSITA, *U. S., Br.*—Compound Tincture of Cinchona.

Tinctura chinæ composita, P. G.; *Huxham's tincture of bark*, E.; *Teinture de quinquina composée, Elixir fébrifuge d'Huxam*, Fr.; *Zusammengesetzte Chinatinktur*, G.

Preparation.—Red Cinchona 100 Gm.; Bitter Orange-peel 80 Gm.; Serpentaria 20 Gm.; Glycerin 75 Cc.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix the glycerin with 850 Cc. of alcohol and 75 Cc. of water. Having mixed the cinchona, orange-peel, and serpentaria, reduce them to a fine (No. 60) powder. Moisten the powder with 200 Cc. of the menstruum, and macerate for twenty-four hours; then pack it firmly in a cylindrical glass percolator, and gradually pour on the remainder of the menstruum. When the liquid has disappeared from the surface, gradually pour upon it enough of a mixture of alcohol and water, using the same proportions as before, and continue the percolation until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of compound tincture of cinchona use 3 av. ozs. and 148 grains of red cinchona, 2 av. ozs. and 293 grains. of bitter-orange peel, and 293 grains of serpentaria; moisten with 6½ fluidounces of the menstruum, glycerin 2½ fluidounces, alcohol 27 fluidounces, and water 2½ fluidounces, and continue percolation subsequently with a mixture of alcohol 85 volumes, water 15 volumes.

Red cinchona 2 oz. av.; bitter orange-peel 1 oz. av.; serpentary-root ½ oz. av.; saffron 55 grains; cochineal 28 grains; proof spirit sufficient to obtain 1 pint (Imperial).—*Br.*

The tincture of the German Pharmacopœia is also known as *Elixir roborans Whyttii* (Tintura de corteza de naranjas compuesta, *Sp.*), and is composed of cinchona 6 parts, orange-peel and gentian-root, each 2 parts, Chinese cinnamon 1 part, alcohol (spec. grav. 0.894) 50 parts.

The first formula directs a menstruum containing nearly one-fourth more alcohol than is ordered for the simple tincture of cinchona; the strength of the latter appears to be ample also for the compound tincture. The preparation has a deep red-brown color, an aromatic odor, and a bitter and astringent taste.

Uses.—The one disease—or morbid condition, rather—in which this preparation of cinchona is superior to all others is the *typhoid state*, whatever may be the original affection during which it is developed. In doing good the cinchona is aided by the serpentaria and alcohol of the compound, if not, as was once believed, by the saffron also (*Br. P.*). It should be given in small and repeated *doses* of Gm. 4–8 (f℥j–ij), with 3 or 4 parts of water.

TINCTURA CINNAMOMI, *U. S., Br., F. Cod., P. G., P. A.*—Tincture of Cinnamon.

Teinture de cannelle, Fr.; *Zimmttinktur*, G.; *Tintura de canela*, Sp.

Preparation.—Ceylon Cinnamon, in No. 40 powder, 100 Gm.; Glycerin 50 Cc.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix the glycerin with 750 Cc. of alcohol and 200 Cc. of water. Having moistened the powder with 50 Cc. of the menstruum, pack it in a conical percolator, gradually pour on the balance of the menstruum, and continue percolation with a mixture of alcohol 3 volumes and water 1 volume until 1000 Cc. of tincture have been obtained.—*U. S.*

To make 1 quart of tincture of cinnamon use 3 av. ozs. and 148 grains of Ceylon cinnamon, and moisten with 1½ fluidounces of a mixture of 13 fluidrachms of glycerin, 24 fluidounces of alcohol, and 6⅜ fluidounces of water; finally, percolation should be continued with a mixture of alcohol 3 volumes, water 1 volume.

Ceylon cinnamon 2½ oz. av., proof spirit sufficient for 1 pint (Imperial).—*Br.* Ceylon cinnamon 1 part, alcohol (sp. grav. 0.863) 5 parts.—*F. Cod.* Chinese cinnamon 1 part, alcohol (sp. grav. 0.894) 5 parts.—*P. G.*

The tincture has a red-brown color and a sweetish, warmly aromatic, and somewhat astringent taste. It sometimes gelatinizes when the menstruum becomes too weak in alcohol. This is intended to be overcome by the presence of glycerin and greater alcoholic strength in the official formula.

Uses.—The agreeable taste and slight astringency of this preparation render it a suitable addition to mixtures intended to check recent diarrhœa. It may be added to lime-water to control *nausea* and *vomiting*. *Dose*, Gm. 2–8 (fʒss–ij).

TINCTURA COCCI, *Br.*—Tincture of Cochineal.

Teinture de cochenille, Fr.; *Cochenilletinktur*, G.

Preparation.—Take of Cochineal, in powder, 2½ oz. av.; Proof Spirit 1 pint (Imperial). Macerate for seven days in a closed vessel, with occasional agitation; strain, press, filter, and add sufficient proof spirit to make 1 pint.—*Br.* Cochineal 1 part, alcohol (spec. grav. 0.863) 10 parts.—*F. Cod.*

This tincture has a deep-red color, which is affected by reagents, as described on page 511.

Uses.—It is used exclusively for coloring tinctures, ointments, and mixtures.

TINCTURA COLCHICI SEMINIS, *U. S., Br., P. A.*—Tincture of Colchicum-seed.

Tinctura colchici, P. G.—*Tincture of colchicum*, E.; *Teinture de colchique*, Fr.; *Zeitlosentinktur*, G.; *Tintura de semilla de colchico*, Sp.

Preparation.—Colchicum-seed, in No. 30 powder, 150 Gm.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix alcohol and water in the proportion of 600 Cc. of alcohol and 400 Cc. of water. Having moistened the powder with 100 Cc. of the menstruum, macerate for twenty-four hours; then pack it moderately in a cylindrical percolator, and gradually pour menstruum upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of colchicum-seed use 5 av. ozs. of powdered colchicum-seed, and moisten with 3¼ fluidounces of the menstruum (alcohol 3 volumes, water 2 volumes).

Colchicum-seed 2½ oz. av., proof spirit sufficient for 1 pint (Imperial).—*Br.* Colchicum-seed 1 part, alcohol (sp. gr. 0.912) 5 parts.—*F. Cod.* Colchicum-seed 1 part, alcohol (sp. grav. 0.894) 10 parts.—*P. G.*

That unbroken colchicum-seeds may be completely deprived of colchicine by digestion has been mentioned on page 516; but all the pharmacopœias direct the seeds to be bruised or powdered. The tincture is of a brownish-yellow color, has a bitter taste, and becomes opalescent with water.

Uses.—This tincture possesses the proper virtues of colchicum, and may be used as well as the wine. The difference of alcoholic strength between it and the wine can make no perceptible difference in the effects of such doses as are employed in practice. The *dose* is Gm. 0.60–2 (ɱ x–xxx).

TINCTURA CONII, *Br.*—Tincture of Conium.

Teinture de ciguë, Fr.; *Schierlingstinktur*, G.

Preparation.—Macerate 2½ av. ozs. of finely-comminuted conium-fruit for forty-eight hours in 15 fluidounces of proof spirit in a closed vessel, agitating occasionally; transfer to a percolator, and when the liquid has all drained off pour on 5 ounces of proof spirit. Finally, express the mass, filter, and add enough proof spirit to bring the volume up to 1 pint (Imperial).—*Br.*

The U. S. Pharmacopœia no longer recognizes the tincture: the formula of 1880 directed 150 parts of conium-fruit, in No. 30 powder, to be percolated with diluted alcohol containing 0.4 per cent. of diluted hydrochloric acid until 1000 parts (by weight) of tincture have been obtained.

Uses.—Tincture of conium cannot be regarded as an eligible preparation, inasmuch as the quantity of it capable of producing definite effects contains sufficient alcohol to counteract the sedative action of the conium. It is supplanted by the juice of conium. *Dose*, Gm. 1.30–4 (ɱ xx–lx).

TINCTURA CROCI, *U. S., Br., P. G.*—Tincture of Saffron.

Teinture de safran, Fr.; *Safrantinktur*, G.

Preparation.—Saffron 100 Gm.; Diluted Alcohol a sufficient quantity; to make 1000 Cc. Moisten the saffron with 100 Cc. of diluted alcohol, and macerate for twenty-

four hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of saffron use 3 av. ozs. and 148 grains of saffron, and moisten with 3¼ fluidounces of the menstruum (diluted alcohol).

Saffron 1 oz. av.; proof spirit sufficient for 1 pint (Imperial).—*Br.*

Saffron 1 part. Macerate with 10 parts of alcohol (sp. grav. 0.863, *F. Cod.*) (sp. gr. 0.894, *P. G.*) for ten days; express, and filter.—*F. Cod., P. G.*

The tincture is of a rich orange-yellow color, and has the odor and taste of saffron.

Uses.—Tincture of saffron is rarely given alone internally. It is chiefly employed to impart a pleasing color to mixtures. *Dose*, Gm. 4–8 (f℥j–ij).

TINCTURA CUBEBÆ, *U. S., Br.*—Tincture of Cubeb.

Teinture de cubèbe, Fr.; *Kubebentinktur*, G.

Preparation.—Cubeb, in No. 30 powder, 200 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 100 Cc. of alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour alcohol upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of cubeb use 6 av. ozs. and 296 grains of cubeb, and moisten with 3¼ fluidounces of the menstruum (alcohol).

Powdered cubebs 2½ oz. av., rectified spirit sufficient to obtain 1 pint (Imperial).—*Br.* Powdered cubebs 1 part, alcohol (sp. gr. 0.863) 5 parts.—*F. Cod.*

The U. S. P. has increased the strength of the tincture to nearly double that of 1880, and, very properly, has ordered alcohol in place of diluted alcohol as a menstruum, whereby all the oil and resin can be brought into solution, which was not the case formerly. The tincture has a greenish-brown color, and becomes milky when mixed with water.

Uses.—Tincture of cubeb is chiefly of use in *gleet*, but sometimes also as a carminative. The *dose* is Gm. 2–8 (f℥ss–ij).

TINCTURA DIGITALIS, *U. S., Br., P. G., P. A.*—Tincture of Digitalis.

Teinture de digitale, Fr.; *Fingerhuttinktur*, G.

Preparation.—Digitalis, in No. 60 powder, 150 Gm.; Diluted Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 150 Cc. of diluted alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of digitalis use 5 av. ounces of digitalis-leaves, and moisten with 4½ fluidounces of the menstruum (diluted alcohol).

Digitalis 2½ oz. av., proof spirit sufficient for 1 pint (Imperial).—*Br.* Digitalis 1 part, alcohol (sp. grav. 0.912) 5 parts.—*F. Cod.* Fresh digitalis-leaves 5 parts, alcohol (sp. grav. 0.832) 6 parts.—*P. G.*

The tests given on p. 581 are valuable for determining the quality of digitalis; namely, the infusion made with 30 parts of water should become distinctly turbid with a solution of tannin, and the infusion with 10 parts of water should not yield a precipitate with ferric chloride. The tincture has a brown-green color, the peculiar odor of the leaves, and a bitter taste.

Tinctura ætherea digitalis (Tintura etéro de digital, *Sp.*). Bruised digitalis 1 part, ether (sp. grav. 0.758) 5 parts.—*F. Cod.* It is of a dark-green color.

Uses.—The special virtues of digitalis are possessed by this preparation, which is more used than any other to obtain the action of the drug upon the heart. Its convenience, rather than its superiority to the infusion, has probably led to this custom. Friction of the abdomen and of other parts of the body with tincture of digitalis has sometimes been followed by diuresis in *dropsy*. *Dose*, Gm. 0.60–1.20 (♏x–xx) three times a day. Great care should be taken in obtaining a new parcel of the medicine to learn whether it be of the same strength as that previously used.

TINCTURA ERGOTÆ, *Br.*—Tincture of Ergot.

Tinctura secalis cornuti.—Teinture de seigle ergoté, Fr.; *Mutterkorntinktur*, G.

Preparation.—Take of Ergot, finely comminuted, 5 oz. av.; Proof Spirit 1 pint (Imperial). Prepare the tincture by the process described under Tincturæ.—*Br.*

The tincture has a red-brown color and the odor and taste of ergot.

Uses.—The stimulant action of the alcohol in this preparation probably renders it less eligible than the wine or the fluid extract of ergot. The *dose* is Gm. 0.60–4 (♏ x–f℥j).

TINCTURA FERRI ACETATIS, *Br.*—Tincture of Ferric Acetate.

Tinctura ferri acetici ætherea, P. G.—*Tincture of acetate of iron*, E.; *Teinture d'acétate de fer*, Fr.; *Eisenacetattinktur*, G.

Preparation.—Take of strong solution of acetate of iron 5 fluidounces; acetic acid 1 fluidounce; rectified spirit 5 fluidounces; distilled water 9 fluidounces. Mix, and then add sufficient distilled water to make 20 fluidounces. Preserve in a stoppered bottle. —*Br.*

Solution of ferric acetate 80 parts, alcohol 12 parts, acetic ether 8 parts.—*P. G.*

The former process of double decomposition has been abandoned in the present British Pharmacopœia for a tincture which contains an excess of acetic acid, while that of the P. G. contains a basic salt (see p. 955); the last authority orders also the addition of acetic ether. The solution of ferric acetate, *Br.* (see p. 955), is of the same strength as the tincture, but contains less free acetic acid.

Properties.—This tincture is a clear, dark reddish-brown liquid, transparent in thin layers, having the odor of acetic ether, an acidulous and astringent taste, and a slightly acid reaction. Sp. gr. about 1.044–1.046. It is miscible in all proportions with water, without becoming turbid.—*P. G.* The tincture should be kept in the dark and in a cool place.

A weak tincture or solution of ferric acetate is largely used as a *wood-stain*. Woods containing tannin are thereby colored black, resembling ebony. To produce the same imitation with wood which is free from tannin, this is first soaked in a solution of extract of logwood before it is treated with ferric acetate.

Tests.—The diluted tinctures, after being precipitated by an excess of ammonia, yield a filtrate which should not be precipitated by hydrogen sulphide (zinc, copper), barium chloride (sulphate), or, after having been acidulated with nitric acid, by silver nitrate (chloride); and on being evaporated and ignited should not leave any fixed residue (alkalies, earths).

Uses.—This preparation is reputed by English authorities to be not only an excellent chalybeate for general purposes, but also one of the best of the *styptic* ferruginous preparations for internal administration. It should be given largely diluted with water and taken in small and repeated doses. The *dose* is Gm. 0.20–2 (♏ v–xxx). The acetic-ethereal tincture is convenient in hysterical anæmic cases, but only as an occasional substitute for the more actively reconstituent preparations of iron.

TINCTURA FERRI CHLORIDI, *U. S.*—Tincture of Ferric Chloride.

Tinctura ferri perchloridi, Br.; *Tinctura ferri sesquichloridi—Tincture of perchloride of iron*, *Tincture of chloride of iron*, E; *Teinture de perchlorure de fer*, Fr.; *Eisenchloridtinktur*, G.

A hydro-alcoholic solution of ferric chloride containing about 13.6 per cent. of the anhydrous salt, and corresponding to about 4.7 (4.69) per cent. of metallic iron.—*U. S.*

Preparation.—Solution of Ferric Chloride 250 Cc.; Alcohol a sufficient quantity; to make 1000 Cc. Mix the solution with enough alcohol to make 1000 Cc. Let the tincture stand in a closely-covered vessel at least three months; then transfer it to glass-stoppered bottles, and keep it protected from light.—*U. S.*

Mix strong solution of perchloride of iron 5 fluidounces with rectified spirit 5 fluidounces and distilled water 10 fluidounces.—*Br.*

The two tinctures are practically alike, except that the first contains free hydrochloric acid, and when it is kept on hand for some time, as now directed by the Pharmacopœia, previous to dispensing it, acquires an ethereal odor from the formation of various compounds, resulting from the action upon the alcohol of the free acid, and probably also of the ferric chloride, the latter being reduced to ferrous chloride, more particularly on exposing the tincture to the light. The present Br. P. has reduced the alcohol to one-third the former strength.

Tincture of ferric chloride is perfectly transparent, and has a brown-yellow or bright

brownish color, an agreeable ethereal odor, a strongly astringent, ferruginous taste, and an acid reaction. Its specific gravity is 0.960 at 15° C. (59° F.) (*U. S.*). The tincture behaves to alkalies, potassium ferrocyanide, and silver nitrate like the solution (see page 957). Dr. Robert Battey and Mr. J. C. Wharton (1870) occasionally observed the tincture to deposit white crystals of calcium sulphate, which were probably derived from impurity in the acid. After the tincture has been exposed for some time to daylight it yields a blue or greenish color with potassium ferricyanide, showing the presence of some ferrous salt, due to reduction.

Tests.—Impurities like nitric acid, copper, zinc, alkalies, and ferric oxychloride are detected in the same manner as stated for the salt and the solution (see pp. 719 and 957). In testing for oxychloride the Pharmacopœia directs 8 parts of the tincture to be diluted with 100 parts of distilled water before boiling. If 1.12 (1.1176) Gm. of the tincture be introduced into a glass-stoppered bottle (having a capacity of about 100 Cc.), together with 15 Cc. of water and 2 Cc. of hydrochloric acid, and after the addition of 1 Gm. of potassium iodide the mixture be kept for half an hour at a temperature of 40° C. (104° F.), and then allowed to cool and mixed with a few drops of starch test-solution, it will require about 9.4 Cc. of decinormal sodium thiosulphate solution to discharge the blue or greenish color of the liquid (each Cc. of the volumetric solution consumed indicating 0.5 per cent. of metallic iron)."—*U. S.*

Tinctura ferri chlorati ætherea, *P. G.*, s. Tinctura tonico-nervina Bestuscheffii, s. Liquor anodynus martiatus, s. Spiritus ferri chlorati ætherens. 1 part of solution of ferric chloride spec. grav. 1.282 (containing 19.9 per cent. Fe_2Cl_6) is mixed with alcohol 7 parts and ether 2 parts, the mixture exposed to the sunlight until colorless, and afterward kept in partially filled bottles in a shady place until it has acquired a yellow color. During the bleaching process the ferric is reduced to ferrous chloride, ethyl chloride and a little aldehyde being generated through the influence of the nascent chlorine. On exposure to the air the salt is partly oxidized to ferric oxychloride. This is known as *Bestuscheff's tincture*. It has a warm and ferruginous taste, is precipitated black by ammonia, white by silver nitrate, and blue by both ferrocyanide and ferricyanide of potasium, and contains 1 per cent. of iron. 10 Cc. of this tincture, after being agitated with an equal volume of the solution of potassium acetate, should separate on standing 3 Cc. of ethereal liquid.

Tasteless Tincture of Iron, introduced by M. Creuse (1873), has the ferruginous taste modified by an alkali citrate, the compound formed being analogous in color and taste to the pharmacopœial ferric phosphate and pyrophosphate. The following formula has been adopted by the Amer. Pharm. Assoc., and also the name, Tincture of citrochloride of iron: Mix 4 fluidounces of official solution of ferric chloride with 4 ounces of water, and add 7 troyounces of sodium citrate; apply gentle heat to effect solution. Add 2½ fluidounces of alcohol, and when cold make up the volume to 16 fluidounces with water. If any saline matter should separate after a few days, filter and restore the original volume by passing sufficient water through the filter. (Each fluidrachm of the tincture contains an amount of iron equivalent to about 7½ grains of dry ferric chloride.)

Action and Uses.—Tincture of iron chloride is, of all ferruginous compounds except the solutions of the chloride and of the persulphate, the one that exerts the most powerful local action as a styptic, and indeed as a caustic, upon delicate tissues. Even when largely diluted it constringes the mouth and fauces. A diuretic action is attributed to it, which is probably due to the ether which it contains. It is very apt to attack the teeth unless properly diluted and taken through a tube. One or two cases are reported of strangury caused by its external application.

Like the solution of iron chloride, this preparation may be used as a local styptic, but it is less efficient than the former. It is better suited for internal administration in all cases of passive *hæmorrhage*, and especially in that from the uterus. It is eminently serviceable when hæmorrhage depends upon imperfect coagulability of the blood, associated with a lax condition of the solids and general debility. For these reasons, doubtless, it is very efficient in *purpura hæmorrhagica*. It is probably the best preparation that can be employed in chronic *albuminuria*, although the utility of other ferruginous preparations in the same affection proves that they do not act by their astringency as much as by their reconstituent power in the blood. Indeed, the form in which the tincture is ordinarily given in renal disorders, "Basham's mixture," no longer holds iron as a chloride, but as an acetate. Possibly, the free acids of this preparation act as diuretics. The formula for this solution is as follows: ℞. Tr. ferri chloridi f℥iss; Acid. acetic. dil. f℥j; Liq. ammoniæ acet. f℥ivss; Tr. aurant. cort. f℥iss; Glycerinæ f℥ss.—M. S. A

tablespoonful, largely diluted, two or three times a day. Instead of this preparation, Wyss recommends Bestuscheff's tincture in doses of 5 to 10 drops from three to six times a day. The tincture of the chloride is the best form in which iron can be given in *diabetes*.

In various chronic mucous fluxes, including *leucorrhœa*, *blennorrhœa*, *bronchorrhœa*, *diarrhœa*, and also in passive *sweats*, this preparation is often of essential service, both by its constringing action and its reconstituent operation. It is scarcely less efficient in *vesical catarrh*, especially when it is associated with paralysis of the bladder. Doubtless the double action just indicated renders it an efficient remedy for *seminal losses* due to excessive or unnatural stimulation of the genital organs. To its astringency must probably be ascribed its remarkable efficacy in *idiopathic erysipelas* and its alleged utility in other forms of the same affection. In regard to the first-named disease, the virtues of the medicine are incontestable whenever it is administered in sufficient doses—*i. e.* of Gm. 1.30–2 (gtt. xx–xxx) every two hours, both night and day. In many cases of traumatic erysipelas its utility is equally well established. Applied topically and undiluted, it is said to prevent the spreading of the eruption (Hopadze, *Med. Record*, xix. 364), but this statement may not apply to the idiopathic affection. In *puerperal fever*, an affection which stands in the closest relationship to erysipelas, the power of this medicine has been unequivocally demonstrated (Bell, *Edinburgh Med. Jour.*, xxvi. 50, 74). In *diphtheria* this tincture is one of the most efficient topical applications to the parts on which the exudation is seated, and its internal administration in appropriate doses, such as from Gm. 0.30–1 (5 to 15 drops) every half hour or hour, has produced better results than any other medicine. When thus administered the more special topical use of the medicine may be dispensed with (*Boston Med. and Surg. Jour.*, July, 1881, p. 58). As an application to *chilblains* it is sometimes used, and it is one of the many articles recommended as applications in *poisoning* by Rhus toxicodendron, and it has been vaunted (*Brit. Med. Jour.*, Sept. 4, 1886) as a remedy for *whooping cough*. It has also been employed, in large and repeated doses, in acute articular *rheumatism*, but, while the results show that it is tolerated in most instances, and appears to be beneficial in a small proportion of mild cases, yet the proportion of cardiac complications occurring during its administration seems to have been unusually large.

This tincture may be applied in the same manner as the solution of chloride of iron for arresting *hæmorrhage*, whether external or internal. It may be inhaled as an atomized solution in cases of pulmonary hæmorrhage. For the latter purpose a solution of 1 part of the tincture to 10 parts of water may be used.

The *dose* of this medicine is from Gm. 0.60–2 (gtt. x–xxx), largely diluted with water. The astringency can be nullified by a solution of sodium bicarbonate or citrate. But the preparation is thereby deprived of one of its distinctive virtues. Syrup also tends to protect the teeth from free acid in the compound.

Bestuscheff's tincture has long been used as an agreeable nervine tonic in *chlorosis* attended with nervous symptoms.

TINCTURA GALLÆ, *U. S.*, *Br.*—Tincture of Nutgall.

Tinctura gallarum, P. G., P. A.—*Tincture of galls*, E.; *Teinture de noix de galle*, Fr.; *Galläpfeltinktur*, G.

Preparation.—Nutgall, in No. 40 powder, 200 Gm.; Glycerin 100 Cc.; Alcohol a sufficient quantity; to make 1000 Cc. Mix the glycerin with 900 Cc. of alcohol, and, without moistening the powder, pack it in a conical glass percolator; then gradually pour upon it, first, the remainder of the mixture, and afterward alcohol, until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of nutgall use 6 av. ozs. and 296 grains of powdered galls, percolate with a mixture of 3¼ fluidounces of glycerin and 28¾ fluidounces of alcohol, and continue percolation with alcohol until 32 fluidounces of tincture have been obtained.

Nutgall 2½ oz. av., proof spirit sufficient for 1 pint (Imperial).—*Br.* Macerate nutgall 1 part with 5 parts of alcohol spec. grav. 0.912 (*F. Cod.*). (sp. grav. 0.894, *P. G.*).

Nutgall yields over 60 per cent., or 20 parts yield at least 12 parts, of extract. The addition of glycerin is intended to retard the formation of gallic acid. The tincture has a yellowish-brown color, a strongly astringent taste, and an acid reaction, and yields blue-black precipitates with ferric salts.

Uses.—Tincture of nutgall is seldom given internally, but is sometimes used, diluted with water, as a lotion in relaxed conditions of the *mouth* and *fauces*, of the *rectum*, and of the *vagina*. *Dose*, from Gm. 2–8 (ʒss–ij).

TINCTURA GELSEMII, *U. S., Br.*—Tincture of Gelsemium.

Teinture de gelsemium, Fr.; *Gelsemiumtinktur*, G.

Preparation.—Gelsemium, in No. 60 powder, 150 Gm.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix alcohol and water in the proportion of 650 Cc. of alcohol to 350 Cc. of water. Having moistened the powder with 100 Cc. of the menstruum, macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour menstruum upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of gelsemium use 5 av. ozs. of gelsemium, and moisten the powder with 3¼ fluidounces of the menstruum (alcohol 65 volumes, water 35 volumes).

The tincture is of a brown-yellow color, becomes milky with water, and has the aromatic odor and bitter taste of the drug. A somewhat weaker alcohol, spec. grav. 0.912, ordered by the French Codex for preparing *extract of gelsemium*, appears to be too aqueous for conveniently exhausting all the desirable principles. The Br. P. orders gelsemium 2½ ounces, proof-spirit 20 fluidounces.

Uses.—This preparation represents all the virtues and all the dangers of gelsemium. It may be prescribed in *doses* of Gm. 0.60 (ℳ x), and gradually increased.

TINCTURA GENTIANÆ COMPOSITA, *U. S., Br.*—Compound Tincture of Gentian.

Preparation.—Gentian, 100 Gm.; Bitter Orange-peel, 40 Gm.; Cardamom, 10 Gm.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix the gentian, orange-peel, and cardamom, and reduce the mixture to a moderately coarse (No. 40) powder. Mix alcohol and water in the proportion of 600 Cc. of alcohol and 400 Cc. of water. Having moistened the powder with 100 Cc. of menstruum, macerate for twenty-four hours; then pack it in a cylindrical percolator, and gradually pour menstruum upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of compound tincture of gentian use 3 av. ozs. and 148 grains of gentian, 1 av. oz. and 246 grains of bitter orange-peel, and 146 grains of cardamom, and moisten the mixed powders with 3¼ fluidounces of the menstruum (alcohol 6 volumes, water 4 volumes).

The British Pharmacopœia prepares 1 pint (Imperial) of tincture from gentian 1½ ounces, bitter orange-peel ¾ ounce, and ¼ ounce (av.) of cardamom-seeds deprived of the pericarps, using sufficient proof-spirit.

The tincture has a brown-yellow color, an agreeable aromatic odor, and a bitter taste. It acquires with ferric salts a dark black-brown color.

Allied Tinctures.—Tinctura gentianæ alkalina.—Teinture de gentiane alcaline (stomachique). Elixir amèr de Peyrylhe, *F. Cod.*—Gentian 10 parts, crystallized sodium carbonate 3 parts, alcohol (sp. grav. 0.912) 300 parts.

Tinctura gentianæ.—Tincture of gentian, *E.*; Teinture de gentiane, *Fr.*; Enziantinktur, *G.*—Macerate gentian 1 part in 5 parts of alcohol spec. grav. 0.912 (*F. Cod.*), (sp. grav. 0.894, *P. G.*).

Uses.—This tincture is a very agreeable bitter and an efficient stomachic in cases of *feeble digestion*. It is especially adapted to improve the tone of the stomach exhausted by the abuse of alcoholic drinks. The *dose* is Gm. 4–8 (fʒj–ij). The addition of sodium bicarbonate to a watery dilution of the officinal tincture is preferable to the tincture of the Fr. Codex.

TINCTURA GUAIACI, *U. S., P. A.*—Tincture of Guaiac.

Teinture de résine de gayac, Fr.; *Guajaktinktur*, G.

Preparation.—Guaiac, in coarse powder, 200 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Mix the powder with 800 Cc. of alcohol, and macerate for seven days in a closed vessel; then filter through paper, adding, through the filter, enough alcohol to make the tincture measure 1000 Cc.—*U. S.*

To make 1 quart of tincture of guaiac use 6 av. ozs. and 296 grains of guaiac resin, macerate with 25½ fluidounces of alcohol for seven days, and after filtering wash the filter with sufficient alcohol to make 32 fluidounces of tincture.

Since guaiac resin dissolves completely in alcohol with the exception of the impurities, the tincture is conveniently made by maceration. The tincture has been dismissed from

the German Pharmacopœia; that of the French Codex (1 part resin to 5 parts alcohol, sp. gr. 0.863) is weaker. The tincture has a dark brownish-red color, is precipitated by water, and is colored green or blue by ferric chloride and other agents.

Allied Tincture.—Tinctura guaiaci ligni.—Tincture of guaiacum-wood, *E.;* Teinture de gayac, *Fr.*—Macerate for ten days guaiacum-wood 10 parts in alcohol (spec. grav. 0.912) 50 parts; express and filter.—*Fr. Cod.*

Uses.—The tincture may be used in most of the cases to which other preparations of guaiacum are adapted, but especially in chronic fibrous *rheumatism* and in scanty or painful *menstruation.* It has been especially recommended in *tonsillitis.* The ammoniated tincture is in general to be preferred, and may be employed as a *gargle* in the proportion of 1 fluidrachm to 2 fluidounces of water. Both tinctures, being decomposed by water, should be administered internally in mucilage or syrup. *Dose,* Gm. 4–8 (f℥j–ij) several times a day.

TINCTURA GUAIACI AMMONIATA, *U. S., Br.*—Ammoniated Tincture of Guaiac.

Teinture de gayac ammoniacale, Fr.; *Ammoniakalische Guajaktinktur,* G.

Preparation.—Guaiac, in coarse powder, 200 Gm.; Aromatic Spirit of Ammonia a sufficient quantity; to make 1000 Cc. Mix the powder with 800 Cc. of aromatic spirit of ammonia, and macerate for seven days in a closed vessel; then filter through paper, adding, through the filter, aromatic spirit of ammonia until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of ammoniated tincture of guaiac macerate 6 av. ozs. and 296 grains of guaiac resin with 25½ fluidounces of aromatic spirit of ammonia for seven days, and after filtering wash the filter with sufficient menstruum to make 32 fluidounces of tincture.

Guaiacum resin in powder 4 oz. av., aromatic spirit of ammonia sufficient for 1 pint (Imperial).—*Br.*

The two formulas yield practically identical tinctures, which resemble tincture of guaiac in appearance, but have an ammoniacal odor and taste.

Allied Tincture.—Dewees's Tincture of Guaiacum. Digest for a few days powdered guaiacum resin 4 ounces, sodium or potassium carbonate 90 grains, powdered pimento 1 ounce, in diluted alcohol 1 pint. Add spirit of ammonia, if required, in the proportion of 1 or 2 drachms to each 4 fluidounces of the tincture.

Uses.—The uses of this preparation are the same as those of the simple tincture. It may be applied locally in *tonsillitis* by means of a brush. The ammonia it contains may possibly promote the curative effects of the resin. At all events, the ammoniated tincture is generally preferred. *Dose,* Gm. 4–8 (f℥j–ij).

Dewees claimed that in idiopathic *amenorrhœa* of long standing he had for more than forty years almost daily used the preparation which bears his name, without its having failed in any case proper for its use. He prescribed a teaspoonful of it three times a day in a wine-glassful of milk or white wine.

TINCTURA HUMULI, *U. S.*—Tincture of Hops.

Tinctura lupuli, Br.; *Teinture de houblon,* Fr.; *Hopfentinktur,* G.

Preparation.—Hops, well dried and in No. 20 powder, 200 Gm.; Diluted Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 400 Cc. of diluted alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of hops use 6 av. ozs. and 296 grains of well-dried hops, and moisten with 12 fluidounces of the menstruum (diluted alcohol).

The British tincture of hop is about one-third weaker, and is made from 2½ ounces av. of hop, with sufficient proof-spirit to obtain 1 pint (Imperial).

Hops should not be dried by artificial heat; when air-dry, they may be conveniently reduced to powder by grinding them together with some clean sand in an ordinary drug-mill; when unground, they are unsuited for percolation, and so bulky that in preparing the tincture by maceration most of the liquid is absorbed, necessitating the frequent agitation of the mixture and afterward its forcible expression. The tincture is of a yellow-

ish-brown color, and has the odor and bitter taste of hop, though in less degree than the tincture of lupulin, which has been dismissed from the Pharmacopœia.

Uses.—The proportion of hops or of lupulin in the average dose of this tincture is too small to produce much effect beyond that of the alcohol it contains. A draught of good malt liquor would generally be preferable. The *dose* is Gm. 4–12 (fʒj–iij).

TINCTURA HYDRASTIS, *U. S., Br. Add.*—Tincture of Hydrastis.

Teinture de hydrastis, Fr.; *Hydrastistinktur*, G.

Preparation.—Hydrastis, in No. 60 powder, 200 Gm.; Diluted Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 150 Cc. of diluted alcohol, and macerate for twenty-four hours; then pack it in a cylindrical percolator, and gradually pour diluted alcohol upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of hydrastis moisten 6 av. ozs. and 296 grains of hydrastis in powder with 5 fluidounces of diluted alcohol, and percolate with the same menstruum after due maceration.

Hydrastis rhizome, in No. 60 powder, 2 ounces, proof-spirit sufficient to make 1 pint (Imperial) of tincture.—*Br. Add.*

The tincture has a brown-yellow color and bitter taste. A menstruum of alcohol 2 volumes and water 1 volume would, we think, materially improve the preparation.

Uses.—Probably this tincture fully represents hydrastis. Its *dose* is yet to be determined, but provisionally may be stated at Gm. 4 (fʒj).

TINCTURA HYOSCYAMI, *U. S., Br.*—Tincture of Hyoscyamus.

Teinture de jusquiame, Fr.; *Bilsenkrauttinktur*, G.

Preparation.—Hyoscyamus, recently dried and in No. 60 powder, 150 Gm.; Diluted Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 150 Cc. of diluted alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of hyoscyamus use 5 av. ozs. of hyoscyamus-leaves, and moisten with 5 fluidounces of the menstruum (diluted alcohol).

Hyoscyamus-leaves, in coarse powder, 2½ oz. av., proof-spirit sufficient for 1 Imperial pint.—*Br.* Hyoscyamus 1 part, alcohol (sp. grav. 0.912) 5 parts.—*F. Cod.*

The tincture is greenish-brown, and has the narcotic odor of the leaves and a bitter taste.

Uses.—The tincture is generally believed to contain all the virtues of hyoscyamus, and is directed to be given in the *dose* of Gm. 2–4 (fʒss–j). But, according to Mr. Boulter's experiments (*St. Bartholomew's Reports*, xv. 224), the tinctures of the leaves and seeds are practically quite useless, although they occasion some dilatation of the pupils and render the pulse weak, irregular, and intermittent. The tincture of the root, on the other hand, in doses of from ½ to 2 fluidrachms, produced dryness of the mouth and fauces, dilated pupils, with thirst, flushed face, cracked lips, and sometimes delirium. A woman who swallowed about 6 drachms of the tincture (B. P.), soon followed by emetics, presented these symptoms, besides paresis of the limbs. On the following day recovery was complete (*Brit. Med. Jour.*, Sept. 12, 1889).

TINCTURA IODI, *U. S., Br., F. Cod., P. G., P. A.*—Tincture of Iodine.

Tinctura iodinii.—Teinture d'iode, Fr.; *Jodtinktur*, G.; *Tintura de Yodo*, Sp.

Preparation.—Iodine 70 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Triturate the iodine rapidly in a mortar to a coarse powder, and transfer it at once to a graduated bottle. Rinse the mortar with several successive portions of alcohol, and pour the rinsings into the bottle. Then add enough alcohol, shaking the bottle occasionally until the iodine is dissolved and the finished tincture measures 1000 Cc.—*U. S.*

To make 1 quart of tincture of iodine dissolve 2 av. ozs. and 147 grains of iodine in sufficient alcohol to obtain 32 fluidounces of solution.

Iodine ½ oz. av., potassium iodide ½ oz. av., rectified spirit 1 pint (Imperial).—*Br.* Iodine 1 part, alcohol (spec. grav. 0.833) 12 parts. *F. Cod.* (10 parts. *P. G.*).

The tincture has a deep brown-red color and the odor of iodine, evaporates completely without leaving any fixed residue (that of Br. P. leaves KI), and yields a precipitate of

iodine on being mixed with water. The iodine gradually reacts with alcohol at ordinary temperatures, and more rapidly at a somewhat elevated temperature, resulting in the formation of hydriodic acid and other compounds, which prevent the precipitation by water of some of the iodine. According to Guibourt, after the tincture has been kept on hand for about eighteen months it is scarcely rendered turbid by water. The tincture should therefore be made in moderate quantities only, or, according to Castelhaz (1882), may be preserved of proper strength by the addition of ½ of 1 per cent. of potassium iodate, which salt is insoluble in alcohol and regenerates iodine from the hydriodic acid formed; at the same time, however, a corresponding quantity of iodate is converted into iodide; $KIO_3 + 6HI$ yields $3I_2 + KI + 3H_2O$. According to Pavesi (1883), chloral hydrate dissolves in tincture of iodine without decomposition, and renders it miscible with water without precipitation. The tincture should be kept in well-stoppered bottles to prevent the evaporation of alcohol.

Tests.—"6.33 Gm. of the tincture, mixed with a solution of 2 Gm. of potassium iodide in 25 Cc. of water and a little gelatinized starch, should require for complete decoloration 35 Cc. of decinormal sodium thiosulphate solution."—*U. S.* This test indicates 7 Gm. of iodine in 100 Cc., and is perfectly correct for the freshly-prepared tincture, but entirely too rigorous for that which has been kept on hand for some time. The same test has been adopted by the P. G.; but, while the freshly-made tincture contains 9.09 per cent. of free iodine, the tincture is regarded as being of good quality if the iodine has been reduced to 8.78 per cent. The French Codex directs the tincture to be recently made, without further indicating the limit of time.

Allied Tinctures.—Tinctura iodi decolorata, N. F., Decolorized tincture of iodine.—Digest 610 grains each of iodine and sodium thiosulphate with 1½ fluidounces of distilled water at a gentle heat until a perfect solution is obtained. Then add 2 fluidounces of alcohol, and afterward 1 fluidounce of stronger ammonia-water. Shake until the liquid has become colorless; cool and add enough alcohol to make 16 fluidounces. Set aside in a cold place for a few hours and filter. The solution contains ammonium iodide, ethyl iodide, C_2H_5I, triethylamine hydriodide, $N(C_2H_5)_3HI$, together with sodium iodide, sulphate, and tetrathionate: a crystalline precipitate of the latter salt is apt to form upon standing for some time. It has an ethereal, freely ammoniacal odor. A less complex solution is obtained by the formula of Dr. Curtman (1869): iodine 10 drachms, alcohol 13 fluidounces, stronger ammonia-water 3 fluidounces. But about twenty-seven days are required to effect complete decoloration.

Tinctura iodi (*Churchill*), N. F., Churchill's tincture of iodine.—Dissolve 240 grains of potassium iodide in 4 ounces of distilled water, add 1200 grains of iodine, and, lastly, enough alcohol to make the tincture measure 16 fluidounces. (Churchill's tincture of iodine must not be confounded with Churchill's iodine caustic. See Liquor iodi causticus, page 970.)

Tinctura iodinii composita, *Compound tincture of iodine.* Dissolve iodine 240 grains and potassium iodide 480 grains in alcohol 1 pint.—*U. S.* 1870. This tincture resembles the simple tincture of iodine in appearance, but differs from it in being miscible with water without causing precipitation. The British *Tinctura iodi* likewise contains potassium iodide, but in insufficient quantity to prevent its precipitation by water, at least when recently made.

Uses.—These are set forth at length under Iodum. This preparation is unsuited for internal administration, since the addition of water precipitates its iodine. The *dose* of the simple tincture is stated to be Gm. 0.30–1 (♏ v–xv).

Decolorized tincture of iodine is, as above pointed out, no longer a tincture of iodine, and is practically of no more value as a local discutient than a solution of iodide of sodium or ammonium in water.

The compound tincture (1870) is not precipitated by water, and is also more permanent than the simple tincture, as well as less irritating and more absorbable. It is greatly to be preferred for internal use. The *dose* is Gm. 0.60–2 (gtt. x–xxx), largely diluted with water or some mild liquid.

TINCTURA IPECACUANHÆ ET OPII, *U. S.*—Tincture of Ipecac and Opium.

Preparation.—Deodorized Tincture of Opium 1000 Cc.; Fluid Extract of Ipecac 100 Cc.; Diluted Alcohol a sufficient quantity; to make 1000 Cc. Evaporate the deodorized tincture of opium on a water-bath until it weighs 800 Gm. When it has become cold add to it the fluid extract of ipecac; filter the mixture and pass enough diluted alcohol through the filter to make the tincture measure 1000 Cc.

To make 1 quart of tincture of ipecac and opium evaporate 32 fluidounces of deodorized tincture of opium down to 25 fluidounces, and when cold add 3 fluidounces and 96

minims of fluid extract of ipecac; filter and pass enough diluted alcohol through the filter to make 32 fluidounces.

This tincture has been admitted into the Pharmacopœia to take the place of similar preparations which have been used to some extent under the designation of *tincture of Dover's powder.*

Uses.—The virtues of this preparation, which is apparently intended to present Dover's powder in a liquid form, are not very evident. If, as generally has been supposed, the gradual solution and absorption of the opium and ipecac in that preparation has much to do with its diaphoretic operation, then in the liquid form the object is less likely to be attained. And it is difficult to understand why an extemporaneous mixture of deodorized tincture of opium and wine of ipecac would not have answered the same purpose as this officinal formula.

TINCTURA JALAPÆ, *Br.*—Tincture of Jalap.

Teinture de jalap, Fr.; *Jalapentinktur*, G.

Preparation.—Macerate and displace coarsely-powdered jalap 2½ oz. av. with sufficient proof-spirit to obtain 1 pint (Imperial).—*Br.*

Jalap 1 part, alcohol (sp. grav. 0.912) 5 parts.—*F. Cod.*

Uses.—This tincture is seldom used except as an addition to other purgative liquids. The *dose* is Gm. 2–8 (f℥ss–ij).

TINCTURA KINO, *U. S., Br.*—Tincture of Kino.

Teinture de kino, Fr.; *Kinotinktur*, G.

Preparation.—Kino 100 Gm.; Glycerin 150 Cc.; Water 200 Cc.; Alcohol a sufficient quantity; to make 1000 Cc. Mix the glycerin with the water and 650 Cc. of alcohol. Rub the kino in a mortar, adding gradually a sufficient quantity of menstruum until a smooth paste is made; transfer this to a bottle, add the remainder of the menstruum, and macerate for twenty-four hours, occasionally shaking the bottle; then filter through paper, adding, through the filter, enough alcohol to make the tincture measure 1000 Cc. Keep the tincture in well-stoppered bottles.—*U. S.*

To make 1 quart of tincture of kino use 3 av. ozs. and 148 grains of kino, 4¾ fluidounces of glycerin, 6⅜ fluidounces of water, and sufficient alcohol to make 32 fluidounces.

Kino in coarse powder 2 ounces; glycerin 3 fluidounces; distilled water 5 fluidounces; rectified spirit 12 fluidounces. Macerate for seven days in a closed vessel, with occasional agitation; filter and add sufficient alcohol to make 1 pint (Imperial).—*Br.*

Macerate for ten days kino 1 part with alcohol (sp. grav. 0.913) 5 parts, and filter.—*F. Cod.*

Tincture of kino is conveniently prepared by maceration, and has a dark brown-red color. Made with alcohol and properly preserved, it will remain limpid, but if made with diluted alcohol it will gradually lose its astringency and become gelatinous. According to P. P. Fox (1877), this may be prevented, without increasing the alcoholic strength, by replacing one-half of the water with an equal measure of glycerin—a fact noticed by Haselden as early as 1860; and this is substantially the process adopted by the present U. S. Pharmacopœia. The employment of magnesia, logwood, and other foreign substances with the same end in view is objectionable and unnecessary. The origin of kino, and probably also its age, may influence the tendency to gelatinize.

In our experience tincture of kino keeps remarkably well if preserved in small vials, so as to avoid frequent exposure to the air: we have kept the tincture in well-corked 2-ounce vials for over a year without observing the slightest change.

Uses.—This tincture is used for most of the internal purposes of kino in the *dose* of Gm. 4–8 (f℥j–ij).

TINCTURA KRAMERIÆ, *U. S., Br.*—Tincture of Krameria.

Tinctura ratanhiæ, P. G., P. A.—*Tincture of rhatany*, E.; *Teinture de ratanhia*, Fr.; *Ratanhiatinktur*, G.

Preparation.—Krameria, in No. 40 powder, 200 Gm.; Diluted Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 200 Cc of diluted alcohol, and macerate for twenty-four hours; then pack it in a cylindrical percolator, and gradually pour diluted alcohol upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of rhatany use 6 av. oz. and 296 grains of krameria, and moisten with 6½ fluidounces of the menstruum (diluted alcohol).

Rhatany 2½ oz. av., proof spirit sufficient for 1 pint (Imperial).—*Br.* Macerate rhatany 1 part in 5 parts of alcohol sp. grav. 0.912, *F. Cod.* (sp. grav. 0.894, *P. G.*).

This tincture has a brown-red color and a strongly astringent taste. After having been kept in partly-filled bottles it deposits rhatany-red, and occasionally gelatinizes. It is therefore best prepared in small quantities. In our experience tincture of rhatany keeps very much better if the menstruum contains about one-eighth of its volume of glycerin.

Uses.—This is the form in which rhatany is perhaps more frequently used than any other astringent in the treatment of subacute *diarrhœa*. For this purpose it is usually added to the chalk mixture. Diluted with water, it forms a very useful mouth-wash when the *gums* are spongy. It has also been reputed serviceable in atonic *menorrhagia* and in other forms of passive *hæmorrhage*. The *dose* is Gm. 4–8 (fʒj–ij).

TINCTURA LACTUCARII, *U. S.*—Tincture of Lactucarium.

Teinture de lactucarium, Fr.; *Lactucariumtinktur*, G.

Preparation.—Lactucarium, 500 Gm.; Glycerin 250 Cc.; Water, Alcohol, Benzin, Diluted Alcohol, each a sufficient quantity; to make 1000 Cc. Beat the lactucarium, in an iron mortar, with clear sand, to a coarse powder, and introduce it into a bottle; add 2000 Cc. of benzin, tightly cork the bottle, and set it aside for forty-eight hours, frequently agitating the mixture. Pour the mixture on a double filter, and allow it to drain. Wash the dregs by gradually adding 1500 Cc. of benzin. Allow the lactucarium to dry by exposing it to a current of air. When it is dry reduce it to a powder, using more sand if necessary, and pack it moderately in a conical percolator. Mix the glycerin with 200 Cc. of water and 500 Cc. of alcohol, and moisten the powder with 500 Cc. of the mixture. When the liquid begins to drop from the percolator, close the lower orifice, and, having closely covered the percolator, macerate for twenty-four hours. Then allow the percolation to proceed very slowly, gradually adding, first, the remainder of the menstruum, and then diluted alcohol, until the lactucarium is exhausted. Reserve the first 750 Cc. of the percolate, evaporate the remainder on a water-bath at a temperature not exceeding 71° C. (160° F.) to 250 Cc., and mix with the reserved portion. Filter, and add enough diluted alcohol through the filter to make the product measure 1000 Cc. —*U. S.*

To make 1 quart of tincture of lactucarium reduce 16 av. ozs. and 303 grains of lactucarium to a coarse powder with sand, treat with 4 pints of benzin for forty-eight hours, filter, and wash dregs well with 3 pints of benzin. Dry the residue in air, reduce to powder, and percolate as directed above, using first a mixture of 8 fluidounces of glycerin, 6½ fluidounces of water, and 16 fluidounces of alcohol, and, finally, diluted alcohol; reserve the first 24 fluidounces of percolate, and evaporate the balance down to 8 fluidounces. Mix and filter.

Since tincture of lactucarium is intended chiefly for the preparation of the syrup, it is desirable that a liquid be obtained which shall give a clear mixture with syrup, and as lactucarium contains objectionable inert matter in the form of caoutchouc, the treatment with benzin (suggested by Lemberger in 1875) is directed for its removal. The subsequent percolation of the powder mixed with sand presents no difficulty, as the active bitter principles are soluble in the menstruum ordered, but the percolate should be collected in very slow drops. Each Cc. of the tincture represents 0.5 Gm. of the drug.

Uses.—This alcoholic preparation of lactucarium is quite as valueless and more objectionable than the syrup of the same drug.

TINCTURA LARICIS, *Br.*—Tincture of Larch.

Teinture d'écorce de mélèze, Fr.; *Lärchenrindentinktur*, G.

Preparation.—Take of Larch-bark, in No. 40 powder, 2½ oz. av.; Rectified Spirit 1 pint. Prepare 1 pint (Imperial) of tincture by the formula given under Tincturæ.—*Br.*

This tincture has a red-brown color, and should be carefully preserved like other astringent tinctures.

Uses.—Tincture of larch-bark is not employed in this country. It has been used in England as a remedy for passive *hæmorrhages*, *purpura*, and *chronic bronchitis*. The *dose* is Gm. 1.30–2 (♏xx–xxx).

TINCTURA LAVANDULÆ COMPOSITA, *U. S., Br.*—Compound Tincture of Lavender.

Spiritus lavandulæ compositus.—Compound spirit of lavender, Lavender drops, E.; *Teinture de lavande composée*, Fr.; *Zusammengesetzte Lavendeltinktur*, G.

Preparation.—Oil of lavender 8 Cc.; Oil of Rosemary 2 Cc.; Cinnamon, in coarse powder, 20 Gm.; Cloves 5 Gm.; Nutmeg 10 Gm.; Red Saunders, in coarse powder, 10 Gm.; Alcohol 700 Cc.; Water 250 Cc.; Diluted Alcohol a sufficient quantity; to make 1000 Cc. Dissolve the oils in the alcohol and add the water. Crush the nutmeg in a mortar, mix it with the cinnamon, cloves, and red saunders, and reduce the mixture by grinding to a coarse (No. 20) powder. Moisten the mixture with a sufficient quantity of the alcoholic solution of the oils, pack it firmly in a cylindrical percolator, gradually pour upon it the remainder of the alcoholic solution and afterward sufficient diluted alcohol, until 1000 Cc. of the tincture are obtained.—*U. S.*

To make 1 quart of compound tincture of lavender use 292 grains of cassia cinnamon, 73 grains of cloves, 146 grains each of nutmeg and red saunders, 120 minims of oil of lavender-flowers, 30 minims of oil of rosemary, 23 fluidounces of alcohol, 7½ fluidounces of water, and diluted alcohol a sufficient quantity.

Take of oil of lavender 1½ fluidrachms; oil of rosemary 10 minims; cinnamon-bark, bruised, nutmeg, bruised, each 150 grains; red sandal-wood 300 grains; rectified spirit 2 pints (Imperial). Macerate the cinnamon, nutmeg, and red sandal-wood in the spirit for seven days in a closed vessel, with occasional agitation; then strain and press, dissolve the oils in the strained tincture, filter, and add sufficient rectified spirit to make 2 pints. —*Br.*

The tincture of the first formula is stronger in volatile oils and aromatics than that made by the British formula. Both have a red color, form opalescent mixtures with water, and, if prepared from good materials, have an agreeable odor and a strong but pleasant aromatic taste.

Uses.—Of the numerous ingredients in this popular and useful compound, oil of lavender, except by its disproportionate quantity, is one of the least active and efficient. It is universally employed in this country as a domestic cordial remedy for *nausea, flatulent colic*, and gastric distress after food. It is most conveniently administered on a lump of sugar or in a little hot and sweetened water. The *dose* is Gm. 2–4 (ʒss–j).

TINCTURA LIMONIS, *Br.*—Tincture of Lemon-peel.

Teinture de zeste de citron (limon), Fr.; *Citronenschalentinktur*, G.

Preparation.—Take of Fresh Lemon-peel, sliced thin, 2½ oz. av.; Proof Spirit 1 pint. Macerate for seven days in a closed vessel, with occasional agitation; strain, press, and filter; then add sufficient proof spirit to make 1 pint (Imperial).—*Br.*

Uses.—Tincture of lemon-peel is used for flavoring mixtures, etc. *Dose*, Gm. 4 (fʒj).

TINCTURA LOBELIÆ, *U. S., Br., P. G., P. A.*—Tincture of Lobelia.

Teinture de lobélie enflée, Fr; *Lobeliatinktur*, G.

Preparation.—Lobelia, in No. 40 powder, 200 Gm.; Diluted Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 200 Cc. of diluted alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of lobelia use 6 av. ozs. and 296 grains of lobelia, and moisten with 6½ fluidounces of the menstruum (diluted alcohol).

Lobelia 2½ oz. av., proof spirit sufficient for 1 pint (Imperial).—*Br.* Lobelia 1 part, alcohol (spec. grav. 0.912) 5 parts.—*P. Cod.* Lobelia 1 part, alcohol (spec. grav. 0.894) 10 parts.—*P. G.*

The tincture is of a green-brown color and has a somewhat heavy odor and a bitter and acrid taste.

Uses.—Lobelia is most frequently prescribed in this tincture and in the cases described under Lobelia. Its *dose* as an expectorant is Gm. 0.60–4 (♏x–fʒj). In asthmatic attacks Gm. 4–8 (fʒj–ij) should be administered every half hour or hour.

TINCTURA LOBELIÆ ÆTHEREA, *Br.*—Ethereal Tincture of Lobelia.

Preparation.—Take of Lobelia, in coarse powder, 2½ oz. av.; Spirit of Ether 1 pint. Macerate for seven days in a closed vessel, with occasional agitation; then strain, press, filter, and add sufficient spirit of ether to make 1 pint (Imperial).—*Br.*

It is of a brownish-green color.

Uses.—This preparation is perhaps more efficient than the simple tincture in *asthma.* The *dose* is Gm. 0.60–2 (♏ x–xxx).

TINCTURA MATICO, *U. S.*—Tincture of Matico.

Teinture de matico, Fr.; *Maticotinktur*, G.

Preparation.—Matico, in No. 40 powder, 100 Gm.; Diluted Alcohol a sufficient quantity; to make 1000 Cc. Moisten the matico with 100 Cc. of diluted alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 1000 Cc. are obtained.—*U. S.*

To make 1 quart of tincture of matico use 3 av. ozs. and 148 grains of matico, and moisten with 3¼ fluidounces of the menstruum (diluted alcohol).

This tincture is of about one-tenth the strength of the fluid extract, and, being made with a weaker alcohol, is of a greenish-brown color. The following formula yields a brown-green tincture: Matico 1 part, alcohol (spec. grav. 0.863) 5 parts.—*F. Cod.*

Uses.—In nearly all the affections in which matico is used alcohol is contraindicated, and hence it would seem that the already officinal fluid extract of matico was sufficient without a tincture. Of the latter preparation the dose may be stated at Gm. 4–8 (ʒj–ij).

TINCTURA MOSCHI, *U. S., P. G.*—Tincture of Musk.

Teinture de musc, Fr.; *Moschustinktur*, G.

Preparation.—Musk 50 Gm.; Alcohol 450 Cc.; Water 450 Cc.; Diluted Alcohol a sufficient quantity; to make 1000 Cc. Rub the musk in a mortar first with a little of the water, until a smooth mixture is made, and then with the remainder of the water. Transfer the whole to a bottle, add the alcohol, and macerate the mixture for seven days, occasionally shaking the bottle. Then filter through paper, adding through the filter enough diluted alcohol to make the tincture measure 1000 Cc.—*U. S.*

To make 1 quart of tincture of musk use 730 grains of musk, 14½ fluidounces each of alcohol and water, and diluted alcohol a sufficient quantity.

Musk 10 parts, alcohol (spec. grav. 0.863) 100 parts.—*F. Cod.* Musk 2 parts, water and alcohol (spec. grav. 0.894), of each 50 parts.—*P. G.*

The manipulation described above is the same as directed by the German Pharmacopœia, but the strength of the alcohol and the proportion of musk differ considerably. Strong alcohol gives a light-brown tincture, which becomes slightly opalescent with water; but weak alcohol yields a dark reddish-brown tincture, which has a strong musk odor and remains clear on the addition of water. The present official tincture is of about one-half the strength of that of 1880.

Uses.—This preparation will be found convenient for the rare occasions in which musk is used medicinally. The alcoholic menstruum promotes its action. 10 minims of the tincture contain about ½ grain of the musk. *Dose*, about Gm. 8 (fʒij).

TINCTURA MYRRHÆ, *U. S., Br., P. G., P. A.*—Tincture of Myrrh.

Teinture de myrrhe, Fr.; *Myrrhentinktur*, G.

Preparation.—Myrrh, in moderately coarse powder, 200 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Mix the powder with 800 Cc. of alcohol, and macerate for seven days in a closed vessel; then filter through paper, adding through the filter enough alcohol to make the tincture measure 1000 Cc.—*U. S.*

To make 1 quart of tincture of myrrh macerate 6 av. ozs. and 296 grains of myrrh with 25½ fluidounces of alcohol for seven days; filter and pass enough alcohol through the filter to make 32 fluidounces of tincture.

Myrrh 2½ oz. av., rectified spirit sufficient for 1 pint (Imperial).—*Br.* Myrrh 1 part, alcohol spec. grav. 0.863 (*F. Cod.*) (or 0.832 *P. G.*) 5 parts.

The tincture is of a brownish-yellow or reddish-yellow color, has the balsamic odor of

myrrh and a bitter aromatic taste, and yields a precipitate of resin on the addition of water. E. B. Shuttleworth (1871) suggested the utilization of the gum left on preparing the tincture for making a mucilage, by dissolving it in boiling water, straining, and allowing to settle. The adhesive properties are increased by the addition of a small quantity of molasses.

Uses.—Tincture of myrrh is seldom given internally, but it may be prescribed in *doses* of Gm. 2–4 (ʒss–j). It is chiefly used as a stimulant, astringent, and protective agent in the treatment of *aphthæ, spongy gums, relaxed uvula*, aphthous affections of the *vagina*, etc. In these cases it is generally diluted with water, which precipitates its resin. Campardon (1879) reports that "*whooping cough* yields easily and promptly to tincture of myrrh administered in 'wine of cinchona.'" He prescribes it in doses of 10 drops or of 5 drops every hour, according to the age of the patient, and asserts that in every one of numerous cases it destroyed the spasmodic element of the cough in a few days (*Bull. de Thérap.*, xcv. 193).

TINCTURA NUCIS VOMICÆ, *U. S., Br.*—Tincture of Nux Vomica.

Tinctura strychni, P. G., P. A.—*Teinture de noix vomique*, Fr.; *Krähenaugentinktur*, G.

Preparation.—Extract of Nux Vomica, dried at 100° C. (212° F.), 20 Gm; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Dissolve the extract of nux vomica (which should contain 15 per cent. of alkaloids) in a sufficient quantity of a mixture of 3 volumes of alcohol and 1 volume of water to make the product measure 1000 Cc.—*U. S.*

To make 1 quart of tincture of nux vomica use 292 grains of extract of nux vomica, thoroughly dried and in powder, and sufficient menstruum (alcohol 3 volumes, water 1 volume) to obtain 32 fluidounces of solution.

The Pharmacopœia requires that "100 Cc. of the tincture of nux vomica, evaporated to dryness, and the residue tested by the process of assay given under Extractum Nucis Vomicæ, shall be found to contain 0.3 Gm. of alkaloids in 100 Cc."

Dissolve extract of nux vomica, 133 grains, in distilled water 4 fluidounces and rectified spirit sufficient for 20 fluidounces.—*Br.*

Rasped nux vomica 1 part, alcohol (sp. gr. 0.863) 5 parts.—*U. Cod.* Nux vomica 1 part, alcohol (sp. gr. 0.894) 10 parts.—*P. G.*

Tinctura strychni ætherea. Coarsely-powdered nux vomica 1 part, spirit of ether 10 parts. Macerate for eight days, express, and filter.—*P. G.* 1872.

These tinctures have a yellowish color and a very bitter taste, and become opalescent when mixed with water. A few drops of the tincture, evaporated to dryness, leave a brownish-yellowish residue, which is colored yellowish-red by nitric acid. The U. S. and Br. tinctures, although made in the same manner from extract containing 15 per cent. of alkaloids, differ in strength considerably, the U. S. tincture representing in each fluidounce about 1.35 grains (1Cc. = 0.003 Gm.) of alkaloids, whereas the Br. tincture represents in each fluidounce 1 grain. The present U. S. formula, while differing radically from that of 1880, yet yields a tincture which corresponds to the latter in containing 2 per cent. of dry extract, but is far superior at the same time on account of the prescribed definite quantity of alkaloid in solution, the only trustworthy and desirable standard of valuation.

Uses.—This is a very convenient form for the exhibition of nux vomica, especially in small doses. It is particularly adapted for use in *atonic dyspepsia*, induced by excessive eating or by prolonged abstinence, by sedentary habits and the resulting constipation, by mental strain such as accompanies undue study or overwrought passions, and also in the *nervous erethism* that attends some of these states. (See Strychnina.) *Dose*, Gm. 0.30–1.30 (♏ v–xx); this may be considered safe. Much larger doses have been used. One reporter states as the initial dose 10 drops three times a day, and refers to a patient, aged twenty-four years, who "took 200 drops three times daily with most decided benefit," and to another, "aged sixteen years, 125 drops were exhibited without producing any bad effects" (*Therap. Gaz.*, x. 9).

TINCTURA OPII, *U. S., Br.*—Tincture of Opium.

Tinctura opii simplex, P. G., P. A.—*Tinctura extracti opii*, Fr. Cod.; *Tinctura thebaica, Tinctura meconii.—Laudanum*, E.; *Teinture d'extrait d'opium, Teinture thébaïque*, Fr.; *Einfache Opiumtinktur*, G.; *Tintura de extracto de opio*, Sp.

Preparation.—Powdered Opium 100 Gm.; Precipitated Calcium Phosphate 50

Gm.; Water, 400 Cc.; Alcohol 400 Cc.; Diluted Alcohol a sufficient quantity; to make 1000 Cc. Rub the powders in a mortar, with the water previously heated to the temperature of 90° C. (194° F.), until a smooth mixture is made, and macerate for twelve hours; then add the alcohol, mix thoroughly, and transfer the whole to a cylindrical percolator. Return to the percolator the first portion of the percolate until it becomes clear, and, when the liquid ceases to drop, gradually pour on diluted alcohol, continuing the percolation slowly until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of opium use 3 av. ozs. and 148 grains of powdered opium, 1 av. oz. and 293 grains of precipitated calcium phosphate, 12½ fluidounces each of water and alcohol, and diluted alcohol a sufficient quantity.

Take of opium, in coarse powder, 1½ oz. av., proof spirit 1 pint. Macerate for seven days in a closed vessel, with occasional agitation; then strain, press, filter, and add sufficient proof spirit to make 1 pint (Imperial). It contains the soluble matter of 33 grains of opium nearly, or about 3.3 grains of morphine in 1 fluidounce.—*Br.*

Powdered opium 1 part, alcohol sp. grav. 0.894 and distilled water, each 5 parts.—*P. G.* Extract of opium 10 parts, alcohol (sp. grav. 0.912) 120 parts.—*F. Cod.*

The Pharmacopœia requires that tincture of opium, when assayed by the following process, shall be found to contain from 1.3 to 1.5 Gm. of crystallized morphine in 100 Cc. of tincture:

U. S. P. Process for the Assay of Tincture of Opium.—"Tincture of Opium 100 Cc.; Ammonia-water, 3.5 Cc.; Alcohol, Ether, Water, each a sufficient quantity. Evaporate the tincture to about 20 Cc., add 40 Cc. of water, mix thoroughly, and set the liquid aside for an hour, occasionally stirring, and disintegrating the resinous flakes adhering to the capsule. Then filter, and wash the filter and residue with water, until all soluble matters are extracted, collecting the washings separately. Evaporate in a tared capsule, first the washings to a small volume, then add the first filtrate, and evaporate the whole to a weight of 14 Gm. Rotate the concentrated solution about in the capsule until the rings of extract are redissolved, and pour the liquid into an Erlenmeyer flask having a capacity of about 100 Cc., and rinse the capsule with a few drops of water at a time, until the solution weighs 20 Gm. Then add 10 Gm. (or 12.2 Cc.) of alcohol, shake well, add 25 Cc. of ether, and shake again. Now add the ammonia-water from a graduated pipette or burette, stopper the flask with a sound cork, shake it thoroughly during ten minutes, and then set it aside, in a moderately cool place, for at least six hours or over night. Remove the stopper carefully, and, should any crystals adhere to it, brush them into the flask. Place two rapidly-acting filters, of a diameter of 7 Cm., plainly folded, one within the other (the triple fold of the inner filter being laid against the single side of the outer filter; the latter being used merely to facilitate filtration), in a small funnel, wet them well with ether, and decant the ethereal solution as completely as possible upon the inner filter. Add 10 Cc. of ether to the contents of the flask, rotate it, and again decant the ethereal layer upon the inner filter. Repeat this operation with another portion of 10 Cc. of ether. Then pour into the filter the liquid in the flask in portions, in such a way as to transfer the greater portion of the crystals to the filter, and when this has passed through, transfer the remaining crystals to the filter by washing the flask with several portions of water previously saturated with ether, using not more than about 10 Cc. in all. Allow the double filter to drain, then apply water to the crystals, drop by drop, until they are practically free from mother-water, and afterward wash them, drop by drop, from a pipette, with alcohol previously saturated with powdered morphine. When this has passed through, displace the remaining alcohol by ether, using about 10 Cc., or more if necessary. Allow the filter to dry in a moderately warm place, at a temperature not exceeding 60° Cc. (140° F.), until its weight remains constant; then carefully transfer the crystals to a tared watch-glass and weigh them. The weight found represents the amount of crystallized morphine obtained from 100 Cc. of the tincture."—*U. S.*

Each fluidrachm (U. S. measure) of these tinctures represents 4.3 grains (*Br.*), 5.7 grains (*U. S.*), and 5.3 grains (*P. G.*) of dry opium, and 4 grains (*F. Cod.*) of extract of opium. Calculating 60 per cent. as the yield of extract from dry opium, 1 grain of powdered opium is represented by 9 minims (*F. Cod.*), 11.3 minims (*P. G.*), 10.5 minims (*U. S.*), and 14 minims (*Br.*), U. S. measure, of these tinctures. The powdered or dry opium used is directed to contain of morphine 13 to 15 per cent. (*U. S.*), about 10 per cent. (at least 6 to 8 per cent. for crude opium, *Br.*), at least 10 to 12 per cent. (*F. Cod.*), 10 per cent. (*P. G.*).

With due care, opium is readily exhausted by weak alcohol, about 60 per cent. of its constituents being soluble in that menstruum. To ensure uniformity of strength in this

important preparation, the opium employed in making it should be well dried, of full morphine strength, and sufficiently long macerated or digested in the menstruum to be completely disintegrated at least a day before it is transferred to a percolator or filter. The residue after drying should yield nothing to water, and dilute acids should dissolve from it only minute quantities of alkaloid compounds. The color of the tincture is deep reddish-brown. It has the narcotic odor and bitter taste of opium, and should be preserved in well-stoppered bottles to prevent evaporation of the alcohol.

The term *laudanum* is still recognized by several European pharmacopœias as a synonym for opium. In connection with various epithets (antihystericum, diureticum, etc.) it was formerly employed to designate numerous solid compound preparations of opium, while the stronger liquid opiates were called *laudanum liquidum*, and distinguished by other epithets—tincture of opium, for instance, as *laudanum liquidum simplex*. However, in the United States and Great Britain the tincture is popularly known as laudanum.

Allied Tinctures.—Tinctura opii acetata, *U. S.* 1870. Dry powdered opium 2 troyounces, distilled vinegar 12 fluidounces, alcohol ½ pint; macerate for a week, express, and filter. The yield is about 20 fluidounces, and 10 minims contain 1 grain of opium. This tincture is now rarely used.

Tinctura opii muriatica. Macerate for two weeks powdered opium 1 ounce, hydrochloric acid 1 ounce, and distilled water 20 ounces; filter (Nichol). This is of less than half the strength of laudanum, and contains no alcohol.

Uses.—The simple tincture of opium—or laudanum, as it is distinctively called—possesses most of the good and evil qualities of pure opium. Of the latter the most conspicuous is its tendency to nauseate. This operation is supposed to depend upon the narcotine which it contains, and which is removed in the process for making the deodorized tincture. The latter is therefore preferable for internal administration, but laudanum forms a convenient addition to liniments, poultices, and other external anodyne applications. It should be remembered that by being kept in imperfectly stoppered vials it becomes relatively stronger by the evaporation of its alcohol. The *dose* for an adult is about Gm. 0.75 (gtt. xxij or ♏xij), equivalent to about Gm. 0.06 (1 grain) of opium.

TINCTURA OPII AMMONIATA, *Br.*—Ammoniated Tincture of Opium.

Teinture d'opium ammoniacale, Fr.; *Ammoniakalische Opiumtinktur*, G.

Preparation.—Take of Opium in coarse powder, 100 grains; Saffron, cut small, Benzoic Acid, each 180 grains; Oil of Anise 1 fluidrachm; Strong Solution of Ammonia 4 fluidounces; Rectified Spirit 16 fluidounces. Macerate for seven days in a well-closed vessel, with occasional agitation; then strain, press, filter, and add sufficient rectified spirit to make 1 pint (Imperial).—*Br.*

This is a slight modification of the formula formerly recognized by the Edinburgh Pharmacopœia. The preparation was known as *elixir paregoricum scoticum*, and in Scotland employed as paregoric elixir. It contains the opium alkaloids in a free state, dissolved by the aid of alcohol and of an excess of ammonia. 90 minims of it represent very nearly 1 grain of opium.

Uses.—This preparation, sometimes called Scotch paregoric, is composed of nearly the same ingredients as ordinary paregoric, except that in it ammonia takes the place of the camphor in that preparation. The *dose* is Gm. 2–4 (fʒss–j).

TINCTURA OPII CAMPHORATA, *U. S.*—Camphorated Tincture of Opium.

Tinctura camphoræ composita, Br.; *Tinctura extracti opii camphorata*, F. Cod.; *Tinctura opii benzoica*, P. G.; *Elixir paregoricum.—Paregoric elixir*, E.; *Elixir parégorique*, *Teinture d'opium camphrée*, Fr.; *Benzoësäurehaltige Opiumtinktur*, G.

Preparation.—Powdered Opium 4 Gm.; Benzoic Acid 4 Gm.; Camphor 4 Gm.; Oil of Anise 4 Cc.; Glycerin 40 Cc.; Diluted Alcohol a sufficient quantity; to make 1000 Cc. Add 900 Cc. of diluted alcohol to the other ingredients contained in a suitable vessel, and macerate for three days, frequently stirring; then filter through paper in a well-covered funnel, and pass enough diluted alcohol through the filter to make the product measure 1000 Cc.—*U. S.*

To make 1 quart of paregoric use 58½ grains each of powdered opium, benzoic acid, and camphor, 60 minims of oil of anise, 10 fluidrachms of glycerin, and 29 fluidounces

of diluted alcohol; macerate for three days, filter, and wash the filter with sufficient diluted alcohol to make 32 fluidounces.

Opium, in coarse powder, benzoic acid, each 40 grains; camphor 30 grains; oil of anise ½ fluidrachm; proof spirit 1 pint (Imperial).—*Br.* Extract of opium, benzoic acid, oil of anise, each 3 parts; camphor 2 parts; alcohol (sp. gr. 0.912) 650 parts.—*F. Cod.* Powdered opium and oil of anise, each 1 part; benzoic acid 4 parts; camphor 2 parts; alcohol (sp. gr. 0.894) 192 parts.—*P. G.*

1 grain of opium is represented in 263 (*U. S.*) and 230 (*Br.*) minims (U. S. measure), and in 200 (*P. G.*), and 132 (*F. Cod.*) grains of the tincture. This tincture has a brownish-yellow color, an anise-like and camphoraceous odor, a sweetish, pungently aromatic, and slightly bitter taste, and an acid reation; on the addition of water it turns milky. It is an ingredient in Mistura glycyrrhizæ comp., *U. S.*

Allied Preparations.—The following formulas were adopted by the Philadelphia College of Pharmacy (1833) for the nostrums named:

Bateman's Pectoral Drops. Digest for twenty-four hours rasped red saunders 2 troyounces in 4 gallons of diluted alcohol; filter, and add powdered opium, catechu, and camphor, each 2 troyounces, oil of anise 4 fluidrachms. Digest for ten days and filter. It is of the same opium strength as paregoric.

Godfrey's Cordial. Dissolve potassium carbonate 2½ troyounces in water 26 pints; add sugar-house molasses 16 pints; heat the mixture over a gentle fire until it simmers; remove the scum; add tincture of opium 1½ pints, alcohol 2 pints, and oil of sassafras 4 fluidrachms, previously mixed together. Each fluidounce represents nearly 1¼ grains of opium.

Uses.—Camphorated tincture of opium is in common use to relieve *abdominal pains* produced by flatus or by irritability of the stomach or bowels, and for allaying *cough* when there is no active inflammation of the respiratory organs. The *dose* for an adult is Gm. 4–8 (fʒj–ij), and for an infant from Gm. 0.30–0.60 (gtt. v–x). It is usually administered in sweetened water.

TINCTURA OPII DEODORATI, *U. S.*—Tincture of Deodorized Opium.

Tinctura opii deodorata, U. S. 1880.

Preparation.—Powdered Opium 100 Gm.; Precipitated Calcium Phosphate 50 Gm.; Ether 200 Cc.; Alcohol 200 Cc.; Water a sufficient quantity; to make 1000 Cc. Rub the powders in a mortar with 400 Cc. of water previously heated to the temperature of 90° C. (194° F.), until a smooth mixture is made, and macerate for twelve hours; then pour the mixture on a filter or transfer it to a cylindrical percolator, and gradually pour on water until the opium is practically exhausted. Reduce the percolate, by evaporation on a water-bath, to 100 Cc., and when it has cooled shake it repeatedly with the ether in a bottle. When the ethereal solution has separated by standing, pour it off, and evaporate the remaining liquid until all traces of ether have disappeared. Mix the residue with 500 Cc. of water, and filter the mixture through paper. When the liquid has ceased to pass add enough water through the filter to make the filtered liquid measure 800 Cc. Lastly, add the alcohol, and mix them. If 100 Cc. of tincture of deodorized opium be assayed by the process given under Tinctura Opii, it should yield from 1.3 to 1.5 Gm. of crystallized morphine.—*U. S.*

To make 1 quart of tincture of deodorized opium mix 3 av. ozs. and 148 grains of powdered opium and 1 av. oz. and 293 grains of calcium phosphate; treat with hot and cold water until exhausted as directed above, concentrate the percolate to 3¼ fluidounces, shake well with 6½ fluidounces of ether, decant, evaporate, add 16 fluidounces of water, filter, and add enough water to obtain 25½ fluidounces of filtrate. Lastly, add 6½ fluidounces of alcohol.

This tincture is of the same opium strength (by volume) as laudanum, but rather lighter in color, so that 10.5 minims represent 1 grain of opium. It is nearly identical with *denarcotized tincture of opium*, and takes the place of several preparations which were at one time introduced as *elixirs* of opium.

The present official formula differs from that of 1880 chiefly in directing 1000 Cc., instead of 1000 Gm. (as formerly), of tincture to be made from 100 Gm. of powdered opium. By the treatment with ether it is intended to remove narcotine and the odorous principle, which is effectually accomplished, but if the directions of the Pharmacopœia be strictly followed—namely, to shake the ether repeatedly with the concentrated infusion—a very annoying and persistent emulsion will generally result. A much better plan is to add the ether to the liquid in a cylinder or large globular separator, and bring

the two fluids into intimate contact, either by rotating the separator or by slowly inverting the cylinder: this treatment should be continued for some time, and repeated frequently during twelve or twenty-four hours. The aqueous fluid should then be carefully separated, either by being drawn off or by decanting or siphoning off the ether, and the washing with ether repeated, this time using only one-fourth or one-half as much ether as before.

In 1887, E. C. Federer proposed a process for preparing deodorized tincture of opium without the use of ether (see *Drugg. Circ.*, April, 1887), which consists in exhausting the powdered opium with water heated to 56.7° C. (138° F.), and collecting about 5 parts of infusion for each part of opium: the liquid is cooled to 0° C. (32° F.) and filtered, keeping the temperature down by placing ice in the filter. The filter is washed with ice-water until 8 parts of clear filtrate are obtained, to which 2 parts of alcohol are then added. We have tried the process with carefully assayed opium, and have found that, while the deodorization was complete and the filtrate free from narcotine, there was also a loss of morphine amounting to as much as one-fourteenth of the total amount of morphine present in the opium: the marc was found entirely free from morphine, showing that the loss occurred in the dark odorous deposit formed upon cooling the infusion to 0° C. (32° F.). Our best results were obtained by freezing the liquid over night, and filtering at a temperature of between 3.5° and 5° C. (38.3° and 41° F.).

Repeated experiments made with benzene and petroleum benzin have shown us their inferiority to ether (mainly on account of their own disagreeable and rather persistent odor); we have, however, experienced considerable satisfaction in making the infusion from opium previously deodorized and denarcotized with ether (see OPIUM DEODORATUM), evaporating this to the desired volume, and adding the necessary quantity of alcohol: this involves the use of a larger quantity of ether, but entirely obviates the formation of troublesome emulsions, and ensures the full quantity of morphine in the finished product.

Allied Preparations.—LIQUOR OPII COMPOSITUS. Opium is exhausted with water, the infusion concentrated, precipitated by alcohol, the clear liquid evaporated to a small bulk equal in weight to that of the opium, and agitated with ether. The aqueous liquid, freed from the ether, is diluted with 1 part of its own weight of water, filtered, mixed with 1 part of stronger alcohol, and diluted with water to 5 parts. A portion of this is assayed, and the whole liquid is then mixed with the remaining ingredients in such proportions that 30 Cc. or 1 fluidounce shall contain 6 grains of morphine, 1 Cc. of chloroform, 2 Cc. of acetic ether, and 13 Cc. of stronger alcohol, the remaining liquid being water. As originally suggested by Dr. Squibb, this preparation contained 4 grains of morphine in the fluidounce, but after the appearance of the Pharmacopœia of 1880 this amount was increased to 6 grains. (For details see *Amer. Jour. Phar.*, 1870, p. 47.)

BATTLEY'S SEDATIVE DROPS. 3 ounces of extract of opium are dissolved in 30 ounces of hot water, and the solution filtered and mixed with 6 ounces of alcohol. This preparation is about 50 per cent. stronger than those above described.

Uses.—The nauseating effects of laudanum are supposed not to be produced by this preparation, which is of the same strength. It may be given in the *dose* of Gm. 0.75 (ℳ xij = gtt. xxij).

TINCTURA PHYSOSTIGMATIS, *U. S.*—TINCTURE OF PHYSOSTIGMA.

Teinture de fève du Calabar, Fr.; *Kalabarbohnentinktur*, G.

Preparation.—Physostigma, in No. 40 powder, 150 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 100 Cc. of alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour alcohol upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of physostigma use 5 av. ozs. of powdered Calabar bean, and moisten with 3½ fluidounces of the menstruum (alcohol).

Physostigma 1 part, alcohol (sp. gr. 0.863) 5 parts.—*F. Cod.*

In view of the fact that physostigmine and its salts when in solution are readily altered by the influence of light and air (see pp. 1221 and 1224), it is doubtful whether the tincture is a sufficiently stable preparation: it is advisable, therefore, to make it only in small quantities as needed, and since the amount of matter soluble in strong alcohol is quite small (see p. 694), the tincture may very properly be made by maceration. The present official tincture is very much stronger than that of 1880, representing about 68½ grains of the drug in each fluidounce against 38 grains formerly.

Uses.—This preparation fully represents physostigma. Its commencing *dose* may be stated at Gm. 0.60 (ℳ x).

TINCTURA PYRETHRI, *U. S.*, *Br.*—Tincture of Pyrethrum.

Tincture of pellitory, E.; *Teinture de pyrèthre*, Fr.; *Bertramwurzeltinktur*, G.

Preparation.—Pyrethrum, in No. 40 powder, 200 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 150 Cc. of alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour alcohol upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of pyrethrum use 6 av. ozs. and 296 grains of pyrethrum, and moisten with 5 fluidounces of the menstruum (alcohol).

Powdered pellitory 4 oz. av., rectified spirit sufficient for 1 pint (Imperial).—*Br.* Pellitory 1 part, alcohol (sp. gr. 0.863) 5 parts.—*F. Cod.*

It has a brownish-yellow color and a very acrid taste, and on the addition of water becomes opalescent and milky.

Uses.—Tincture of pellitory is not given internally, but is a convenient substitute for the root of the plant as an application to painful cavities in *carious teeth* and as a local stimulant in *paralysis* of the *tongue*, *velum palati*, and *pharynx*.

TINCTURA QUASSIÆ, *U. S.*, *Br.*—Tincture of Quassia.

Teinture de quassie amère, Fr.; *Quassiatinktur*, G.

Preparation.—Quassia, in No. 40 powder, 100 Gm.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix alcohol and water in the proportion of 350 Cc. of alcohol to 650 Cc. of water. Having moistened the powder with 100 Cc. of the menstruum, macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour menstruum upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of quassia use 3 av. ozs. and 148 grains of quassia, and moisten with 3 fluidounces of the menstruum (alcohol 35 volumes, water 65 volumes).

Quassia-wood, in chips, ¾ oz. av., proof-spirit sufficient for 1 pint (Imperial).—*Br.* Quassia 1 part, alcohol (sp. gr. 0.912) 5 parts.—*F. Cod.*

The tincture has a light brownish-yellow color and a persistently bitter taste, and is not colored black by ferric salts.

Uses.—It is occasionally employed during convalescence from low fevers and other exhausting acute diseases, as well as in various atonic *dyspeptic conditions* of gastric origin; but it is less frequently prescribed alone than as an addition to the infusion of quassia or of other bitter tonics or associated with their tinctures. The average *dose* is about Gm. 4 (f℥j). It is sometimes given in enema to destroy rectal *ascarides*.

TINCTURA QUILLAJÆ, *U. S.*—Tincture of Quillaja.

Tincture of soap-bark, E.; *Teinture d'écorce de quillaya*, Fr.; *Seifenrindentinktur*, G.

Preparation.—Quillaja, coarsely ground, 200 Gm.; Alcohol 350 Cc.; Water a sufficient quantity; to make 1000 Cc. Boil the quillaja, placed in a suitable vessel, with 800 Cc. of water for fifteen minutes, strain, and wash the residue on the strainer with 100 Cc. of water. Then boil the strained liquid down to 600 Cc., allow it to cool, mix it with the alcohol, and, when the insoluble matter has subsided, filter the liquid portion through paper, and add enough water to make the tincture measure 1000 Cc.—*U. S.*

To make 1 quart of tincture of soap-bark boil 6 av. ozs. and 296 grains of ground quillaja-bark with 1½ pints of water for fifteen minutes, strain, and wash the residue with 3 ounces of water. Boil the liquid down to 19 fluidounces, cool, mix with 10½ fluidounces of alcohol, and filter, passing enough water through the filter to make the liquid measure 32 fluidounces.

Uses.—This preparation would appear to be a convenient one for external application when diluted with water, and for the various uses mentioned under Quillaja.

TINCTURA QUININÆ, *Br.*—Tincture of Quinine.

Preparation.—Take of Quinine Hydrochlorate 160 grains; Tincture of Orange-peel 1 pint (Imperial). Dissolve the quinine hydrochlorate in the tincture with the aid of a gentle heat; then allow the solution to remain for three days in a closed vessel, shaking it occasionally, and then filter.—*Br.*

Uses.—This preparation might very properly have been left to magistral prescription. Gm. 4 (1 fluidrachm) contain 1 grain of quinine hydrochlorate.

TINCTURA QUININÆ AMMONIATA, *Br.*—Ammoniated Tincture of Quinine.

Preparation.—Take of Quinine Sulphate 160 grains; Solution of Ammonia 2½ fluidounces (Imperial); Proof Spirit 17½ fluidounces. Dissolve the quinine sulphate in the spirit with a gentle heat, and add the solution of ammonia.—*Br.*

Uses.—The association of quinine and ammonia is supposed to be indicated in *neuralgia* and other *nervous affections* due to a want of nervous energy. The *dose* is Gm. 2–4 (f℥ss–j).

TINCTURA RHEI, *U. S., Br.*—Tincture of Rhubarb.

Teinture de rhubarbe, Fr.; *Rhabarbertinktur*, G.

Preparation.—Rhubarb 100 Gm.; Cardamom 20 Gm.; Glycerin 100 Cc.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix the rhubarb and cardamom, and reduce the mixture to a moderately coarse (No. 40) powder. Mix the glycerin with 600 Cc. of alcohol and 300 Cc. of water. Moisten the powder with 100 Cc. of the menstruum, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour on the remainder of the menstruum. When the liquid has disappeared from the surface, gradually pour on more of the mixture of alcohol and water, using the same proportion as before, and continue the percolation until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of rhubarb use 3 av. ozs. and 148 grains of rhubarb and 292 grains of cardamom; moisten with 3¼ fluidounces of the menstruum, glycerin 3¼ fluidounces, alcohol 19½ fluidounces, water 9¼ fluidounces, and use for final percolation a mixture of alcohol 2 volumes, water 1 volume.

Rhubarb, in coarse powder, 2 oz. av.; cardamom-seeds, freed from the pericarps and bruised, coriander-fruit, bruised, saffron, each ¼ oz. av.; proof spirit sufficient for 1 pint (Imperial).—*Br.*

Rhubarb 1 part and alcohol (sp. gr. 0.912) 5 parts.—*F. Cod.*

The tincture is of a deep reddish-brown color, has the odor and taste of rhubarb, becomes turbid with water, and on standing deposits orange-yellow granular crystals, consisting of chrysophanic acid and emodin, mixed with phæoretin, erythoretin, and aporetin. The use of stronger alcohol and the addition of glycerin to the menstruum are intended to prevent the precipitation, but in this will probably not be entirely successful.

Allied Tinctures.—Tinctura rhei aquosa, *P. G., P. A.* Take of rhubarb, cut into thin pieces, 100 parts; powdered borax, potassium carbonate, each 10 parts; add boiling distilled water 900 parts, and after fifteen minutes alcohol 90 parts; macerate for one hour, express slightly, and to 850 parts of liquid add cinnamon-water 150 parts.

Tinctura rhei et absinthii; Tinct. absinthii composita, *F. Cod.*—Elixir stomachique de Stoughton, *Fr.*—Rhubarb, gentian, wormwood, germander, and bitter orange-peel, of each 5 parts; aloes and cascarilla, each 1 part; alcohol (sp. gr. 0.912) 200 parts.—*F. Cod.* Numerous other formulas for *Stoughton's bitters* have been in use, rhubarb, gentian, and orange-peel being the principal ingredients.

Tinctura rhei et aloes, s. *Elixir sacrum.* Rhubarb, bruised, 10 drachms, aloes 6 drachms, cardamom 4 drachms, diluted alcohol 2 pints. Macerate for fourteen days, express, and filter.—*U. S.* 1850.

Tinctura rhei et gentianæ, s. *Tinct. rhei amara.* Rhubarb, bruised, 2 troyounces, gentian, bruised, 4 drachms, diluted alcohol 2 pints. Proceed as above.—*U. S.* 1850.

Tinctura rhei et sennæ. Rhubarb 1 troyounce, senna 120 grains, coriander, fennel, each 60 grains, liquorice 30 grains, raisins, deprived of their seeds, 6 troyounces, diluted alcohol 3 pints. Macerate for seven days, express, and filter through paper.—*U. S.* 1870. This tincture is known as *Warner's gout cordial*, and has a reddish-brown color.

Uses.—Tincture of rhubarb is used to qualify the action of saline purgatives and in *gouty* or other feeble states of the system requiring a stimulant as well as a laxative medicine. Its *dose* is Gm. 16–32 (f℥ss–j) as a purgative. As a stomachic it may be given in the dose of about Gm. 4 (f℥j).

The association of rhubarb with tonics, aromatics, or laxatives, mentioned above, is sometimes very useful. The disused compounds can be imitated by associating simple tinctures.

TINCTURA RHEI AROMATICA, *U. S.*—Aromatic Tincture of Rhubarb.

Teinture de rhubarbe aromatique, Fr.; *Aromatische Rhabarbertinktur*, G.

Preparation.—Rhubarb 200 Gm.; Cassia Cinnamon 40 Gm.; Cloves 40 Gm.; Nutmeg 20 Gm.; Glycerin 100 Cc.; Alcohol, Water, Diluted Alcohol, each a sufficient quantity; to make 1000 Cc. Mix the rhubarb, cinnamon, cloves, and nutmeg, and reduce the mixture to a moderately coarse (No. 40) powder. Mix the glycerin with 500 Cc. of alcohol and 400 Cc. of water. Moisten the powder with 150 Cc. of the menstruum, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour on the remainder of the menstruum. When the liquid has disappeared from the surface, gradually pour diluted alcohol upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of aromatic tincture of rhubarb use 6 av. ozs. and 296 grains of rhubarb, 1 av. oz. and 147 grains each of cassia cinnamon and cloves, and 292 grains of nutmeg; moisten with 5 fluidounces of the menstruum, glycerin 3¼ fluidounces, alcohol 16 fluidounces, water 12¾ fluidounces, and use diluted alcohol for final percolation.

This tincture, intended for preparing spiced-syrup of rhubarb, has a dark red-brown color, a pleasant aromatic odor, and a spicy and bitter taste; on keeping it deposits some chrysophanic acid and other principles of rhubarb; on the addition of water it becomes turbid.

Uses.—This preparation seems to have been intended to represent the aromatic syrup of rhubarb. It may, however, be added to the number of purgative tinctures which are used in gouty and enfeebled states of the system, such as the tinctures of aloes and myrrh or of rhubarb and senna (1870), and indeed may be appropriately administered along with them. *Dose*, Gm. 8–16 (fʒij–iv).

TINCTURA RHEI DULCIS, *U. S.*—Sweet Tincture of Rhubarb.

Teinture de rhubarbe douce, Fr.; *Süsse Rhabarbertinktur*, G.

Preparation.—Rhubarb 100 Gm.; Glycyrrhiza 4 Gm.; Anise 4 Gm.; Cardamom 1 Gm.; Glycerin 100 Cc.; Alcohol, Water, Diluted Alcohol, each a sufficient quantity; to make 1000 Cc. Mix the rhubarb, glycyrrhiza, anise, and cardamom, and reduce the mixture to a moderately coarse (No. 40) powder. Mix the glycerin with 500 Cc. of alcohol and 400 Cc. of water. Moisten the powder with 150 Cc. of the menstruum, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour on the remainder of the menstruum. When the liquid has disappeared from the surface, gradually pour diluted alcohol upon it until 1000 Cc. of tincture are obtained. —*U. S.*

To make 1 quart of sweet tincture of rhubarb use 3 av. ozs. and 148 grains of rhubarb, 58½ grains each of glycyrrhiza and anise, and 15 grains of cardamom; moisten with 5 fluidounces of the menstruum (glycerin 3¼ fluidounces, alcohol 16 fluidounces, water 12¾ fluidounces), and use diluted alcohol for final percolation.

This tincture has been in use for a number of years, and was admitted into the Pharmacopœia of 1880. It resembles tincture of rhubarb in appearance, but is one-third weaker in rhubarb, the bitter taste of which is somewhat modified by the other ingredients.

Uses.—From the small proportion of rhubarb in this preparation it may be surmised that it was intended for infantile disorders. But as the aromatic tincture or the aromatic syrup can readily be employed in doses appropriate to such cases, the need of this officinal preparation is not apparent. The *dose* may be stated at Gm. 8–12 (fʒij–iij).

TINCTURA SABINÆ, *Br.*—Tincture of Savin.

Teinture de sabine, Fr.; *Sadebaumtinktur*, G.

Preparation.—Take of Savin-tops, dried and coarsely powdered, 2½ oz. av.; Proof Spirit 1 pint. Prepare the tincture according to the formula given under Tincturæ. —*Br.*

Proof spirit appears to be hardly strong enough for dissolving the volatile oil and resin contained in savin. The tincture has a brown-green color.

Uses.—Tincture of savin may be employed internally in all cases in which that mode of administering savin is appropriate. *Dose*, Gm. 1.30–4 (♏xx–fʒj).

TINCTURA SANGUINARIÆ, *U. S.*—Tincture of Sanguinaria.

Tincture of bloodroot, E.; *Teinture de sanguinaire*, Fr.; *Blutwurzeltinktur*, G.

Preparation.—Sanguinaria, in No. 60 powder, 150 Gm.; Acetic Acid 20 Cc.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix alcohol and water in the proportion of 600 Cc. of alcohol to 400 Cc. of water. Moisten the powder with 100 Cc. of the mixture, to which the acetic acid had previously been added, and macerate for twenty-four hours; then pack it firmly in a cylindrical glass percolator, and gradually pour menstruum upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of sanguinaria use 5 av. ozs. of sanguinaria, and moisten with 3½ fluidounces of the menstruum (alcohol 3 volumes, water 2 volumes), to which 308 minims of acetic acid had previously been added.

In alcoholic strength the present official menstruum is weaker than that of 1880, which consisted of alcohol 2½ volumes (nearly) and water 1 volume; the addition of acetic acid is valuable, as not only facilitating the exhaustion of the drug, but also as materially adding to the permanency of the tincture. Tincture of sanguinaria has a rich brownish-red color and the bitter, acrid taste of the root.

Uses.—This tincture contains all the virtues of bloodroot. It may be given in *doses* of Gm. 2–4 (f℥ss–j) as an "alterative" and expectorant, and as an emetic in doses of Gm. 4–16 (f℥j–iv).

TINCTURA SCILLÆ, *U. S., Br., P. G.*—Tincture of Squill.

Teinture de scille, Fr.; *Meerzwiebeltinktur*, G.

Preparation.—Squill, in No. 30 powder, 150 Gm.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix 750 Cc. of alcohol with 250 Cc. of water. Moisten the powder with 200 Cc. of the menstruum, and macerate for twenty-four hours; then pack it moderately in a conical percolator, and gradually pour the remainder of the menstruum upon it; when this has disappeared from the surface, gradually pour on more of the mixture of alcohol and water, using the same proportions as before, and continue the percolation until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of squill use 5 av. ozs. of squill, and moisten with 6½ fluidounces of the menstruum (alcohol 3 volumes, water 1 volume).

Squill 2½ oz. av., proof spirit sufficient for 1 pint (Imperial).—*Br.* Squill 1 part, alcohol (sp. gr. 0.912, *F. Cod.*) (sp. gr. 0.894, *P. G.*) 5 parts.

The increase in the alcoholic strength of the official menstruum is decidedly advantageous with a view to extracting less of inert mucilaginous matter. The tincture is of a light yellow-color, with the nauseous bitter taste of squill.

Allied Tincture.—Tinctura scillæ kalina. Macerate for a week squill 8 parts and caustic potassa 1 part in alcohol (sp. gr. 0.894) 50 parts; express and filter. It has a brownish color.—*P. G.* 1872.

Uses.—Tincture of squill is perhaps better adapted than squill in substance for the treatment of *dropsy*. It is generally associated with other medicines, as in the following efficient formula: ℞. Tincture of digitalis f℥ij–f℥iij; tincture of squill f℥ss; compound spirit of juniper f℥ij; sherry wine f℥x; acetate of potassium ℥j. M.—S. A tablespoonful, largely diluted, three times a day. Tincture of squill is said to have produced diuresis when applied to the skin with friction. The *dose* is Gm. 0.60–1.30 (♏x–xx).

TINCTURA SENEGÆ, *Br.*—Tincture of Senega.

Teinture de polygala de Virginie, Fr.; *Senegatinktur*, G.

Preparation.—Take of Senega-root, in coarse powder, 2½ oz. av.; Proof Spirit 1 pint (Imperial). Proceed according to the directions given under Tincturæ.—*Br.* Senega 1 part, alcohol (sp. gr. 0.863) 5 parts.—*F. Cod.*

The tincture has a yellowish-brown color and the acrid taste of senega.

Uses.—This preparation is probably less efficient than the syrup of senega in affections of the air-passages, and than the fluid extract as a stimulant of the uterine functions. The alcohol it contains renders it peculiarly unsuitable in the former, and probably impairs its virtues in the latter case, while it tends to produce a local irritant action upon the stomach. Its *dose* is Gm. 2–8 (f℥ss–ij).

TINCTURA SENNÆ, *Br.*—Tincture of Senna.

Elixir salutis.—Teinture de séné aromatique, Elixir de salut, Fr.; *Sennatinktur*, G.

Preparation.—Take of Senna, broken small, 2½ oz. av.; Raisins, freed from seeds, 2 ounces; Caraway-fruit, bruised, Coriander-fruit, bruised, each ½ ounce; Proof Spirit 1 pint. Prepare 1 pint (Imperial) of tincture according to the formula given under Tincturæ.—*Br.*

Senna 1 part, alcohol (sp. gr. 0.912) 5 parts.—*F. Cod.*

It is used in preparing Mistura sennæ comp., *Br.* The formulas of old pharmacopœias directed rhubarb or jalap in addition to the senna.

Uses.—It is convenient as an addition to cathartic infusions, and particularly to the compound infusion of senna, or "black draught," or along with the tincture of rhubarb in cases that require a stimulating purge, especially in persons of a gouty habit. The *dose* is Gm. 4–16 (f℥j–iv).

TINCTURA SERPENTARIÆ, *U. S., Br.*—Tincture of Serpentaria.

Teinture de serpentaire, Fr.; *Schlangenwurzeltinktur*, G.

Preparation.—Serpentaria, in No. 40 powder, 100 Gm.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix 650 Cc. of alcohol with 350 Cc. of water. Moisten the powder with 100 Cc. of the menstruum, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour the remainder of the menstruum upon it: when this has disappeared from the surface, gradually pour on more of the mixture of alcohol and water, using the same proportions as before, and continue the percolation until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of serpentaria use 3 av. ozs. and 148 grains of serpentaria, and moisten with 3¼ fluidounces of the menstruum (alcohol 65 volumes, water 35 volumes).

Serpentaria 2½ oz. av., proof spirit sufficient to make 1 pint (Imperial).—*Br.*

The tincture has a brownish-yellow color and the camphoraceous odor and taste of the drug.

Uses.—In the low forms of febrile disease for which serpentaria is employed the tincture is the most appropriate form for administering it. It may be associated advantageously in such cases with the compound tincture of cinchona. *Dose*, Gm. 4–8 (f℥j–ij).

TINCTURA STRAMONII SEMINIS, *U. S., Br.*—Tincture of Stramonium-seed.

Tinctura stramonii, Br.—*Tincture of stramonium*, E.; *Teinture de semences de stramoine*, Fr.; *Stechapfelsamentinktur*, G.

Preparation.—Stramonium-seed, in No. 40 powder, 150 Gm.; Diluted Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 100 Cc. of diluted alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour diluted alcohol upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of stramonium-seed use 5 av. ozs. of stramonium-seed, and moisten with 3¼ fluidounces of the menstruum (diluted alcohol).

Stramonium-seeds 2½ oz. av., proof spirit sufficient for 1 pint (Imperial).—*Br.*

The tincture has a brownish-yellow color and becomes opalescent with water. The tincture of the first formula is about one-fourth stronger than that of the British formula, and about two-thirds stronger than that of the U. S. P. 1880. Teinture de stramoine (*F. Cod.*) is made from stramonium-leaves 1 part and alcohol (sp. gr. 0.912) 5 parts.

Uses.—Although less frequently used than other preparations of stramonium, the tincture is probably one of the best, whether for internal administration or as a topical anodyne. It would seem appropriate for inhalation, when atomized, in cases of *spasmodic asthma*, and it has been used with marked advantage for the relief of *dysmenorrhœa*. It may also be given internally for the relief of *neuralgia*, and used locally for that affection and for *muscular rheumatism* in anodyne liniments. Even in subacute and chronic *articular rheumatism* it may be employed in the same way with advantage. The average *dose* of the tincture is Gm. 1 (♏xv).

TINCTURA STROPHANTHI, *U. S., Br. Add., P. G., P. A.*—Tincture of Strophanthus.

Teinture de semences de strophanthe, Fr.; *Strophanthussamentinktur*, G.

Preparation.—Strophanthus, in No. 30 powder, 50 Gm.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix 650 Cc. of alcohol with 350 Cc. of water. Digest the powder with 70 Cc. of the menstruum for two days, then transfer it to a cylindrical percolator, and gradually pour on more menstruum, and continue the percolation very slowly until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of strophanthus use 1 av. oz. and 293 grains of strophanthus-seed, and digest for two days with 18 fluidrachms of the menstruum (alcohol 65 volumes, water 35 volumes); afterward percolate very slowly with sufficient menstruum to yield 32 fluidounces of tincture.

Percolate strophanthus, in No. 30 powder, 1 ounce, with ether until the latter passes colorless; dry the mass at a temperature not above 48.9° C. (120° F.), and percolate slowly with rectified spirit until 10 fluidounces have passed; then dilute the percolate with rectified spirit to 1 pint (Imperial).—*Br. Add.*

Macerate 1 part of bruised strophanthus-seed, deprived of as much oil as possible by pressure without heat, with 10 parts of diluted alcohol (spec. grav. 0.894), and remove any oil which may separate from the tincture upon subsequent filtration.—*P. G.*

Strophanthus-seeds are very rich in fixed oil, for the removal of which no provision is made in the U. S. P. formula; it is true the weaker alcoholic menstruum, in which the active glucoside strophanthin is perfectly soluble, will not take up large quantities of the oil; but we think the process given in the National Formulary of the A. P. A., which is practically identical with the directions of the Brit. Pharm., yields a more satisfactory product. The ether used for the removal of the fixed oil does not affect the active virtues of the seed, and the alcoholic tincture has been used by physicians for years. The color of the tincture will depend upon the menstruum employed: made by the U. S. P. and P. G. formulas, the color is brownish-yellow, while if made by the Br. Ph. the color is greenish-yellow. The taste is very bitter.

Uses.—An efficient preparation of strophanthus. *Dose*, 4 to 8 minims.

TINCTURA SUMBUL, *U. S., Br.*—Tincture of Sumbul.

Teinture de sumbul, Fr.; *Sumbultinktur*, G.

Preparation.—Sumbul, in No. 30 powder, 100 Gm.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix alcohol and water in the proportion of 650 Cc. of alcohol to 350 Cc. of water. Moisten the powder with 100 Cc. of the menstruum, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour on more menstruum until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of sumbul use 3 av. ozs. and 148 grains of sumbul, and moisten with 3¼ fluidounces of menstruum (alcohol 65 volumes, water 35 volumes).

Sumbul 2½ oz. av., rectified spirit sufficient for 1 pint (Imperial).—*Br.*

The medicinal strength of tincture of sumbul (U. S. P.) is about the same as that of 1880, but the menstruum has been changed in alcoholic strength to about two-thirds of the former, which is supposed to be sufficiently strong to exhaust the powdered root; considering that the virtues of sumbul reside in an acid and volatile oil, a mixture of alcohol 3 volumes and water 1 volume would appear preferable, as in the case of valerian.

Uses.—This tincture probably possesses all the virtues of sumbul. Its *dose* is Gm. 0.60–2 (♏ x–xxx).

TINCTURA TOLUTANA, *U. S., Br.*—Tincture of Tolu.

Teinture de baume de Tolu, Fr.; *Tolubalsamtinktur*, G.

Preparation.—Balsam of Tolu 100 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Add the balsam of Tolu to 900 Cc. of alcohol, and macerate until dissolved; then filter through paper, adding, through the filter, enough alcohol to make the tincture measure 1000 Cc.—*U. S.*

To make 1 quart of tincture of Tolu dissolve 3 av. ozs. and 148 grains of balsam of Tolu in 29 fluidounces of alcohol, and add sufficient of the latter to make 32 fluidounces.

Balsam of Tolu 2½ oz. av., rectified spirit sufficient to make 1 pint (Imperial).—*Br.*

Balsam of Tolu 1 part, alcohol (sp. gr. 0.863) 5 parts.—*F. Cod.*

The tincture has a yellowish color, and becomes milky on the addition of water.

Uses.—This preparation is used for little else than to flavor cough mixtures; it is ineligible even for that purpose, since it is decomposed by water. Its flavor, however, remains after the removal of its resin, and in this manner the agreeable officinal syrup is formed. *Dose*, Gm. 4–8 (fʒj–ij).

TINCTURA VALERIANÆ, *U. S., Br., P. G., P. A.*—Tincture of Valerian.

Teinture de valériane, Fr.; *Baldriantinktur*, G.

Preparation.—Valerian, in No. 60 powder 200 Gm.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix alcohol and water in the proportion of 750 Cc. of alcohol and 250 Cc. of water. Having moistened the powder with 100 Cc. of the menstruum, macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour menstruum upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of valerian use 6 av. ozs. and 296 grains of valerian, and moisten with 3¼ fluidounces of the menstruum (alcohol 3 volumes, water 1 volume).

Valerian 2½ oz. av., proof spirit sufficient for 1 pint (Imperial).—*Br.* Valerian 1 part, alcohol (sp. gr. 0.912, *F. Cod.*) (sp. gr. 0.894, *P. G.*) 5 parts.

The alcoholic and medicinal strength of the official tincture has been altered, so that it is now practically identical with those of the French and German Pharmacopœias. The tincture is of a brown or reddish-brown color, varying somewhat with the variety of valerian employed, and has the odor and taste of the drug in a marked degree. On the addition of water it becomes opalescent and turbid.

Allied Tincture.—Tinctura valerianæ ætherea. Valerian 1 part, spirit of ether 5 parts. —*P. G.* Valerian 2 parts, ether (sp. gr. 0.724) 7 parts, alcohol 3 parts.—*F. Cod.* It is of a yellow or brownish-yellow color, and becomes opalescent and turbid on the addition of water.

Uses.—The tincture is much less frequently employed than the other preparations of valerian, although in certain cases it is more efficacious—those, namely, in which a prompt and efficient operation is required. Such cases are the *typhoid state* with predominance of ataxic phenomena and *delirium tremens*. On the other hand, in purely nervous disorders, especially of an hysterical kind, it is far less eligible than the infusion, the oil, the ammoniated tincture, or even the fluid extract of valerian. The *dose* is Gm. 4–8 (fʒj–ij).

TINCTURA VALERIANÆ AMMONIATA, *U. S., Br.*—Ammoniated Tincture of Valerian.

Teinture de valériane ammoniacale, Fr.; *Ammoniakalische Baldriantinktur*, G.

Preparation.—Valerian, in No. 60 powder, 200 Gm.; Aromatic Spirit of Ammonia a sufficient quantity; to make 1000 Cc. Moisten the powder with 200 Cc. of aromatic spirit of ammonia, and macerate for twenty-four hours in a closed vessel; then pack it firmly in a cylindrical glass percolator, and gradually pour aromatic spirit of ammonia upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of ammoniated tincture of valerian use 6 av. ozs. and 296 grains of valerian, and moisten with 6½ fluidounces of the menstruum (aromatic spirit of ammonia).

Valerian 2½ oz. av., aromatic spirit of ammonia sufficient for 1 pint (Imperial).—*Br.*

The tincture is of a brown color, with the odor and taste of valerian and of ammonia.

Uses.—This preparation may be employed in all the disorders in which the simple tincture is eligible, but it is perhaps best adapted to cases of a purely nervous description, in which its use need not be prolonged. It may be given in *doses* of from Gm. 2–4 (30 to 60 minims) in sweetened water or mucilage, but never in milk. A non-officinal preparation, the elixir of ammonium valerianate, operates in the same manner, but much less energetically. Both are suited to cases of *nervous headache* and of general nervousness with *insomnia*, produced by exhaustion of mind or body. *Dose*, Gm. 4–8 (fʒj–ij).

TINCTURA VANILLÆ, *U. S., P. A.*—Tincture of Vanilla.

Teinture de vanille, Fr.; *Vanilletinktur*, G.

Preparation.—Vanilla, cut into small pieces and bruised, 100 Gm.; Sugar, in coarse powder, 200 Gm.; Alcohol, Water, each a sufficient quantity; to make 1000 Cc. Mix

alcohol and water in the proportion of 650 Cc. of alcohol to 350 Cc. of water. Macerate the vanilla in 500 Cc. of this mixture for twelve hours, then drain off the liquid, and set it aside. Transfer the vanilla to a mortar, beat it with the sugar into a uniform powder, then pack it in a percolator, and pour upon it the reserved liquid. When this has disappeared from the surface gradually pour on the menstruum, and continue the percolation until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of vanilla macerate 3 av. ozs. and 148 grains of cut vanilla for twelve hours in 16 fluidounces of a mixture of alcohol 65 volumes, water 35 volumes; drain off the liquid, transfer the vanilla to a mortar, and beat it to powder with 6 av. ozs. and 296 grains of sugar; percolate with the expressed liquid, and afterward with fresh menstruum, until 32 fluidounces have been obtained.

Vanilla, cut, 1 part, alcohol (sp. grav. 0.863) 10 parts.—*F. Cod.*

The first formula agrees in the main with that for *essence* or *fluid extract of vanilla*, given in previous editions of this work; but the strength has been increased about 50 per cent., the commercial essence being usually made from 1 ounce of vanilla to 1 pint of tincture. Maceration of the cut vanilla with a portion of the menstruum previous to beating the former with sugar into powder was already directed in 1880, and facilitates the exhaustion of the bean.

Tincture of vanilla is used only as a flavoring agent.

TINCTURA VERATRI VIRIDIS, *U. S., Br.*—Tincture of Veratrum Viride.

Tincture of green (American) hellebore, E.; *Teinture de vératre vert*, Fr.; *Grün-Nieswurztinktur*, G.

Preparation.—Veratrum Viride, in No. 60 powder, 400 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Moisten the powder with 150 Cc. of alcohol, and macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour alcohol upon it until 1000 Cc. are obtained.—*U. S.*

To make 1 quart of tincture of veratrum viride use 13 av. ozs. and 155 grains of veratrum viride, and moisten with 5 fluidounces of the menstruum (alcohol).

Veratrum viride 4 oz. av., rectified spirit sufficient for 1 pint (Imperial).—*Br.*

This tincture is now about 20 per cent. weaker than that of the U. S. P. 1880, but still more than twice as strong as that of the Br. P. It is of a deep red-brown color, has a bitter and acrid taste, and becomes opalescent and turbid on the addition of water. The present English title is to be preferred to the older one, as not likely to lead to confounding this preparation with the tincture of Helleborus viridis which is employed in some parts of Europe.

Allied Tinctures.—Veratrum viride not being recognized by the French and German Pharmacopœias, these authorities have adopted a tincture from the closely-allied Veratrum album:

Tinctura veratri, *P. G.*—Teinture d'hellébore blanc (vératre blanc), *Fr.*—White veratrum 1 part, alcohol (sp. grav. 0.863) 5 parts.—*F. Cod.* White veratrum 1 part, alcohol (sp. grav. 0.894) 10 parts.—*P. G.*

Uses.—The American is more than twice as strong as the British tincture, and may be given to adults in *doses* of Gm. 0.40–0.50 (♏ vj–viij) every three hours, and cautiously increased until nausea is felt or the pulse begins to fall. The dose of the British tincture is from Gm. 0.30–1.30 ("5 to 20 minims"). This preparation and the fluid extract have been used hypodermically. Dr. E. R. Squibb suggests as the proper dose "8 to 10 minims of the fluid extract, or double that dose of the tincture, every fifteen minutes at first." The physiological effect may be certain; the therapeutical result is improbable. It may be remarked here, as was implied in the account given of green (American) hellebore itself, that while some of our native physicians exalt this medicine to the rank of a panacea, others condemn its use altogether as scientifically illogical and practically dangerous. Among the latter we desire to be reckoned. The reasons that have led us to this judgment are set forth under Veratrum Viride.

TINCTURA ZINGIBERIS, *U. S., Br., P. G.*—Tincture of Ginger.

Teinture de gingembre, Fr.; *Ingwertinktur*, G.

Preparation.—Ginger, in No. 40 powder, 200 Gm.; Alcohol a sufficient quantity; to make 1000 Cc. Moisten the ginger with 50 Cc. of alcohol, macerate for twenty-four hours; then pack it firmly in a cylindrical percolator, and gradually pour alcohol upon it until 1000 Cc. of tincture are obtained.—*U. S.*

To make 1 quart of tincture of ginger use 6 av. ozs. and 296 grains of ginger, and moisten with 1½ fluidounces of the menstruum (alcohol).

Ginger 2½ oz. av., rectified spirit sufficient for 1 pint (Imperial).—*Br.* Ginger 1 part; alcohol (sp. gr. 0.863, *F. Cod.*) (sp. grav. 0.894, *P. G.*) 5 parts. The tincture is brownish-yellow or reddish, has the aromatic odor and hot taste of ginger, and is rendered milky by water. Diluted alcohol yields a turbid tincture.

Allied Tincture.—Tinctura zingiberis fortior, *Br.*—Strong tincture of ginger, *E.*—Take of ginger, in fine powder, 10 ounces, rectified spirit a sufficiency. Pack the ginger tightly in a percolator, and pour over it carefully ½ pint of the spirit. At the expiration of two hours add more spirit, and let it percolate slowly until 1 pint (Imperial) of tincture has been collected.—*Br.* This has about one-half the strength of the fluid extract of ginger.

Uses.—These tinctures suffice for nearly all the purposes to which ginger can be applied, either internally or externally, and especially to parts slightly affected with muscular *rheumatism*, and to the abdomen in cases of *nausea* or colic; and internally the weaker tincture may be given for flatulent *colic*, *dysmenorrhœa*, etc. The British strong tincture is twice as strong as the American tincture, but neither is as strong as the fluid extract. The latter tincture may be prescribed in *doses* of Gm. 0.60–4 (♏ x–lx), the former in the dose of Gm. 0.30–2 (♏ v–xxx).

TRAGACANTHA, *U. S.*, *Br.*, *P. G.*—Tragacanth.

Gummi tragacantha.—Gomme adragante, F. Cod.; *Traganth*, G.; *Goma tragacanta*, Sp.

A gummy exudation from Astragalus gummifer, *Labillardière*, and from other species of Astragalus. Bentley and Trimen, *Med. Plants*, 73.

Nat. Ord.—Leguminosæ, Papilionaceæ.

Origin.—The genus Astragalus comprises numerous herbaceous, suffruticose, and shrubby species, and is characterized by its flowers having ten stamens, nine of which are united into a bundle, and by having the lower suture of their legumes inflexed so as to make the fruit apparently two-celled. The subgenus Tragacantha has the stipules united with the permanent petioles, which become thorny. According to Boissier and Haussknecht, the principal species yielding tragacanth are Astragalus adscendens, *Bois. et Haussk.*, A. brachycalyx, *Fischer*, A. microcephalus, *Willdenow*, A. pycnocladus, *Bois. et Haussk.*, A. stromatodes, *Bunge*, A. kurdicus, *Bois.*, A. cylleneus, *Bois. et Heldreich* (probably a variety of A. Parnassi, *Boissier*); also, A. verus, *Olivier*, and A. creticus, *Lamarck*. All are low shrubs, indigenous to a portion of the territory lying between Eastern Persia and Greece.

The secretion of tragacanth is due to a transformation of the cell-walls, with their incrusting layers, of the pith and medullary rays contained in the stem and older branches, as was first observed by Hugo von Mohl (1857), whose observations were corroborated by Wigand (1861). The altered tissue is confined in the plant between the wood-wedges with considerable tension, and oozes out with some force on breaking a branch or making an incision.

Collection.—Tragacanth exudes spontaneously either from fissures or from punctures and longitudinal incisions made into the stem and older branches. From such incisions flake tragacanth is obtained, while the spontaneously exuding gum often forms irregularly globular or somewhat conical pieces. The rapidity with which the gum exudes chiefly determines the shape in which it ultimately hardens, and the time which elapses before it is sufficiently hard for collection influences the color of the product, which is white if congealed rapidly, and more or less yellowish and brown if hardened slowly. Tragacanth enters commerce from the ports of Asia Minor and from the Persian Gulf.

Properties.—Tragacanth consists of different layers, either laid upon one another and spirally twisted, or confluent into tear-like masses, or extended into curved, narrow, or broad bands, varying in width between 6 and 25 Mm. (¼ inch and 1 inch), and sometimes 10–13 Cm. (4 or 5 inches) long. These bands are rarely made up of a single layer, but usually are marked with several parallel ridges, indicating the various strata, which are united into broader and thicker laminæ. This form of tragacanth is known as *flake tragacanth* or *leaf gum*, and is the more valuable the whiter and more translucent it is. Smyrna tragacanth is mostly in rather broad and thick flakes, which are yellowish or of a brownish tint, and often prominently ridged. Thin, ribbon-like, and white flakes are produced in Kurdistan and Persia, but are sometimes distinguished in commerce as Syrian tragacanth. Another variety is *vermiform tragacanth*, also called *vermicelli*. It

consists of very narrow, variously coiled, and contorted string-like pieces, the different coils of which are most frequently confluent. *Common tragacanth*, or *sorts*, in Europe known as *traganton*, is the product obtained by spontaneous exudation, forming subglobular, conical, or variously shaped tear-like pieces, with the surface rounded and more or less irregular, and usually of a brownish or brown color, and rather waxy in appearance; but it shows the stratification described above, and, like the white and thin bands, encloses starch.

Tragacanth is hard, tough, difficult to powder, inodorous, and tasteless, insoluble in alcohol and ether, and forms with 50 parts of water a thick, jelly-like mucilage. When diffused in a much larger quantity of water it forms a ropy liquid which may be passed through a filter, leaving behind an insoluble residue, which in contact with iodine acquires a blue color from the presence of starch. The mucilage acquires a yellow color on the addition of caustic soda, and the solution of tragacanth yields clear mixtures with borax, ferric chloride, and sodium silicate, is precipitated by alcohol, thickened by cold lead acetate and subacetate, and precipitated by these salts on heating (Flückiger).

Composition.—The soluble gum is not identical with arabin, though its solution is precipitated by alcohol and ammonium oxalate. The insoluble gum is known as *bassorin*, *traganthin*, *adraganthin*. It is soluble in hydrochloric acid and in ammonia, and is stated to have the composition $C_{12}H_{20}O_{10}$. According to Giraud (1876), tragacanth consists essentially of *pectose* or a closely-allied principle, which on being digested with water is gradually converted into a soluble compound, *pectin*, which is precipitated by alcohol. He regards it as very improbable that tragacanth should originate from a transformation of cellulose, since this body is ordinarily converted into dextrin and sugar, which compounds are not met with in tragacanth. According to this author, the average composition of tragacanth is 20 per cent. water, 60 per cent. pectin compound, 8 to 10 per cent. soluble gum, 3 per cent. cellulose, 2 or 3 per cent. starch, 3 per cent. of mineral constituents, and a trace of nitrogenous matter. By drying, tragacanth loses about 15 per cent. of moisture; the ash contains over half its weight of calcium carbonate.

Allied Gums.—Cherry Gum. The different species of cherry and plum trees frequently yield gummy exudations which harden to irregular nodulous masses, are of a more or less brown color, translucent, and dissolve imperfectly in water. According to Guérin, the insoluble portion of this gum is not identical with bassorin.

Bassora or Kutera Gum is a Persian product of unknown origin, and is met with in yellowish or brownish, semi-transparent, and tasteless masses, which swell considerably with water. It is used in Smyrna for adulterating the cheaper varieties of tragacanth, and is then usually broken into smaller pieces of about the same size as the tragacanth. Such broken pieces are angular, and are said to be sometimes artificially whitened with white lead. This fraud may be readily detected by treating the gum with cold dilute nitric acid, when the presence of lead in the solution may be established without difficulty.

Cashew Gum, *Gomme acajou*, is an exudation of Anacardium occidentale (see page 207), is brown-yellow, translucent, somewhat iridescent, and partly soluble in water. (See also Hog Gum, page 7.)

Other Species of Astragalus.—A. baeticus, *Linné*. An herbaceous annual of the basin of the Mediterranean. Its brownish-yellow, angular, subcubical seeds have been used as a substitute for coffee; they were examined by Trommsdorff (1824).

A. exscapus, *Linné*. This perennial is indigenous to the mountainous parts of Southern and Central Europe. Its root is mucilaginous, somewhat astringent and bitter, and was formerly used as a diuretic. Examined by Fleurot (1833), no peculiar active principle was found.

A. glycyphyllos, *Linné*. The leaves and seeds of this perennial, indigenous to Europe and Northern Asia, have an unpleasant sweet taste and are used as diuretics.

A. crotalariæ, *Gray*. This is a California plant, known as *loco-weed* and *rattle-weed*, and is reported to be poisonous to horses and cattle.

A. mollissimus, *Torrey*. It is indigenous to North America west of the Mississippi from Nebraska to Western Texas. Its leaflets are densely covered with a glossy, soft, white or yellowish pubescence. It is claimed to be poisonous to horses, but from neither this nor the preceding could poisonous principles be isolated.

Action and Uses.—Tragacanth is demulcent and nutritious. It was apparently unknown to the Greek physicians until the fourth or fifth century, and was then used to allay *cough* and *hoarseness* and promote *expectoration*, and, in a word, for all the affections in which gum-arabic has been employed. Its difficult solubility renders it less eligible than the latter gum in most instances. On the other hand, the greater tenaciousness of its mucilage fits it to be a better protective in some local affections, such as *burns*.

A. mollissimus has been studied by Dr. Isaac Ott, who summarizes its effects as follows: It lessens the irritability of the motor nerves and of the sensory ganglia of the central nervous system; has a spinal tetanic action; reduces the action of, and then arrests, the heart; salivates; ultimately it diminishes arterial tension, and dilates the

pupil (*Phila. Med. Times*, xii. 892; *Med. Record*, xxxiii. 197). *A. legum* is described by Gray as a species of the vetch tribe, and as rendering horses valueless. Dr. J. W. Carhart and Dr. Thornton Parker have described its effects on horses. Their hair grows dull, their flesh fails, their gait is staggering, their sight is impaired, and they seem intoxicated (*Med. Record*, xxxi. 10, 130). It does not appear to have affected man nor any animals but those of the equine species.

TRILLIUM.—Bethroot.

Birthroot, *Wakerobin*, E.; *Trillium*, Fr., G.

The rhizome of Trillium erectum, *Linné*.

Nat. Ord.—Liliaceæ.

Origin.—Bethroot is generally stated to be obtained from Trillium pendulum, which is now regarded as a white flowering variety of Tr. erectum, but the drug as met with in the market is evidently derived from different plants, and it is not unlikely that in different localities bethroot is collected from such species of Trillium as may be most abundant. All the species have a simple stem, mostly about 30 Cm. (1 foot) high, bearing at its apex a single hexandrous flower, and beneath it a whorl of three leaves, which are reticulate-palmately veined and usually broadly ovate or rhomboid in shape. The fruit is a triangular-ovate, three-celled, and many-seeded dark purple or red berry. The different species grow in moist thickets and shady woods in various parts of the United States and Canada. Two of the species have the dark-purple flower sessile between the leaves—namely, Tr. sessile, *Linné*, with erect petal and sessile leaves, and Tr. recurvatum, *Beck*, with recurved petals and stalked leaves. Two species have white flowers on erect peduncles and petiolate leaves—namely, Tr. nivale, *Riddell*, with the leaves and petals obtuse, and Tr. erythrocarpum, *Michaux*, with pointed leaves and petals, and the latter striped with purple near the base. Tr. cernuum, *Linné*, and Tr. stylosum, *Nuttall*, have white or rose-colored flowers on peduncles which are deflexed under the leaves, the last-named species being distinguished by the partly-united styles. Tr. erectum, *Linné*, bears a nodding and finally deflexed flower, with dark-purple spreading petals, or in the variety album (Tr. pendulum, *Muhlenberg*) with greenish-white or yellowish petals. The variety declinatum has a horizontal peduncle and white or pink-colored petals. Tr. grandiflorum, *Salisbury*, has a large white or rose-colored suberect flower.

Description.—Bethroot is a subglobular, oblong, or nearly obconical and oblique rhizome, which is truncate at the lower end and terminates above with a short tuft of sheathing leaf-bases. The rhizome is 25–38 Mm. (1 or 1½ inches) long, 12–18 Mm. (½ to ¾ inch) in diameter, slightly flattened, finely but distinctly annulate, and, particularly in the upper portion, beset with circular rows of straw-colored or pale-brownish rootlets or with the short remnants of the same. Bethroot is externally of a yellowish orange-brown color, internally whitish or more frequently yellowish or light-brown, and upon transverse section is seen to be composed of rather spongy parenchyma and of small scattered fibro-vascular bundles, which are circular, elongated, or irregularly curved, and more numerous toward the circumference than near the centre. It is inodorous or nearly so, and has a sweetish, astringent, afterward bitter and acrid taste.

Constituents.—On moistening a section of bethroot with solution of iodine the tissue assumes a uniform blue color, with the exception of the wood-bundles, proving the presence of starch in the parenchyma. From an investigation by Prof. E. S. Wayne (1856), it appears that on evaporating the tincture and diluting with water fatty and resinous matter, and perhaps a little volatile oil, are separated, and that from the aqueous liquid tannin and coloring matter are precipitated by lead acetate and subacetate, while the acrid principle remains in solution. On removing the excess of lead by sulphuric acid and filtering, the acrid principle, or probably a decomposition-product of it, is deposited as a gelatinous mass, soluble in alcohol, but insoluble in water, and producing with it on agitation a permanent foam. The principle deserves further investigation.

Action and Uses.—This is one of the plants used as a medicine by the American aborigines. Its acrid principle causes it to irritate the mouth and throat when chewed, and increase the flow of saliva. It is reputed to be astringent, tonic, and alterative, and to have a special action upon the uterine system, controlling *menorrhagia* and quickening the uterine contractions during *parturition*. It thus received the name of "birthwort." In large doses the root is alleged to be emetic, and the bruised herb has been applied with supposed advantage to unhealthy *ulcers* and to *tumors*. Trillium erectum appears to be the most active species. The *dose* of its dried and powdered root is stated at Gm. 4 (℥j).

TRIMETHYLAMINA.—Trimethylamine.

Triméthylamine, Fr.; *Trimethylamin*, G.

Formula $N(CH_3)_3$. Molecular weight 58.92.

Origin and Preparation.—This compound, frequently incorrectly called *propylamine*, with which it is isomeric, has been obtained from ergot (*secaline*), from the leaves of Beta vulgaris and Chenopodium vulvaria, from the flowers of Arnica montana, Pyrus communis, Sorbus aucuparia, and Cratægus oxyacantha, and from cod-liver oil, bone oil, and guano. It is also produced on heating codeine with potassa, but may be economically obtained from herring-pickle, which contains this alkaloid in considerable quantity and owes to it its peculiar odor. A mixture of herring-pickle and lime is subjected to distillation, the alkaline distillate is neutralized with hydrochloric acid and evaporated, and the saline residue is treated with absolute alcohol, which leaves ammonium chloride undissolved. The alcoholic solution is evaporated, the residue redissolved in a little water, and again carefully distilled with lime. If the vapors are first passed through an empty bottle before they are condensed by means of ice or conducted into water, several less volatile alkaloids are separated in the bottle. Large quantities of trimethylamine are now obtained from the residues left in the preparation of sugar from beets.

Properties.—In its pure state trimethylamine is a colorless, thin, and strongly alkaline liquid having a strong ammoniacal odor modified by the peculiar odor of herring-pickle, and boiling at 9.8° C. (49.6° F.). At ordinary temperatures it is a colorless, inflammable gas. It is readily soluble in water and alcohol, and an aqueous solution of it has been sold as *propylamine*. Trimethylamine chloroplatinate is soluble in alcohol and water, crystallizes in well-defined orange-colored octahedrons, and contains 37.21 per cent. of platinum. More characteristic, particularly in the presence of methylamine and allied bases, is the double salt with gold, which is very sparingly soluble in cold water, and has the composition $N(CH_3)_3HCl.AuCl_3$ (Hesse, 1857, 1883).

Trimethylamine hydrochloride, $N(CH_3)_3HCl$, is obtained on neutralizing the alkaloid with hydrochloric acid and evaporating. It crystallizes in white or colorless prisms. is nearly inodorous, has a saline pungent taste, is very deliquescent on exposure, and dissolves freely in water and alcohol.

Allied Compounds.—Amylamina, $NH_2C_5H_{11}$, is a colorless liquid, having a penetrating ammoniacal odor, and the density 0.7503 at 18° C., and boiling at 95° C. (203° F.). The hydrochlorate crystallizes in octahedrons, is freely soluble in water and alcohol, and is insoluble in ether.

Propylamina, $NH_2C_3H_7$, is a colorless, strongly refracting, inflammable liquid of an ammoniacal odor, boiling at 50° C. (122° F.), and yielding with platinic chloride a double salt, which crystallizes in orange-yellow clinorhombic plates.

Methylamina, NH_2CH_3, and Dimethylamina, $NH(CH_3)_2$, are colorless inflammable gases of an ammoniacal odor, very soluble in water, and condensing to colorless liquids, the former at − 18° C. (0.4° F.), the latter below 8° C. (46.4° F.).

Bilineurina, Cholina, $C_5H_{13}NO_2$, is obtained by boiling bile with caustic baryta, and in a similar manner from brain, yelk of egg (see Vitellus), and mustard-seed (*sinkaline*). It is present also in cotton-seed, fenugreek, fly agaric, herring-pickle; is formed in the human corpse in the beginning of decomposition, and has also been prepared synthetically. It is a colorless, syrupy, non-volatile liquid of a strongly alkaline reaction, very hygroscopic, combining readily with carbon dioxide, and soluble in alcohol or water in all proportions; on heating it gives off trimethylamine, and on boiling its aqueous solution the same alkaloid is given off and ethyleneglycol produced. On treating its hydroiodide with silver oxide, the anhydrous base, $C_5H_{13}NO$, is separated. By careful oxidation *betaine*, $C_5H_{11}NO_2$ (see p. 591), is produced.

Action and Uses.—Applied to the sound skin, trimethylamine is negative in its action unless friction is employed, in which case it causes redness very much as ammonia does. Upon the mucous membrane it acts as a strong irritant, causing a lively sense of burning, with redness, and if allowed to continue its action it produces superficial ulceration. Its taste is ammoniacal and saline, and if taken in a large dose and undiluted it occasions a burning sensation in the throat, œsophagus, and stomach. Propylamine and trimethylamine hydrochloride agree in their effects; 30 or 40 grains of the former or 10 grains of the latter will reduce the pulse about ten beats in the minute, and under the influence of the muriate the temperature may fall 1° or 2° F. In febrile rheumatism the decline of the pulse-rate and temperature is more decided. But the medicine causes neither diaphoresis, diuresis, colic, nor diarrhœa.

The disease in connection with which trimethylamine was first brought into notice, and the only one in which its importance as a medicine was recognized, is *articular rheu-*

matism. It does not appear what motives first led to its use in the treatment of this affection by Awenarius of St. Petersburg, who between 1854 and 1856 treated by its means more than two hundred and fifty rheumatic patients, and affirmed that it dissipated the pain of the acute disease from one day to another. Isolated statements attributing to it a similar efficacy were made in France previous to 1864; but in 1870, Lagrange confirmed them, and in 1873, Dujardin-Beaumetz gave the history of seven cases of acute articular rheumatism which were cured in a very short time by trimethylamine. The improvement in general was rapid, and sometimes great relief was experienced within twelve hours, the pain first and then the swelling subsiding, as well as the fever. Further experience led him to conclude that of all the remedies hitherto used in the treatment of acute articular rheumatism, trimethylamine hydrochloride appeared to be the most efficient. A number of physicians in France have sustained this conclusion by their own experience; a few have published a similar judgment in England, and also in Germany. The less favorable accounts of some others are attributed to their having made use of ill-prepared and inert preparations of the medicine or of those which did not contain a due proportion of the active ingredient. As will be observed, this history of the virtues of trimethylamine in rheumatism has a striking analogy with that of salicylic acid and its salts in the same disease; the same mode of action is attributed to the two medicines, and the same extraordinary curative powers are ascribed to both. These medicines in their turn have been supplanted by antipyrine and antifebrin, so that of the oldest in the group hardly any trace can be found in medical literature since 1879.

Weiss has reported that this medicine is very efficient in the treatment of *chorea*, moderating the spasmodic movements greatly, even when it did not suspend them, when it was given to the extent of Gm. 1–1.30 (gr. xv–xx) a day.

The *dose* of trimethylamine is Gm. 0.10–0.40 (♏ij–vj) every three or four hours. Its extremely offensive taste and smell render necessary its administration in syrup flavored with mint, or anise, or some other aromatic water. To obviate this objection the substitution of the trimethylamine hydrochloride, which has no smell and only a faint taste, has been proposed. Dr. J. L. Tyson has reported favorably of its use in doses of 2 grains every two hours (*Phila. Med. Times*, ix. 374). It is generally given in doses of Gm. 0.10–0.20 (gr. ij–iij), dissolved in a syrup and repeated at similar intervals, so that not less than Gm. 1 (gr. xv) shall be taken during the day.

TRIOSTEUM.—Fever-root; Horse-gentian.

Feverwort, Bastard ipecac, Tinker's weed, E.; *Trioste*, Fr.; *Dreisteinwurzel*, G.

The root of Triosteum perfoliatum, *Linné.*

Nat. Ord.—Caprifoliaceæ.

Origin.—This perennial herb is indigenous to the United States, grows in woodlands, and flowers in June. The stem is from 0.6–1.2 M. (2 to 4 feet) high, soft-hairy, and has opposite spatulate-ovate and entire leaves, which are about 10 Cm. (4 inches) long, abruptly narrowed below and connate at the base. The flowers are in axillary clusters, and have a five-lobed brown-purple corolla, about 12 Mm. (½ inch) long. The ripe fruit is orange-colored, drupaceous, and contains three hard nutlets. All parts of the plant have a bitter taste, but only the rhizome and root are employed. The more slender and rougher Tr. angustifolium, *Linné*, which has greenish flowers and grows chiefly in the Western and Southern United States, is said to have similar properties.

Description.—The rhizome is horizontal, from 15–30 Cm. (6 to 12 inches) long, knotty-cylindrical, about 18 Mm. (¾ inch) thick, somewhat branched, and on the upper side bears numerous cup-shaped scars of the over-ground stems about 6 Mm. (¼ inch) in diameter. The numerous spreading rootlets are inserted mainly on the lower side of the rhizome, and are at their base 6–9 Mm (¼ to ⅜ inch) thick, and 12–25 Cm. (5 to 10 inches) long. Both the rhizome and the rootlets are slightly wrinkled longitudinally, externally of a yellowish-brown color, internally white, and contain a hard, slightly bitter wood, with delicate medullary rays. The bark of the rhizome is thin, that of the roots rather thick, and has a bitter somewhat nauseous taste. Fresh fever-root has a slight disagreeable odor, which is dissipated on drying.

Constituents.—On moistening a transverse section of the roots with solution of iodine a deep-blue color is imparted to the medullary rays and the cambium-layer, but the bark acquires only a slight-blue tinge. Fever-root has not been subjected to analysis; its bitter principle is dissolved both by water and alcohol.

Uses.—A decoction of this plant is said to have been used by some of the American aborigines in the treatment of *fevers* and *female obstructions*. The fresh root, in the dose of Gm. 1.30–2 (gr. xx–xxx), and the extract in the dose of Gm. 0.60–1 (gr. x–xv), purge actively after the manner of jalap. The bark of the root is said to be emetic.

TRITICUM, *U. S.*—Triticum; Couch-grass.

Rhizoma (Radix) graminis.—*Quick-grass, Quickens, Quitch*, E.; *Chiendent officinal, Petit chiendent*, Fr. Cod.; *Queckenwurzel, Grasswurzel*, G.; *Grama*, Sp.

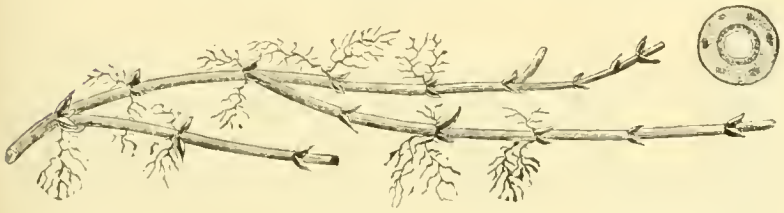
The rhizome of Agropyrum (Triticum, *Linné*) repens, *Beauvais*, collected in the spring and deprived of the rootlets.

Nat. Ord.—Graminaceæ.

Origin.—Couch-grass is a troublesome perennial weed growing along roadsides and in cultivated grounds throughout the northern hemisphere. The plant has a long, jointed, whitish rhizome, with a tuft of fibrous rootlets at each joint. The culm is about 0.6 M. (2 feet) or sometimes 1.2 M. (4 feet) high, and has compressed spikes 7–10 Cm. (3 or 4 inches) long, and four- to eight-flowered spikelets. The florets are variable, mostly awnless, and either pointed or rather obtuse.

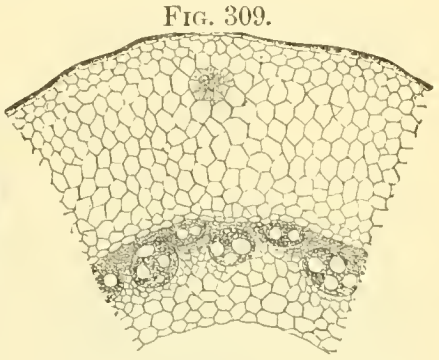
Description.—Couch-grass root is met with in the market cut into short sections, about 5–10 Mm. ($\frac{1}{5}$ to $\frac{2}{5}$ inch) in length, about 2 Mm. ($\frac{1}{12}$ inch) in diameter, of a straw-yellow color, smooth, hollow in the centre, inodorous, and of a sweet taste. The transverse section shows the central cavity surrounded by a narrow layer of delicate parenchyma, projecting somewhat into the equally narrow circle of fibro-vascular bundles, which is separated by the nucleus-sheath from the broad outer layer of parenchyma containing about six or eight isolated, distant fibro-vascular bundles in a loose circle. In Spain and Mexico the rhizome of *Bermuda grass* or *Scotch grass*, Cynodon Dactylon, *Persoon*, is employed like couch-grass.

Fig. 308.



Triticum repens: rhizome; transverse section, magnified 3 diam.

Fig. 309.



Section through portion of rhizome, magnified 65 diam.

Constituents.—The latest analysis of couch-grass root is by Ludwig and H. Müller (1872, 1873), who obtained from it malates, a nitrogenous principle which is readily darkened by heat, fruit-sugar (2.4 or 3.3 per cent.), levulose, and a right-rotating sugar which is not identical with cane-sugar. A peculiar gum-like principle, *triticin*, was isolated, which resembles inulin in its optical behavior, and, like this, may be converted into levulose. It is obtained by exhausting the rhizome with water, neutralizing with baryta, concentrating, precipitating with lead subacetate, removing the excess of lead, treating with animal charcoal, neutralizing the filtrate, again concentrating, and precipitating by alcohol (Reidemeister, 1880). Triticin is amorphous and transparent in thin layers or forms a white powder; it is inodorous, tasteless, very hygroscopic, in damp air deliquescent, insoluble in ether and absolute alcohol, and is oxidized by nitric acid to oxalic acid. Mannit, which was stated by Berzelius (1837) and Völker (1846) to be present in the rhizome, has not been obtained by later investigations; but the extract of couch-grass root may contain calcium lactate, and possibly also mannit, as products resulting from fermentation. Couch-grass root yields about 4.5 per cent. of ash, which is rich in silica.

Allied Drugs.—Sorghum-fruit is 3–4 Mm. ($\frac{1}{8}$ or $\frac{1}{6}$ inch) long, nearly as wide, broadly oval, somewhat flattened, brownish-yellow, and somewhat granular externally, or covered with the glossy dark-purple paleæ; internally white and mealy; inodorous and of a farinaceous and sweetish taste.

Action and Uses.—Couch-grass was employed by the ancients as a vulnerary and for the relief of dysury. They also believed that it removed stone, or at least *gravel*,

from the bladder. In modern times it has been very generally regarded as emollient, antiphlogistic, and diuretic. Its infusion is a common medicinal drink in European hospitals and private life, and is regarded as adapted to relieve thirst, allay fever, and promote urination. It was formerly employed as a popular diet-drink to "purify the blood" in the spring season, and doubtless assisted in purging, through the kidneys, the accumulated organic detritus of a long winter. It was also thought to be very efficient in relieving congestions of the liver and portal circulation with *jaundice* arising under analogous circumstances, and in a less degree chronic *bronchitis*, *skin diseases*, *gout*, etc. It was even alleged to be capable of curing gastric cancer and removing biliary calculi. In truth, it possesses no special medicinal virtues beyond being, when given in infusion, an agreeable drink, which, owing to the sugar it contains, tends to increase the urinary secretion, and thereby palliate irritations of the *urinary passages*. It is best administered in a decoction prepared with Gm. 64–128 in Gm. 1000 (℥ij–iv in Oij) of water, and reduced one-half by boiling. The officinal fluid extract may be used for the same purposes if largely diluted.

The seeds of *Sorghum vulgare*, or broom-corn, are said to have been in common use as a remedy for disorders of the bladder by the plantation negroes of Maryland and Virginia. They made a decoction by boiling 2 ounces of the seed in a quart of water until reduced to a pint. It has been found useful as a palliative in several cases of *cystitis* by Dr. Garnett (*Amer. Jour. of Med. Sci.*, July, 1881, p. 165).

TRITURATIONES, *U. S.*—Triturations.

Triturations, Fr.; *Triturationen*, G.

This term has been used in homœopathic pharmacy in the same sense in which it has been adopted by the U. S. Pharmacopœia—namely, for powders prepared by trituration of a medicinal substance with a definite quantity of milk-sugar. In homœopathy this is done with a view of developing the medicinal power, and two proportions are used, termed the centesimal and the decimal scales; 1 part of the substance being triturated with 99 parts or with 9 parts of the milk-sugar gradually added.

Preparation.—The directions for preparing these powders are very similar to those followed in homœopathic dispensing, excepting that the length of time for mixing and triturating has been omitted.

"Triturations are to be prepared by the following formula: Take of the substance 10 parts, sugar of milk, in moderately fine powder, 90 parts; to make 100 parts. Weigh the substance and sugar of milk separately; then place the substance, previously reduced, if necessary, to a moderately fine powder, in a mortar; add about an equal bulk of sugar of milk, mix well by means of a spatula, and triturate them thoroughly together. Add fresh portions of the sugar of milk from time to time until the whole is added, and continue the trituration until the substance is intimately mixed with the sugar of milk, and finely comminuted."—*U. S.*

Uses.—The utility of this new title is open to very grave doubts on moral as well as therapeutical grounds, the former because the title is borrowed from a fraudulent and illegitimate system of medicine, and the latter because all of the liquid and most of the solid medicines dispensed in this form could as well be given in solution. Moreover, it encourages the prevalent habit, fostered also by the officinal pills, and as erroneous scientifically as it is practically misleading, that the doses of medicines are fixed quantities. Sugar of milk is undoubtedly susceptible of minuter divisions by trituration than cane-sugar, but its use is a practical detail that may very well be left to the physician and the pharmaceutist, and modified according to circumstances.

TRITURATIO ELATERINI, *U. S.*—Trituration of Elaterin.

Trituration d'élatérine, Fr.; *Elaterintrituration*, G.

Preparation.—Elaterin 10 parts, Sugar of Milk 90 parts; to make 100 parts. Mix them thoroughly by trituration.—*U. S.*

Medical Uses.—The average *dose* of elaterin being Gm. 0.004 ($\frac{1}{16}$ grain), and the proportion of the drug in the trituration being one-tenth, it follows that the dose of the latter should be about Gm. 0.05 (gr. $\frac{3}{4}$).

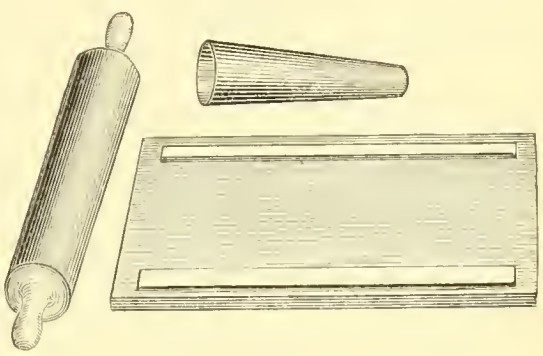
TROCHISCI, *U. S., Br., P. G.*—Troches.

Tabellæ, F. Cod.—*Lozenges*, E.; *Tablettes*, *Pastilles*, F.; *Pastillen*, *Zeltchen*, G.

Troches are mixtures of medicinal substances with sugar or extract of liquorice, formed by the aid of mucilage into stiff, pasty masses, and divided into flat circular, oblong, rectangular, or stellate pieces, usually weighing about 10 or 20 grains. A cylindrical shape has been adopted for a few of the official lozenges. The French Codex makes a distinction between tablettes and pastilles, and applies the former term to the preparations just defined, and restricts the term *pastilles* to the sugar drops described below.

Preparation.—The dry ingredients are separately reduced to fine powders and thoroughly mixed in a mortar or by sifting. Volatile oils, tinctures, and similar liquids should now be intimately incorporated with the powder, and the whole beaten into a rather firm mass by the addition of mucilage of tragacanth or of acacia. The mass is then rolled out into sheets of suitable thickness and cut into the requisite number of pieces by a punch. A hard and smooth board or a polished marble slab, dusted over with finely-powdered sugar, is well adapted for this purpose; and in order to keep the mass at a somewhat elevated temperature while being rolled out the roller is sometimes made of iron or glass and hollow in the interior, so that it may be filled with water of any desired temperature. When lozenges are ordered on extemporaneous prescriptions, the mass is usually rolled out into a square, rectangular, or rhombic cake, and then divided by means of a ruler and knife into the requisite number of pieces, all having the same size and shape. After lozenges have been cut they are spread out on a sieve or other surface and exposed to a current of warm air until they are sufficiently dry.

Fig. 310.



Board, Roller, and Punch for making Lozenges.

The amount of powdered tragacanth necessary for imparting the requisite adhesiveness varies with the nature of the ingredients: 1 part of it is sufficient for 100 parts, and even more, of sugar and similar powders if, after the addition of water, the mass is well beaten. A much larger proportion of tragacanth renders the lozenges, after some time, very hard and slowly soluble. If mucilage of acacia is employed instead of tragacanth, the lozenges become somewhat translucent, and a similar effect is produced by employing the white of eggs as the adhesive material. In order to secure a perfectly smooth paste it is advisable to use bolted sugar, known among confectioners as lozenge sugar, which can be had pure and in almost impalpable powder. In place of mucilage, fruit paste made from red or black currants is frequently employed in the preparation of lozenges: this, aside from its agreeably acidulous taste, is highly prized in the treatment of certain throat affections. Some manufacturers employ a machine with movable dies for cutting lozenges of any desired shape, and for stamping them at the same time with the name of the principal ingredient. A simple instrument for cutting lozenges with a tubular punch has been described by A. D. Marcy in *New Remedies*, 1882, p. 34. Lozenge-boards, adjustable for different sizes, are described by F. L. Slocum and F. E. Harrison in *Amer. Jour. Pharmacy*, 1879, p. 589, and 1880, p. 254.

If the lozenges are to be made of a cylindrical shape, the mass is rolled out into thin cylinders, in a manner similar to that of making pills, and then cut into shorter pieces having the requisite weight. The mass should be sufficiently firm not to flatten on drying, and the rolling-board, instead of being dusted with sugar, is greased with a little olive oil, to prevent the mass from adhering to it. (For a description and sketch of an apparatus by F. C. Hill, suitable for making such lozenges, see *Amer. Jour. Phar.*, 1874, p. 402.)

The general directions of the French Codex for the preparation of tablettes agree with the description given above. But for some years past *compressed tablettes* have been in use, prepared in a manner similar to that in which compressed pills are made (see p. 1238); and this form has been adopted by the German Pharmacopœia, which gives the following general directions: "For preparing *sugar pastilles*, the whole amount of the medicinal substance is intimately mixed with sufficient powdered sugar to make each

lozenge weigh 1 Gm.; alcohol (sp. gr. 0.994) is now carefully added to produce a damp powder, which by compression will form a coherent mass; from this powder the requisite number of lozenges are made. For *chocolate pastilles* a mass is made by melting together, with the aid of a steam-bath, equal weights of cacao and sugar, and a sufficient weight of medicinal substance is added, so as to form lozenges weighing 1 Gm.; the somewhat cooled mass is then divided into the requisite number of lozenges."

The French Codex likewise directs the tablettes to weigh 1 Gm., and permits some kinds to be variously flavored, for which purpose to every 1000 Gm. of mass may be added 1 Gm. of volatile oil of anise, lemon, or peppermint or 10 Gm. of tincture of vanilla; and in case the flavor of rose or orange-flower is desired, the distilled aromatic water is used in the place of water for preparing the mucilage employed in rendering the mass plastic.

Pastilli (Rotulæ) sacchari.—Sugar lozenges, Sugar drops, *E.;* Pastilles, Orbicules, *Fr.;* Zuckerplätzchen, *G.*—This form of lozenges is usually made by the confectioner, and the medication merely is left to the pharmacist. The lozenges are prepared by mixing, in a pan having a suitable lip, some granulated sugar with a sufficient quantity of water to form a pasty mixture; this is heated carefully to prevent empyreuma, until it begins to boil. An additional quantity of sugar is then stirred in to give the requisite consistence; 100 parts of sugar require about 12 to 15 parts of water. The semi-liquid mass is now poured out upon cold, polished sheet iron in such a manner that each drop is kept separate, when, on touching the iron plate, it will congeal into a flattish hemispherical body. The peppermint drops of the French Codex are made in this manner, ½ per cent. of oil of peppermint being incorporated with the sugar and 12½ per cent. of water; this mixture is heated in small portions and dropped in the manner stated. *Chocolate drops* are made by a similar process. The term *trochisques*, formerly used in France for such lozenges, is now usually applied to the little cones obtained in drying clutriated powders (see p. 552).

Rotulæ menthæ piperitæ, *P. G.*—Peppermint drops, *E.;* Pastilles de menthe à la goutte, *Fr.;* Pfefferminzkuchen, *G.*—Dissolve 1 part of oil of peppermint in 2 parts of alcohol; add the solution to 200 parts of sugar drops in a bottle, and well agitate, so as to impregnate them uniformly with the liquid; afterward expose to the air for a few minutes, and when the alcohol has evaporated keep in a stoppered bottle. By substituting other volatile oils for the oil of peppermint, lozenges of any desired flavor may be obtained.

Most of the lozenges of the British Pharmacopœia vary but slightly from 1 Gm. (15.43 grains) in weight, but the majority of the troches of the U. S. Pharmacopœia weigh between 10½ and 12½ grains, or between .68 and .80 Gm., while troches of cubeb weigh 6⅔ grains (.44 Gm.), and troches of potassium chlorate about 24 grains (1.56 Gm.).

In addition to the troches described below, the following have been admitted by the French Codex, of which we give the title and the weight of medicinal ingredient in each: Tablettes de baume de Tolu, .05 Gm.; T. de borate de soude, .10 Gm.; T. de calomel, .05 Gm.; T. de charbon, .50 Gm.; T. de gomme, .01 Gm.; T. de guimauve, .01 Gm.; T. de kermès, .01 Gm.; T. de lichen (made with one-third saccharure, p. 441); T. de manne, .20 Gm.; and T. de soufre, .10 Gm.

TROCHISCI ACIDI TANNICI, *U. S., Br.*—Troches of Tannic Acid.

Tablettes (Pastilles) de tannin, Fr.; *Tanninpastillen*, G.

Preparation.—Tannic Acid 6 Gm.; Sugar, in fine powder, 65 Gm.; Tragacanth, in fine powder, 2 Gm.; Stronger Orange-flower Water a sufficient quantity; to make 100 troches. Rub the powders together until they are thoroughly mixed; then with orange-flower water form a mass, to be divided into 100 troches.—*U. S.*

To make 25 tannin lozenges use 25 grains of tannic acid, 250 grains of sugar, and 8 grains of powdered tragacanth.

Tannic acid 360 grains; tincture of Tolu ½ fluidounce; refined sugar, in powder, 25 oz. av.; gum-acacia, in powder, 1 oz. av.; mucilage of gum-acacia 2 fluidounces; distilled water 1 fluidounce; prepare 720 lozenges.—*Br.*

Trochisci acidi benzoici, *Br.*, are made like the preceding from 360 grains of benzoic acid, but omitting tincture of Tolu.

Uses.—Tannic-acid troches are suitable in relaxed states of the mucous membrane of the mouth, throat, and larynx to allay *cough* produced by irritation of these parts. They may also be used in mild cases of *diarrhœa* after a preliminary evacuation of the bowels.

TROCHISCI AMMONII CHLORIDI, *U. S.*—Troches of Ammonium Chloride.

Tablettes (Pastilles) de sel ammoniac, Fr.; *Salmiakpastillen*, G.

Preparation.—Ammonium Chloride, in fine powder, 10 Gm.; Extract of Glycyrrhiza, in fine powder, 25 Gm.; Sugar, in fine powder, 50 Gm.; Tragacanth, in fine powder, 2 Gm.; Syrup of Tolu a sufficient quantity; to make 100 troches. Rub the powders together until they are thoroughly mixed; then with syrup of Tolu form a mass, to be divided into 100 troches.—*U. S.*

To make 25 ammonium chloride lozenges use 40 grains of ammonium chloride, 100 grains of extract of liquorice, 200 grains of sugar, and 8 grains of powdered tragacanth.

Uses.—These lozenges may be used to palliate subacute and chronic inflammations of the *throat* and *air-passages*, but they are less efficient than the inhalations of the salt recommended elsewhere.

TROCHISCI BISMUTHI, *Br.*—Bismuth Lozenges.

Tabellæ cum subnitrate bismuthico, F. Cod.—*Tablettes (Pastilles) de sous-nitrate de bismuth*, Fr.; *Wismuthpastillen*, G.

Preparation.—Take of Bismuth Subnitrate 1440 grains; Magnesium Carbonate 4 oz. av.; Precipitated Calcium Carbonate 6 ounces; Refined Sugar 29 ounces; Gum-Acacia, in powder, 1 ounce; Mucilage of Gum-Acacia 2 fluidounces; Rose-water a sufficiency. Mix the dry ingredients, then add the mucilage, and form the whole into a proper mass with rose-water. Divide the mass into 720 lozenges, and dry these in a hot-air chamber with a moderate heat. Each lozenge contains 2 grains of bismuth subnitrate.—*Br.*

The corresponding lozenges of the French Codex contain 0.10 Gm. (1.5 grains) of the subnitrate, but no magnesia or calcium carbonate.

Uses.—This form of administering bismuth is very unprofitable, since bismuth does not act except mechanically and by diffusion.

TROCHISCI CATECHU, *U. S., Br.*—Troches of Catechu.

Tabellæ cum catechu, F. Cod.—*Catechu lozenges*, E.; *Tablettes (Pastilles) de cachou*, Fr.; *Katechupastillen*, G.

Preparation.—Catechu, in fine powder, 6 Gm.; Sugar, in fine powder, 65 Gm.; Tragacanth, in fine powder, 2 Gm.; Orange-flower Water a sufficient quantity; to make 100 troches. Rub the powders together until they are thoroughly mixed; then with orange-flower water form a mass, to be divided into 100 troches.—*U. S.*

To make 25 catechu lozenges use 25 grains of catechu, 250 grains of sugar, and 8 grains of powdered tragacanth.

Pale catechu, in powder, 720 grains; refined sugar, in powder, 25 oz. av.; acacia, in powder, 1 oz. av.; mucilage of gum-acacia 2 fluidounces; distilled water a sufficiency; prepare 720 lozenges.—*Br.* Each lozenge contains 1 grain, *U. S.*, *Br.* (0.10 Gm. = 1.5 grains, *F. Cod.*) of catechu.

Uses.—These troches, each containing 1 grain of catechu, are serviceable in the cases mentioned under Trochisci Acidi Tannici. They are generally employed to obviate the *hoarseness* or huskiness of the voice due to prolonged speaking or to slight *pharyngeal* or *laryngeal catarrh*.

TROCHISCI CRETÆ, *U. S.*—Troches of Chalk.

Tablettes (Pastilles) de craie lavée, Fr.; *Kreidepastillen*, G.

Preparation.—Prepared Chalk 25 Gm.; Acacia, in fine powder, 7 Gm.; Spirit of Nutmeg 3 Cc.; Sugar, in fine powder, 40 Gm.; Water a sufficient quantity; to make 100 troches. Rub them together until they are thoroughly mixed; then with water form a mass, to be divided into 100 troches.—*U. S.*

To make 25 chalk lozenges use 100 grains of prepared chalk, 28 grains of acacia, 150 grains of sugar, and 12 minims of spirit of nutmeg.

The spirit of nutmeg which is now used in place of grated nutmeg (1880) should be well triturated with a portion of the sugar before mixing with the other ingredients. Each lozenge contains 4 grains (.26 Gm.) of prepared chalk.

Uses.—Troches of chalk may be used to correct *acidity* of the stomach and a slight tendency to *diarrhœa*.

TROCHISCI CUBEBÆ, *U. S.*—Troches of Cubeb.

Pastilles de cubèbe, Fr.; *Kubebenpastillen*, G.

Preparation.—Oleoresin of Cubeb 4 Gm.; Oil of Sassafras 1 Cc.; Extract of Glycyrrhiza, in fine powder, 25 Gm.; Acacia, in fine powder, 12 Gm.; Syrup of Tolu a sufficient quantity; to make 100 troches. Rub the powders together until they are thoroughly mixed; then add the oleoresin and oil and incorporate them with the mixture. Lastly, with syrup of Tolu form a mass, to be divided into 100 troches.—*U. S.*

To make 25 cubeb lozenges use 16 grains of oleoresin of cubeb, 6 drops of oil of sassafras, 100 grains of extract of liquorice, and 48 grains of powdered acacia.

This is a modification of the formula for *Spitta's lozenges*, from which it differs essentially in the substitution of oleoresin for powdered cubebs. The lozenges are usually made of a cylindrical shape, and each contains about $\frac{2}{3}$ grain of oleoresin of cubeb.

Uses.—These troches are chiefly used in cases of subacute and chronic inflammation of the *pharynx* and *larynx*, especially when these parts are covered with viscid mucus.

TROCHISCI FERRI, *U. S.*—Troches of Iron.

Tablettes (Pastilles) de l'hydrate de fer, Fr.; *Ferrihydrat-Pastillen*, G.

Preparation.—Ferric hydroxide, dried at a temperature not exceeding 80° C. (176° F.), 30 Gm.; Vanilla, cut into slices, 1 Gm.; Sugar, in fine powder, 100 Gm.; Mucilage of Tragacanth a sufficient quantity; to make 100 troches. Rub the vanilla first with a portion of the sugar to a uniform powder, and afterward with the iron and the remainder of the sugar, until they are thoroughly mixed. Then with mucilage of tragacanth form a mass, to be divided into 100 troches.—*U. S.*

To make 25 iron lozenges use 116 grains of carefully dried ferric hydroxide, 4 grains of sliced vanilla bean, and 386 grains of sugar.

Each lozenge contains nearly 5 grains of ferric hydroxide. The French Codex recognizes three lozenges made with soluble salts of iron—namely, Tablettes de lactate de fer, T. de citrate de fer ammoniacal, and T. de tartrate de fer ammoniacal.—*F. Cod.* These are flavored with vanilla, and each lozenge contains .05 Gm. ($\frac{3}{4}$ grain) of the salt.

Uses.—Ferric hydroxide of iron in troches is only a little less objectionable than the reduced iron troches of the British Pharmacopœia. Both deserve to be classed among pharmaceutical and medical superfluities. We may repeat concerning troches of iron what was said of troches of the subcarbonate of iron in a former edition of this work: they are convenient for administering to "refractory children, who may be tempted by their agreeable flavor to take them." Each troche contains Gm. 0.30 (gr. v) of hydrated oxide of iron.

TROCHISCI FERRI REDACTI, *Br.*—Reduced Iron Lozenges.

Tablettes (Pastilles) de fer, Tablettes chalybées, Fr.; *Eisenpastillen*, G.

Preparation.—Take of Reduced Iron 720 grains; Refined Sugar, in powder, 25 oz. av.; Gum-Acacia, in powder, 1 oz. av.; Mucilage of Gum-Acacia, 2 fluidounces; Distilled Water 1 fluidounce or a sufficiency. Mix the iron, sugar, and gum, and add the mucilage and water to form a proper mass. Divide into 720 lozenges, and dry these in a hot-air chamber with a moderate heat. Each lozenge contains 1 grain of reduced iron. —*Br.*

Uses.—It is not easy to discern the merits of this preparation. Reduced iron can be serviceable only when it is acidulated by the gastric acids, and that action is better secured by administering it in powder.

TROCHISCI GLYCYRRHIZÆ ET OPII, *U. S.*—Troches of Glycyrrhiza (Liquorice) and Opium.

Trochisci opii, Br.—*Opium lozenges*, E.; *Pastilles d'opium, P. de réglisse opiacées*, Fr.; *Opiumpastillen*, G.

Preparation.—Extract of Glycyrrhiza, in fine powder, 15 Gm.; Powdered Opium 0.5 Gm.; Acacia, in fine powder, 12 Gm.; Sugar, in fine powder, 20 Gm.; Oil of Anise 0.2 Cc.; to make 100 troches. Rub the powders together until they are thoroughly

mixed; then add the oil of anise, and incorporate it with the mixture. Lastly, with water form a mass, to be divided into 100 troches.—*U. S.*

To make 25 liquorice-and-opium lozenges use 58 grains of extract of liquorice, 2 grains of powdered opium, 48 grains of acacia, 78 grains of sugar, and 1 drop of oil of anise.

Extract of opium 72 grains, tincture of Tolu ½ fluidounce; refined sugar, in powder, 16 oz. av.; gum-acacia, in powder, 2 oz. av.; extract of liquorice 6 oz. av.; distilled water a sufficiency; prepare 720 lozenges.—*Br.*

The lozenge of the first formula (*U. S.*) contains about $\frac{1}{12}$ grain of powdered opium, and that of the second formula (*Br.*) $\frac{1}{10}$ grain of extract of opium. The lozenges of the United States Pharmacopœia are much used under the name of *Wistar's cough lozenges*, and are prepared of a cylindrical shape. Lozenges of the same shape and composition, but with the omission of opium, have been introduced as *liquorice lozenges*, and are similar to the *Trochisci bechici nigri*, which are still used to some extent in Europe, and usually contain a small quantity of orris-root and balsam of Tolu.

Uses.—This popular medicine is well adapted for use in *bronchitis* and *laryngitis* attended with harassing cough, but without marked febrile reaction. Its efficiency is greatly increased in the more acute forms of the affections mentioned by the addition of a minute proportion of tartar emetic, not exceeding the fortieth of a grain, or of half a grain of ipecacuanha, to each troche. On an average, one troche may be taken every three hours, but in general it is better to use the third of a troche every hour. Patients are very apt to use them in excess, and thereby induce constipation and loss of appetite.

TROCHISCI IPECACUANHÆ, *U. S., Br.*—Troches of Ipecac.

Tabellæ cum ipecacuanha, F. Cod.; *Ipecacuanha lozenges*, E.; *Tablettes (Pastilles) d'ipécacuanha*, Fr.; *Brechwurzelpastillen*, G.

Preparation.—Ipecac, in No. 60 powder, 2 Gm.; Tragacanth, in fine powder, 2 Gm.; Sugar, in fine powder, 65 Gm.; Syrup of Orange a sufficient quantity; to make 100 troches. Rub the powders together until they are thoroughly mixed; then with syrup of orange form a mass, to be divided into 100 troches.—*U. S.*

To make 25 ipecac lozenges use 8 grains of powdered ipecac, 8 grains of tragacanth, and 250 grains of sugar.

Ipecacuanha, in powder, 180 grains; refined sugar, in powder, 25 oz. av.; gum-acacia, in powder, 1 oz. av.; mucilage of gum-acacia 2 fluidounces; distilled water 1 fluidounce or a sufficiency; prepare 720 lozenges.—*Br.*

Each lozenge contains about .02 Gm. ($\frac{1}{3}$ grain) *U. S.*, ¼ grain *Br.*, 0.01 Gm. ($\frac{1}{7}$ grain) *F. Cod.*, of ipecacuanha.

Uses.—Ipecacuanha troches are useful in *laryngeal* and *bronchial inflammation* before secretion has been established. One troche, containing a third of a grain of ipecacuanha, may be taken every half hour until the dryness of the air-passages abates or the stomach begins to be nauseated. On the other hand, they are often very serviceable in *humid asthma*, or that asthmatic affection which is met with in cases of pulmonary emphysema complicated with obstructive disease of the heart, especially as they may conveniently be carried about by the patient and used in anticipation of a paroxysm.

TROCHISCI KRAMERIÆ, *U. S.*—Troches of Krameria.

Tablettes (Pastilles) de ratanhia, Fr.; *Ratanhiapastillen*, G.

Preparation.—Extract of Krameria 6 Gm.; Sugar, in fine powder, 65 Gm.; Tragacanth, in fine powder, 2 Gm.; Orange-flower Water a sufficient quantity; to make 100 troches. Rub the powders together until they are thoroughly mixed; then with orange-flower water form a mass, to be divided into 100 troches.—*U. S.*

To make 25 rhatany lozenges use 25 grains of extract of rhatany, 250 grains of sugar, and 8 grains of powdered tragacanth.

Uses.—Krameria troches may be used for the same purposes as tannic acid or catechu troches—*i. e.* for constringing the mucous membrane of the mouth, fauces, larynx, and digestive canal.

TROCHISCI MENTHÆ PIPERITÆ, *U. S.*—Troches of Peppermint.

Tabellæ cum oleo volatilé menthæ piperitæ, Fr. Cod.; *Tablettes de menthe, Pastilles de menthe anglaises*, Fr.; *Pfefferminzpastillen*, G.

Preparation.—Oil of Peppermint 1 Cc.; Sugar, in fine powder, 80 Gm.; Mucilage of Tragacanth a sufficient quantity; to make 100 troches. Rub the oil of peppermint and the sugar together until they are thoroughly mixed; then with mucilage of tragacanth form a mass, to be divided into 100 troches.—*U. S.*

To make 25 peppermint lozenges use 5 drops of oil of peppermint and 310 grains of sugar.

These lozenges, made according to the French Codex, contain 1 per cent of the volatile oil. (See also *Pastilli Sacchari* and *Rotulæ Menthæ Piperitæ*, under the general heading Trochisci.)

Uses.—Peppermint troches are employed to relieve *flatulence* and *colic* and to prevent *sea-sickness* and other forms of *nausea*. They are apt to excite gastric pain when too freely used.

TROCHISCI MORPHINÆ, *Br.*—Morphine Lozenges.

Pastilles de morphine, Fr.; *Morphinpastillen*, G.

Preparation.—Take of Morphine Hydrochlorate 20 grains; Tincture of Tolu ½ fluidounce; Refined Sugar, in powder, 24 oz. av.; Gum-Acacia, in powder, 1 oz. av.; Mucilage of Gum-Acacia a sufficiency; Distilled Water ½ fluidounce. Dissolve the morphine hydrochlorate in the water; add this solution to the tincture of Tolu, previously mixed with 2 ounces of the mucilage; then add the gum and sugar, previously mixed, and more mucilage if necessary to form a proper mass. Divide into 720 lozenges, and dry these in a hot-air chamber with a moderate heat.—*Br.*

Uses.—Each of these lozenges contains about Gm. 0.0018 ($\frac{1}{36}$ grain) of morphine hydrochlorate. They are chiefly used to allay *laryngeal* and *bronchial irritation*.

TROCHISCI MORPHINÆ ET IPECACUANHÆ, *U. S., Br.*—Troches of Morphine and Ipecac.

Morphia and ipecacuanha lozenges, E.; *Tablettes (Pastilles) de morphine et d'ipécacuanha*, Fr.; *Morphinpastillen mit Brechwurzel*, G.

Preparation.—Morphine Sulphate 0.16 Gm.; Ipecac, in No. 60 powder, 0.5 Gm.; Sugar, in fine powder, 65 Gm.; Oil of Gaultheria 0.2 Cc.; Mucilage of Tragacanth a sufficient quantity; to make 100 troches. Rub the powders together until they are thoroughly mixed; then add the oil of gaultheria, and incorporate it with the mixture. Lastly, with mucilage of tragacanth form a mass, to be divided into 100 troches.—*U. S.*

To make 25 morphine-and-ipecac lozenges use ⅔ grain of morphine sulphate, 2 grains of powdered ipecac, 250 grains of sugar, and 1 drop of oil of gaultheria.

Morphine hydrochlorate 20 grains; ipecacuanha, in fine powder, 60 grains; tincture of Tolu ½ fluidounce; refined sugar, in powder, 24 oz. av.; gum-acacia, in powder, 1 oz. av.; mucilage of gum-acacia a sufficiency; distilled water ½ fluidounce; prepare 720 lozenges.—*Br.*

Uses.—Each of these troches contains about Gm. 0.0016 (gr. $\frac{1}{40}$) of morphine sulphate or hydrochlorate and Gm. 0.005 (gr. $\frac{1}{12}$) of ipecacuanha. They allay *cough* and promote expectoration.

TROCHISCI POTASSII CHLORATIS, *U. S., Br.*—Troches of Potassium Chlorate.

Tabellæ cum chlorate potassico, F. Cod.—*Tablettes (Pastilles) de chlorate de potasse*, Fr.; *Kaliumchlorat-Pastillen*, G.

Preparation.—Potassium Chlorate, in fine powder, 30 Gm.; Sugar, in fine powder, 120 Gm., Tragacanth, in fine powder, 6 Gm.; Spirit of Lemon 1 Cc. Mix the sugar with the tragacanth and the spirit of lemon by trituration in a mortar; then transfer the mixture to a sheet of paper, and by means of a bone spatula mix with it the potassium chlorate, being careful to avoid trituration and pressure, to prevent the mixture from

igniting or exploding. Lastly, with water form a mass, to be divided into 100 troches.—*U. S.*

To make 25 potassium chlorate lozenges use 116 grains of finely-powdered potassium chlorate, 465 grains of sugar, 25 grains of tragacanth, and 6 drops of spirit of lemon.

Take of potassium chlorate, in powder, 3600 grains; refined sugar, in powder, 25 ounces; gum-acacia, in powder, 1 ounce; mucilage of gum-acacia, 2 fluidounces; distilled water 1 fluidounce or a sufficiency. Mix the powders, and add the mucilage and water to form a proper mass. Divide into 720 lozenges, and dry these in a hot-air chamber with a moderate heat.—*Br.*

By the above formulas lozenges are obtained containing a little over 4½ grains, *U. S.*, and exactly 5 grains, *Br.*, of potassium chlorate; those of the French Codex contain only 0.10 Gm. (1.5 grains) of the same salt.

Uses.—Potassium chlorate troches may be used in the treatment of *aphthæ* and other forms of *ulcer* of the mouth and throat, but they are much less efficient than solutions of the chlorate.

TROCHISCI SANTONINI, *U. S., Br., P. G.*—Troches of Santonin.

Santonin lozenges, E.; *Tablettes (Pastilles) de santonine*, Fr.; *Santoninzeltchen*, G.

Preparation.—Santonin, in fine powder, 3 Gm.; Sugar, in fine powder, 110 Gm.; Tragacanth, in fine powder, 3 Gm.; Stronger Orange-flower Water a sufficient quantity; to make 100 troches. Rub the powders together until they are thoroughly mixed; then with stronger orange-flower water form a mass, to be divided into 100 troches. Santonin troches should be kept in dark, amber-colored bottles.

To make 25 santonin lozenges use 12 grains of santonin, 425 grains of sugar, and 12 grains of tragacanth.

Santonin, 720 grains; refined sugar, in powder, 25 ounces; gum-acacia, in powder, 1 ounce; mucilage of gum-acacia 2 fluidounces; distilled water 1 fluidounce; prepare 720 lozenges.—*Br.*

The official santonin lozenges of the U. S. P. contain about ½ grain of santonin, while those of the Br. and Germ. Pharm. contain 1 grain each.

Uses.—Troches of santonin are a convenient preparation of an efficient anthelmintic. Like other preparations of this medicine, they should be given in the evening to lessen the annoyance produced by the yellow vision they occasion.

TROCHISCI SODII BICARBONATIS, *U. S., Br.*—Troches of Sodium Bicarbonate.

Tabellæ cum bicarbonate sodico, F. Cod.—*Bicarbonate of soda lozenges*, E.; *Tablettes (Pastilles) de bicarbonate de soude, P. de Vichy, P. digestives*, Fr.; *Natronpastillen*, G.

Preparation.—Sodium Bicarbonate 20 Gm.; Sugar, in fine powder, 60 Gm.; Nutmeg, in fine powder, 1 Gm.; Mucilage of Tragacanth a sufficient quantity; to make 100 troches. Rub the sodium bicarbonate with the powders until they are thoroughly mixed; then with mucilage of tragacanth form a mass, to be divided into 100 troches.—*U. S.*

To make 25 sodium bicarbonate lozenges use 75 grains of sodium bicarbonate, 240 grains of sugar, and 4 grains of nutmeg.

Sodium bicarbonate 3600 grains; refined sugar, in powder, 25 oz. av.; gum-acacia, in powder, 1 oz. av.; mucilage of gum-acacia 2 fluidounces; distilled water 1 fluidounce; prepare 720 lozenges.—*Br.*

The freshly-grated nutmeg should be rubbed with a portion of the sugar to a uniform powder, and afterward thoroughly mixed with the remaining powders. In France these lozenges are variously flavored, either with the volatile oil of anise, lemon, or peppermint, with the distilled water of orange-flowers or rose, or with tincture of vanilla. As directed by the different pharmacopœias, the lozenges contain .33 Gm. (5 grains) *Br.*, .20 Gm. (3 grains) *U. S.*, and 0.025 Gm. (⅜ grain) *F. Cod.*, of sodium bicarbonate.

Uses.—Troches of sodium bicarbonate are convenient and useful in cases of habitual *acidity* of the stomach. The utility of the nutmeg they contain is not apparent.

TROCHISCI SULPHURIS, *Br. Add.*—Sulphur Lozenges.

Tablettes (Pastilles) de soufre, Fr.; *Schwefelpastillen*, G.

Preparation.—Precipitated Sulphur 3600 grains; Acid Potassium Tartrate, Acacia, in powder, each 720 grains; Refined Sugar, in powder, 5760 grains; Tincture of Orange-

peel, Mucilage of Acacia, each 720 minims. Mix the tincture of orange-peel with the powders, and add the mucilage, to form a suitable mass. Divide into 720 lozenges, and dry these in a hot-air chamber at a moderate temperature.—*Br. Add.*

Each lozenge contains 5 grains of sulphur.

TROCHISCI ZINGIBERIS, *U. S.*—Troches of Ginger.

Tablettes (*Pastilles*) *de gingembre*, Fr.; *Ingwerpastillen*, G.

Preparation.—Tincture of Ginger 20 Cc.; Tragacanth, in fine powder, 4 Gm.; Sugar, in fine powder, 130 Gm.; Syrup of Ginger a sufficient quantity; to make 100 troches. Mix the tincture of ginger with the sugar, and, having exposed the mixture to the air until dry, reduce it to a fine powder; to this add the tragacanth and mix thoroughly. Lastly, with syrup of ginger form a mass, to be divided into 100 troches.—*U. S.*

To make 25 ginger lozenges use 80 minims of tincture of ginger, 16 grains of tragacanth, and 500 grains of sugar.

Uses.—Troches of ginger are used to relieve flatulent *colic* and quicken laborious digestion.

TUSSILAGO.—Coltsfoot.

Tussilage, *Pas d'âne*, Fr.; *Huflattig*, *Rosshuf*, G.; *Tusilago una de caballo*, Sp.

Tussilago Farfara, *Linné.*

Nat. Ord.—Compositæ, Eupatorieæ.

Origin and Description.—Coltsfoot is a perennial herb which is indigenous to Europe and Northern Asia, has been naturalized in the United States from New England to Pennsylvania, and grows in damp clayey soil and along ditches and brooks. All parts of the plant have been used, but the leaves and flower-heads have been generally employed, and the former have been admitted into the German, the latter into the French, Pharmacopœia. The *rhizome* is creeping, 30–45 Cm. (12 to 18 inches) long, branching, about 3 Mm. (⅛ inch) thick, with joints about 5 Cm. (2 inches) long, radiating on the nodes, and of a grayish-white or pale-brownish color. It is fragile when dry, has a thick whitish bark, yellowish porous wood-wedges, and a prominent pith, is inodorous, and has a mucilaginous, bitterish, and astringent taste. The *leaves* (*Folia farfaræ*, *s. tussilaginis*, P. G.) appear after the flowers, and are radical, long-petiolate, about 10 Cm. (4 inches) long and broad, roundish heart-shaped, angular-toothed, dark-green and smooth above, and white tomentose beneath. They are rather fleshy while fresh, and fragile after drying. The *flower-heads* (*Tussilage* [*capitule*], Fr. Cod.) are smaller than those of dandelion, make their appearance in early spring upon sealy scapes, and have a cylindrical involucre of lance-linear scales in a single row, numerous yellow narrowly-ligulate pistillate ray-florets in several rows, and about twenty tubular staminate disk-florets. The pappus is long, silky-hairy, and white. The dried flowers and leaves are inodorous and have a mucilaginous, bitterish, and somewhat astringent taste.

The rhizome of Asarum canadense is known in some parts of the United States as *coltsfoot-root.*

Constituents.—All parts of coltsfoot contain *mucilage*, a *bitter principle* which has not been isolated, and *tannin*, producing a dark-green precipitate with ferric salts.

Allied Drugs.—Senecio, Groundsel, *E.*; Kreuzkraut, Jacobskraut, *G. Nat. Ord.* Compositæ, Senecionideæ. Several European species of this genus have been employed, among which may be mentioned Sen. Saracenicus, S. Doronicum, S. Jacobæa, and S. vulgaris, *Linné.* The latter, with rayless flower-heads, is a common weed in Europe and sparingly naturalized in North America. It has lanceolate, pinnatifid, and toothed, clasping and rather fleshy leaves, and a cylindrical involucre; it is inodorous and has a bitterish saline and acrid taste. The most common North American species is Senecio aureus, *Linné*, known as *golden ray-weed*, *squaw-weed*, and *life-root.* It is found on the borders of streams, in thickets, and in swamps, and has a thin horizontal rhizome with numerous slender rootlets; long-petioled, round or roundish heart-shaped, and crenately toothed radical leaves; lyrate or pinnatifid, usually lanceolate stem-leaves; and a corymbose inflorescence with many-flowered heads, having bright-yellow pistillate ray-florets. There are many varieties, differing chiefly in the shape of the radical leaves. These plants seem to contain a little tannin and a bitter and an acrid principle.

Action and Uses.—Coltsfoot was anciently renowned in pulmonary affections, for whose relief the smoke of its burning root was inhaled through a funnel; even in modern times it was smoked in pipes for the same purpose by the peasantry of Sweden and Ger-

many. It is demulcent and tonic through its mucilaginous and bitter constituents, and has been compared in its action to Iceland moss. It has been widely used in the treatment of chronic *bronchitis* and for various *scrofulous* affections, both internally and locally. It may be administered in decoction or infusion made with the dried leaves and flowers, Gm. 32 to Gm. 500 (℥j in Oj) of water. The expressed juice is also employed.

Cineraria maritima was said, in 1888, to have been successfully used in Venezuela for the removal of *cataract* by the application to the eye of the juice of the fresh plant. There has, apparently, been no confirmation of the original report.

Senecio, or groundsel, appears to be emollient and also slightly acrid. It was employed by the American aborigines as a vulnerary. In Germany its juice is a domestic remedy for *colic*, *intestinal worms*, etc. It is used in France to prepare gargles for *sore throats*, to make poultices for *boils*, *rheumatic swellings*, and local *cutaneous eruptions*, and to prepare emollient and laxative enemas. Dr. N. S. Davis found that in doses of Gm. 3–6 (♏ xlv–xc) the fluid extract of senecio-root relieved the pains of chronic muscular *rheumatism* (*Phila. Med. Times*, ix. 634). A decoction may be prepared with Gm. 4–8 in Gm. 120 (f℥j–ij in f℥iv) of water.

ULMUS, *U. S.*—Elm ; Slippery Elm.

Ulmi cortex, *Cortex ulmi interior.—Elm-bark*, E. ; *Orme jauve*, *Orme champêtre*, F. Cod. ; *Ulmenrinde*, *Rüsterrinde*, G. ; *Olmo*, Sp.

The inner bark of Ulmus fulva, *Michaux* (*U. S.*, *F. Cod.*), of Ulmus campestris, *Linné* (*F. Cod.*). Bentley and Trimen, *Med. Plants*, 232, 233.

Nat. Ord.—Urticaceæ, Ulmeæ.

Origin.—The elms are trees with alternate, oblique, and slightly heart-shaped, serrate, and straight-veined leaves, and with lateral clusters of small polygamous flowers, having a bell-shaped four- to nine-lobed perianth, the same number of stamens, and two nearly sessile styles. The fruit is a one-celled and one-seeded samara, surrounded with a membranous wing, which is notched or cleft at the apex. The American official elm, known as *slippery elm*, *red elm*, or *moose elm*, is a small or medium-sized tree, which is usually about 9, and occasionally 18, M. (30–60 feet) high, with a diameter of 30–60 Cm. (1 or 2 feet), and with a reddish wood. The leaves are 10–20 Cm. (4 to 8 inches) long, elliptic-oblong, pointed and very rough above ; the flowers are reddish pubescent, precede the leaves, and have the perianth six- to nine-cleft ; the samara is orbicular and not ciliate. The tree grows in woods and rich soil from Canada westward to Lake Superior and Nebraska, and southward to near the Gulf of Mexico, but is most abundant in the Western States. The *white elm*, Ulmus americana, *Linné*, is taller, 18–24 M. (60 to 80 feet) high, bears an oval, on the margin densely ciliate samara, and is a favorite shade-tree in New England.

Ulmus alata, *Michaux*, the winged elm, grows in the Southern United States, where it is known as *wahoo* (see also p. 629). The wood is fine-grained and heavy, and the bark, which on the branches has prominent corky wings, is used for making ropes.

The European official elm is probably a native of Western Asia and Eastern Europe, but now is naturalized or cultivated throughout the greater portion of Asia, Europe, and Northern Africa. It has likewise been introduced in some parts of New England. Its leaves are only about 6 Cm. (2½ inches) long, oval or obovate, and acute or somewhat pointed ; the flowers are mostly pentamerous, and the samara is roundish-obovate, smooth, and has the seed placed near the apical notch. The European *black elm*, Ulmus effusa, *Willdenow*, which has larger ovate or elliptical leaves and roundish-elliptic ciliate fruits, likewise furnishes some elm-bark.

Description.—Slippery-elm bark is met with in commerce in flat pieces, consisting of the liber only, the corky layer being removed before drying, and usually 1 M. or so long and 10–15 Cm. (4 or 6 inches) broad. It is about 3 Mm. (⅛ inch) thick, is externally of a very light-cinnamon color or pale brownish-white, smooth, occasionally with small fragments of the corky layer adhering, and upon the inner surface grayish-white, finely ridged longitudinally, and usually more or less woolly from some detached bast-fibres. The bark breaks, or rather tears, readily in a longitudinal direction, the fragments adhering together with the wavy bast-fibres. It breaks with some difficulty in a transverse direction with a fibrous and mealy fracture, and when cut transversely the bast-fibres are seen arranged in tangential rows, imbedded in a loose parenchyma, and dissected by numerous fine medullary rays, giving to the transverse section a delicately checkered appearance. Slippery-elm bark has a slight but distinct odor, resembling that

of fenugreek, and a mucilaginous, insipid taste. It is also met with as a coarse fibrous and as a somewhat fine and uniform powder, both having a light fawn-color.

European elm-bark.—It resembles the preceding, but is usually rather thinner, upon both surfaces of a cinnamon color, nearly inodorous, and of a mucilaginous, bitterish, and astringent taste.

Constituents.—Both barks contain a considerable amount of mucilage, which, as obtained from the European elm, according to Bracounot (1846), resembles the mucilage of flaxseed. The mucilage of slippery-elm bark is precipitated by lead acetate, but alcohol separates from its solution a gelatinous liquid; starch is present in small grains. European elm-bark contains a small quantity of a bitter principle which has not been isolated, and a little tannin, which is precipitated by gelatin and the salts of most metals, gives a dingy-green precipitate with ferric chloride, reduces gold and silver salts, is a glucoside, and on fusion with potassa yields pyrocatechin and acetic and butyric acids (Johansen, 1875). Starch is usually not present in the bast-layer of this bark.

Action and Uses.—Slippery-elm bark is highly demulcent, and in some degree nutritious. It is grateful to the taste, and does not readily disorder the stomach. Like the inner bark of the European elm (U. Campestris), which is slightly astringent, it has been used with alleged advantage in chronic *cutaneous eruptions*, including some of syphilitic origin. It is also asserted to be a remedy for *tape-worm*. It is, however, chiefly employed in medicine to produce a mucilage which is officinal. The fibrous bark, disintegrated so as to form a mass of flexible spongy tissue, is, like sea-tangle, readily moulded into tents, which are made use of to dilate the neck of the *uterus*, *fistulous openings*, etc., and which do not so readily become offensive as sponge tents. They have also been saturated with various medicinal extracts and used as vaginal and rectal suppositories. (Their preparation was described by Tuckerman, *Boston Med. and Surg. Jour.*, Jan. 1881, p. 46.)

UNGUENTA, *U. S., Br., F. Cod., P. G.*—Ointments.

Pomata, F. Cod.—*Pommades*, *Onguents*, Fr.; *Salben*, G.; *Unguentos*, Sp.

Preparation.—Ointments are unctuous preparations of such a consistence that they may be easily rubbed on the skin, and when in contact with it are gradually liquefied. They consist chiefly of benzoinated lard, or lard which is combined in some cases with a small quantity (about one-fifth) of wax, yellow wax being very properly preferred by the U. S. P. and P. G.; in some cases soft paraffin (petrolatum or paraffin ointment, see p. 1208) is used for the base. In the latter case the ointment is prepared by careful trituration; but if wax is a constituent, this is first melted by a moderate heat, and the lard added in small quantities, or previously heated to about the same temperature: the ingredients being thoroughly liquefied, the vessel is removed from the fire, and its contents beaten with a spatula or transferred to a warm mortar, and then well stirred with the pestle to prevent the partial separation of the wax. The addition of aqueous liquids, which should not be too cold, is made in small quantities, and with continued stirring or beating, as soon as the ointment begins to assume an opaque appearance. In all cases the operation should be continued until the temperature of the ointment has been reduced to that of the surrounding atmosphere, and until the preparation is perfectly smooth and homogeneous. Solid substances may be incorporated in a similar manner, provided they have been previously reduced to an impalpable powder. But in most cases, and more particularly when the powder is heavy, much better and more uniform ointments are obtained by triturating the solid material until a powder is obtained, adding a small quantity of oil or of the ointment, and continuing the trituration until all signs of grittiness have disappeared; after which the remaining portion of the ointment may be gradually added and thoroughly incorporated. Salts and other substances which are soluble in water are often conveniently combined with the fatty base by dissolving them in a small quantity of hot water and incorporating this solution in a warm mortar, with the ointment gradually added. If extracts are to be added to ointments, they should be thoroughly softened in a warm mortar, by trituration with a little water, before the fat is added in small portions and with continued trituration. Alcoholic liquids, except when used in very small proportions, are less conveniently incorporated with ointments than concentrated aqueous solutions. Whenever camphor is to be mixed with an ointment, it should be added after extracts and all other ingredients have been incorporated with

the fatty vehicle: in order to ensure its ready solution in the fat, camphor should always be used in the form of fine powder.

Most of the European pharmacopœias make no distinction between cerates and ointments, but designate both classes as *unguenta*. In France the term *onguent* is usually confined to an ointment into the composition of which resinous substances enter, while ointments with a purely fatty base are designated as *pommades*, and, if the base be a mixture of wax and fat, as cerates. In Europe olive oil or almond oil, melted together with some wax, is frequently employed as the base for ointments in preference to lard. (See also CERATA (p. 432), STEATINA (p. 433), GLYCERITUM AMYLI and GLYCELÆUM (p. 783).)

Preservation.—With few exceptions, ointments should be prepared extemporaneously when wanted for use. The fats should in all cases be free from incipient rancidity, and, if carefully prepared, the ointments may be kept for a limited time in well-closed vessels and in a cool place, at a temperature of about 15° C. (59° F.).

In addition to the formulas given farther on, the following are contained in *Br. P.* 1885:

UNGUENTUM ACIDI BORICI. Boric acid 1 oz.; soft paraffin 4 oz.; hard paraffin 2 oz.

UNGUENTUM ACIDI SALICYLICI. Salicylic acid 60 gr.; soft paraffin 1080 gr.; hard paraffin 540 gr.

UNGUENTUM CONII. Hemlock-juice 2 fluidounces. Evaporate to 2 fluidrachms at a temperature not exceeding 60° C. (140° F.); add boric acid 10 grains and hydrous wool-fat ¾ ounce, and mix thoroughly.

UNGUENTUM EUCALYPTI. Oil of eucalyptus 1 oz.; soft paraffin 2 oz.; hard paraffin 2 oz.

UNGUENTUM GLYCERINI PLUMBI SUBACETATIS. Glycerin of lead subacetate 3 oz.; soft paraffin 12 oz.; hard paraffin 4 oz.

UNGUENTUM HAMAMELIDIS. Mix liquid extract of hamamelis 50 minims with simple ointment 410 grains.

UNGUENTUM STAPHISAGRIÆ. Stavesacre-seeds 4 oz. Crush and macerate them for two hours in benzoated lard 8 oz., melted over a water-bath; strain and cool.

UNGUENTUM, *U. S.*—OINTMENT.

Unguentum simplex, Br., P. A.; *Unguentum adipis.—Simple ointment*, E.; *Pommade simple*, Fr.; *Wachssalbe*, G.

Preparation.—Lard 800 Gm.; Yellow Wax 200 Gm.; to make 1000 Gm. Melt the wax and add the lard gradually; then stir the mixture constantly while cooling.—*U. S.*

White wax 2 oz., benzoated lard 3 oz., almond oil 3 fluidounces. Melt the wax and lard in the oil on a water-bath; then remove the mixture, and stir constantly while it cools.—*Br.*

Uses.—Simple ointment, as it was formerly and more appropriately called, is used as a protective for sores and excoriations and to facilitate the introduction of the hand or finger, surgical instruments, etc. into the urethra, vagina, rectum, etc.

UNGUENTUM ACIDI CARBOLICI, *U. S.*, *Br.*—OINTMENT OF CARBOLIC ACID.

Pommade phénique, Fr.; *Phenolsalbe*, G.

Preparation.—Carbolic Acid 5 Gm.; Ointment 95 Gm.; to make 100 Gm. Mix them thoroughly.—*U. S.*

Each troyounce of the official ointment is composed of 24 grains of carbolic acid and 456 grains of ointment, and is exactly of one-half the strength of the carbolic-acid ointment of 1880.

Carbolic acid 60 gr.; soft paraffin 720 gr.; hard paraffin 360 gr. Melt and mix.—*Br.*

Uses.—Carbolic-acid ointment has been used in the treatment of *lupus* and other diseases of the skin, but carbolized oil is preferable as a dressing for wounds. A similar 5 per cent. solution in oil has been found a safe and efficient surgical dressing.

UNGUENTUM ACIDI TANNICI, *U. S.*—OINTMENT OF TANNIC ACID.

Pommade de tannin, Fr.; *Tanninsalbe*, G.

Preparation.—Tannic Acid 20 Gm.; Benzoinated Lard 80 Gm.; to make 100 Gm.

Rub the tannic acid with the benzoinated lard, gradually added, until they are thoroughly mixed, avoiding the use of an iron spatula.—*U. S.*

Each troyounce of tannic-acid ointment is composed of 96 grains of tannic acid and 384 grains of benzoinated lard; the acid should be rubbed into an impalpable powder, and only horn, porcelain, or glass utensils used in mixing the ointment, so as to avoid darkening of the color.

Uses.—No ointment made with a vegetable astringent is as powerful as a solution of the same substance in water, or even in glycerin. Tannic-acid ointment is no exception to the rule. This preparation may, however, be applied on tampons to the vagina, and introduced into the rectum, in relaxed states of these parts.

UNGUENTUM ACONITINÆ, *Br.*—Ointment of Aconitine.

Pommade d'aconitine, Fr.; *Aconitinsalbe*, G.

Preparation.—Take of Aconitine 8 grains; Rectified Spirit ½ fluidrachm; Benzoated Lard 1 ounce. Dissolve the aconitine in the spirit, add the lard, and mix thoroughly.—*Br.*

Uses.—This powerful local anæsthetic is chiefly of use in *neuralgia* of the superficial nerves, especially of the head, face, and trunk. It should be applied, by means of a soft thick brush or small pledget of lint, over the points of emergence and the terminal distribution of the affected nerves. It should not be allowed to touch denuded cutaneous surfaces or mucous membranes.

UNGUENTUM ANTIMONII TARTARATI, *Br.*—Ointment of Tartarated Antimony.

Pomatum stibiatum, F. Cod.; *Unguentum tartari stibiati*, P. G.; *Unguentum antimonii, Ung. stibio-kali tartarici, Ung. stibiatum.—Antimonial ointment*, E.; *Pommade stibiée, P. d'Autenrieth*, Fr.; *Brechweinsteinsalbe, Pockensalbe*, G.

Preparation.—Take of Tartarated Antimony, in very fine powder, ¼ oz.; Simple Ointment 1 oz.; mix thoroughly.—*Br.*

Tartar emetic 1 part, benzoinated lard 3 parts.—*F. Cod.* Tartar emetic 1 part, paraffin ointment 4 parts.—*P. G.*

Uses.—Antimonial ointment is occasionally employed to produce its characteristic pustular eruption in cases requiring vigorous counter-irritation, but the painful ulcers and the sloughs it sometimes occasioned, and the permanent scars it often left behind, have caused it to be generally abandoned, and there is no reason for a revival of its use.

UNGUENTUM AQUÆ ROSÆ, *U. S.*—Ointment of Rose-water.

Unguentum leniens, P. G.—*Unguentum emolliens*, P. A.—*Cold cream*, E., Fr., G.

Preparation.—Spermaceti, 125 Gm.; White Wax, 120 Gm.; Expressed Oil of Almond, 600 Cc.: Stronger Rose-water, 190 Cc.; Sodium Borate, in fine powder, 5 Gm. Reduce the spermaceti and white wax to fine shavings, and melt them at a moderate heat. Then add the expressed oil of almond, pour the mixture into a warmed, shallow wedgewood mortar, carefully add, without stirring, the whole of the stronger rose-water, in which the sodium borate had previously been dissolved, and then stir rapidly and continuously until the mixture becomes uniformly soft and creamy.—*U. S.*

Each troyounce of rose-water ointment contains 62.5 grains of spermaceti, 60 grains of white wax, 275 grains of oil of almond (expressed), 2.5 grains of borax, and 1½ fluidrachms of stronger rose-water.

The present official formula differs from that of 1880 in ordering increased proportions of spermaceti, white wax, and expressed oil of almond, while the amount of water is reduced to about two-thirds: this change will yield a more permanent ointment, and we can see no advantage in the addition of borax, which may cause trouble when cold cream is ordered in ointments with calomel, mercuric oxide, cocaine salts, etc. By warming the rose-water before adding it to the fats the danger of a granular ointment by partial precipitation of the spermaceti is obviated.

Other pharmacopœias direct: Almond oil 215, spermaceti 60, white wax 30, rose-water 60, tincture of benzoin 15 Gm., oil of rose 10 drops.—*F. Cod.* Almond oil 32, spermaceti 5, white wax 4, rose-water 16 parts, oil of rose 1 drop to 50 Gm.—*P. G.*

The successful preparation of this ointment depends mainly on the pains taken in incorporating the materials while cooling: to facilitate the process, E. C. Marshall (1875)

recommended the use of an ordinary egg-beater. The ointment should be very white, soft, and perfectly homogeneous. If well made it will retain these properties for some time, but gradually it becomes rancid.

Allied Ointments.—Ceratum Galeni, Cerat de Galien, *F. Cod.* White wax 1 part, expressed oil of almonds 4 parts, distilled rose-water 3 parts. It is prepared in the same manner as cold cream.

Ceratum flavum, Cerat jaune, *F. Cod.* Yellow wax 10 Gm., almond oil 35 Gm., water 25 Gm.

Ceratum laudanisatum, Cerat laudanise, *F. Cod.* Sydenham's laudanum 10 Gm., Galen's cerate 90 Gm.

Uses.—Cold cream, as it is commonly called, is an agreeable and efficient protective in cases of *abrasions*, *ulcers*, *frostbite*, and other superficial lesions of the skin. The addition to it of a small proportion of glycerin, and also of benzoic acid, tends both to preserve the ointment longer and to render it more efficient. As thus modified it is one of the best means of protecting the hands and lips from being chapped.

UNGUENTUM ATROPINÆ, *Br.*—Ointment of Atropine.

Pommade d'atropine, Fr.; *Atropinsalbe*, G.

Preparation.—Take of Atropine 8 grains; Rectified Spirit ½ fluidrachm; Benzoated Lard 1 ounce. Dissolve the atropine in the spirit, add the lard, and mix thoroughly.—*Br.*

Uses.—This preparation is, in most cases, preferable to belladonna ointment, on account of its superior cleanliness and the smaller quantity of it that is efficacious. It is chiefly used in superficial *neuralgiæ*, to relieve other *local pains*, and, applied to the perineum, to allay *urethral* and *rectal* irritation and spasm.

UNGUENTUM BELLADONNÆ, *U. S.*, *Br.*—Belladonna Ointment.

Pomatum cum extracto belladonnæ, F. Cod.; *Pommade belladonée*, Fr.; *Tollkirschensalbe*, G.

Preparation.—Alcoholic Extract of Belladonna-leaves 10 Gm.; Diluted Alcohol 5 Cc.; Benzoinated Lard 85 Gm.; to make 100 Gm. Rub the extract with the diluted alcohol until uniformly soft, then gradually add the lard, and mix thoroughly.—*U. S.*

Each troyounce of the U. S. P. belladonna ointment contains 48 grains of extract of belladonna-leaves, 25 minims of diluted alcohol, and 408 grains of benzoinated lard.

Other pharmacopœias direct—Alcoholic extract of belladonna 50 grains, benzoated lard 1 oz. av.—*Br.* Extract of belladonna 4 Gm., water 2 Gm., lard 24 Gm.—*F. Cod.*

Allied Ointment.—Pomatum populeum, Pommade de bourgeon de peuplier, Onguent populeum, *F. Cod.* Digest the fresh leaves of belladonna, hyoscyamus, black nightshade, and poppy, of each 5 parts, in lard 40 parts; when the moisture has completely evaporated, add poplar-buds 8 parts; digest for a day, express, and strain.

Uses.—Belladonna ointment was originally used in all the cases of *local pain*, *spasm*, etc. to which atropine ointment is now applied, and where cleanliness is not imperative it answers nearly as well. It is better suited than the ointment of the alkaloid for application to absorbing surfaces, as the urethra, vagina, rectum, and ulcerated parts. Associated with astringent ointments (Ung. gallæ), it is a valuable palliative in *prolapsus ani*, especially if applied within the sphincter by means of a small female syringe from which the fenestrated end has been removed.

UNGUENTUM CANTHARIDIS, *Br.*—Ointment of Cantharides.

Unguentum cantharidum, P. G.; *Pomatum cum cantharide*, F. Cod.; *Ung. irritans*, *Ung. ad fonticulos.*—*Pommade épispastique*, Fr.; *Spanischfliegensalbe*, G.

Preparation.—Take of Cantharides, Yellow Wax, of each 1 ounce; Olive Oil 6 fluidounces. Infuse the cantharides in the oil in a covered vessel for twelve hours; then place the vessel in boiling water for fifteen minutes, strain through muslin with strong pressure, add the product to the wax, previously melted, and stir constantly while the mixture cools.—*Br.*

Coarsely-powdered cantharides 3 parts, olive oil 10 parts; digest, express, filter, and to 12 parts of the filtrate add 8 parts of yellow wax.—*P. G.*

The ointment was dismissed from the U. S. P. 1880. Cantharidin being readily soluble in fats, the ointment prepared by digesting cantharides in olive oil has the active

principle more uniformly diffused than by incorporating powdered cantharides with ointment. Cerate of extract of cantharides is well adapted for preparing this ointment extemporaneously; it has a greenish-yellow color.

Allied Ointment.—Unguentum acre. Melt together yellow wax 15 parts, resin 30 parts, turpentine 60 parts, and lard 250 parts; add powdered cantharides 50 parts, and powdered euphorbium 10 parts; mix, and stir until cool—*P. G.* 1872.

The French Codex recognizes a yellow and a green cantharides ointment, of which the former is prepared by infusing cantharides 1 part in melted lard 14 parts, adding a little turmeric, filtering, melting together with yellow wax 2 parts, and adding a little oil of lemon. The green ointment is a mixture of powdered cantharides 1 part, poplar ointment (see Ung. Belladonnæ) 28 parts, and wax 4 parts.

Uses.—Ointment of cantharides is intended to be used as a dressing for recently blistered surfaces, in order to prolong the discharge from them, and also to act as a rubefacient upon the sound skin when blistering is not desirable. In this manner it may sometimes be applied in *muscular rheumatism*, in partial *paralysis*, and in *alopecia*. But in all these cases various stimulant liniments are more suitable. In many cases also for which this ointment is appropriate the plaster of Burgundy pitch with cantharides is much more efficient.

UNGUENTUM CETACEI, *Br.*—Ointment of Spermaceti.

Onguent de blanc de baleine, Fr.; *Walratsalbe*, G.

Preparation.—Melt together Spermaceti 5 oz., White Wax 2 oz., and Almond Oil 1 pint (Imper.); add benzoin in coarse powder ½ oz., and, frequently stirring the mixture, continue the application of heat for two hours; strain the mixture and stir constantly until quite cold.—*Br.*

Except in consistency it resembles spermaceti cerate (p. 434).

Uses.—This ointment, when freshly made, is an appropriate dressing for *wounds*, *excoriations*, and *blisters*.

UNGUENTUM CHRYSAROBINI, *U. S., Br.*—Chrysarobin Ointment.

Pommade de chrysarobine, Fr.; *Chrysarobinsalbe*, G.

Preparation.—Chrysarobin 5 Gm.; Benzoinated Lard 95 Gm.; to make 100 Gm. Mix thoroughly by trituration.—*U. S.*

Each troyounce of the present U. S. P. chrysarobin ointment contains 24 grains of chrysarobin and 456 grains of benzoinated lard, being of one-half the strength of that of 1880.

Melt benzoated lard 480 grains, add chrysarobin 20 grains, and stir them together, maintaining a moderate temperature, so as to promote solution; then stir until cold.—*Br.*

This ointment has been admitted as a more uniform preparation than the *ararobo ointment* originally proposed by Da Silva Lima. Balmano Squire (1877) recommended the solution of chrysarobin in lard to be effected by heating in a water-bath with benzene, and the latter to be evaporated by stirring the liquid in a warm dish while cooling and congealing. The ointment is of a yellow color, and should be entirely free from grittiness, which condition is difficult to obtain, owing to the variable quality of commercial chrysarobin.

Uses.—The various applications of this ointment are described under Chrysarobin.

UNGUENTUM CREOSOTI, *Br.*—Ointment of Creosote.

Pommade créosotée, Fr.; *Kreosotsalbe*, G.

Preparation.—Take of Creosote 1 fluidrachm; Simple Ointment 1 ounce. Mix thoroughly.—*Br.*

Uses.—Creosote ointment is a protective, and, like creosote-water, a wholesome stimulant in numerous cases, including *burns*, *chilblains*, *ulcers* of various descriptions, and especially those which have flabby, fungous granulations, an ichorous secretion, a tendency to gangrene, or a connection with carious bone. Even for *cancerous* ulcers it forms an eligible dressing, especially after they have been washed with creosote-water. Indeed, the applications of the latter, enumerated elsewhere, are, *mutatis mutandis*, those of creosote ointment.

UNGUENTUM DIACHYLON, *U. S., P. G.*—Diachylon Ointment.

Unguentum plumbi Hebræ.—Hebra's lead ointment, E.; *Onguent diachylon*, Fr.; *Diachylonsalbe*, G.

Preparation.—Lead Plaster 500 Gm.; Olive Oil 490 Gm.; Oil of Lavender-flowers 10 Cc.; to make 1000 Gm. Melt together the lead plaster and olive oil at a moderate heat; then, having permitted the mass to become partly cool, incorporate with it the oil of lavender, and stir constantly until cold.—*U. S.*

Each troyounce of diachylon ointment contains 240 grains of lead plaster, 235 grains of olive oil, and 5 drops of oil of lavender-flowers.

Lead plaster 5 parts; free it from glycerin by washing, and from water by heating on a water-bath; melt it at a moderate heat with olive oil 5 parts; stir until cold, and after several hours stir again.—*P. G.*

The decrease of the quantity of lead plaster and corresponding increase of olive oil add very much to the quality and stability of the ointment and bring the two formulas into close harmony.

Uses.—Speaking of the treatment of *eczema*, Hebra said of this ointment, "I have called it *Ung. diachyli*, and prescribed it either alone or in combination with balsam of Peru. It is either applied by means of the finger or rubbed in with balls of charpie from one to three times a day; or, if it be desirable to increase its effect, it may be spread on linen or flannel and applied like a plaster" (*Diseases of the Skin*, Sydenham Soc. ed., ii. 151). This eminent dermatologist recommends the ointment in *fetid sweating* of the feet (*ibid.*, i. 89) and as a part of the treatment of *sycosis menti* (*ibid.*, ii. 317).

UNGUENTUM ELEMI, *Br.*—Ointment of Elemi.

Unguentum (Balsamum) Arcæi, F. Cod.; *Onguent (Baume) d'Arcæus*, Fr.; *Elemisalbe*, G.

Preparation.—Take of Elemi ¼ ounce; Simple Ointment 1 ounce. Melt, strain through flannel, and stir constantly until the ointment solidifies.—*Br.*

Elemi and Venice turpentine, each 15 parts, suet 20 parts, lard 10 parts; melt, strain, and stir until cold.—*F. Cod.*

Uses.—Ointment of elemi is a mild local stimulant, and as such may be used for dressing slightly indolent *ulcers* and for maintaining the suppuration of issues and setons. Formerly an ointment known as *Balsamum Arcæi*, and containing elemi and larch turpentine in equal proportions, was used for the same purpose, and, except in trifling cases, probably with more effect.

UNGUENTUM GALLÆ, *U. S., Br.*—Nutgall Ointment.

Pommade de noix de galle, Fr.; *Galläpfelsalbe*, G.

Preparation.—Nutgall, in No. 80 powder, 20 Gm.; Benzoinated Lard 80 Gm.; to make 100 Gm. Rub the nutgall with the benzoinated lard, gradually added, until they are thoroughly mixed.—*U. S.*

Each troyounce of nutgall ointment contains 96 grains of nutgall and 384 grains of benzoinated lard; the nutgall is preferably passed through a bolting-cloth before adding the lard. The official ointment is twice as strong as that of 1880.

Uses.—Ointment of nutgall, like that of tannic acid, its active constituent, is appropriately applied to relaxed tissues, but especially to those of the *vagina* and *rectum*, to prevent or diminish *prolapsus* of these parts. In the latter case, when *piles* exist, an ointment composed of equal parts of the ointments of nutgall and stramonium and Goulard's cerate is a very efficient remedy.

UNGUENTUM GALLÆ CUM OPIO, *Br.*—Ointment of Galls and Opium.

Preparation.—Take of Ointment of Galls 1 ounce; Opium, in powder, 32 grains. Mix thoroughly.—*Br.*

Uses.—This preparation is intended to fulfil the same indications as those of the compound ointment mentioned under Unguentum Gallæ, but it is far less efficient as applied to the anus, and, owing to the large proportion of opium it contains, not without danger if introduced into the vagina or the rectum.

UNGUENTUM HYDRARGYRI, *U. S., Br., P. A.*—Mercurial Ointment.

Unguentum hydrargyri cinereum, P. G.; *Pomatum cum hydrargyro*, F. Cod.; *Unguentum mercuriale s. neapolitanicum.—Ointment of mercury, Blue ointment*, E.; *Pommade (Onguent) mercurielle à parties égales, P. napolitaine*, Fr.; *Graue Quecksilbersalbe*, G.

Preparation.—Mercury 500 Gm.; Lard 250 Gm.; Suet 230 Gm.; Oleate of Mercury 20 Gm.; to make 1000 Gm. Triturate the oleate of mercury with the mercury, gradually added, in a mortar, until globules of the metal are no longer visible. Then add the lard and suet, previously melted together and partially cooled, and continue the trituration until globules of mercury are no longer visible under a lens magnifying ten diameters. —*U. S.*

Each troyounce of mercurial ointment contains 240 grains of pure mercury, 120 grains of lard, 115 grains of suet, and 5 grains of mercuric oleate.

Mercury, prepared lard, each 1 pound; prepared suet 1 ounce; rub them together until metallic globules cease to be visible.—*Br.*

Mercury and benzoinated lard equal parts. Melt the lard, pour about one-third of it into an iron vessel, and keep it at a temperature so as to remain sufficiently soft; add the mercury very gradually, triturate until extinct, add the remainder of the lard, and continue the trituration until a perfect mixture is obtained.—*F. Cod.*

The German Pharmacopœia has a similar process, but uses lard and mutton-suet in the proportion of 13 : 7, and incorporates with this mixture 10 parts of mercury. This ointment contains one-third its weight of mercury, globules of which should not be visible to the naked eye.

With the exception of the French Codex, the pharmacopœias have very properly discarded *weak mercurial ointment*, leaving the physician to order the dilution of the strong ointment as he may think necessary.

The extinguishment of the mercury, if the directions of the last three formulas are literally followed, requires such a long time that few pharmacists will undertake the trouble of preparing the ointment. The operation is greatly facilitated by the use of mercuric oleate, which is decidedly preferable to tincture of benzoin, sulphur and oil, and other agents formerly employed.

A clean iron mortar is well adapted for the preparation of this ointment on a limited scale, though a small portion of the mercury will superficially combine with the iron. A wedgewood or marble mortar does not occasion even this slight loss.

The extinguishment of the mercury is most readily observed by the use of a lens of moderate power, or by rubbing a small portion of the ointment between folded paper, when no metallic globules should become visible to the naked eye. Rhigini observed that on triturating a little of the ointment in a marble mortar with a wooden pestle until the ointment has been absorbed, the pestle will have a bright metallic surface in case the mercury had not been completely extinguished.

On keeping mercurial ointment at a temperature at which it becomes soft without liquefying, it will slowly alter in composition in such a manner that the lower strata contain a larger proportion of mercury than the upper ones. Hence it is necessary in warm weather to employ fat or a mixture of fats having a higher fusing-point than lard, such as is directed by the U. S. Pharmacopœia.

When made with fresh and sweet fats the ointment contains the mercury in a minutely divided condition. As rancidity commences and increases, a portion of the mercury will be found in chemical combination, and this amount is increased at an elevated temperature. It follows from this that mercurial ointment should be kept in a cool place and in a well-closed jar, and that it may be still further protected by covering the surface of the ointment with paper which has been saturated with tincture of Tolu or tincture of storax.

Uses.—By means of this ointment, duly rubbed upon the skin, the constitutional effects of mercury can be secured without as much risk of disordering the digestion of the patient as when mercury in any of its forms is given by the mouth. It is eliminated by the kidneys and the intestine, but chiefly by the latter, and for months after the inunction has ceased. This was at one time the chief method of treating constitutional and even primary *syphilis*, and, in spite of its being "dirty, laborious, and troublesome," it is better than any other form of mercurial treatment (with the exception, perhaps, of the hypodermic), since "it cures the disease better, and does not damage the constitu-

tion half so much" (Brodie). The inunctions should be made upon different parts of the body successively, as the thighs, the flanks, the arms, the chest, and usually before a fire or in the direct sunlight. Gm. 4–8 (ʒj–ij) should be rubbed in daily; the patient should be clothed in flannel, sleep between blankets, and every two or three days cleanse the skin with a bath of warm water and soap. If he is able he should make the friction with his own hands; and if he cannot do this, the hands of the attendant making them should be protected by a caoutchouc glove or by a pig's bladder previously softened with warm water. In other cases, and especially when mercurial ointment is employed to supplement the internal use of mercurials, it may be spread upon a cloth and applied to a recently blistered surface. In cases of infantile syphilis a flannel roller smeared with the ointment may be secured around the body of the patient. (For further details regarding mercurial inunction in syphilis, typhoid fever, pneumonia, etc., see HYDRARGYRUM.)

All chronic superficial *swellings* resulting from inflammation have their absorption hastened by friction made with mercurial ointment. This treatment is peculiarly appropriate in *glandular* and other enlargements arising from syphilic infection, but it is sometimes also used to promote the resolution of chronic engorgement of the *liver* or *spleen*. *Paronychia* may be prevented from suppurating by frictions with mercurial ointment made every hour for five minutes at a time, while in the intervals the part is kept enveloped in a poultice. In subacute and chronic inflammation of the *joints* much benefit has been derived from wrapping them, previously blistered or not, in cloths spread with mercurial ointment, and keeping them at rest by means of appropriate splints. A like advantage sometimes accrues in chronic or subacute *orchitis* from covering the affected organ in a similar manner. But the simple ointment is less efficacious than that of the iodide of mercury. There can be no doubt that mercury, applied in one form or another to an eruption of *small-pox* upon the face during its papular stage, sometimes prevents the papules from maturing and leaving scars. The ointment may be spread, alone or rendered more tenacious by the admixture of starch, upon linen, with suitable apertures for the nostrils and mouth, and closely applied to the face like a mask. It has been used after the same manner in the treatment of *erysipelas* of the face, but, on the whole, without advantage, and frequently with the effect of causing salivation. It is also a palliative of *prurigo pudendi*, but in this case it is open to the same objection. Unna recommends for common *warts* and *condylomata acuminata* the continuous application of mercurial ointment containing 5 per cent. of arsenic. This dressing is said not to irritate the part, but to cause the warts to wither (*Boston Med. and Surg. Jour.*, Oct. 1882, p. 321).

UNGUENTUM HYDRARGYRI AMMONATI, *U. S.*, *Br.*—OINTMENT OF AMMONIATED MERCURY.

Unguentum hydrargyri album, P. G.—*Ointment of white precipitate*, E.; *Pommade de mercure précipité blanc*, Fr.; *Weisse Quecksilbersalbe*, G.

Preparation.—Ammoniated Mercury, in very fine powder, 10 Gm.; Benzoinated Lard 90 Gm.; to make 100 Gm. Rub the ammoniated mercury with the benzoinated lard, gradually added, until they are thoroughly mixed.—*U. S.*

Each troyounce of the ointment contains 48 grains of ammoniated mercury and 432 grains of the base.

Ammoniated mercury 50 grains; simple ointment 450 grains.—*Br.* Ammoniated mercury 1 part; paraffin ointment 9 parts.—*P. G.*

Uses.—Ointment of ammoniated mercury is used as a stimulant in cases of chronic *blepharitis* and in several cutaneous affections, especially in *psoriasis* of limited extent, and in those of parasitic origin, including *ringworm* of the scalp (porrigo scutulata). In *herpes circinatus*, *sycosis*, and *pityriasis* it is also employed. In *herpes zoster* it has been reported, on insufficient grounds, to be useful. It is more efficacious in chronic forms of circumscribed *eczema* and of tubercular and squamous *syphilis*. Like other mercurial ointments, it is a destroyer of *lice*. The following may be used instead: R. Hydrarg. ammoniat., gr. xxxv; balsam Peruviani, ʒj; ol. petrolei, ʒiiss; lanolini ad ʒviij.—M. (Whitlaw). Ointment of ammoniated mercury has over the others the advantage of cleanliness, and it may be perfumed with some agreeable essential oil, such as lavender or bergamot.

UNGUENTUM HYDRARGYRI COMPOSITUM, *Br.*—Compound Ointment of Mercury.

Pommade mercurielle composée, Fr.; *Kampfer-Quecksilbersalbe*, G.

Preparation.—Take of Ointment of Mercury 6 ounces; Yellow Wax, Olive Oil, each 3 ounces; Camphor 1½ ounces. Melt the wax with a gentle heat, and add the oil; then, when the mixture is nearly cold, add the camphor in powder and the ointment of mercury, and mix the whole thoroughly together.—*Br.*

The ointment has a greenish tint, and is softened by the camphor.

Uses.—It is impossible to discover any sufficient reason for the existence of this preparation, which probably has the virtues, and no others, of simple mercurial ointment.

UNGUENTUM HYDRARGYRI IODIDI RUBRI, *Br.*—Ointment of Red Iodide of Mercury.

Pommade d'iodure mercurique, Fr.; *Jodquecksilbersalbe*, G.

Preparation.—Take of Red Iodide of Mercury, in fine powder, 16 grains; Simple Ointment 1 ounce. Mix thoroughly.—*Br.*

Uses.—This ointment is chiefly used as a stimulant of indolent *scrofulous* and *syphilitic ulcers* and scrofulous *glandular swellings*. In India *goitre* has been cured in many thousands of cases by rubbing into the tumor an ointment made with 60 grains of red iodide of mercury to a pound of lard, and then exposing the patient for several hours to the direct action of the sun. The operation is repeated twice a day for several days, the applied ointment being allowed to remain (Macnamara, *Dublin Quart. Jour.*, Nov. 1857, p. 500). A very similar method has been employed with remarkable success in the treatment of enlargement of the *liver* and *spleen*, the heat of a fire being substituted for that of the sun.

UNGUENTUM HYDRARGYRI NITRATIS, *U. S., Br.*—Ointment of Nitrate of Mercury.

Pomatum citrinum, F. Cod.; *Unguentum hydrargyri citrinum*, *Unguentum citrinum*.—*Citrine ointment*, E.; *Pommade citrine*, *Onguent citrin*, Fr.; *Quecksilbernitratsalbe*, G.

Preparation.—Mercury 70 Gm.; Nitric Acid 175 Gm.; Lard Oil 760 Gm. Heat the lard oil in a glass or porcelain vessel to a temperature of 100° C. (212° F.); then withdraw the heat, gradually add 70 Gm. of nitric acid, and, when the reaction moderates, reapply the heat until effervescence ceases. Then allow the mixture to cool to about 40° C. (104° F.). Having dissolved the mercury in the remainder of the nitric acid with the aid of sufficient heat to prevent the solution from crystallizing, add this solution to the mixture. When the mass has become entirely cold, mix it thoroughly by trituration, avoiding the use of an iron spatula.—*U. S.*

To make 4 av. ozs. of citrine ointment use 123 grains of mercury, 306 grains of nitric acid, and 1330 grains of lard oil: 123 grains of the acid are used for treatment of the lard oil, and the remainder for the solution of the mercury. It is important that the nitric acid should be of official strength, and that the oxidation of the fat be completed before the addition of the mercurial solution, so as to avoid reduction of the mercurial salt, and consequent discoloration. When carefully made the ointment is of a bright lemon-yellow color and keeps well, gradually, however, darkening somewhat in color.

Take of mercury, by weight, 4 ounces; nitric acid 12 fluidounces; prepared lard 15 ounces; olive oil 32 fluidounces. Dissolve the mercury in the nitric acid with the aid of a gentle heat; melt the lard in the oil, by a steam- or water-bath, in a porcelain vessel capable of holding six times the quantity, and, while the mixture is at about 100° C., add the solution of mercury, also at about the same temperature, mixing them thoroughly. If the mixture do not froth up, increase the heat till it occurs. Keep it stirred until it is cold.—*Br.*

On mixing melted fats with a solution of mercuric nitrate containing free nitric acid, a very complicated reaction takes place, resulting, on the one hand, in the oxidation of the fat and the evolution of nitric oxide (nitrogen dioxide) and nitrogen tetroxide, and, on the other hand, in the conversion by the latter of the olein contained in the fat into solid elaidin. The products of oxidation of the fat contain various volatile fatty acids, but must necessarily vary with the nature of the fat, the amount of free nitric acid, and the degree of the heat. Should the nitric acid be insufficient in

quantity or the temperature rise to too high a degree, the oxidation is effected in part at the expense of the mercuric nitrate, which is thereby reduced to mercurous salt. The B. P. formula orders a much larger quantity of nitric acid than is necessary, and indicates about 100° C. as the temperature at which the fat should be mixed with the mercuric solution. According to the temperature at which the nitric acid acts upon the mercury, the solution will contain mercurous or mercuric nitrate, or both salts, with or without hyponitric acid. If free from mercurous nitrate, the solution will yield with lard at 200° F. a citrine ointment having, at least at first, a bright-yellow color. In our experience an equally good and permanent ointment is obtained by heating both the mercuric solution and the fat to about 70° C. (158° F.) before mixing them; and even a lower degree of heat, about 50° C. (122° F.), will produce good results if the reaction is completed before the ointment is permitted to cool. All difficulties are, however, overcome by following the process adopted by the U. S. P. Unsalted butter and many other fats, the drying oils excepted, similarly treated, will yield an equally handsome ointment. The French Codex directs 1 part of mercury and 2 parts of nitric acid to 20 parts of fat composed of equal weights of lard and olive oil; this salve is firm, and is sold in the form of square cakes.

Citrine ointment should be prepared in glass or porcelain vessels, and should not be brought into contact with iron or other metal.

Allied Ointment.—Unguentum nitricum, Ung. oxygenatum, *P. G.* 1872. Melt 50 parts of lard, add 3 parts of nitric acid spec. grav. 1.185, and heat slowly and with constant stirring until the reaction ceases; then pour into paper moulds (see page 432). It is of a light-yellow color.

Unguentum hydrargyri nitratis dilutum, *Br.* Mix nitrate-of-mercury ointment 1 ounce with soft paraffin 2 ounces.

Uses.—Ointment of mercuric nitrate is employed in nearly all of the cases mentioned under the head of ointment of ammoniated mercury, but especially in chronic diseases of the *skin*, and in the affections enumerated under ointment of red oxide of mercury. It is more stimulating than the former preparation, and generally needs dilution with lard. It is very apt to occasion salivation.

UNGUENTUM HYDRARGYRI OXIDI FLAVI, *U. S.*—Ointment of Yellow Mercuric Oxide.

Pommade d'oxyde jaune de mercure, Fr.; *Gelbe Quecksilberoxydsalbe*, G.

Preparation.—Yellow mercuric oxide, in very fine powder, 10 Gm.; Ointment 90 Gm.; to make 100 Gm. Rub the oxide of mercury with the ointment, gradually added, until they are thoroughly mixed.—*U. S.*

Each troyounce of the ointment contains 48 grains of yellow mercuric oxide and 432 grains of simple ointment.

Yellow oxide of mercury 1 part, petrolatum 15 parts.—*F. Cod.*

The yellow wax contained in the simple ointment will protect this preparation from rancidity, but it is best to keep the ointment on hand for a short time only or to prepare it when needed.

Uses.—This preparation was introduced as a substitute for ointment of the red oxide of mercury, with which it is identical in its medicinal qualities; but owing to the amorphous condition and the greater fineness of subdivision of the particles of the oxide from which it is made, it appears to be more suitable for application to the *eye* and other delicate tissues.

UNGUENTUM HYDRARGYRI OXIDI RUBRI, *U. S., Br.*—Ointment of Red Mercuric Oxide.

Unguentum hydrargyri rubrum, P. G.; *Pomatum cum oxydo-hydrargyrico*, F. Cod.; *Ung. precipitatum rubrum.—Pommade d'oxyde rouge de mercure, Pommade de Lyon, Baume ophthalmique rouge*, Fr.; *Rothe Quecksilbersalbe*, G.

Preparation.—Red Mercuric Oxide, in very fine powder, 10 Gm.; Castor Oil 5 Gm.; Ointment 85 Gm.; to make 100 Gm. Triturate the red mercuric oxide with the castor oil until a perfectly smooth mixture results; then gradually incorporate the ointment and mix thoroughly.—*U. S.*

Each troyounce of the ointment contains 48 grains of red mercuric oxide, 24 grains of castor oil, and 408 grains of simple ointment.

Take of red oxide of mercury, in very fine powder, 62 grains; hard paraffin ¼ ounce;

soft paraffin ¾ ounce. Melt the hard and soft paraffins together, and when the mixture in cooling begins to thicken add the oxide of mercury in a glass or porcelain mortar, and mix the whole thoroughly.—*Br.*

Red oxide of mercury 1 part, petrolatum 15 parts, *F. Cod.* (paraffin ointment 9 parts, *P. G.*).

The reduction of red mercuric oxide to a very fine powder is materially facilitated by trituration with alcohol, which also changes the color from bright scarlet to a deep orange. If kept on hand for some time, the ointment is apt to become rancid and discolored: this can be entirely prevented by using a mixture of yellow wax and castor oil, suggested by J. B. Baxley, as follows: Melt together 108 grains of yellow wax and 324 grains of castor oil, and when the mixture begins to cool add 48 grains of finely powdered red mercuric oxide, and incorporate thoroughly.

Allied Ointments.—Unguentum ophthalmicum, *P. G.* 1872. Melt together 30 parts of expressed oil of almond and 19 parts of yellow wax, and mix these intimately with 1 part of very finely-levigated oxide of mercury.

Unguentum ophthalmicum compositum, s. Ung. ophthalmicum St. Yves, *P. G.* 1872. Melt together lard 140 parts, and yellow wax 24 parts; add red oxide of mercury 15 parts and pure oxide of zinc 6 parts, and mix thoroughly with camphor 5 parts, previously dissolved in expressed oil of almond 10 parts.

Pomatum de Regent; Pommade de Régent, *F. Cod.*—Red oxide of mercury 1 Gm.; lead acetate 1 Gm.; camphor 0.10 Gm.; petrolatum 18 Gm.

Uses.—This ointment when used as a dressing for *ulcers* is very apt to produce the specific effects of mercury upon the system. It should not, therefore, be too freely applied nor upon too large a surface at once. Its use is very much restricted to the treatment of indolent *syphilitic sores* and chronic inflammation of the edges of the eyelids (*blepharitis*). For the latter purpose the ointment should be diluted. 1 part of ointment of red oxide of mercury to 8 or 10 of simple ointment is usually strong enough. An ointment made with red oxide of mercury 1½ gr. and lanoline or vaseline ʒss has been recommended to abort *furuncles* and as a palliative of *acne*.

UNGUENTUM HYDRARGYRI SUBCHLORIDI, *Br.*—Ointment of Subchloride of Mercury.

Unguentum calomelanos.—Pommade de chlorure mercureux, *P. de calomel*, Fr.; *Quecksilberchloriirsalbe*, G.

Preparation.—Take of Subchloride of Mercury 80 grains; Benzoated Lard 1 ounce. Mix thoroughly.—*Br.*

Calomel 1 part, benzoinated lard 9 parts.—*F. Cod.* This ointment, being known in France also as *pommade au précipité blanc*, should not be confounded with the ointment of ammoniated mercury. (See pp. 826 and 846.)

Uses.—Calomel ointment has the advantage over all the ointments made with salts of mercury of being wholly unirritating, and over simple mercurial ointment of not discoloring the skin or staining the clothing. It is therefore adapted to the local treatment of *cutaneous eruptions* of limited extent, and especially to those of a *syphilitic* nature. It is conveniently associated with white precipitate ointment in the affections to which that ointment is applied.

UNGUENTUM IODI, *U. S., Br.*—Iodine Ointment.

Unguentum iodinii.—Pommade d'iode, Fr.; *Jodsalbe*, G.

Preparation.—Iodine 4 Gm.; Potassium Iodide 1 Gm.; Water 2 Cc.; Benzoinated Lard 93 Gm.; to make 100 Gm. Rub the iodine and potassium iodide first with the water, and then with the benzoinated lard, gradually added, until they are thoroughly mixed, avoiding the use of an iron spatula.—*U. S.*

Each troyounce of iodine ointment contains 20 grains of iodine, 5 grains of potassium iodide, 12 minims of water, and 445 grains of benzoinated lard.

Iodine and potassium iodide each 32 grains; glycerin 1 fluidrachm; prepared lard 2 oz. av.—*Br.*

The water and potassium iodide are serviceable for effecting the fine division of the iodine. The lard should be added at first in very small quantities, and the trituration continued until the solid ingredients are perfectly levigated and the mixture is entirely free from grittiness and uniform in color.

Allied Ointment.—Unguentum iodinii compositum, *U. S.* 1870; Pomatum cum iodureto potassico iodurato, *F. Cod.*; Compound iodine ointment, *E.*; Pommade d'iodure de potassium ioduré, *Fr.*; Jodkaliumsalbe mit Jod, *G.*—Iodine 15 grains; potassium iodide 30 grains; water 30 minims; lard a troyounce.—*U. S.* 1870. Iodine 2, potassium iodide 10, water 10, and benzoinated lard 80 parts.—*F. Cod.*

Uses.—Iodine ointment has been employed extensively to promote the absorption of the exudation occurring in local inflammations. It is used in indolent enlargement of the *tonsils*, the *thyroid*, and the *lymphatic glands*; also in *hydrarthrosis*, *cold abscess*, and chronic *peritonitis*. It may be applied to the *mamma* when abscess threatens to form in that gland, to promote the absorption of *pleural* and *pericardial effusions*, to prevent the development of inflammation in *tendinous sheaths*, and that of *chilblains*, etc.

Compound iodine ointment (*U. S.* 1870), it will be observed, contained less iodine than the simple ointment. The advantage of the potassium iodide in it, if any, must have depended upon the absorption of the salt, which could not be great from the limited surfaces to which the ointment is usually applied. The compound and the simple ointments are used in the same affections.

UNGUENTUM IODOFORMI, *U. S., Br.*—Iodoform Ointment.

Pommade d'iodoforme, Fr.; *Jodoformsalbe*, G.

Preparation.—Iodoform, in very fine powder, 10 Gm.; Benzoinated Lard, 90 Gm.; to make 100 Gm. Rub the iodoform with the benzoinated lard, gradually added, until they are thoroughly mixed.—*U. S.*

Each troyounce of the ointment contains 48 grains of iodoform and 432 grains of benzoinated lard. An impalpable powder of iodoform is readily obtained by trituration with alcohol.

Dissolve iodoform 1 ounce in melted benzoated lard 9 ounces, and cool.—*Br.*

The ointment should be perfectly smooth and free from grittiness; it has a light-yellow color and the peculiar odor of iodoform. (For disguising the odor consult pp. 879, 885.)

Allied Preparation.—Crayons d'iodoforme, *F. Cod.*; Iodoform pencils. Triturate iodoform 20 parts with powdered acacia 1 part, and by means of very little water and glycerin form a mass of pilular consistence which is rolled out into cylinders of suitable size.—*F. Cod.* Butter of cacao may be used with an equal weight of iodoform; these pencils are dusted with lycopodium.

Uses.—Under Iodoform the numerous applications of this ointment have been mentioned. It is anæsthetic and stimulant.

UNGUENTUM PICIS LIQUIDÆ, *U. S., Br.*—Tar Ointment.

Pomatum cum pice, F. Cod.—*Pommade de goudron*, Fr.; *Theersalbe*, G.

Preparation.—Tar 500 Gm.; Yellow Wax 125 Gm.; Lard 375 Gm.; to make 1000 Gm. Melt together the yellow wax and the lard at a moderate heat. Then incorporate the tar, strain the mixture through muslin, and stir the ointment until it is cool. —*U. S.*

Each troyounce of tar ointment contains 240 grains of tar, 60 grains of yellow wax, and 180 grains of lard.

Tar 5 ounces; yellow wax 2 ounces; melt the wax with a gentle heat, add the tar, and stir the mixture briskly while it cools.—*Br.*

Tar 1 part, lard 9 parts; mix.—*F. Cod.*

The substitution of wax and lard for the suet of the 1880 formula will prove a desirable change; the ointment as now made is far less liable to be granular than formerly.

Allied Ointments.—Unguentum picis betulæ, s. U. rusci, Wolff's tar ointment. Birch tar (see p. 1255) 8 Gm., simple ointment 42 Gm.

Unguentum picis compositum, *N. F.*, Compound tar ointment.—Melt together, at a gentle heat, 26 parts of yellow wax, 32 parts of lard, and 35 parts of cotton-seed oil; add 2 parts of tincture of benzoin, and continue heating until the alcohol has evaporated. Remove the heat, add 4 parts of oil of tar and 3 parts of zinc oxide, and incorporate thoroughly by stirring until cool.

Uses.—Tar ointment will sometimes cure *scabies*, but its action is uncertain and dilatory. In scaly eruptions, as *psoriasis* and *lepra*, its efficacy is much more decided, as well as in *chronic eczema* after the liquid secretion has ceased. In *ringworm* and in *prurigo* it is one of the best applications, and it may be used with advantage in the greater number of indolent and gangrenous *ulcers*.

UNGUENTUM PLUMBI ACETATIS, *Br.*—Ointment of Lead Acetate.

Preparation.—Take of Lead Acetate, in fine powder, 12 grains; Benzoated Lard 1 oz. av. Mix thoroughly.—*Br.*

Allied Ointments.—Unguentum narcotico-balsamicum Hellmundi, Hellmund's ointment. Triturate together lead acetate 10 parts and extract of conium 30 parts; add gradually simple ointment 240 parts, balsam of Peru 30 parts, and wine of opium (with saffron) 5 parts, and mix thoroughly.—*P. G.* 1872.

Unguentum plumbi tannici (see page 1264).

Uses.—The action and uses of lead acetate ointment are probably identical with those of the cerate of lead subacetate. It is applied as a dressing to *wounds*, *excoriations*, and *inflamed surfaces* generally.

UNGUENTUM PLUMBI CARBONATIS, *U. S., Br.*—Ointment of Lead Carbonate.

Pomatum cum carbonate plumbico, F. Cod.; *Unguentum cerussæ, s. Ung. album simplex*, P. G., P. A.—*Pommade de carbonate de plomb, Onguent blanc de Rhazes*, Fr.; *Bleiweissalbe*, G.

Preparation.—Lead Carbonate, in very fine powder, 10 Gm.; Benzoinated Lard 90 Gm.; to make 100 Gm. Rub the lead carbonate with the benzoinated lard, gradually added, until they are thoroughly mixed.—*U. S.*

Each troyounce of this ointment contains 48 grains of lead carbonate and 432 grains of benzoinated lard.

Other pharmacopœias direct—Lead carbonate 62 grains; simple ointment 1 oz. av.—*Br.* Lead carbonate 1 part; benzoinated lard 5 parts.—*F. Cod.* Lead carbonate 3 parts; paraffin ointment 7 parts.—*P. G.*

Allied Ointment.—Unguentum cerussæ camphoratum. Ointment of lead carbonate 95 parts, powdered camphor 5 parts.—*P. G.*

Uses.—It is used for the same purposes as the last-mentioned ointment, from which it perhaps differs in being less astringent. It forms a suitable dressing for recent *burns* of the first degree. The danger of poisoning by the absorption of the lead it contains is an objection to its prolonged use.

UNGUENTUM PLUMBI IODIDI, *U. S., Br.*—Ointment of Lead Iodide.

Pomatum cum iodureto-plumbico, F. Cod.; *Pommade d'iodure de plomb*, Fr.; *Jodbleisalbe*, G.

Preparation.—Lead Iodide, in very fine powder, 10 Gm.; Benzoinated Lard 90 Gm.; to make 100 Gm. Rub the lead iodide with the benzoinated lard, gradually added, until they are thoroughly mixed.—*U. S., F. Cod.*

Each troyounce of the ointment contains 48 grains of lead iodide and 432 grains of benzoinated lard.

Lead iodide, in fine powder, 62 grains; simple ointment 1 oz. av.; mix thoroughly.—*Br.*

Uses.—The discutient influence of this ointment upon *enlarged glands* of the lymphatic system, and even upon certain *mammary tumors* of uncertain nature, is sometimes very distinctly marked. In chronic enlargement of the *testicle* following gonorrhœa it is often of palpable use. It has also been applied to some local *cutaneous eruptions*, but without demonstrable advantage.

UNGUENTUM POTASSÆ SULPHURATÆ, *Br.*—Ointment of Sulphurated Potash.

Pommade de foie de soufre, Fr.; *Schwefellebersalbe*, G.

Preparation.—Take of Sulphurated Potash 30 grains; Hard Paraffin ¼ ounce; Soft Paraffin ¾ ounce. Triturate the sulphurated potash in a glass or porcelain mortar, and gradually add the melted mixture of paraffins, rubbing them together until the ointment is perfectly smooth and free from grittiness. This ointment should be recently prepared. —*Br.*

Uses.—Sulphurated potash ointment is only used in the treatment of *scabies*, for which it is an efficient remedy.

UNGUENTUM POTASSII IODIDI, *U. S.*, *Br.*—Ointment of Potassium Iodide.

Unguentum kalii iodati, P. G.; *Pomatum cum iodureto potassico*, F. Cod.; *Pommade d'iodure de potassium*, Fr.; *Jodkaliumsalbe*, G.

Preparation.—Potassium Iodide, in fine powder, 12 Gm.; Sodium Thiosulphate (Hyposulphite) 1 part; Water, hot, 10 Cc.; Benzoinated Lard, 77 Gm.; to make 100 Gm. Dissolve the potassium iodide and the sodium thiosulphate in the hot water; then gradually add the benzoinated lard, and mix thoroughly.—*U. S.*

Each troyounce of the ointment contains 58 grains of potassium iodide, 5 grains of sodium thiosulphate, 50 minims of hot water, and 370 grains of benzoinated lard.

Potassium iodide 64 grains; potassium carbonate 4 grains; distilled water 1 fluidrachm; benzoated lard 1 oz. av.—*Br.* Potassium iodide 10 parts, water 10 parts, benzoinated lard 80 parts.—*F. Cod.* Potassium iodide 20 parts, sodium thiosulphate ¼ part, water 15 parts, lard 165 parts.—*P. G.*

The addition of sodium thiosulphate is made for the purpose of preventing the liberation of free iodine and the gradual change of the color of the ointment from white to yellow and brown. Iodine added to this ointment will likewise be decolorized, with the formation of sodium iodide. (See Sodii Hyposulphis.) The addition of a little potassium carbonate, as directed by the Br. P., or of a few drops of potassa or soda solution, will likewise preserve the white color of the ointment.

Uses.—The discutient powers of this ointment are certainly inferior to those of the ointments of iodine; its only advantages consist in its being colorless and in not staining the linen. It is used to promote the reduction of *enlarged glands*.

UNGUENTUM STRAMONII, *U. S.*—Stramonium Ointment.

Pommade de stramoine, Fr.; *Stechapfelsalbe*, G.

Preparation.—Extract of Stramonium-seed 10 Gm.; Diluted Alcohol, 5 Cc.; Benzoinated Lard 85 Gm.; to make 100 Gm. Rub the extract with the diluted alcohol until uniformly soft, then gradually add the benzoinated lard, and mix thoroughly.—*U. S.*

Each troyounce of the ointment contains 48 grains of extract of stramonium-seed, 28 minims of diluted alcohol, and 408 grains of benzoinated lard.

Uses.—Stramonium ointment, although less efficient than belladonna ointment, may be used for the same purposes—viz. to allay *pain* and relieve *spasm*. It has been found to palliate the suffering caused by open *cancer* of the breast, and it affords much comfort in cancer of the *rectum*, *piles*, fissures and prolapsus of the *anus*, etc. An ointment composed of equal parts of stramonium ointment, ointment of galls, and cerate of lead subacetate is very useful in these affections, and also to arrest the itching caused by vermicular *ascarides*.

UNGUENTUM SULPHURIS, *U. S.*, *Br.*—Sulphur Ointment.

Pomatum sulfuratum, F. Cod., P. A.; *Unguentum sulfuratum simplex.—Pommade soufrée*, Fr.; *Schwefelsalbe*, G.

Preparation.—Washed Sulphur 300 Gm.; Benzoinated Lard 700 Gm.; to make 100 Gm. Rub the sulphur with the benzoinated lard, gradually added, until they are thoroughly mixed.—*U. S.*

Each troyounce of the ointment contains 144 grains of washed sulphur and 336 grains of benzoinated lard.

Sublimed sulphur 1 ounce; benzoated lard 4 ounces.—*Br.* Washed sulphur 10 parts, almond oil 10 parts, benzoinated lard 80 parts.—*F. Cod.*

We fail to see any advantage in the substitution of washed sulphur for sublimed sulphur, as formerly directed: the purposes for which sulphur ointment is used, as an antiparasitic, would seem to point in favor of sulphur containing some free acid.

Allied Ointments.—Unguentum sulfuratum compositum. Mix 1 part each of sublimed sulphur and powdered zinc sulphate with 8 parts of lard.—*P. G.* 1872.

Unguentum sulphuris alkalinum. Alkaline sulphur ointment *E.*; Helmerich's Salbe. *G.*—Washed sulphur 20 parts; potassium carbonate 10 parts; water 5 parts; benzoinated lard 65 parts; to make 100 parts. Rub the sulphur with the potassium carbonate and the water, gradually add the benzoinated lard, and mix thoroughly.—*U. S.* 1880. Potassium carbonate

5 Gm., water 5 Gm., sulphur 10 Gm., expressed almond oil 5 Gm.; lard 35 Gm. Mix in the order stated.—*F. Cod.*

Unguentum sulphuris compositum, *N. F.*; Compound sulphur ointment, Wilkinson's ointment, Hebra's itch ointment.—Mix 15 parts of oil of cade with 30 parts each of lard and green soap; then gradually incorporate 15 parts of sublimed sulphur and 10 parts of precipitated calcium carbonate.

Uses.—The chief use of sulphur ointment is in the treatment of *scabies*. The modes of using it and the conditions of its success have been described under Sulphur.

UNGUENTUM SULPHURIS IODIDI, *Br.*—Ointment of Iodide of Sulphur.

Pommade d'iodure de soufre, Fr.; *Jodschwefelsalbe*, G.

Preparation.—Take of Sulphur Iodide 30 grains; Hard Paraffin ¼ oz.; Soft Paraffin ¾ oz. Triturate the sulphur iodide in a glass or porcelain mortar, and gradually add the melted mixture of paraffins, rubbing them together until the ointment is perfectly smooth and free from grittiness.—*Br.*

Uses.—Its tendency to speedy decomposition renders this ointment practically of little value, even in the treatment of limited chronic eruptions of *eczema*, *lepra*, and *acne*, and of *lupus*.

UNGUENTUM TEREBINTHINÆ, *Br., P. G.*—Ointment of Turpentine.

Onguent térébenthiné, Fr.; *Terpentinsalbe*, G.

Preparation.—Take of Oil of Turpentine 1 fluidounce; Resin, in coarse powder, 54 grains; Yellow Wax, Prepared Lard, each ½ ounce. Melt these ingredients together by the heat of a steam or water-bath. Remove the vessel, and stir the mixture constantly while it cools.—*Br.*

Melt turpentine and yellow wax, of each 1 part, and add oil of turpentine 1 part.—*P. G.*

Unguentum digestivum simplex, *F. Cod.*—Onguent digestif simple, *Fr.*—Triturate Venice turpentine 40 parts with yelk of egg 20 parts, and add olive oil 10 parts.

Uses.—This ointment has the same virtues as the compound resin cerate, but, being softer, is more convenient for application to *burns*, *erysipelas*, *erythema*, and other recent local inflammations of the skin.

UNGUENTUM VERATRINÆ, *U. S., Br.*—Veratrine Ointment.

Unguentum veratriæ, Br.—*Veratria ointment*, E.; *Pommade de vératrine*, Fr.; *Veratrinsalbe*, G.

Preparation.—Veratrine 4 Gm.; Olive Oil 6 Gm.; Benzoinated Lard 90 Gm. Rub the veratrine with the olive oil in a mortar; then gradually add the benzoinated lard, and mix thoroughly.—*U. S.*

Each troyounce of the ointment contains 20 grains of veratrine, 30 grains (34 minims) of olive oil, and 430 grains of benzoinated lard.

Rub together veratrine 8 grains and olive oil 1 fluidrachm; melt hard paraffin ¼ ounce and soft paraffin ¾ ounce, and mix the whole thoroughly in a mortar until cold.—*Br.*

To prevent annoyance from the dust arising during the trituration of dry veratrine, the alkaloid should be previously covered with a small quantity of olive oil, as directed in the first formula.

Uses.—The American is more than twice as strong as the British ointment. (For an account of its uses see Veratrina.)

UNGUENTUM ZINCI OXIDI, *U. S.*—Ointment of Zinc Oxide.

Unguentum zinci, Br., P. G.; *Unguentum de nihilo albo.—Pommade d'oxyde de zinc*, Fr.; *Zinksalbe*, G.

Preparation.—Zinc oxide 200 Gm.; Benzoinated Lard 800 Gm.; to make 1000 Gm. Sift the zinc oxide, through a No. 20 sieve, upon the surface of the benzoinated lard, previously melted, and incorporate it by stirring, which is to be continued until the ointment is cool.—*U. S.*

Each troyounce of the ointment contains 96 grains of zinc oxide and 384 grains of benzoinated lard.

Other pharmacopœias direct—Zinc oxide 80 grains, benzoinated lard 1 oz. av.—*Br.* Zinc oxide 1 part, benzoinated lard (lard, *P. G.*) 9 parts.—*F. Cod.*

Since zinc ointment is frequently applied to very tender excoriated surfaces, it is of great importance that it should be entirely free from lumps and gritty particles, and for this reason we should prefer to sift the zinc oxide through fine bolting-cloth, instead of the No. 20 sieve directed above. On keeping, the ointment gradually acquires a tough consistence.

Allied Preparations.—Unguentum zinci oleati, *Br.* Oleate of zinc 1 oz.; soft paraffin 1 oz. Unguentum calaminæ, *Br.* (Turner's cerate). Prepared calamine 1 oz.; benzoated lard 5 oz. Ceratum zinci carbonatis, *U. S.* 1870. Precipitated zinc carbonate 1 oz.; simple ointment 5 oz.

Uses.—Zinc oxide ointment is a protective, astringent, and mildly stimulant application, adapted to *ulcers* which are irritable, have loose granulations, and discharge pus copiously. It is especially useful as a dressing for *fissures* of the nipple and anus; for local eruptions of *eczema*, *herpes*, and *impetigo;* for all cases of simple *abrasion* or *ulceration*, including blistered surfaces, after their active inflammation has subsided; for *ophthalmia tarsi*, etc. The cerate, which is no longer officinal, was employed in similar affections.

UREA.—Urea.

Carbamide.—Urée, Fr.; *Harnstoff*, G.

Formula $CH_4N_2O = CO(NH_2)_2$. Molecular weight 59.95.

Origin.—Urea was discovered in urine by Rouelle (1773), and, in the impure condition in which he obtained it, designated as *extrait savonneux de l'urine*. Fourcroy and Vauquelin (1799) prepared it in the pure state. It has been found in the urine of mammals, more particularly in that of the Carnivora, in the urine of birds and other animals, and in many animal fluids. Human urine contains from 2 to 4 per cent. of urea. The transformation into urea of ammonium cyanate by evaporating its aqueous solution, as observed by Wöhler (1828), was the first instance in which an organic compound produced in the living organism was artificially formed. Urea has also been artificially prepared from other cyanogen compounds.

Preparation.—Urine is evaporated to a syrupy consistence, allowed to cool, and the residue mixed with an equal volume of nitric acid. The nitrate of urea, which crystallizes in scales and prisms, is purified by washing with cold water and by recrystallization, and is then decomposed by boiling with water and barium carbonate; the filtrate is evaporated and the residue exhausted with alcohol. Oxalic acid and calcium carbonate may be substituted in this process for nitric acid and barium carbonate.

Properties.—Urea crystallizes in colorless and inodorous four-sided prisms, which have a cooling saline taste and are permanent in dry air. It melts near 120° C. (248° F.), and at a higher heat is decomposed, giving off ammonia and leaving cyanuric acid, which at a still higher temperature yields cyanic acid. Urea dissolves in its own weight of cold water, is readily soluble in alcohol, but is slightly soluble in pure ether. In contact with nitrogen trioxide urea is decomposed into carbon dioxide, nitrogen, and water. A similar decomposition is effected by an acidulated solution of potassium permanganate. Dissolved in pure water, urea keeps unchanged for a long time, but in the presence of putrefiable matter it is rapidly decomposed, yielding ammonia and carbon dioxide; hence foul urine contains no urea.

Urea forms crystallizable compounds with acids, with metallic oxides, and with many neutral salts. *Urea hydrochlorate* is very deliquescent. *Urea nitrate*, $CH_4N_2O.HNO_3$, is slightly soluble in cold water and alcohol and nearly insoluble in nitric acid; it contains 48.78 per cent. of urea. *Urea oxalate*, $(CH_4N_2O)_2.H_2C_2O_4$, crystallizes in scales which dissolve at 15° C. (59° F.) in 23 parts of water, but require a much larger quantity of solution of oxalic acid; it contains 57.14 per cent. of urea. The amount of urea in urine is frequently determined by forming the compound either with nitric or oxalic acid.

Allied Compound.—Formamide, $CH_3NO = CHO.NH_2$. It is produced on the dry distillation of ammonium formate or heating a mixture of this salt and of urea to about 140° C. (284° F.), on heating ethylformate and ammonia, and by various other processes. It is a colorless oily liquid, which in vacuo distils without decomposition below 150° C. (302° F.), and which is soluble in water and alcohol in all proportions, but is insoluble in ether. Mercuric Formamide, Hydrargyrum formamidatum, has been used hypodermically.

Action and Uses.—More than half a century ago it was demonstrated by Ségalas that urea injected into the veins of animals increased notably the discharge of urine, with a greatly augmented proportion of urea, and, much more recently, Wöhler and Frerichs alleged that when introduced into an animal's stomach it reappeared almost entirely in the urine. Gallois, however, proved that only two-thirds at most of the urea thus administered was recoverable from the urine, and also that in very large doses, such as 300 grains, given to a rabbit, it occasioned prostration, trembling, convulsions, and death. Similar large doses injected into the veins or hypodermically produced the same effects, and non-lethal quantities of urea occasioned deep coma, paroxysmal spasms, hurried respiration, trembling, injection of the capillary vessels, and frequent urination.

Although, according to Rabuteau, it exhibits no diuretic action in man, even when taken to the extent of Gm. 5 (gr. lxxv.) a day, yet several physicians have testified to its virtues in *dropsy*, and one of high reputation particularly recommended the nitrate of urea as a remedy for scarlatinous dropsy. It was prescribed in *doses* of Gm. 0.12–0.18 (gr. ij–iij) several times a day.

URETHANUM.—Urethane.

Ethyl urethane, *Ethyl carbamate*, E.; *Uréthane*, Fr.; *Urethan*, G.

Formula $C_2H_5NH_2CO_2$ or $CO.NH_2.OC_2H_5 = C_3H_7NO_2$. Molecular weight 88.94.

In chemistry the general term "urethane" is applied to all ethers of carbamic acid, which acid, however, has thus far never been isolated, and is only known in combination: its most familiar compound is ammonium carbamate, $NH_4NH_2CO_2$, one of the constituents of official ammonium carbonate. If the formula for carbamic acid is assumed to be HNH_2CO_2, then the formation of all urethanes may be explained by the substitution of a univalent radical for the 1 atom of displaceable hydrogen, which may be brought about in various ways.

Preparation.—In medicine the name urethane is meant to signify but one combination, ethyl urethane, which was discovered by Dumas in 1833, and may be obtained either by the action of ammonia on ethyl carbonate or ethyl chlorocarbonate, by the direct union of cyanic acid with ethyl alcohol, or by the action of urea or carbamide on ethyl alcohol at a high temperature. The following equations will explain the four different reactions: 1st. $(C_2H_5)_2CO_3 + NH_3 = C_2H_5NH_2CO_2 + C_2H_5OH$; 2d. $C_2H_5ClCO_3 + NH_3 = C_2H_5NH_2CO_2 + HCl$; 3d. $CNHO + C_2H_5OH = C_2H_5NH_2CO_2$; 4th. $(NH_2)_2CO + C_2H_5OH = C_2H_5NH_2CO_2 + NH_3$. For use in medicine urethane is generally prepared by heating in a sealed tube for several hours, to a temperature of 120° or 130° C. (248° or 266° F.), a mixture of urea nitrate and an excess of alcohol; upon cooling a crystalline mass results, which is dissolved in water and shaken with ether. The ethereal solution upon distillation leaves urethane in crystals which may be purified by recrystallization from water.

Properties and Tests.—Urethane occurs in colorless columnar or tabular crystals, which are not deliquescent, are inodorous, and of a pleasant saline somewhat cooling taste, and melt between 47° and 50° C. (116.6° and 122° F.). Urethane boils between 170° and 180° C. (338° and 356° F.), but sublimes at a much lower temperature. According to Vulpius, urethane is soluble at medium temperature (60° F.?) in 1 part of water, 0.6 part of alcohol, 1 part of ether, 1.5 parts of chloroform, 0.8 part of liquefied carbolic acid, 3 parts of glycerin, 15 parts of castor oil, or 20 parts of olive oil: a 10 per cent. aqueous solution should have a neutral reaction. Heated on platinum-foil, urethane is completely volatilized; it is decomposed by potassa, yielding potassium carbonate, ammonia, and alcohol. 2 Gm. dissolved in 2 Cc. of cold water should not yield a white precipitate upon addition of 5 Cc. of nitric acid, or of oxalic acid or of mercuric nitrate (absence of urea).

Allied Compound.—Europhin, or phenyl urethane, $C_2H_5NHC_6H_5CO_2$, is obtained by the interaction of aniline and chloroformic ethyl ether; thus, $C_6H_5NH_2 + C_2H_5ClCO_2 = C_2H_5NHC_6H_5CO_2 + HCl$, and is purified by recrystallization from diluted alcohol. It is a white or colorless crystalline powder, of faint aromatic odor and slight clove-like after-taste. Europhin is sparingly soluble in cold, but more readily in hot, water, and soluble in alcohol, ether, and hydro-alcoholic mixtures, such as wines, etc.; it is also soluble without color in cold concentrated sulphuric acid. The compound melts between 49° and 50° C. (120.2° and 122° F.).

Action and Uses.—In 1885, Jaksch found that in man a dose of from 8–15 grains of urethane produced peaceful slumber of several hours' duration (*Times and Gaz.*, Oct. 1885, p. 485). It did not appear to exert any direct anodyne influence. Friedländer's

investigations seemed to prove that even in the minute dose of Gm. 0.001 ($\frac{1}{50}$ grain) it occasioned lassitude and depression, with retching and vomiting. The visible mucous membranes turned pale, the pupils acted irregularly, and the pulse and heart failed. But no such effects from similar doses have been noted by other observers. While suffering from pain Friedländer took a drachm of urethane, and secured thereby a comfortable night's rest, while on the following night it excited him (*Therap. Gaz.*, ix. 852). The inharmonious statements concerning the effects of this preparation do not appear to diminish as its use becomes less restricted. Hübner and Sticker affirm that it occasions no unpleasant after-effects, and that a dose of 30 grains is not less hypnotic than a dose of 60 grains; but Otto and Koenig allege that it is more apt than paraldehyde to occasion vomiting, and that its narcotic action is less decided. They also accuse it of producing loss of appetite, etc. On the whole, the action of this preparation resembles that of paraldehyde, over which it has the advantage of being free from unpleasant smell and taste.

The general result of experience appears to be that urethane is an unreliable hypnotic. (Compare Gordon, *Therap. Gaz.*, xiv. 102.) Kroepelin found it useful for melancholic patients suffering from *insomnia* and in cases of "mild excitement or depression accompanied by exhaustion or depressed nutrition" (*Med. News*, xlviii. 626). Otto and Koenig, on the other hand, claim it to have had a very favorable action in violence of an hysterical or epileptic nature, and Rottenbiller seems to have used it with general advantage for the relief of insomnia in the insane in doses of from 30 to 60 grains. He also employed with similar results hypodermic injections, two of which, of 4 grains each, sufficed (*Therap. Gaz.*, x. 474). But, besides its uncertainty of action even in doses of 30 or more grains, it is apt, if continued, to induce disorder of the stomach. (Compare Griffith and Kirby, *Med. News*, lii. 547.) Adam, however, found it a very useful hypnotic in various forms of insanity, provided it were given in doses of Gm. 3–4 (45–60 gr.) (*Annuaire de Thérap.*, 1889, p. 16). Vakulovsky (*Lond. Med. Record*, July, 1886, p. 305) found it of little use in alcoholic delirium, rheumatic pains, sleeplessness, and cancer of the stomach when given in 10-grain doses. A case of traumatic *tetanus* in a boy of fifteen years is said to have been cured by urethane given in 4-grain doses every two hours—a result that it would be desirable to have confirmed by experience. In a case of *tetany* of long standing the medicine gave prompt relief (*ibid.*, Sept. 1889, p. 230). The experiments of Anrep also show the control of this agent over tetanoid spasms (*Bull. de Thérap.*, cxii. 130). A case of severe and obstinate *chorea* is reported in which urethane procured sleep and tranquillity after the bromides had failed to do so (*Boston Med. and Surg. Jour.*, May, 1886, p. 419). In many cases it has been found an efficient substitute for opiates.

Urethane may be given in capsules or in a flavored and sweetened watery solution. Its average dose is about Gm. 1 (gr. xv), but three times as much has frequently been taken without untoward effects. It has also been administered hypodermically, and generally in about one-fourth of the dose given by the mouth, without occasioning infiltration or abscess. But its hypnotic action when thus administered is more uncertain than when the medicine is taken in the ordinary manner. It is conveniently given by the rectum.

Ural partakes of the hypnotic qualities of its constituents, urethane and chloral hydrate. It is declared by Poppi (*Centralb. f. Ther.*, viii. 184; *Therap. Gaz.*, xiii. 687) to affect but slightly the blood-pressure and the temperature; but, like chloral, it quickens the pulse-rate and induces sleep, which in man is usually light, but apt to be followed by more or less heaviness of the head and drowsiness. It neither dulls the mind nor occasions faintness or disturbance of the stomach. It has been used with reputed advantage to relieve obstinate *cough* and the *pain* of *angina pectoris*, to procure *sleep*, etc. The primary dose is said to be Gm. 1.50–2 (gr. xx–xxx). As much as 60 or 70 grains have been given without harm. (See also page 455.)

Euphorin is reported to be antithermic, antirheumatic, analgesic, and antiseptic. According to the experiments, clinical and bacteriological, of Dr. C. Curtis, it is both a powerful and a safe antipyretic, producing the phenomena of a natural defervescence, causes no serious secondary effects and never collapse, and is "a most potent antirheumatic." In "simple fever the dose is Gm. 1–2, taken in four or five doses. In febrile rheumatic affections Gm. 1–2 should be given during twenty-four hours." It is also said to be "a sure analgesic in neuralgia unless when due to a specific cause;" it is a powerful antiseptic; and "one of the most effective disinfectants in thrush." Locally, it is thought to have advantages over iodoform, iodol, aristol, etc.; and in an ointment with vaselin or lanolin it is an anodyne and promotes the healing of wounds and ulcers (Squibb, *Ephemeris*, iv. 26). These favorable estimates of the preparation are hardly confirmed by the later observations of Köster, who described its action as "capricious" (*Therap. Monatsh.*,

Aug. 1892). It has been found useful as a topical application to *ulcers* and for purulent and fetid discharges.

URTICA.—Nettle.

Ortie brulante, Fr.; *Brennessel*, G.; *Ortigo*, Sp.

Urtica dioica, *Linné*, and T. urens, *Linné*.

Nat. Ord.—Urticaceæ, Urticeæ.

Origin and Description.—Both plants are common in waste places, along hedges and roadsides, throughout the greater part of Europe and Northern Asia, and have been thoroughly naturalized in North America, where the small annual, U. urens, is less frequent than the taller perennial, U. dioica. Both species are covered with stiff stinging hairs and have opposite stipulate and petiolate leaves.

Urtica dioica. The leaves are 5–8 Cm. (2 or 3 inches) long, dark-green above, whitish downy beneath, ovate or ovate-lanceolate, heart-shaped, pointed, and coarsely serrate. The small greenish flowers are usually diœcious, in small clusters, and these are arranged in branching and hanging spikes. The bast-fibres have been used for the manufacture of *nettle-cloth*.

Urtica urens. The leaves are 2–5 Cm. (1 or 2 inches) long, pale-green, elliptic, deeply serrate, and almost five-nerved. The small and loose flower-clusters appear in axillary pairs.

Allied Plants.—Urtica (Laportea, *Gaudichaud*) canadensis, *Linné*. The leaves are alternate, 10–15 Cm. (4 to 6 inches) long, long-petioled, ovate or elliptic, obtusely serrate, and strongly feather-veined. The flower-clusters form axillary loosely-paniculate cymes. The plant is common in miry, shaded grounds, attains a height of .9–1.5 M. (3 to 5 feet), is armed with stinging hairs, and has strong bast-fibres.

Urtica crenulata, *Roxburgh*, U. stimulans, *Linné*, and U. urentissima, *Blume*, indigenous to India, are more violently irritating than the above species.

U. pilulifera, *Linné*, grows in India, Central Asia, and in Southern Europe. The fruit, a glossy, gray-brown akene and roundish, somewhat resembles flaxseed, but is smaller, has an oily, mucilaginous, and slightly acrid taste; it is used in Oriental countries as a galactagogue. The root is regarded as diuretic.

The bast-fibres of several nettles in addition to those mentioned above are valuable for cordage and woven fabrics. Urtica cannabina, *Linné*, is cultivated in Siberia. Bœhmeria nivea, *Hooker et Arnott*, of Eastern Asia, yields the *ramie* fibre, from which *China grass-cloth* is made. The variety candicans, *Weddell* (B. tenacissima, *Gaudichaud*) yields the *rhea* fibre. The fabrics often possess considerable brilliancy, and these fibres are used as a substitute for, or are mixed with, silk.

Constituents.—The analyses of the fresh nettle by Saladin (1830) and by Bohlig (1840) proved the presence of mucilage, salts, and other common constituents of plants, and on distilling the herb with water notable quantities of ammonia and carbonic acid were found in the distillate. B. Shoemaker (1866) observed that the watery distillate from the root had diuretic properties. Gorup-Besanez (1849) recognized the irritating compound contained in the stinging hairs as free *formic acid*, which is also contained in the aqueous distillate of the fresh herb. A. Buchner, however, observed that the inflammation produced by free formic acid is of a different character from that produced by nettles, and regarded the presence of another irritating compound besides formic acid as probable.

Action and Uses.—The seeds and leaves of the nettle were much used in ancient times in poultices or bruised for unhealthy ulcers as well as for recent wounds and sprains. The bruised leaves were introduced into the nostrils to arrest epistaxis, and given in honey for the cure of pulmonary catarrhs. The well-known irritation of the skin caused by nettles is due to an acrid secretion contained in a minute vesicle situated at the base of each of the stiff hairs that beset the leaves. When the points of these sharp and hollow spines penetrate the skin, the poisonous juice is expressed into its tissue, and gives rise to a burning and stinging pain, with inflammatory redness and swelling. The case is recorded of a woman who, by mistake, drank 2 cupfuls of a decoction of nettle-leaves. On the following day she experienced severe burning over the whole of the upper part of the body, with formication and stiffness. The features were greatly swollen. Over the affected surface minute vesicles appeared, which burst and discharged a limpid and in some parts a bloody fluid. In the course of five or six days the eruption dried up. No fever accompanied the attack (*Archives gén.*, 1835).

Nettle-juice has always been reputed to be an efficient remedy for spontaneous hæmorrhage of nearly every variety, including *hæmoptysis*, *menorrhagia*, *post-partum hæmor-*

rhage, and *epistaxis*. Allowing for the difficulty of determining the efficacy of any medicine in arresting hæmorrhage, there appears to remain so great a preponderance of evidence in favor of the one under consideration as to render scepticism in regard to it unreasonable, especially as in most of the cases numerous hæmostatics of recognized activity had failed before this medicine was employed. The juice was administered in doses of half an ounce or an ounce at intervals of several hours, and in no case does it appear to have given rise to any disagreeable or untoward effects. This preparation is also reported to have been very efficacious in certain cases of *gravel*, *jaundice*, and *dropsy*, and the seeds have been used in *diarrhœa*, *dysentery*, *leucorrhœa*, and nocturnal *incontinence of urine*. The decoction of the leaves and stalks is also said to display curative powers in chronic *diseases of the skin*, and, as well as the expressed juice, to cure ulcerative affections of the mouth and throat. Poultices made by boiling the fresh leaves have been reputed to cure gangrenous, scorbutic, and other unhealthy *ulcers*. Urtication is the name applied to producing an irritation of the skin by means of nettles. It is performed by taking in the gloved hand a bunch of nettles and flagellating the skin with it until the redness and the stinging pain denote that the intended effect is produced. This rude stimulant revulsion and counter-irritation has been long employed for arousing to consciousness persons affected with *lethargy*, *congestion of the brain*, *intoxication* by *alcohol* or *opium*, or *hysterical insensibility*. It has also been used upon the loins and thighs to cure *amenorrhœa* and *sexual impotence*, and, above all, as a means of restoring power to *paralyzed limbs*. The advantages it presents over blistering, pustulation by croton oil, etc. consist in the vivid and intense impression it produces, and which likens it to electricity and massage. It seems to be a rude expedient, but cases may occur, particularly in the country, for which it would be peculiarly adapted.

In Germany the dried young shoots are used in a decoction made with from 10 to 20 parts to 100 parts of water. The juice of the fresh plant is given internally in tablespoonful doses.

Lamium album (Urtica iners, U. mortua) was long ago used as a domestic remedy for hæmorrhages, scrofula, bronchitis, and leucorrhœa, and was regarded by physicians as tonic and astringent. In 1887 like virtues were ascribed to it by Ménière, and also by Florain, who procured from it a substance which he called *lamine* (*Bull. de Thér.*, cxii. 512).

UVÆ, *Br.*—Raisins.

Uva passa, U. S. 1870; *Passulæ.—Raisin*, F. Cod.; *Rosinen, Zibeben*, G.; *Pasas*, Sp.

The dried fruit of Vitis vinifera, *Linné*. Bentley and Trimen, *Med. Plants*, 66.

Nat. Ord.—Vitaceæ.

Origin.—The Vitis vinifera is indigenous to Western Asia and probably to Northern Africa, and has been cultivated in Europe from a very early period; it has been introduced into North America, chiefly on the Pacific coast, and into other temperate countries. A large number of varieties have been produced, differing in the shape, size, and color of their berries and in other characters. Some botanists refer the different varieties of grapevine to three or four species. The *Catawba*, *Isabella*, *Concord*, and other grapes usually cultivated in the United States are varieties of the indigenous Vitis Labrusca, *Linné*.

The genus Vitis consists of shrubs climbing by tendrils, and bearing these and the greenish, compound-racemose flowers opposite the leaves. The calyx is small, the five petals are united at the apex, fall off together by separating at the base, and alternate with five stamens, which enclose a two-celled ovary, ripening into a juicy berry containing about four hard pyriform seeds.

The tender branchlets (*pampini vitis*) with the leaves are sometimes employed for their agreeable acidulous flavor. The unripe berries (*agresta*) contain a considerable amount of tartaric acid, and yield, when expressed, a very acerb juice (*omphacium*), which after fermentation is suc de verjus, *F. Cod.* The mature fruits, dried, constitute the raisins.

Collection.—When the grapes are ripe their stalks are cut half through or a portion of the bark is removed, and the grapes are allowed to remain upon the vines for a few weeks, and then cut off, sometimes steeped for a short time in a weak lye to remove the waxy bloom, and then completely dried; or the ripe grapes are cut off, spread out upon a hard clay floor, and dried by exposure to the sun, which requires a week or two. In rainy weather artificial heat is used for drying them.

Description.—The ripe berry of the grapevine is one-celled from the obliteration

of the cell-wall, and is globular or oblong in shape. After drying it is shrivelled and flattened, more or less orbicular, of a brownish color, and somewhat translucent. When long kept, raisins become more opaque, owing to the crystallization of the sugar and cream of tartar. Raisins are produced in Southern Europe, and in commerce are distinguished generally by the ports of exportation.

Varieties.—Uvæ malacenses, *F. Cod.*, Passulæ majores.—Raisins de Malaga, *Fr.*—Those produced in Spain are usually preferred, and are ordered by the Br. P. They have either been removed from the stalks, like the *Valencia raisins*, or are sold in bunches, like the *Malaga* or *Muscatel raisins*. The *seedless* or *Sultana raisins* are rather smaller than the Spanish and Italian raisins, and are exported from Asia Minor.

Uvæ corinthiacæ, *F. Cod.*, Passulæ minores.—Corinthian raisins, *E.*: Raisins de Corinth, *Fr.*: Korinthen, *G.*—They are produced in Greece and the adjacent islands, and are often incorrectly called *currants*; they are much smaller than those previously described, are usually deprived of their stalks, mostly adhere together in masses, and have a vinous odor and a sweet and acidulous taste.

Constituents.—The *skin* of ripe grapes contains tannin and coloring matter. The chief constituents of the *pulp* are grape-sugar and acid potassium tartrate, besides gummy matter, calcium tartrate, and a small quantity of malic acid. The *seeds* contain about 5 per cent. of tannin, green resin, and over 10 per cent. of a bland oil (see p. 1130).

Uses.—The pulp of raisins is nutritive and demulcent, and is used to flavor mucilaginous and amylaceous infusions, such as those of flaxseed, oatmeal, rice, barley, etc. In its fresh state the pulp is diuretic, chiefly through the grape-sugar it contains.

Ribes nigrum, or black currant, tops and leaves are stated by Cazin to be astringent, tonic, diuretic, diaphoretic, etc. They were employed in France in hot infusion and also in decoction as a diuretic. An infusion in white wine was considered efficient in chronic *vesical catarrh*. The juice of the fruit is subacid, and is used as a gargle and also in the form of a jelly for *sore throat*.

UVA URSI, *U. S., F. Cod.*—Uva Ursi.

Uvæ ursi folia, Br., P. G.—*Bearberry-leaves*, E.; *Busserole*, *Raisin d'ours*, Fr.; *Bärentraubenblätter*, G.; *Gayuba*, Sp.

The dried leaves of Arctostaphylos (Arbutus, *Linné*) Uva ursi, *Sprengel* (Arct. officinalis, *Wimmer*). Bentley and Trimen, *Med. Plants*, 163.

Nat. Ord.—Ericaceæ, Arbuteæ.

Origin.—The bearberry is a trailing, much-branched, evergreen shrub, which is distributed throughout the northern portion of the northern hemisphere, and grows in most parts of Europe, in Northern Asia, and throughout the North American continent as far south as New Jersey and in the mountains of Colorado. It is found in dry, rocky, or sandy places and in pine woods; southward it grows chiefly in hilly or mountainous regions. It bears short and drooping racemes of from three to twelve whitish, urn-shaped flowers and small, bright-red drupes containing five flattened nutlets, each with one seed. The flowers appear in May, and the fruit ripens in autumn, at which time the leaves should be collected.

Fig. 311.

Arctostaphylos Uva ursi, *Sprengel*.

Description.—Bearberry-leaves are nearly sessile, about 2 Cm. ($\frac{4}{5}$ inch) long, 6–8 Mm. ($\frac{1}{4}$ or $\frac{1}{3}$ inch) wide, obovate or oblong-spatulate, entire, and slightly revolute on the margin, obtuse or apparently retuse at the apex, and almost wedge-shaped at the base. They have a leathery texture, a dark-green rather glossy upper surface, with depressed veins, are paler, smooth, and reticulately-veined beneath, and the leaves have a faint hay-like odor and a strongly astringent and slightly bitter taste.

Constituents.—Meissner (1824) found in uva ursi gallic acid and tannin, producing with ferric salts a blue-black precipitate. Kawalier (1852) corroborated the existence of gallic acid in bearberry-leaves, and to its presence is due the

red and violet color produced by a fragment of ferrous sulphate when agitated with an infusion made from 1 part of uva ursi with 50 parts of water. Bowman (1869) determined the amount of tannin, by means of gelatin, to be 6.33 per cent. Besides resin, sugar, and some other unimportant constituents, Kawalier isolated from the leaves arbutin and ericolin, and Trommsdorff another crystalline body, ursone. *Arbutin*, $C_{24}H_{32}O_{14}.H_2O$, is obtained from the decoction of the leaves by precipitating it with lead subacetate, treating the filtrate with hydrogen sulphide, and evaporating to crystallize. It forms neutral, colorless, silky needles, of a bitter taste, freely soluble in hot water and in alcohol, and sparingly soluble in ether. Julius Jungmann (1872) observed that an aqueous solution of arbutin, rendered alkaline by ammonia or potassa, acquires a deep azure-blue color on the addition of phosphomolybdic acid. On being dissolved in strong nitric acid, arbutin yields, after the addition of alcohol, pale-yellow needles of *dinitro-arbutin*. By emulsin or by hot diluted sulphuric acid arbutin is decomposed into glucose and *hydroquinone* or *arcturin*, $C_6H_6O_2$, and *methylhydroquinone*, $C_7H_8O_2$. Hydroquinone crystallizes in colorless, fusible, and sublimable prisms, is easily soluble in water, alcohol, and ether, and is also produced from kinic acid by destructive distillation. On oxidizing hydroquinone or arbutin with manganese dioxide and sulphuric acid *quinone* is formed (see page 360). Hughes' *ursin* (1847) was proven by Jungmann to be impure arbutin.

The mother-liquor from the preparation of arbutin contains *ericolin*.

Ericinol, $C_{10}H_{16}O$, a decomposition-product of the glucoside *ericolin*, $C_{34}H_{56}O_{21}$, which was discovered by Rochleder and Schwarz (1852), is likewise contained in other ericaceous plants, and is inodorous, hygroscopic, brown-yellow, bitter, soluble in water, alcohol, and alcoholic ether, nearly insoluble in ether, chloroform, and benzin, and not precipitated by lead salts. Thal (1883) gives to ericolin the formula $C_{26}H_{30}O_3$, and to ericinol $C_{20}H_{26}O$; combining with water, the latter forms *hydro-ericinol*, $C_{10}H_{20}O_4$, which is a thick, brown-yellow, balsamic, not bitter fluid. Thal obtained ericolin from over thirty species of Ericaceæ. After washing the alcoholic extract of bearberry-leaves with water and ether, boiling alcohol extracts from the residue *ursone*, $C_{20}H_{34}O_2$; this crystallizes in tasteless, silky, fusible, and sublimable needles, is insoluble in water, dilute acids, and alkalies, and is sparingly soluble in ether and cold alcohol.

Arbutin, ericolin, and ursone have been obtained also from the leathery leaves of other ericaceous plants.

Adulterations and Substitutions.—The leaves of the following plants are said to have been sometimes mistaken for those of uva ursi:

Vaccinium vitis-idæa, *Linné*. It is known as *cowberry*, and grows from New England northward and in Europe. The leaves resemble those of uva ursi, but are not reticulate, and on the lower surface are dotted with fine, blackish, bristly points.

Vaccinium uliginosum, *Linné*. This is known as *bog-bilberry*, and grows in Europe and the northern part of North America. The leaves are scarcely leathery, and are pale blue-green and pubescent on the lower surface; otherwise they resemble the leaves of uva ursi.

Leiophyllum buxifolium, *Elliott*. The *sand-myrtle*, indigenous to the United States from New Jersey southward, is a small shrub. Its leaves are oval or oblong, shining, reticulate, and revolute on the margin.

Buxus sempervirens, *Linné*. The box, commonly cultivated in gardens, has ovate leaves, which are narrower toward the apex than near the base. The leaves contain tannin (Buchner), butyraceous volatile oil, bitter extractive, etc. (Bley, 1834); the bitter taste is due to *buxine* and *parabuxine*. (See Nectandra and Pareira Brava.)

Epigæa repens, *Linné*. Trailing Arbutus, Ground-laurel, Gravel-plant, May-flower, *E. Nat. Ord.* Ericaceæ, Ericineæ. This is a prostrate hairy North American shrub about 30 Cm. (1 foot) long, growing in sandy woods and flowering in early spring. The thin woody stem is covered with a brown bark. The evergreen leaves are alternate, about 5 Cm. (2 inches) long, petiolate, coriaceous, and reticulated; their shape is ovate, the margin entire, the base heart-shaped, and the apex tipped with a short point. The flowers are in small axillary clusters, rose-colored or whitish, fragrant, have a deeply five-parted bracted calyx, a salver-form corolla with the tube hairy inside, ten stamens, and produce five-lobed and five-celled capsules containing numerous seeds. The leaves are inodorous, and have a bitterish and astringent taste. The leaves contain tannin, which produces a black precipitate with iron salts. Using gelatin as a precipitant, H. K. Bowman (1869) determined its amount to be 3.5 per cent. Jefferson Oxley (1872) proved the constituents to be identical with those of uva ursi—namely, *arbutin*, *ursen*, and *ericolin*. Formic acid was also found, and a principle having in its behavior to tests some resemblance to gallic acid, without, however, yielding pyrogallic acid.

Oxydendrum arboreum, *De Candolle*, s. Andromeda arborea, *Linné*, *sorrel tree* or *sour wood*, is about 12 M. (40 feet) high. The leaves are deciduous, oblong-lanceolate, pointed, serrulate on the margin, and nearly smooth. They resemble peach-leaves in shape and have a refreshing acidulous taste. The tree grows in the Alleghanies and westward to Arkansas.

All the species named above belong to North America.

Allied Species.—Arctostaphylos glauca, *Lindley.* This shrub or small tree grows in dry and rocky localities on the western slope of the Sierras in California, where it is known as *manzanita.* The leaves are about 5 Cm. (2 inches) long, coriaceous, ovate-oblong, acute above and rounded or obtuse at the base, entire on the margin, and of a pale-green color. It was examined by J. H. Flint (1873), and found to contain arbutin, 9.8 per cent. of tannin, and 6 per cent. of ash. The leaves are employed like uva ursi.

Arc. polifolia, *Kunth*, A. mucrocifera, *De Candolle*, are employed in Mexico like uva ursi: also the shrubs known as *madrona*, Arc. tomentosa, *Douglas*, and Arbutus xalapensis, *Kunth*: this last species extends into Western Texas.

Action and Uses.—Uva ursi, or bearberry, in small doses appears to promote the appetite and confine the bowels, but in large quantities it occasions vomiting and purging. On the healthy system it does not produce any diuretic action, but in calculous affections the urine sometimes seems to augment under its influence. It gives to this secretion a dark color and a peculiar odor. According to Lewin, the most active constituents of uva ursi are tannin and arbutin. The latter undergoes decomposition in the system and generates hydroquinone, which is antiseptic and antizymotic and retards the putrefaction of urine (*Therap. Gaz.*, Sept. 1883). Some observers ascribe a diuretic operation to arbutin, but it is not clinically or physiologically established. Arbutin certainly does not represent all the virtues of uva ursi, especially in the diseases for which the latter is most frequently employed.

Uva ursi appears to have been first used by physicians about the middle of the eighteenth century. It was then employed in calculous affections and in all chronic disorders of the urinary passages, from the kidneys to the urethra. It has proved useful in chronic *pyelitis* and *cystitis*, and even in calculous forms of those affections, probably by constringing the mucous membrane of the kidneys and bladder, diminishing its vascularity, and thereby obtunding its sensibility. In many cases, as a consequence of this mode of action, it has caused the parts affected to become more or less insensible to the mechanical irritation of the concretions enclosed by them, and thereby lessened the impediment to the passage of the urine. In this manner, no doubt, it often relieves *incontinence of urine*, *dysury*, and *strangury*. So complete is the relief sometimes afforded by it that a notion once gained credit of its being a solvent of *urinary calculi*. But, in truth, its mode of action is in great part like that of lime-water, whose efficacy under analogous circumstances is well known: it renders the mucous membrane of the urinary passages less susceptible to mechanical irritation. The benefits of the medicine in most of the cases referred to are only to be obtained by its persistent use. But in strangury from blisters its action is sometimes very prompt. Uva ursi has been also used with advantage for chronic *bronchitis* and atonic *diarrhœa*, *leucorrhœa*, and *hæmorrhage*, especially uterine hæmorrhage. It is said to act as an *oxytocic*. Arbutin is stated, but upon insufficient grounds, to be an efficient diuretic in *cardiac dropsy*, and it has also been prescribed with alleged advantage in *urethritis*. It may be taken in large doses without any ill effect. As a diuretic it has been given in doses of about Gm. 1 (gr. xv) per diem, mixed with powdered sugar; and also in a 5 per cent. watery solution. Lewin recommends that a decoction should be prepared with from 30 to 80 parts of the leaves to 180 parts of water, and its tannin removed with charcoal. But this removal impairs the energy of the preparation. Arbutin may also be given with powdered sugar to the extent of Gm. 0.6–0.8 (gr. x–xij) a day.

The *dose* of uva ursi in powder is generally stated to be Gm. 1.30–4 (gr. xx–lx), but its most striking effects have been obtained by doses not greater than a fourth of those just mentioned. The decoction, infusion, and fluid extract of uva ursi are efficient; the last is officinal.

Buxus sempervirens was found by Ringer and Murrell to produce tetanus, followed by paralysis, in frogs (*Med.-Chir. Trans.*, lix. 389). A decoction has been used to cure, by sweating, syphilis, rheumatism, gout, intermittent fever, etc. In over-doses it may act as an emeto-cathartic. Buxine, besides such effects, is said to cause disorder and sedation of the nervous system. A decoction of the leaves applied to the scalp to prevent the hair from falling out, and accidentally to the face, produced an eczematous eruption on the latter (*Boston Med. and Surg. Jour.*, Dec. 1889, p. 583).

Oxydendron arboreum is said to be diuretic and laxative. A semi-solid extract in doses of Gm. 0.20–0.80 (gr. iij–xij) a day is said to have removed dropsical swellings.

Epigæa (*trailing arbutus*) has been compared with uva ursi and buchu; it possesses some astringency like the former, and has been used for the relief of *strangury* and *vesical catarrh*. A decoction is prepared with Gm. 32 (℥j) of the dried leaves and stems in Gm. 500 (Oj) of water, and given in the *dose* of a wine-glassful three or four times a day.

VALERIANA, *U. S.*—Valerian.

Valerianæ rhizoma, Br.; *Radix valerianæ*, P. G.; *Radix valerianæ minoris.*—*Valerian-root*, E.; *Valériane officinale*, F. Cod.; *Baldrian*, G.; *Valeriana sylvestre*. Sp.

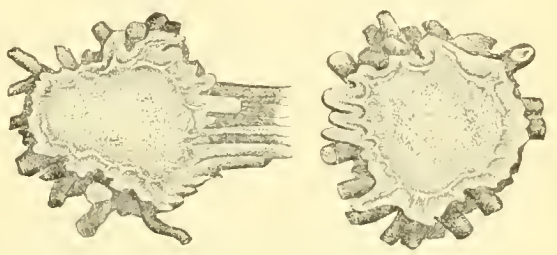
The root of Valeriana officinalis, *Linné*. Bentley and Trimen, *Med. Plants*, 146.

Nat. Ord.—Valerianaceæ.

Origin.—Valerian is a native of Europe from the Mediterranean northward, and of Northern Asia, and is cultivated to some extent in Holland and England, and in this country in New England and New York. It is an herbaceous perennial, and grows on the banks of streams and other wet places, and likewise in uplands and dry situations. It varies considerably in size and in foliage, and several of the varieties have been regarded by some botanists as distinct species. The plant is easily propagated from short horizontal runners. It is .6–1.2 M. (2 to 4 feet) high, branching at the top, has opposite, clasping, long-petiolate and oddly pinnate leaves, with from four to ten pairs of oval or lance-linear, entire or toothed, sessile, and smooth leaflets, and bears compound cymes composed of numerous small pinkish, triandrous flowers. The fruit is an ovoid, compressed akene, crowned by a plumous pappus. The rhizome with the rootlets attached constitute the official portion, and is collected in autumn.

Description.—The rhizome of valerian is upright, subglobular or obconical, truncate below, and at the apex often crowned with short portions of the overground stem or with a tuft of short leaf-bases, and indistinctly marked with closely approximate leaf-scars. It varies in length between about 1–3 Cm. ($\frac{1}{2}$ and 1¼ inches), has a diameter nearly of the same dimensions, and is on all sides furnished with numerous slender nearly cylindrical rootlets. These are from 5–15 Cm. (2 to 6 inches) long, about 3 Mm. ($\frac{1}{8}$ inch) thick at the base, simple, except near the tip, where they are divided into numerous fine fibres, which are rarely present in the commercial drug. A few short stolons, with long internodes, are occasionally attached to the rhizome. The rhizomes collected from dry situations are the smallest, have a light yellowish-brown color, are subglobular in shape, have a comparatively large number of rather short, thin, and light-colored rootlets attached, and are preferred for medicinal purposes on account of the larger proportion of volatile oil contained in them. The rhizomes collected in wet localities are more elongated, of larger dimensions, more fleshy and hygroscopic, and are therefore frequently cut longitudinally to facilitate their drying; they are darker in color, near the lower end marked by scars from decayed rootlets, and near the middle and upper portion have longer, thicker, and darker-colored rootlets than the preceding variety, attaining a length of 25–30 Cm. (10 or 12 inches). The rootlets of valerian are rather brittle and break with a short fracture; the rhizome is tougher, and in the interior rather horny and of a light grayish-brown color. It has a thin bark, which by a dark cambium-line is separated from a narrow circle of whitish woody tissue, and this encloses a large central pith. The rootlets have a thick bark surrounding a slender ligneous cord. Under the microscope the parenchyma is seen to contain cells filled with starch, extractive matter, and oil or resin. The recent rhizome has a very slight odor, but on drying a peculiar somewhat camphoraceous and terebinthinate odor appears, which on long keeping gradually changes to a strong somewhat cheese-like odor. The taste of valerian is at first sweetish, afterward unpleasant, camphoraceous, and somewhat bitter. The rootlets of the commercial drug sometimes cover a large amount of dirt.

Fig. 312. Fig. 313.



Longitudinal and transverse section of rhizome of Valerian.

Constituents.—The most important constituent of valerian is its volatile oil (see page 1116), which varies in proportion between about $\frac{1}{2}$ and 2 per cent., the fresh rhizome from dry soil yielding the larger amount. Cultivated valerian seems to be less rich in volatile oil. Recent valerian on being distilled with water yields a distillate which, according to Schoonbroodt (1868), is neutral or nearly so. Free valerianic acid does not exist in fresh valerian, but is generated from the volatile oil on exposure. The relative proportions of the volatile oil and valerianic acid must therefore vary with the age of the drug. Aschoff (1846) found in the root also malic, acetic, and formic acids. The constituents which are of less medicinal importance are tannin, extractive, sugar, starch, mucilage, resin, etc.

Admixtures.—Although valerian is readily distinguished from other medicinal roots, it has been sometimes observed sophisticated with poisonous drugs somewhat resembling valerian in appearance, and from contact with the latter having acquired to some extent its peculiar odor. Cynanchum Vincetoxicum (p. 299) was noticed by Charbonnier (1877), Veratrum album (see below) by Holmes (1877), and Sium latifolium (p. 477) by Bernbeck (1880).

Pharmaceutical Preparations.—AQUA VALERIANÆ. Distil 1 part of bruised valerian with sufficient water to obtain 4 parts of distillate.—*F. Cod.*

SYRUPUS VALERIANÆ. Extract of valerian 4 Gm., valerian-water 100 Gm., sugar 180 Gm.—*F. Cod.*

SPIRITUS ANGELICÆ COMPOSITUS. Valerian 4 parts, juniper-berries 4 parts, angelica 16 parts, alcohol 75 parts, and water 125 parts; distil 100 parts, and dissolve in the distillate camphor 2 parts.—*P. G.*

Allied Drugs.—VALERIANA PHU, *Linné*, is a tall perennial of Western Asia and Southern Europe, and is occasionally cultivated. The root was known as *radix valerianæ majoris*, and consists of an oblique rhizome which is 10–15 Cm. (4 to 6 inches) long, about 12 Mm. (½ inch) thick, is distantly annulated, of a brown color, on the lower side furnished with numerous yellowish rootlets, and has a much weaker odor and taste than official valerian.

VAL. MEXICANA and V. TOLUCANA, *De Candolle*, of Mexico, yield much valerianic acid, and are used like the official drug.

NARDUS SPICA CELTICA is the rhizome of Valeriana celtica, *Linné*, a native of the Alps. It is thin, about 75 Mm. (3 inches) long, densely covered with brown scaly leaf-remnants, has long simple rootlets on the lower side, and possesses a strong odor and a taste of valerian.

NARDUS INDICA, S. SPICA NARDI, or true *spikenard*, formerly much employed, is obtained from Nardostachys (Valeriana, *Roxburgh*) Jatamansi, *De Candolle*, indigenous to India. It is about 6 Mm. (¼ inch) thick, densely beset with numerous fibrous remnants of leaf-stalks, and has a bitter aromatic taste and penetrating odor resembling that of serpentaria.

PATRINIA SCABIOSÆFOLIA, *Link*. The root is known in Japan as *kesso*, and was sent to England in 1879. It resembles valerian in appearance, odor, and taste, but has a short rhizome, not over 8 Mm. (⅓ inch) thick, and this is densely covered with dark-brown scaly rootlets, which are 5–10 Cm. (2 to 4 inches) long.

Action and Uses.—Valerian is not a cure for *hysteria*, but it is a most valuable palliative when employed to avert or mitigate hysterical paroxysms provoked by some accidental cause. Especially is this the case in females of weak constitution and excitable temperament, and who are exhausted by care and anxiety. It is still more efficient in preventing the development of those hysteroidal attacks which weak and morbidly sensitive girls and women are liable to, and which consist in an excessive susceptibility to impressions, and in the power of converting into real sensations the suggestions of a disordered fancy, whereby countless subjective perceptions and various disordered actions of the lungs, heart, stomach, etc. arise. In mild cases of *mental derangement*, especially when caused by nervous shock or strain; in nervous *atony* simulating paralysis; in cases also of irregular distribution of the blood, accompanied, it may be, with indications of cerebral congestion, or, on the other hand, of cerebral anæmia, of which the chief symptoms are *vertigo*, a sense of rush of blood to the head, or fainting, confusion of sight and hearing, etc., which more than at any other time are apt to occur about the menopause, —valerian is the most promptly efficient of all the palliatives that have been used. In all these cases valerian exhibits the same potency as asafetida, musk, and castor, and more decidedly. Oil of valerian dissolved in ether may be administered by inhalation in such attacks. Valerian is one of the best remedies for *nervous headache*, especially when it is associated with ammonia, as in the ammoniated tincture of valerian or the popular elixir of ammonium valerianate. These preparations may be used advantageously, along with a carminative tincture, in cases of *flatulence* accompanied with palpitation of the heart. The same medicines are equally efficient in relieving *infantile colic*, an affection for which domestic medicine generally provides an analogous remedy in catnep.

Valerian is one of the innumerable articles that from time to time have been vaunted as remedies for *epilepsy*, and, allowing for the common error of confounding epilepsy with epileptiform reflex convulsions, and even with hysteria, there can be no doubt that it has sometimes cured the disease in females and young children, and especially when it originated in fright or some analogous impression. Even in these cases it must be administered in large doses and be long continued, while other and especially hygienic measures are employed to give permanent strength to the nervous system.

Valerian is useful in the treatment of the milder forms of *delirium tremens*, especially when they follow surgical operations or injuries, and in the ataxic phenomena which belong to the *typhoid state* of fevers and inflammations. It has had some reputation as a *vermifuge* for children when associated with purgatives, such as jalap, and by

enema as a remedy for ascarides of the rectum. It has also been used successfully for the relief of *dysmenorrhœa* and in *polyuria* or *diabetes insipidus*. Bouchard, however, claims that when the urine contains an excess of urea (azoturia) or of sugar (glycosuria), valerian diminishes the amount of solids discharged and thus acts as a conservator of tissue and of force. Butte, on the other hand, maintains that valerian causes the destruction of the glucose in the blood (*Univers. Med. Mag.*, iii. 498).

Valerian may be prescribed in powder in *doses* of Gm. 2–6 (gr. xxx–xc), repeated three or four times a day. Its disagreeable taste may be masked by the addition of an aromatic powder. Of its several preparations, the infusion and the fluid extract are to be preferred; next to these ranks the oil. The tincture, however, is officinal, and so is the ammoniated tincture, which is decidedly preferable to either the simple tincture or the fluid extract.

Caffeine Valerianate (so called) was tried by Paret (1775) in hysteria to moderate *nervous vomiting*, and in some cases with success, the medicine appearing to act as a general stimulant; in the vomiting of phthisis it was useless, but in *whooping cough* it decidedly lessened the paroxysms. It was given in pills, in the dose of Gm. 0.10 (gr. ij) three times a day.

VANILLA, *U. S.*—Vanilla.

Fructus (*s. Siliqua*) *vanillæ*, P. G.—*Vanille*, Fr. Cod., G.; *Vainilla*, Sp.

The prepared unripe fruit of Vanilla planifolia, *Andrews*. Bentley and Trimen, *Med. Plants*, 272.

Nat. Ord.—Orchidaceæ.

Origin.—The name "vanilla" is derived from the Spanish *baynilla*, the diminutive of *bayna*, a pod. The plant is indigenous to Eastern Mexico, where it grows in hot, moist woods, and is cultivated by fastening shoots to trees just above the ground, where they soon strike root, begin to produce fruits in about three years, and continue to bear for about thirty years. The plant has a long fleshy stem, supporting itself by simple aërial rootlets, alternate sessile, fleshy, oval-lanceolate leaves, and axillary spikes of large greenish-white flowers, with a depressed recurved and crenate lip, and with an elongated, fleshy, cylindrical ovary. The cultivated plant is Schiede's Vanilla sativa. The wild-growing plant (Schiede's V. sylvestris) is usually regarded as a mere variety of the former, and yields a smaller and less aromatic fruit, known in Mexico as *baynilla cimarona*. The vanilla-plant has been introduced into some of the West Indian islands, into Bourbon, Madagascar, and several East Indian islands. In its native country it is probably fertilized through the agency of insects; in other countries artificial fertilization is required.

Collection.—The fruit is collected before it is ripe, when the green color begins to change. In order to develop its aroma and to prevent its dehiscence, the unripe fruit is partly sun-dried or exposed to artificial heat, and then wrapped in blankets until it begins to sweat, when the exposure and subsequent wrapping up are repeated. Steeping in hot water is said to be in some places resorted to previous to drying. Some of the constituents are supposed to undergo a kind of fermentation, through which the odorous principle is developed. After the fruits have obtained the proper dark color, agreeable aroma, and sufficient dryness, they are tied into bundles of fifty, weighing a little over 8 ounces, and these are sometimes wrapped in tin-foil and packed in tin boxes.

Properties.—The cultivated vanilla-fruit is known in Mexico as *baynilla corriente*, and is further distinguished and assorted according to its size and the thickness of its integuments. The finest quality attains a length of 30 Cm. (12 inches), has a thin pericarp, and is rarely seen in our market. The varieties usually met with are from 15–25 Cm. (6 to 10 inches) long, about 8 Mm. (⅓ inch) thick, and somewhat triangular, but flattened. Vanilla is of a dark-brown color, glossy, longitudinally wrinkled, somewhat narrowed at both ends, bent or hooked at the base, and rather oblique at the apex. The surface is frequently marked with a few circular or oblong warts, and some varieties are more or less covered with an efflorescence of acicular crystals. The integuments of the fruit are leathery, of a brown color; the interior is filled with a blackish-brown fragrant pulp, in which very numerous minute black flattish-ovate seeds are imbedded. The fruit is one-celled, and has three parietal placentæ, each projecting with four curved branches into the interior. The parenchyma of the integuments contains extractive, oil drops, and crystals of vanillin and calcium oxalate, and an irregular circle of about twenty delicate fibro-vascular bundles.

Varieties.—Mexican vanilla is regarded as the best. Bourbon vanilla resembles it, and is usually covered with crystals, but has an odor somewhat suggesting that of tonka. Costa Rica vanilla is less attennated at the ends, and has hardly the fine flavor of the Mexican variety. Vanilla from the Seychelles is considerably thinner. A vanilla is produced in Venezuela which is 7–15 Cm. (3 to 6 inches) long, rather thick, and of a decided tonka flavor. Van. microcarpa, *Karsten*, a native of Venezuela, has a very aromatic fruit, about 75 Mm. (3 inches) long and 5 Mm. ($\frac{1}{5}$ inch) broad. In Brazil, Peru, and other parts of South America a broad and fleshy vanilla is obtained which is 15–20 Cm. (6 to 8 inches) long, about 12 Mm. ($\frac{1}{2}$ inch) wide, and of an inferior vanilla odor; it is probably the fruit of Vanilla pompona, *Schiede*. It is not unlikely that several other species besides those mentioned above yield vanilla, but the different species are very imperfectly known. Vanilla guianensis, *Splitberger*, indigenous to the north-eastern portion of South America, may yield some of the South American vanilla. Vanilla palmarum, *Lindley*, a native of Bahia, has a thick cylindrical not very fragrant fruit about 5 Cm. (2 inches) long. Vanilla aromatica, *Swartz*, is indigenous to South America, but not to Mexico, and its fruit is said to be not aromatic.

Constituents.—According to the analysis of Bucholz (1828), vanilla contains about 11 per cent. of fixed oil, 2.3 per cent. of soft resin, 6 per cent. of sugar, 11 per cent. of gum, and considerable extractive matter. Leutner (1872) obtained 4 per cent. of resin, 6.6 gum, 10 sugar, 4.7 per cent. of ash, and, besides a little wax and tannin, also oxalic and other acids. The odor of vanilla is not due to a volatile oil. The crystalline efflorescence was for a long time regarded as identical with either benzoic or cinnamic acid, but Bley (1831) proved it to be distinct from both, and Gobley (1858) established its difference from coumarin and named it *vanillin*. It is obtained from the alcoholic extract of vanilla by diffusing it in a little water, agitating with ether, and evaporating the ethereal liquid; the brown odorous residue yields to boiling water vanillin, which is purified by recrystallization and treatment with animal charcoal. Vanillin crystallizes in hard, colorless, four-sided prisms; has the odor of vanilla and a pungent, warm taste, melts near 80° C. (176° F.); sublimes when carefully heated; has a feeble acid reaction, and is freely soluble in boiling water, in alcohol, ether, fats, and volatile oils. It does not decompose alkaline carbonates, but dissolves in caustic alkalies, and is precipitated unaltered from the solutions on the addition of an acid; its aqueous solution is not affected by salts of tin, mercury, and silver, yields a pale-yellowish precipitate with basic lead acetate, and strikes a dark-violet color with ferric chloride. It dissolves in sulphuric acid with a yellow color, and by nitric acid is oxidized to oxalic acid. On account of its feeble acid properties Stokkebye (1864) proposed to name it *vanillic acid* (see below). Carles (1870) found its formula to be $C_8H_8O_3$, and this was corroborated by Tiemann and Haarmann (1874–78), who prepared vanillin artificially from *coniferin*, $C_{16}H_{22}O_8$, a compound contained in the sap of coniferous trees; this on being treated with emulsin is spilt into sugar and *coniferyl alcohol*, $C_{10}H_{12}O_3$, which on being oxidized with a mixture of sulphuric acid and potassium dichromate, like coniferin itself, yields vanillin. Vanillin was recognized as the aldehyde of methyl-protocatechuic acid, $C_6H_3.OCH_3.OH.CHO$; by careful oxidation this is converted into the nearly inodorous *vanillic acid*, $C_6H_3.OCH_3.OH.COOH$. The same authors have further shown the relation of these interesting principles to creosol, eugenol, ferulaic acid, caffeic acid, and other compounds, and devised a process for the artificial preparation of vanillin from oil of cloves, and propose (1875) to estimate the amount of vanillin by completely exhausting not less than 30 Gm. of cut vanilla with ether, concentrating the ethereal tincture, agitating the liquid repeatedly with solution of sodium bisulphite, decomposing the mixed aqueous liquids with dilute sulphuric acid, and dissolving the liberated vanillin by agitation with ether. Mexican vanilla yielded 1.3–1.7, Java vanilla 1.6–2.75, and Bourbon vanilla 0.75–2.9 per cent. of pure vanillin: the last two varieties were found to contain, in addition, an oily matter having a disagreeable odor; and the fruit of Van. pompona, which yielded .4–.7 per cent. of vanillin, was observed to contain another compound, probably *benzaldehyde*, which modifies the odor of the former.

The poisonous effects repeatedly observed to be due to the use of vanilla as a flavor for ices have been referred by Schroff, in the absence of metallic poisons, to the presence of cardol, resulting from the alleged employment of the fixed oil of the cashew-nut (see p. 207) for improving the appearance of vanilla.

Pharmaceutical Uses.—Vanilla is employed in perfumery.

Pulvis vanillæ cum saccharo, *U. S.*, Vanilla saccharata. 1 part of finely-cut vanilla and 9 parts of sugar are triturated together until a grayish-white uniform

powder is obtained, or 2 parts of vanillin dissolved in alcohol are mixed with 98 parts of sugar.

SYRUPUS VANILLÆ. Mix simple syrup with sufficient tincture of vanilla until the desired flavor is obtained.

Action and Uses.—Workmen engaged in handling vanilla-beans suffer from itching of the hands and face; the skin is covered with a pruriginous eruption, and swells, reddens, and desquamates. Others are affected with dizziness, weariness, and muscular pains. The eruption is produced by an acarus, which irritates without penetrating the skin (*Jour. Amer. Med. Assoc.*, i. 621). In Mexico, its native country, the Spanish conquerors found vanilla in common use for flavoring chocolate, and for this purpose it continues to be extensively used. Very probably it promotes the digestion of this aliment, as it does that of many other fatty and farinaceous articles of food, and therefore may be classed with the aromatics. In its action it has some analogy with balsam of Peru. Like the aromatics generally, aphrodisiac qualities are attributed to it. Cases of poisoning by ice-cream flavored with vanilla seem to have been caused by fermentative changes in the cream or milk employed. In medicine vanilla is rarely employed alone, but it may be prescribed in powder in *doses* of Gm. 0.30–2 (gr. v–xxx), mixed with sugar. A syrup made with it and the officinal tincture form agreeable flavoring ingredients of mixtures. It may be added also to troches for a similar purpose, as it is in the officinal troches of iron.

VAPORES.—INHALATIONS.

These are mixtures, consisting of water with a volatile substance, which are perhaps never made by the apothecary, and appear to be better adapted for extemporaneous prescription. The *vapores*, as originally employed in medicine, are external applications.

VAPOR ACIDI HYDROCYANICI, *Br.*—INHALATION OF HYDROCYANIC ACID.

Take of Diluted Hydrocyanic Acid 10 to 15 minims; Water (cold) 1 fluidrachm. Mix in a suitable apparatus, and let the vapor that arises be inhaled.—*Br.*

Uses.—The "inhalation of hydrocyanic acid" is too dangerous a remedy to be recommended under any circumstances. The difficulty, if not impossibility, of determining the exact strength of the solution, the various degrees of susceptibility to its action, and the promptly fatal effects of an overdose inhaled, should condemn it as a medicine.

VAPOR CHLORI, *Br.*—INHALATION OF CHLORINE.

Take of Chlorinated Lime 2 ounces; Water (cold) a sufficiency. Put the powder into a suitable apparatus, moisten it with the water, and let the vapor that arises be inhaled.—*Br.*

Uses.—This preparation is a convenient means of obtaining chlorine for inhalation, but the necessity of making it officinal by prescribing the exact amount of chlorinated lime to be used is the reverse of apparent.

VAPOR CONINÆ, *Br.*—INHALATION OF CONINE.

Take of Juice of Hemlock ½ fluidounce; Solution of Potash 1 fluidrachm; Distilled Water 1 fluidounce. Mix. Put 20 minims of mixture on a sponge in a suitable apparatus, so that the vapor of hot water passing over it may be inhaled.—*Br.*

The potassa is added for the purpose of liberating the coniine contained in the juice.

Uses.—The proportion of the extract of conium directed for this preparation, must vary according to the strength of the extract used; which, being very uncertain, the "inhalation" cannot be of uniform power.

VAPOR CREOSOTI, *Br.*—INHALATION OF CREOSOTE.

Take of Creosote 12 minims; Boiling Water 8 fluidounces. Mix the creosote and water in an apparatus so arranged that air may be made to pass through the solution, and may afterward be inhaled.—*Br.*

Uses.—This "inhalation" appears to be a very superfluous officinal preparation. The proportion of creosote used should vary with the condition it is intended to remedy.

VAPOR IODI, *Br.*—Inhalation of Iodine.

Take of Tincture of Iodine 1 fluidrachm; Water 1 fluidounce. Mix in a suitable apparatus, and, having applied a gentle heat, let the vapor that arises be inhaled.—*Br.*

Uses.—According to our experience, the proportion of tincture of iodine in this "inhalation" is entirely too large for ordinary use if the iodine is vaporized rapidly. It should be left to the judgment of those who are skilful enough to use such a preparation at all. Conine, creosote, and iodine are more efficaciously used by inhalation in atomized solutions.

VAPOR OLEI PINI SYLVESTRIS, *Br.*—Inhalation of Fir-wool Oil.

Take of Fir-wool Oil 40 minims; Light Magnesium Carbonate 20 grains; Water a sufficiency. Rub the fir-wool oil with the magnesium carbonate, and gradually add sufficient water to produce 1 fluidounce. Put 1 fluidrachm of this mixture with 10 ounces of boiling water into an apparatus so arranged that air may be made to pass through the solution and may afterward be inhaled.—*Br.*

Uses.—As an inhalation in chronic affections of the air-passages.

VERATRINA, *U. S., Br., F. Cod.*—Veratrine.

Veratria, Br.; *Veratrinum*, P. G.—*Vératrine*, Fr.; *Veratrin*, G.

Nat. Ord.—Liliaceæ.

A mixture of alkaloids obtained from the seed of Asagræa officinalis (*Schlechtendal* and *Chamisso*), *Lindley*.

Origin.—The mixture of alkaloids which is recognized by the pharmacopœias under the above names was first prepared by Meissner (1819) from sabadilla and named *sabadilline*. Pelletier and Caventou (1819) prepared similar substances from sabadilla and white veratrum, and called them *veratrine*, which name has since been applied to the product from the former source only (see also Veratrum Album); and this was known in an amorphous condition, and supposed to be uncrystallizable until Merck (1855) showed that a portion of it could be crystallized. Sabadilla-seeds are used for preparing veratrine; Schroff (1863), however, has shown that the capsules are very poisonous and probably contain the same alkaloids.

Preparation.—Take of Cevadilla 2 pounds; Distilled Water, Rectified Spirit, Solution of Ammonia, Hydrochloric Acid, each a sufficiency; Purified Animal Charcoal 60 grains. Macerate the cevadilla with half its weight of boiling distilled water in a covered vessel for twenty-four hours. Remove the cevadilla, squeeze it, and dry it thoroughly with a gentle heat. Beat it now in a mortar, and separate the seeds from the capsules by brisk agitation in a deep, narrow vessel or by winnowing it gently on a table with a sheet of paper. Grind the seeds in a coffee-mill and form them into a thick paste with rectified spirit. Pack this firmly in a percolator, and pass rectified spirit through it till the spirit ceases to be colored. Concentrate the spirituous solution by distillation so long as no deposit forms, and pour the residue, while hot, into twelve times its volume of cold distilled water. Filter through calico, and wash the residue on the filter with distilled water till the fluid ceases to precipitate with ammonia. To the united filtered liquids add the ammonia in slight excess; let the precipitate completely subside, pour off the supernatant fluid, collect the precipitate on a filter, and wash it with distilled water till the fluid passes colorless. Diffuse the moist precipitate through 12 fluidounces of distilled water, and add gradually, with diligent stirring, sufficient hydrochloric acid to make the fluid feebly but persistently acid. Then add the animal charcoal, digest at a gentle heat for twenty minutes, filter, and allow the liquid to cool. Add ammonia in slight excess, and when the precipitate has completely subsided pour off the supernatant liquid, collect the precipitate on a filter, and wash it with cold distilled water till the washings cease to be affected by silver nitrate acidulated with nitric acid. Lastly, dry the precipitate first by imbibition with filtering-paper, and then by the application of a gentle heat.—*Br.*

Alcohol extracts from sabadilla-seeds veratrine in its natural combination with veratric acid. On evaporating the alcohol, diluting the syrupy liquid with water, and filtering from the resin, the liquid contains veratrine veratrate, and this salt is decomposed by ammonia or potassa; the alkaloid thus isolated requires to be purified by washing with water, dissolving in a dilute acid, and freeing from coloring matter by animal charcoal; ammonia will then precipitate veratrine as a white powder.

The concentrated alcoholic extract may also be deprived of its alkaloidal constituents by boiling with acidulated water, and the acid solution decomposed by magnesia, the excess of which remains with the liberated alkaloids; the latter are taken up by alcohol combined with sulphuric acid, the alcohol evaporated, the remaining aqueous solution decolorized by animal charcoal, and the veratrine precipitated by ammonia. This was the process of the U. S. P. 1870.

The outlines of the process of the French Codex are as follows: Exhaust with alcohol acidulated with sulphuric acid, add slaked lime to the tincture to liberate the alkaloids, filter from the calcium compounds, distil off the alcohol, dissolve the residue in dilute sulphuric acid, decolorize by means of animal charcoal, precipitate by ammonia, again dissolve in alcohol, and repeat the treatment as before; finally, dissolve the washed and dried veratrine in ether, filter, and evaporate spontaneously.

Several other processes have been recommended for the preparation of veratrine, in which advantage is taken of its ready solubility in acidulated water. Delondre (1855) exhausts the powdered seeds by percolation with water acidulated with hydrochloric acid, precipitates with potassa, and exhausts the washed and dried precipitate with ether, on the evaporation of which the alkaloid is left behind. Merck's process is somewhat similar: powdered sabadilla is boiled with very dilute hydrochloric acid, the solution concentrated to a syrupy consistence, and further acidulated with hydrochloric acid as long as a precipitate of veratric acid appears. The filtrate is precipitated with lime; the precipitate is collected and exhausted with alcohol; the alcohol is distilled off, and the residue dissolved in dilute acetic acid. On the addition of ammonia, veratrine is precipitated; it is obtained as a crystalline powder by dissolving it in ether and evaporating, as directed by the French Codex.

Properties.—As obtained by the first process, veratrine is a white or whitish amorphous powder, permanent in the air, without odor, powerfully sternutatory, and very irritating to the nostrils, and has a persistently acrid taste, "leaving a sensation of tingling and numbness on the tongue" (*U. S.*). It imparts to water an acrid taste, but requires about 1000 parts of boiling water for solution, the excess of the alkaloid cohering in lumps without melting. It has an alkaline reaction to test-paper, neutralizes acids, and when heated melts, and afterward is decomposed, forming a spongy charcoal, and is finally dissipated without leaving any residue. Veratrine is soluble in 3 parts of alcohol and dissolves in about 6 parts of ether (Delondre), in 1.6 (Pettenkofer) or 8.6 (Schlimpert), or 2 (*U. S.*) parts of chloroform; in 96 parts of glycerin (Cap and Garot) and 56 parts of olive oil (Pettenkofer). Nitric acid imparts to veratrine a yellow color or forms a reddish-yellow solution. Its solution in concentrated hydrochloric acid acquires by heat a deep-red color, which remains unaltered for several weeks (Trapp, 1862). Sulphuric acid dissolves veratrine with a yellow color, changing in a few minutes to orange-red, then to blood-red, in about thirty minutes to carmine-red, and subsequently to violet color (Henry). Masing (1869) observed that .00017 Gm. of veratrine may be detected with the last two tests, but that the reaction with hydrochloric acid is less interfered with by the presence of extractive matter. The fresh solution of veratrine in sulphuric acid becomes at once purple-colored on the addition of bromine-water. "On triturating 1 part of veratrine with 100 parts of sulphuric acid, the solution shows a green-yellow fluorescence, the color gradually changing to red" (*P. G.*). The U. S. P. directs for this test no definite quantity of sulphuric acid, but states that the fluorescence first observed becomes more intense on adding more sulphuric acid. On sprinkling powdered sugar upon a thin layer of the solution of veratrine in sulphuric acid, a yellow color is produced, changing to green and blue, and becoming paler after an hour (Weppen, 1874).

Tests.—The tests just described establish the identity of veratrine. On being ignited upon platinum-foil no residue should be left.

Composition.—The formula $C_{32}H_{52}N_2O_8$ is that ascertained by Merck for the crystalline alkaloid in large colorless, rhombic prisms, which on exposure become white, opaque, and friable, and lose their shape in boiling water without melting or dissolving. The crystals are obtained by dissolving medicinal veratrine in alcohol, adding water until a permanent precipitate begins to appear, and evaporating spontaneously; the residue will consist of crystals imbedded in a brown amorphous, resin-like mass, which is removed by cold alcohol, after which the crystals may be purified by recrystallizing from strong alcohol. Weigelin (1871) ascertained that veratrine exists in two distinct modifications, one of which is soluble in water, and by heating the solution is converted into the insoluble variety, which has a resinous appearance; analysis led to the composition $C_{52}H_{86}O_2N_{15}$.

According to E. Schmidt (1877), commercial veratrine contains three distinct modifications—namely, a crystalline base soluble in water, and two amorphous bases, one of which is soluble, the other insoluble, in water. The crystalline base predominates, and is regarded by Schmidt as veratrine proper; he gives it the formula $C_{32}H_{50}NO_9$; its platinochloride was found to be easily soluble in alcohol, less soluble in water, and insoluble in ether. The amorphous modifications appear to have the same formula, which differs from that given by Merck chiefly in the amount of nitrogen.

On treating medicinal veratrine with ether, a residue is left from which Couërbe (1834) isolated a second crystallizable alkaloid, *sabadilline*, for which Weigelin gives the formula $C_{41}H_{66}N_2O_{13}$. It is not sternutatory, and dissolves more or less freely in water, benzene, petroleum benzin, amylic alcohol, and chloroform; neutralizes the acids completely, but yields amorphous gum-like salts with sulphuric and hydrochloric acid, which are not precipitated by alkalies or their carbonates, and yield but slight precipitates with phosphotungstic acid and potassio-cadmium iodide. That portion of medicinal veratrine which is soluble in ether yields to hot water, in which veratrine is insoluble, a third alkaloid, which Weigelin named *sabatrine*, and found to have the composition $C_{51}H_{86}N_2O_{17}$. It is likewise soluble in benzene, petroleum benzin, amylic alcohol, and chloroform, is amorphous and yields amorphous salts, which are precipitated by hot potassium hydroxide and carbonate if not added in excess.

The most recent investigation on the sabadilla alkaloids was made by C. R. A. Wright and A. P. Luff (1878), who were unable to find sabadilline. They regard sabatrine as an alteration-product. They retain the name *veratrine* for the amorphous alkaloid of medicinal veratrine, and deny the existence of isomeric modifications; they give it the formula $C_{37}H_{53}NO_{11}$, and state that on saponification it splits up into veratric acid and a new base, *verine*, $C_{28}H_{45}NO_8$. Merck's crystallizable base is named by them *cevadine*, and is stated to have the composition $C_{32}H_{49}NO_9$, and, on saponification, to be resolved into a new base, *cerine*, $C_{27}H_{43}NO_8$, and the cevadic acid of Pelletier and Caventou, which is methyl-crotonic acid, $C_5H_8O_2$. The third alkaloid, *cevadilline*, $C_{34}H_{53}NO_8$, is insoluble in ether, is probably identical with sabadilline, but separates in an amorphous condition from benzene, and on saponification yields methyl-crotonic acid and the base *cevilline*. 20 pounds of sabadilla-seeds yielded between 60 and 70 Gm. of mixed alkaloids.

It will be observed that medicinal veratrine is a mixture of two or three alkaloids naturally existing in sabadilla, and of several derivatives from these alkaloids.

Action and Uses.—Veratrine has a bitter and acrid taste, and the least portion of it placed upon the tongue produces a peculiar and persistent numbness and tingling, with irritation of the throat and salivation. The minutest quantity of it introduced into the nostrils, and even the casual approach of a vial containing it to the nose, occasion protracted irritation and sneezing, and sometimes coughing. Applied in alcoholic solution or in an ointment to the sound skin, it produces a slight prickling sensation, and upon very delicate portions of the integument a pain compared to that which might be occasioned by its puncture with hot needles. The pain, however, is transient, and is followed by a sense of coolness and numbness. If the preparation is strong and is applied with friction, an eruption of vesicles may follow. If well rubbed in, particularly upon the face, slight twitching of the muscles is sometimes observed, and, more rarely, formication, which extends to remote parts of the body. Applied to the denuded skin or injected hypodermically, it causes severe pain, muscular twitching, and the other ordinary effects of its internal administration. These effects vary with its dose. Gm. 0.001–0.003 (gr. $\frac{1}{60}$–$\frac{1}{20}$) occasion tingling which begins in the fingers and toes, and thence extends to the whole body, followed by a sense of numbness in the same parts and more or less lowering of the pulse. If the usual limit of medicinal doses is exceeded, and Gm. 0.003–0.006 (gr. $\frac{1}{20}$–$\frac{1}{10}$) of the alkaloid or of its acetate is taken, there may occur great faintness and pallor; increased frequency, irregularity, and weakness of the pulse; nausea and vomiting, usually of bilious liquids; diarrhœa, sometimes with bloody stools; cold sweating and muscular twitching; and aching along the spine. If the dose is repeated at intervals, the gastro-intestinal symptoms subside, but the pulse falls considerably below the normal rate. There is also a good deal of irritation and constriction of the fauces, with secretion of mucus.

A woman who swallowed about Gm. 0.20 (3 grains) of veratrine in a liniment containing chloric ether and opium was affected with giddiness, faintness, nausea, thirst, diarrhœa, tenesmus, and constriction of the abdomen; the tongue was swollen, the mouth and throat sore, the pupils contracted, the breathing hurried, the pulse small and quick, the action of the heart feeble. There was extreme itching of the skin which lasted for

several days, a tingling which did not cease for two months, and a peculiar spasmodic snapping of the lower jaw (*St. George's Hosp. Rep.*, v. 69).

Veratrine was used first internally as a remedy for *neuralgia*, and in the most obstinate form of that affection, *sciatica*, which so often depends upon material alterations of structure. It is now very seldom given internally in this or any other variety of neuralgia, but is of common use as a topical application in the functional forms of the affection. Although inferior for this purpose to aconitine, it is nevertheless efficient in many cases of neuralgia of the fifth pair, of the intercostal nerves, and others. Very probably it acts both by obtunding the sensibility of the painful part and by its counter-irritant operation upon the skin when it is applied in due strength directly to the sensitive points of the nerve. It is sometimes injected hypodermically, Gm. 0.01 ($\frac{1}{6}$ grain) at a time, but an application of the officinal ointment of veratrine is preferable. It is rendered much more efficient by the addition to each drachm of it of 2 or 3 grains of morphine hydrochlorate or sulphate. In various forms of *pruritus* the topical use of veratrine is an efficient palliative. It may be given internally with advantage when the itching is general (Chéron, *Med. News*, xlvii. 268).

In the treatment of *acute articular rheumatism* this medicine has been systematically employed, by beginning on the first day of the treatment with a single dose of Gm. 0.005 (gr. $\frac{1}{12}$), and on each successive day giving an additional dose until the sixth or seventh day, unless the disease sooner yielded or the toxical effects of the medicine were developed. In the latter case it was suspended or its dose diminished. It was claimed for this treatment that it speedily reduced the fever and subdued the pain of the disease, and that in a patient of unimpaired constitution it frequently triumphed over an acute attack of the disease in a week. It was further asserted that it did not, like copious bloodletting, exhaust the patient's strength and develop anæmia. This advantage over the older sanguinary method may be admitted, but there is not a shadow of evidence to demonstrate its power of shortening an attack of rheumatism, or, above all, of preventing the most serious of the ordinary complications of the disease, inflammation of the heart and its membranes. Indeed it is seldom employed at present, and those who imagine that the cure of rheumatism consists in repressing certain of its symptoms find in the preparations of green hellebore equally efficient and less dangerous agents. The same remark is literally applicable to the use of veratrine in *pneumonia*. The strongest reason that could be found by an eminent therapeutist for employing veratrine in this disease was that "the results from its use appear to be comparable to those of the antimonial treatment" (Trousseau). But since the latter is one of the most mischievous that was ever employed, the merit of the former may be duly estimated. If some will use this medicine as they would green hellebore, digitalis, aconite, etc. in febrile affections, they must be prepared with diffusible stimulants to combat its sedative effects when they grow alarming.

Veratrine has occasionally been used to allay disordered action of the *heart* in acute and also in chronic diseases of that organ, and it may sometimes become a useful palliative of this distressing symptom, and thereby even avail to diminish cardiac dropsies. But for such purposes other preparations of veratrum are preferable. It is unnecessary to discuss its virtues in eruptive fevers or in typhoid fever, for which it has sometimes been prescribed, or in nervous affections, such as whooping cough, chorea, hysteria, nervous tremor, and functional paralysis, or to do more than state the fact of its having been employed topically to reduce enlarged glands, scrofulous swellings of joints, etc. It is sufficient to say that Liebermeister (*Handbuch des Fiebers*, S. 643), even while advocating its use, warns against giving it to persons with a feeble heart, and, while admitting that it may produce collapse, claims that food and alcohol will rescue the patient from that peril. It is alleged by Féris that various *tremors*, including those due to alcohol, fever, nervous degeneration, etc., are benefited by veratrine in doses of Gm. 0.0005 (gr. $\frac{1}{120}$) three or four times a day (*Practitioner*, xxxii. 212). The statement seems highly improbable.

Owing to its very acrid taste, veratrine is generally given internally in pilular form in doses varying from Gm. 0.0016–0.016 (gr. $\frac{1}{40}$–$\frac{1}{4}$). The dose should be rapidly but cautiously increased from the minimum until nausea or slowing of the pulse occurs. Externally the officinal ointment is a convenient preparation for application by friction, which should be made with a mop or with the finger guarded by a glove, and until a feeling of burning or prickling is perceived by the patient. Solutions in oil and glycerin may be applied in the same manner. For endermic use Gm. 0.008–0.033 (gr. $\frac{1}{8}$–$\frac{1}{2}$), mixed with starch, may be prescribed. Hypodermically, Gm. 0.01 (gr. $\frac{1}{6}$) may be

employed at a single operation, but the method is objectionable on account of the pain it occasions and the probability of abscess being caused by it. In *poisoning* by veratrine the stomach should first be evacuated, then washed with a solution of tannin, and the sedation combated with alcohol, ammonia, electricity, artificial respiration, etc.

Tulipine, an alkaloid derived from the common tulip, is said by Dr. Ringer to be a muscle-poison, like veratrine, although weaker. It paralyzes either the cord or the afferent nerves, or both; its action on the motor nerves, if any, is slight; it affects the heart of frogs like veratrine, and does not affect the pupil (*Practitioner*, xxv. 241).

VERATRUM ALBUM.—White Veratrum (Hellebore).

Rhizoma veratri, P. G.; *Radix hellebori albi.*—*Vératre* (*Hellébore*) *blanc*, Fr.; *Weisse Nieswurzel*, *Weisser Germer*, G.; *Vedegambre* (*Eléboro*) *blanco*, Sp.

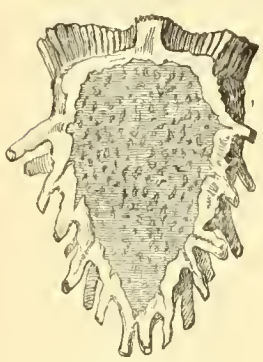
The rhizome (*F. Cod.*), with the rootlets (*P. G.*), of Veratrum album, *Linné*. Bentley and Trimen, *Med. Plants*, 285.

Nat. Ord.—Melanthaceæ.

Origin.—Veratrum album is an herbaceous perennial growing in moist meadows of the Pyrenees and Alps and eastward throughout Russia, Siberia, Northern China, and Japan. It has likewise been found in Colorado and in other parts of Western North America (Ver. californicum, *Durand*). The stem is .6–1.2 M. (2 to 4 feet) high, and has numerous alternate elliptic or broadly oval, entire leaves, which are about 15 Cm. (6 inches) long, strongly ribbed and plicate, and sheathing at the base; the upper ones are smaller, narrower, and lanceolate in form. The inflorescence is a large racemose panicle 30–45 Cm. (12 to 18 inches) long, with polygamous flowers having six spreading lance-oblong, yellowish-white, and externally green sepals. The three-horned fruit consists of three partly-united follicles containing numerous flattened and winged seeds. The rhizome is collected in autumn. The variety viridiflorum, *Mertens et Koch* (Ver. Lobelianum, *Bernhardi*), grows in Europe, and differs chiefly in the more simple inflorescence, the longer bracts, and the pale-green flowers.

Description.—The rhizome of white veratrum is upright, obconical in shape, simple or occasionally divided above into two branches; it is 5–8 Cm. (2 to 3 inches) long, and about 25 Mm. (1 inch) thick, tufted above with the remnants of the leaf-bases, truncate below, the lower half beset with dead and the upper portion with yellowish fleshy nearly simple rootlets, which shrink considerably in drying, and are 20–30 Cm. (8 to 12 inches) long and about 2 Mm. ($\frac{1}{12}$ inch) thick. In the commercial drug the rootlets were formerly often cut off close to the rhizome, and this has been occasionally divided to facilitate the drying. The rhizome is somewhat annulate, externally of a dull black-gray color, and either closely surrounded with rootlets or tuberculated from the root-remnants; internally it is whitish or grayish-white, and shows upon transverse or longitudinal section, at a distance of about 3 Mm. ($\frac{1}{8}$ inch) from the outer surface, a brownish wavy nucleus-sheath, and in the inner portion numerous small wood-bundles, which are scattered, irregularly curved in various directions, and rather crowded near the nucleus-sheath; outside thereof only a few small wood-bundles are seen passing into the rootlets. The nucleus-sheath consists of one or occasionally two rows of cells, having the inner cell-walls much thickened; the parenchyma-cells are filled with small starch-granules or a few of them with raphides of calcium oxalate. The drug is inodorous, but its dust is strongly sternutatory; its taste is bitter and burningly acrid.

Fig. 314.



Veratrum album, *Linné*: longitudinal section of rhizome.

Constituents.—Pelletier and Caventou (1820) obtained from white veratrum liquid and solid fat, a volatile acid, gum, starch, and an alkaloid, which they declared to be identical with veratrine, and to be combined with gallic acid. The existence in veratrum of gallic acid was, however, denied by Pfaff and by Weigand (1841). The latter found in it about 10 per cent. of pectin. E. Simon (1838) announced the isolation of a second alkaloid, *jervine*, $C_{30}H_{46}N_2O_3$. After Charles Bullock (1865) had proved the non-existence of veratrine in Veratrum viride, Dragendorff (1872) announced its absence also from white veratrum; and this observation was corroborated by C. L. Mitchell (1874), who found in it, besides jervine, a second alkaloid, which he named *veratralbine*. Wright and Luff (1879) announced the presence in 1 kilogram of white veratrum of 4.20 Gm. of alka-

loids, of which 1.30 is jervine, $C_{26}H_{37}NO_3$, 0.40 pseudojervine, $C_{29}H_{43}NO_7$, 0.25 rubijervine, $C_{26}H_{43}NO_2$, 2.20 veratralbine, $C_{28}H_{43}NO_5$, and 0.05 another sternutatory base, probably veratrine.

Jervine, when pure, is a white powder, crystallizes from alcohol, is tasteless, not sternutatory, insoluble in water and ether, soluble in alcohol and chloroform, and melts between 198° C. (Bullock) and 237° C. (Wright). Its salts with acetic and phosphoric acids are soluble in water, and these solutions are precipitated by sulphuric, hydrochloric, and nitric acids and their soluble salts. According to Bullock (1875), its acetic acid solution, treated with potassium nitrate, affords a ready method for obtaining the alkaloid in a pure state. Sulphuric acid colors jervine yellow, changing to green, and finally to turbid yellow; on the addition of bromine the green color changes to a faint brownish tint. The other color reactions (yellow by nitric or boiling hydrochloric acid) are not very characteristic.

Pseudojervine, like jervine, dissolves in strong sulphuric acid with a yellow color, the solution gradually turning green; its sulphate is tolerably soluble in water. The alkaloid melts at 299° C., and is insoluble in ether.

Rubijervine is soluble in ether, melts at 237° C., is colored red by sulphuric acid, forms a readily soluble sulphate, and is not sternutatory.

Veratralbine is white, unerystallizable, bitter, burningly acrid, and violently sternutatory. It dissolves in alcohol, amylic alcohol, ether, chloroform, carbon disulphide, and in dilute acids, forming soluble and unerystallizable salts. It melts near 170° C. (338° F.) and sublimes in small feathery crystals. In its behavior to reagents it closely resembles *veratroidine*, and is regarded by Tobien (1877) as being identical with it. According to Wright and Luff, pure veratralbine is not sternutatory.

Weppen (1872) could not find Weigand's pectin, and leaves it undecided whether the presence of that compound is due to an adulteration or to the period at which the rhizome had been collected. Pelletier and Caventou's gallic acid was recognized as a new acid, called jervic acid, and the coloring matter as *veratramarin*, a light-yellow, very bitter, and deliquescent neutral principle, which is present in very minute quantity, so that 60 pounds of the rhizome yielded a quantity insufficient for a thorough chemical investigation. Veratramarin is easily soluble in water and alcohol, insoluble in ether, benzene, chloroform, and petroleum benzin, and is precipitated from its solutions by lead subacetate and tannin.

Jervic acid, $C_{14}H_{10}O_{12}.2H_2O$, is a white crystalline powder, has an acid taste, is insoluble in benzene, carbon disulphide, chloroform, petroleum benzin, and amylic alcohol, is very sparingly soluble in absolute alcohol and ether, and requires more than 100 parts of cold water for solution. The acid is neither fusible nor sublimable; its silver salt crystallizes from the solution in hot water, is insoluble in dilute nitric acid, and is not altered on exposure to light.

Dr. Jos. Waltl (1828) considered the rhizome, with the rootlets attached, to be more active than the rhizome alone, and Schroff (1860) announced the rootlets to have a more powerful action than the rhizome, and somewhat different from it.

Action and Uses.—When taken internally in poisonous doses it occasions soreness of the mouth and swelling of the tongue, burning heat in the stomach, vomiting, anxiety, tremor, vertigo, weakness of the limbs, aphonia, interrupted respiration, syncope, a feeble pulse, convulsions, sinking, distortion of the eyes, dilated pupils, blindness, mental aberration, prolonged insensibility, and cold sweating. Among these symptoms purging is not mentioned, but it occurs under the prolonged use of the drug. When death has resulted directly from poisonous doses, signs of active gastro-intestinal inflammation and congestion of the lungs have been found. In poisoning with recovery there have been observed for several days debility, tremulousness, muscular twitching, and a sense of constriction and distress in the præcordial region.

White hellebore is now hardly used as an internal medicine. Externally, it has been applied in decoction to destroy *vermin* in man and beast and for the relief of *pruritus vulvæ*. It was formerly employed in the treatment of *itch*. Its irritant properties caused it to be used as an *errhine* when diluted with starch or some other inert powder or with snuff. In this way it is sometimes made use of to relieve the frontal headache which occurs in certain cases of *coryza*. If it is administered internally, the commencing *dose* should not exceed Gm. 0.06–0.12 (gr. j–ij).

VERATRUM VIRIDE, *U. S.*—Veratrum Viride.

Veratri viridis rhizoma (*radix*), Br.—*American or Green veratrum* (*hellebore*), *Indian poke*, E.; *Vératre vert*, Fr.; *Grüner Germer*, G.; *Vedegambre verdo*, Sp.

The rhizome and rootlets of Veratrum viride, *Solander* (Ver. album, var. viride, *Baker*, Melanthium virens, *Thunberg*). Bentley and Trimen, *Med. Plants*, 286.

Nat. Ord.—Melanthaceæ.

Origin.—Green veratrum grows in swampy places and on the borders of damp thickets in Canada, and in the United States as far south as Georgia. It resembles the white veratrum so closely that no important botanical difference between them can be ascertained, and Asa Gray remarks that it is "much too near Veratrum album of Europe." It more especially resembles the green flowering variety Lobelianum, and Regel (1861) regarded it as identical with a variety growing in Eastern Siberia. Its flowers are yellowish-green and appear in June. The rhizome is collected in autumn.

Description.—The rhizome agrees in size, shape, color, taste, and structure so closely with that of white veratrum that it is difficult, if not impossible, to distinguish the two drugs if they have been trimmed alike. The American veratrum is nearly always dried with the rootlets attached, and these are from 10–25 Cm. (4 to 10 inches) long, abou' 2 Mm. ($\frac{1}{12}$ inch) thick, much shrivelled, and of a light yellowish-brown color; those on the lower part of the rhizome, if present, are thinner and black. We have occasionally found considerable portions of the leaf-stalks and stems present in the commercial drug; these parts appear to be inert or nearly so, and should be rejected.

Constituents.—H. W. Worthington (1838) isolated an alkaloid from green veratrum which he regarded as identical with veratrine. The same conclusion was arrived at by J. G. Richardson (1857) and by G. J. Scattergood (1861). But Charles Bullock (1865) proved that American veratrum contains two alkaloids, neither of which is identical with veratrine. These alkaloids were subsequently named by Prof. G. B. Wood *viridine* (insoluble in ether) and *veratroidine* (soluble in ether). E. Puegnet (1872) recognized the so-called viridine as impure *jervine*, and C. L. Mitchell (1874) made the same observation. In the same year Mitchell characterized *veratroidine* as follows: It is a white uncrystallizable powder of a bitter taste, leaving a tingling sensation in the fauces, violently sternutatory, and extremely irritating. It fuses near 130° C. (265° F.), is soluble in alcohol, amylic alcohol, ether, chloroform, carbon disulphide, and when freshly precipitated slightly in petroleum benzin. It forms soluble salts with the acids, most of which are uncrystallizable. Sulphuric acid colors it yellow, changing to dark-red. Boiling hydrochloric and nitric acids color it yellow. Tobien's (1877) elementary analysis leads to the formula $C_{51}H_{78}N_2O_{16}$ or to $C_{24}H_{37}NO_7$. He obtained both jervine and veratroidine also from the rhizome and the young leaves of Veratrum lobelianum, and found in the dried rhizome of Veratrum album but little jervine and a larger quantity of veratroidine. C. A. Robbins (1877) announced that he had isolated from American veratrum, besides jervine, another crystallizable alkaloid, which is soluble in ether, and which produces with sulphuric acid and sugar a yellow color changing to blue, and with sulphuric acid a yellow color quickly changing to a pink-red, and after several hours to indigo-blue; presence of jervine or of coloring matter prevents the appearance of the blue color. Bullock (1879) obtained 0.66 per cent. of mixed alkaloids; Wright and Luff (1879) only 0.08 per cent., that portion remaining with the resins probably escaping their notice. The latter investigators consider over one-half of the alkaloids to be cevadine (see Veratrina), one-fourth to be jervine, nearly one-fifth to be *pseudojervine*, and the remainder *rubijervine*, while less than 0.0004 per cent. is regarded by them as *veratrine*, the presence of which, besides jervine, in both the American and white veratrum was announced by Prof. Wormley in 1876. Bullock, however, obtained fully two-thirds of the alkaloids as nitrate of jervine, the remainder being Wright's rubijervine, with probably some pseudojervine. (See Veratrum Album.)

In the investigations recorded above no notice has been taken of the probable difference in the composition of the rootlets and rhizome, as suggested by Prof. Schroff. The rhizome of American, like that of the white veratrum, contains considerable resin, from which the alkaloids are not easily purified.

Action and Uses.—The greater number of reports which have been published concerning the medicinal uses of green veratrum are, unfortunately, not only deficient in the details on which a judgment could securely rest, but exhibit great ignorance of the natural history of disease and of the relation of medicines to its cure. There are many

reporters who attribute to this medicine equal curative virtues in asthenic and sthenic diseases, in *inflammations* (*pneumonia*), and in fevers (*typhoid fever*), and not a few who extol its virtues when it forms only one of several active agents simultaneously administered to the patient. The only conclusion to be drawn from a critical study of the mass of conflicting evidence respecting its use in the diseases referred to is, that the patients would have been better off not only without its use, but also without that of the medicines associated with it. The suggestion has been made that the effects of veratrum viride and of depletion are so similar that the drug may serve as a substitute for that operation; upon which it may be remarked that the condemnation of venesection *upon scientific grounds* has been so general and complete that to advocate a medicine on account of its supposed analogy to depletion is not to recommend it. Nor should it be forgotten that this identical reason was at one time urged in favor of substituting digitalis for depletion. Now, veratrum viride and digitalis are physiological antagonists. But venesection does much more than reduce the pulse-rate in inflammatory affections (and, indeed, in comparison with green veratrum, its action is in this respect very insignificant): it takes away from the blood a portion of the solids which sustain the inflammatory process, and supplies their place with water; it also removes from the system a portion of the effete matters produced by inflammation and which tend to convert the circulating fluid into a poison. The artificial production of perspiration by veratrum or by any other medicine does not accomplish this purpose. It may occasion a profuse discharge of water, and so far may diminish the amount of liquid in the blood-vessels; but there is no reason to believe that it removes the "materies morbi," the "peccant matter," associated with the disease materially and essentially. If it were really curative in this manner, then jaborandi and pilocarpine ought to be the most efficient remedies for fevers and inflammations; which is not claimed in their behalf. The only plausible grounds for its use in pneumonia are more theoretical than practical. What has been observed of its effects in acute *rheumatism* is true of other febrile diseases. As expressed by Boulter (*St. Bartholomew's Hosp. Rep.*, xv. 164), "veratrum viride has little or no effect in reducing the temperature in rheumatic fever; the pains subside no more quickly (?) than under other ordinary modes of treatment; it has no power of warding off cardiac complications; and its only effect—which, however, only takes place in some cases—is to depress the vascular system, as shown by the slowness and irregularity of the heart's action." Cardiac sedatives, of which the medicine under consideration is the type, tend to retain in the blood all that is injurious in it, and at the same time reduce the patient to a state of such wretchedness that he is unable to take food, or to digest it if he eats it, or even to find energy enough to cling to that last refuge of sufferers, hope.

There is but one class of acute cases in which the utility of this medicine is presumable —cases of imminent or *commencing congestion* or *inflammation*, in which the maintenance of its sedative action on the heart for a short period would allow the conservative powers of the system to operate within normal limits (tonsillitis, pleurisy, pneumonia). This statement also applies to certain *wounds* which tend to dangerous results, like those of the head, pericardium and heart, and peritoneum. The comparative immobility in which the inflamed parts are maintained by the infrequent arterial movement may favor their cure. In some cases of organic *heart disease*, as well as of *nervous palpitation*, including *exophthalmic goitre*, this medicine is reported to have afforded great relief, probably by allowing the heart sufficient rest for recovering its power (*Bull. et Mém. Soc. ther.*, 1889, p. 175). It would certainly be unsuited for the treatment of cardiac affections depending upon absolute debility of the organ. It has been used with apparent benefit in *puerperal mania*, *puerperal convulsions* (*Therap. Gaz.*, xi. 675; *Canadian Practitioner*, March, 1885), *epileptiform convulsions*, *tetanus*, *chorea*, and *mania-a-potu*. In a case of persistent *priapism* affecting only the corpora cavernosa, and after failure to reduce it by means of many medicines, including tartar emetic, belladonna, and potassium bromide, the penis began to be relaxed as soon as veratrum viride had reduced the pulse to 50 (Walker, *Amer. Jour. Med. Sci.*, Apr. 1877, p. 565). It will be observed that nearly all of the acute affections in which the medicine has been most unequivocally useful were marked by nervous, and not febrile, excitement; in other words, they were amenable to it as a sedative of the nervous and not of the circulatory system. Remarkable results have been attributed to the sedative influence on the pulse-rate of veratrum viride in *diphtheria*. But since in the series of cases which led to this judgment there were used, besides green veratrum, applications of Monsel's salt, internally potassium chlorate and sublimed sulphur and calomel, and also external applications of "kerosene oil

or some other irritant" (*Med. Record*, xxxiii. 627), the utility of white hellebore in diphtheria cannot be considered as proven by them, and analogy does not render it probable.

Externally, the tincture is used as a discutient and anodyne.

The proper remedies in *poisoning* by this drug are diffusible stimulants, and especially alcohol, which should be given by the rectum if the patient vomits. Its efficacy is shown by the case of a physician who took an ounce of the tincture at one draught; so completely did the alcohol counteract the green veratrum of the preparation that except nausea, vomiting, and some dyspnœa no evil results followed (*N. Amer. Med.-Chir. Rev.*, ii. 930). Besides alcohol, ammonia may be administered, and sinapisms should be applied over the heart, while stimulant (that is, small and repeated) doses of some liquid preparation of opium may be administered. During the treatment the patient's head should be kept as low as his body, or even lower.

Green veratrum may be administered in powder in the *dose* of Gm. 0.12 (gr. ij), but the liquid preparations are more eligible. Of these the fluid extract and the tincture are officinal; the dose of the former is from Gm. 0.05–0.15 (1 to 3 minims), and of the latter from Gm. 0.20–0.40 (4 to 8 minims). They should be given at intervals of about three hours. Their tendency to cause vomiting may be prevented by the administration of from 5 to 10 drops of deodorized laudanum ten or fifteen minutes before each dose. As soon as the pulse begins to fall the dose should be diminished. Females and growing persons ought not to take doses exceeding two-thirds of those mentioned, and for children from one to five years old a sufficient quantity is Gm. 0.06 (gtt. j) of the tincture. Gm. 0.60–1 (♏x–xv) of tincture, largely diluted with water, have been administered hypodermically.

VERBASCUM.—Mullein.

Bouillon-blanc, *Molène*, Fr. Cod.; *Wollkraut*, *Königskerze*, G.; *Gordoloba*, Sp.

The leaves and flowers of Verbascum Thapsus, *Linné* (V. Schraderi, *G. Meyer*). *F. Cod.*; the corolla of V. phlomoides, *Linné*, and V. thapsiforme, *Schrader* (V. Thapsus, *G. Meyer*), *P. G.*

Nat. Ord.—Scrophulariaceæ.

Origin.—The genus Verbascum consists of tall, more or less woolly, biennial or perennial herbs, with the flowers in dense spikes or paniculate racemes. The flowers have a five-parted calyx, a wheel-shaped somewhat unequally five-lobed corolla, five more or less woolly stamens, and a two-celled, two-valved, and many-seeded capsule. Three species have been naturalized in North America—Verb. Blattaria, *Linné*, V. Lychnitis, *Linné*, and V. Thapsus, *Linné*—having the leaves respectively nearly smooth on both sides, tomentose on the lower surface, and densely woolly on both sides.

Description.—Folia verbasci. The leaves are from 10–20 or 30 Cm. (4 to 8 or 12 inches) long, the upper ones sessile on the stem, and all decurrent. They vary in shape between elliptic, oblong, and oval-lanceolate, are acute, more or less crenate on the margin, and densely covered with soft whitish stellate hairs. The leaves are nearly inodorous and have an insipid, mucilaginous, faintly bitter taste.

Flores verbasci. The calyx is rejected, and only the corolla with the adhering stamens is preserved. The wheel-shaped corolla is 25–38 Mm. (1 to 1½ inches) broad, bright-yellow, smooth above, and stellately tomentose beneath, has five obovate roundish lobes about 15 Mm. (⅗ inch) long, and bears in the short tube the stamens, of which the three upper ones have reniform anthers and the filaments covered with a white wool; the two lower stamens are longer and smooth and have elongated decurrent anthers. V. Thapsus has the corolla only about 12 Mm. (½ inch) broad, and the lower stamens with long filaments. V. Lychnitis and V. Blattaria have the anthers reniform upon equal filaments, which are white-woolly in the former and purple-woolly in the latter species. To preserve their bright color the flowers should be thoroughly dried and kept in a dry and well-stoppered bottle; if permitted to become damp they acquire a blackish color. The flowers have a slight, agreeable, honey-like odor and a mucilaginous and sweet taste.

Constituents.—The leaves and flowers contain mucilage. Morin (1826) obtained from the flowers a trace of yellowish volatile oil, a fatty substance, sugar, and coloring matter which is insoluble in ether and cold water and yields in alcoholic solution a yellow precipitate with lead acetate.

Action and Uses.—The chief medicinal constituent of this plant is the mucilage

furnished by its leaves, but its flowers contain an essential oil in small proportion, to which the agreeable odor of the fresh plant and its slight stimulant qualities are due. Fish are said to become stupefied by eating the seeds. The infusion of mullein is useful in catarrhal affections of the *respiratory organs*, and in Ireland is in popular use to palliate *cough* and *diarrhœa*. For this purpose it should be boiled with milk. It is much used in the country mentioned to relieve the cough of *phthisis*. It is recommended in irritations of the *urinary bladder*. It may be used in enema for *dysentery*. It is said, but without sufficient evidence of the assertion, that it has cured *intermittent fever*. A poultice made with the leaves boiled in milk is a convenient application to inflamed *hæmorrhoids*. Olive oil saturated with mullein-flowers during prolonged exposure to the sun, or kept near a fire for several days in a corked bottle, is a popular preparation in Germany for *bruises*, *frost-bite*, and irritable *piles*. The infusion should be made of the fresh leaves and flowers, if possible, in the proportion of Gm. 32 to Gm. 500 (℥j to Oj) of boiling water. When cool it should be strained to free it from the irritating hairs which cover the leaves.

VERONICA.—Speedwell.

Véronique mâle, Fr.; *Ehrenpreis*, G.; *Veronica*, Sp.

Veronica officinalis, *Linné*.

Nat. Ord.—Scrophulariaceæ.

Origin and Description.—The common speedwell is distributed over a considerable portion of the northern hemisphere, and grows in grassy places and open woods. It is a procumbent pubescent perennial with ascending branches and with opposite, short-petiolate, obovate, or elliptic and coarsely crenate or serrate, grayish-green leaves, which are about 25 Mm. (1 inch) long. The flowers are in one or two axillary racemes on the upper part of the branches, are on short pedicels, and have a wheel-shaped four-parted pale-blue corolla with dark-blue stripes and two exserted stamens. The fruit is an inversely heart-shaped, two-celled capsule. The fresh herb is faintly aromatic; after drying it is inodorous and has a bitterish and slightly astringent taste.

Constituents.—Speedwell contains a little tannin and a bitter principle.

Allied Species.—Veronica Beccabunga, *Linné*.—Brooklime, *E.*: Beccabunga, Cressonée, *Fr.*: Bachbungen, *G.*—It grows in Europe and Asia near springs and in brooks, and has an ascending smooth stem, with opposite, short petiolate, oval or oblong, crenate-serrate, obtuse, and smooth leaves, about 38 Mm. (1½ inches) long, and with axillary loose racemes of pale-blue and veined flowers. It is used in the fresh state (*F. Cod.*).

Ver. americana, *Schweinitz*, resembles the preceding, but has petiolate, ovate, acutish, and often slightly heart-shaped leaves.

Brooklime is inodorous, and has a bitterish, somewhat saline, and slightly pungent taste.

Action and Uses.—Veronica is bitter, astringent, and slightly aromatic, in which qualities it resembles hoarhound and several other plants which, like it, have been used in the treatment of chronic *bronchitis*. Its decoction has been applied externally in *scabies*, papular *cutaneous eruptions*, and *ulcers*, and given internally in *urinary* and *calculous disorders*. V. Beccabunga is regarded as antiscorbutic and diuretic, and is said to be slightly stimulant and tonic. It has been employed in chronic affections of the skin, in scrofula, and in scurvy, both internally and topically. It is reported that V. parviflora (*Koroniko*), a New Zealand plant, is very efficient in the treatment of chronic dysentery (*Practitioner*, xxix. 300).

VIBURNUM OPULUS, *U. S.*—Viburnum Opulus (Cramp-bark).

Cranberry-tree bark, E.; *Ecorce d'obier*, Fr.; *Wasserholderrinde*, G.

The bark of Viburnum opulus, *Linné*.

Nat. Ord.—Caprifoliaceæ.

Origin.—This species is indigenous to Canada, Northern United States, Europe, and Northern Asia. It is arborescent, growing to the height of 3 to 4.5 M. (10 to 15 feet), and possesses three-lobed serrate leaves and white or yellowish-white flowers. The fruit is a bright-red, elliptic, one-seeded drupe, resembling the cranberry, and on account of which similarity the tree is known as the cranberry tree.

Description.—The bark is found either in flattish or in curved bands or quills, which are occasionally 30 Cm. (12 inches) long, the bark being from 1 to 1.5 Mm. ($\frac{1}{25}$ to $\frac{1}{16}$ inch) in thickness. The outer surface is ash-gray or brownish-gray in color, with scattered somewhat transversely elongated brownish warts, which are due to abrasion, and

more or less marked with blackish dots, and in a longitudinal direction with black irregular lines or thin ridges. Underneath the readily removable corky layer the bark is of a pale brownish or reddish-brown color. On the inner surface the bark is of a dingy white or brownish color. The bark is tough, and on breaking the tissue separates in layers. It is odorless, and has a somewhat astringent and bitter taste.

Constituents.—Chevreul obtained from the berries a volatile acid which he found to be identical with phocenic acid, obtained by him from the fat of the dolphin. Dumas later found phocenic acid to be identical with valerianic acid. Kramer (1834) obtained a volatile acid from the bark, which he found differed from valerianic acid, but L. von Mono (1841) proved their identity. Kramer further found malic acid, an iron-bluing tannin, and a bitter principle, *viburnin*. This in the pure state constituted a nearly white powder, which was neutral, had a purely bitter taste, and was slightly soluble in water, more freely in alcohol, and on incineration left little ash.

VIBURNUM PRUNIFOLIUM, *U. S.*—Black Haw.

The bark of Viburnum prunifolium, *Linné*.

Nat. Ord.—Caprifoliaceæ.

Origin.—The black haw is a tall shrub or small tree from 3–6 M. (10 to 20 feet) high, and grows in thickets throughout the greater portion of the United States east of the Mississippi. Its leaves are opposite, about 5 Cm. (2 inches) long, shining, oval, or obovate, sharply serrulate, and have short slightly margined petioles. The small white pentamerous flowers are in terminal cymes, have a wheel-shaped corolla, and produce small blue-black edible drupes containing a flattish, smooth putamen. The bark is employed in medicine.

Description.—Black-haw bark is in thin quills, and has externally a somewhat glossy purplish-brown, and when older a grayish-brown, color. The surface is marked with scattered small roundish or transversely elongated warts, and often with minute black dots. The thin, papery, corky layer is easily removed from the green outer bark. The inner bark is white and the inner surface smooth. The bark breaks with a short smooth fracture, is without odor, and has a slightly astringent and distinctly bitter taste.

Allied Species.—Viburnum obovatum, *Walter*, grows in the Southern United States, and is a shrub about 2.4 M. (8 feet) high; it is known as *black haw*. The leaves are 12–25 Mm. (½ to 1 inch) long, rather leathery, broadly obovate or spatulate, narrowed into a short petiole, slightly revolute on the margin, either entire or crenate near the apex, and on the lower surface marked with minute brownish dots. The cymes are small and three-rayed, the flowers white, and the fruit black and ovoid-oblong. The leaves are inodorous and have a bitter taste, which is more persistent than that of the brown or reddish-gray bark.

Viburnum lantana, *Linné*, is a European shrub with ovate or oval, slightly heart-shaped, acutely serrate leaves, and with red, finally black, mealy drupes of a mucilaginous and sweet taste. The inner bark is acrid.

Constituents.—Enz (1863) found in the fruit of V. lantana a hygroscopic, neutral, bitter principle readily soluble in water; also valerianic, acetic, tartaric, and tannic acids. H. Van Allen examined black-haw bark, and obtained valerianic acid, viburnin, a resinous body of a very bitter taste containing sugar, tannin (greenish-black with ferric salts), and oxalic, citric, and malic acids. The air-dry bark contained 7 per cent. of moisture and yielded 8.3 per cent. of ash, consisting mostly of earthy carbonates and phosphates.

Action and Uses.—Nothing definite appears to be known respecting the mode of action of either officinal species. Incongruous qualities are assigned to them, such as to be at once nervine, astringent, diuretic, and tonic. According to Payne's experiments, V. prunifolium "paralyzes the centres of voluntary motion and the reflex functions of the spinal cord" (*Med. News*, lx. 371). The only definite medicinal operation attributed to it does not involve any of these operations—viz. a power of preventing *abortion*, particularly when attempted by the use of cotton-root. A case intended to illustrate such virtue in the drug has been published (*Therapeutic Gaz.*, Nov. 1882), but as the patient also took enormous doses of morphine, as well as potassium bromide, it is impossible to believe that the viburnum had any share in the result. Many cases relied on to demonstrate the virtues of the medicine are equally inconclusive, but others appear to sustain the popular estimate of them (Metcalf, *Ther. Gaz.*, Nov. 1882; Wilson, *British Med. Jour.*, Apr. 3, 1886; Campbell, *ibid.*, Feb. 27, 1886; Roberts, *ibid.*, Nov. 26, 1887; Auvard; Schatz, *Therap. Gaz.*, xii. 106, 628; *ibid.*, xiii. 43, 385; Payne, *Med. News*, lx. 371), while still others do not furnish the grounds for a positive judgment. At a meeting of the Materia Medica Society of New York (1883) the value of V. prunifolium was discussed, and no conclusive

evidence of its alleged virtues was adduced. On the same occasion the use of V. opulus was urgently advocated as a very efficient antispasmodic in asthma, hysteria, puerperal and other convulsions, and as "a powerful uterine sedative" (*Med. Record*, xxiii. 188). In 1876, Leonard described this species as "a uterine sedative, and often a remedy for neuralgic *dysmenorrhœa* and for the commonly associated spinal irritation." Indeed, it has been credited with increasing, and also with diminishing, the menstrual flow. Viburnum has been administered in the form of an infusion or a decoction made with Gm. 32 in Gm. 500 (℥j in Oj) of water, and in *doses* of Gm. 32–64 (1 or 2 ounces), repeated every two or three hours. The officinal fluid extract may be prescribed in doses of Gm. 2.00–8 (f℥ss–ij), or the solid extract in gelatin-coated pills of 4 grains, of which from one to three may be given at a dose.

VINA MEDICATA.—Medicated Wines.

Vins médicinaux, Œnolés, Fr.; *Medicinische Weine*, G.

Medicated wines are preparations analogous to tinctures, but differ from them in the menstruum, which contains a much smaller and a somewhat variable quantity of alcohol and a certain proportion of extractive matter and acid potassium tartrate. The menstruum directed for the medicated wines is either dry white wine (*F. Cod., P. G.*), a mixture of white wine and alcohol (*U. S., F. Cod.*), sherry wine (*Br., P. G.*), or red, Lunel, Grenache, Malaga, and other wines (*F. Cod.*). Since even the strongly alcoholic official wines cannot be kept unaltered for an indefinite period if exposed to the air, the medicated wines, which necessarily contain various principles subject to gradual decomposition, should be kept in well-stoppered bottles.

The Pharmacopœia has discontinued the formula for *stronger white wine*, which, according to the U. S. P. 1880, was prepared by mixing 1 part (by weight) of alcohol with 7 parts (by weight) of white wine, and instead now directs a specified quantity of alcohol in each formula where fortification of the wine is desired.

The following medicated wines made with white wine are not mentioned elsewhere:

Vinum condurango, *P. G.;* Wine of condurango, *E.;* Condurangowein, *G.*—Macerate 1 part of finely-cut condurango-bark with 10 parts of sherry wine for eight days, with frequent agitation; express and filter.

Vinum fraxinæ americanæ, *N. F.;* Wine of white ash.—Macerate 8 troyounces of white-ash bark, in No. 40 powder, with 16 fluidounces of stronger white wine for three days, pack in a percolator, and pour on stronger white wine until 16 fluidounces of percolate are obtained.

Vinum picis, *N. F.;* Wine of tar.—Wash 1½ troyounces of tar thoroughly with 4 ounces of cold water by trituration, and pour the water away. Mix the remaining tar with 2 troyounces of moderately fine pumice, and add 16 fluidounces of stronger white wine; stir frequently during four hours, filter through a well-wetted filter, and pass enough stronger white wine through the filter to bring the volume up to 16 fluidounces.

VINUM ALBUM, *U. S.*—White Wine.

Vinum generosum album.— *Vin blanc*, Fr.; *Weisswein*, G.; *Vino blanco*, Sp.

An alcoholic liquid made by fermenting the unmodified juice of the fresh fruit of Vitis vinifera, *Linné* (nat. ord. Vitaceæ), freed from seeds, stems, and skins. When white wine is prescribed without further specification, it is recommended that dry white wine of domestic production (such as California Riesling, Ohio Catawba, etc.) be employed. White wine should be preserved in well-closed, full casks or in well-stoppered bottles in a cool place.—*U. S.*

Nat. Ord.—Vitaceæ.

Origin.—American wines are mostly obtained from the fruit of cultivated varieties of Vitis Labrusca, *Linné*, and more particularly from Catawba, Concord, and Isabella grapes. The Clinton grape is a variety of V. æstivalis, *Michaux;* the Delaware grape is derived from V. cordifolia or V. riparia, *Michaux;* and the Scuppernong grape from V. vulpini, *Linné*. The European grape was introduced into California at an early period, and large quantities of wine are now manufactured from the different varieties. All European wines are prepared from the fruit of Vitis vinifera, *Linné* (see Uvæ), which is a native of Western Asia and has been cultivated for many centuries; it is not unlikely

that this species originated from two or three different plants, supposed by some botanists to be indigenous to India, and by others to be still found in the wild state in Eastern countries and in Southern and Central Europe.

Manufacture of Wine.—In addition to the constituents of grapes enumerated under UVÆ, vegetable albumen, glutinous matter, pectin, and various extractive matters are found in the juice of grapes, and occasionally racemic acid, either in the free state or partly combined with bases. Besides tartrates, the saline constituents are potassium sulphate, sodium chloride, calcium phosphate, magnesia, alumina, and silica. The relative amount of these principles varies considerably, depending on the nature of the soil and on atmospheric conditions during the growth and ripening of the fruit, when the free acid is gradually diminished and the sugar considerably augmented in quantity. The sugar varies in amount between 12 and 30 per cent., the larger quantity being produced in warm climates. It is obvious from this that the treatment of the grape-juice for the production of wine must vary under different circumstances and in different countries. The grapes are crushed and the juice fermented in the presence of the husks, or the juice, called *must*, is fermented by itself, in which case a light-colored wine is obtained. Red wines are made by fermenting with husks and seeds, called the *marc*, of red or purple grapes. In a short time after the must has been pressed, fermentation commences, and continues for two or three weeks, when the liquid becomes somewhat clear, and is removed from the precipitate into another vessel, where a slow fermentation, called the *after-fermentation*, proceeds for several weeks or months, requiring the occasional removal of the liquid from the sediment formed, until it is fit to be transferred into casks, where it is allowed to "ripen." The best wines are usually bottled some time after they have become perfectly clear, the complete clarification being effected by gelatin, which, in combining with the tannin present, forms an insoluble compound, carrying down with it all traces of yeast and other matters held in suspension. The "bouquet" of wine is much improved after bottling, and red wines, which do not contain a large amount of tannin, become darker, while wines rich in tannin form a deposit in the bottle and become lighter in color.

The conditions under which fermentation takes place, and the results, are explained on page 147. In the presence of the numerous constituents of grapes odorous principles are generated during fermentation, to which wines owe their peculiar aroma or bouquet. If the must contains a moderate quantity of sugar, this is entirely or nearly decomposed into alcohol and carbon dioxide, resulting in a *dry wine*. But in a strongly saccharine must fermentation ceases before the sugar is completely consumed, and the product is a *sweet wine* (vin de liqueur, *Fr.*). In some cases the amount of sugar in the juice is increased by exposing the cut ripe grapes for some time to the sun until a portion of the water has evaporated, or by concentrating a portion of the juice before fermentation. As the alcohol increases during the fermentation of the must, the acid potassium tartrate becomes less soluble and is gradually deposited, the deposition continuing for some time after the storing of the wine in casks.

If wine is bottled before it has undergone the after-fermentation, a *sparkling wine* will be obtained. The fermentation will slowly proceed in the bottle, which is placed upside down, so that the precipitate which forms may settle in the neck, and may be finally withdrawn by carefully removing the stopper and quickly replacing it. The effervescence of sparkling wines is produced by the carbon dioxide confined in the bottle.

IMPROVING.—This term is used to include all those manipulations designed to preserve wine or render it more pleasing in appearance and taste by the addition of alcohol, glycerin, coloring matter, sugar, and other substances. In many cases so-called "improving" must be considered to be merely adulteration; but from the natural variation of the composition of grape-juice it is sometimes desirable to correct an excess or deficiency of one or more constituents, and for this purpose the following processes have been suggested:

1. Gypsum is largely employed in some parts of Europe as an addition to the must, for the purpose of hastening the clarification of wine, which then contains potassium sulphate in the place of bitartrate.

2. Chaptal (1800) proposed the removal of excessive acidity by marble and the addition of sugar to the must.

3. Gall proposed to correct excessive acidity by the addition to the must of sugar and water, whereby, evidently, an acid grape-juice is made to yield a correspondingly larger amount of wine.

4. Petiot (1859) suggested the utilization of the marc left on expressing the must, by

fermenting with it a solution of sugar, the product being either sold as wine or mixed with other wines.

5. Liebig (1848) suggested the removal of free acid by the addition of a concentrated solution of potassium tartrate in such proportion as to form bitartrate, which will be deposited from the wine.

6. To render weak wines stronger without foreign additions, Melsens (1873) introduced the freezing process, whereby a portion of the water is removed in the form of ice.

7. Pasteur's method consists in the heating of wine to from 50° to 65° C. (122°–149° F.), air being excluded, for the purpose of destroying fungoid germs and rendering the wine more permanent.

Properties.—As a class, white wines are distinguished from red wines by the absence of red coloring matter and of notable quantities of tannin, though minute proportions of this compound are usually present. They are never colorless, but vary in shade between pale-yellow and deep-amber color.

Sherry wine (Vinum Xericum, *Br.;* V. Xerense, *P. G.* 1872) has a rather deep-amber color, an agreeable vinous odor, and a warm and very slightly acid taste. We found (1886) its specific gravity to range between 0.978 and 0.995, and its average alcoholic strength to be 20.34 volumetric per cent.; the sugar and extractive averaged 3.27 (highest 5.3) per cent. in 67 samples examined. Similar wines are produced in various parts of Spain, Portugal, the Canaries, and Madeira, several of which are met with in our commerce. *Lisbon wine* has a density of about 0.990, and contains 19 or 20 per cent. of alcohol. *Teneriffe wine* closely resembles the preceding in properties. A stronger wine is *Madeira wine*, which usually contains between 19 and 22 per cent. of alcohol; it has a different somewhat nutty flavor.

Wines of similar strength in alcohol are also made in Italy (*Marsala*), Greece (*vino santo*), and the Cape Colony (*Constantia*). Southern France produces wines containing 14 to 16 per cent. of alcohol, of which those of *Lunel* and *Grenache* are ordered by the Codex. *Burgundy* wines are of about the same strength. Very sweet wines, rich in alcohol, are, among others, *Tokay* (Hungary), *Lachrymæ Christi* (Italy), and *Malaga* (Spain).

The white *Rhenish wines* are known here as *hock* (from *Hochheimer*). They have a more acidulous taste than the preceding wines, from the presence of acid potassium tartrate and the nearly total absence of sugar. They are of a pale-yellow color, and usually contain between 8 and 10 per cent. of alcohol. *Moselle wine* is nearly of the same strength. The *French wines*, both white and red, are required to contain about 10 per cent. of alcohol (*F. Cod.*).

The white wines of the Mississippi and Ohio Valleys and the *California wines* resemble the wines of Central and Southern Europe in appearance, flavor, and alcoholic strength; the weaker varieties of the latter, which are known as *California hock*, have not the fine bouquet of the better qualities of Rhenish wines, but the quality of American wines has considerably improved of late years.

The sparkling *champagne wines* contain between 10 and 12 per cent. of alcohol.

Constituents.—The principal constituents of all wines are water and alcohol. The amount of the latter present in different wines has been given above. The acidulous taste of wine is due to *acid potassium tartrate*, and small quantities of *acetic acid* are met with in old wines, resulting from the spontaneous oxidation of alcohol. A somewhat larger proportion of acetic acid is usually present in the wine of the Eastern section of the United States. The amount of *sugar* varies considerably: while the weaker dry wines contain none or but very little, it is found in sherry to the extent of from 1 to 5 per cent., increases in champagne sometimes to 5 or 6 per cent., in port wine to 6 or 7 per cent., and in the sweet wines, like *Malmsey Madeira*, to 11 or 15 per cent. or more. The "body" of wine has been ascribed by Fauré to a principle which he named *œnanthin*, and which is probably of the nature of gum or dextrin. *Tannin* seems to be present in all wines—in minute proportion in the white, and in larger proportion in the red wines. The *coloring matter* of wine varies for causes stated above; the color of red grapes is not soluble in water, but is extracted during fermentation as the alcohol increases. The *aroma* of wine is doubtless due to the presence of various compound ethers formed in the juice while fermenting. These exist in very minute quantities, and have for this reason not been accurately examined; but the following have been stated to contribute to the aromatic odor of wine: acetic, butyric, caprylic, caproic, œnanthic, pelargonic, capric, and propionic ethers, besides aldehyde, acetal, and probably other compounds.

The inorganic constituents of wine are the same as those of grape-juice, except that calcium tartrate and the greater portion of acid potassium tartrate have been deposited; the ash varies between about .1 and .5 per cent.

The U. S. Pharmacopœia not only permits, but evidently encourages, the use of native wines, provided they be pure and contain between 10 and 14 per cent. by weight of absolute alcohol. From causes explained before, the composition of wines made from the same variety of grape grown in different localities, or from different vintages in the same locality, must be expected to vary to some extent; every quantitative analysis of wine, therefore, refers only to the sample examined. A large number of American wines have been analyzed by Prof. H. B. Parsons, which, classified in principal groups, show the following results for 100 parts of white wines:

	51 Dry Wines.			7 Sherry Wines.			22 Sweet Catawba, Angelica, etc.			15 Sparkling Wines.		
	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.
Specific gravity . .	.9926	1.0105	.9845	.9974	1.0074	.9873	1.0318	1.0515	.9948	1.0255	1.0402	1.0174
Alcohol, per cent., weight . . .	9.35	13.94	7.03	15.47	20.09	12.84	11.46	17.33	8.48	8.28	10.02	6.24
Alcohol, per cent., volume	11.70	17.37	8.80	19.43	25.17	16.15	14.85	22.46	10.82	10.64	12.96	8.01
Total residue . .	1.75	2.64	1.18	4.84	6.83	1.95	12.67	18.04	3.39	9.74	13.31	7.78
Total ash	.181	.335	.090	.270	.479	.166	.171	.371	.101	.130	.164	.102
Glucose	trace.	.300	none.	2.86	4.84	.61	10.57	16.94	1.31	8.28	12.02	6.60
Total acid, as tartaric	.680	.855	.422	.616	.721	.476	.546	.925	.331	.725	.885	.501
Fixed acid, as tartaric	.313	.561	.121	.277	.418	.209	.313	.465	.234	.425	.626	.322
Volatile acid, as acetic	.294	.508	.068	.263	.380	.164	.208	.463	.046	.252	.472	.119

One sweet wine (Muscatel) contained 25.37 per cent. of glucose and 31.34 per cent. of total residue.

Changes.—Like other weak alcoholic liquids, wine is apt to undergo acetic fermentation, which is prevented by excluding atmospheric oxygen. Mucous fermentation causes wine to become ropy; white wines are subject to this change more than red wines, caused by the presence of insufficient tannin in the must for precipitating all the albuminoids. Some wines, like Burgundy, are liable to acquire a bitter taste, and occasionally wine becomes mouldy. Scrupulous cleanliness of the vessels in which wine is kept and exclusion of air will prevent most of these changes.

Tests.—With the exception of the U. S. P., none of the pharmacopœias give any tests for determining the quality of wine, which is directed to be ascertained as follows: "White wine should have a full, fruity, agreeable (and red wine a moderately astringent) taste, without excessive sweetness or acidity, and it should have a pleasant odor, free from yeastiness. Its sp. gr. at 15.6° C. (60° F.) should not be less than 0.990 (red wine 0.989) nor more than 1.010. If 10 Cc. of white wine be diluted with an equal volume of distilled water and treated with 5 drops of test-solution of ferric chloride, only a faint, greenish-brown color should make its appearance (absence of more than traces of tannic acid) (with red wine the liquid should acquire a brownish-green color, due to tannic acid). Upon evaporation and twelve hours' drying on the water-bath it should leave a residue of not less than 1.5 per cent. nor more than 3.0 per cent. (red wine between 1.6 and 3.5 per cent.). Using phenolphtalein test-solution as an indicator, 50 Cc. of white wine should require for complete neutralization not less than 3 nor more than 5.2 Cc. of the normal volumetric solution of potassium hydroxide (limit of free acid). Tested by the following method, white (and red) wine should contain not less than 10 per cent. nor more than 14 per cent., by weight (equivalent to 12.4 to 17.3 per cent. by volume), of absolute alcohol: Take the specific gravity (to four decimals) of a sufficient portion of the white wine at the temperature of 15.6° C. (60° F.), evaporate the wine in a tared capsule to one-third of its original weight, cool, and add water until the liquid measures its original volume at 15.6° C. (60° F.); then take the specific gravity (to four decimals) again. The difference between the two specific gravities, deducted from 1.0000, corresponds to the specific gravity of an alcohol containing the same percentage of absolute alcohol, by weight or volume, as the wine under examina-

tion, the corresponding percentage being ascertained by referring to the alcoholometric tables.—*U. S.*

Aside from the coloring matter, the requirements and tests of the Pharmacopœia are alike for white and red wine, with slight modifications for the latter, as indicated above. Wines from fruit other than the grape, and artificial or sophisticated wines, may correspond closely with the above requirements. For the detection of such the following brief summary from the observations of Prof. Nessler will be useful: By far the largest number of dry grape-wines contain between 1.6 and 2.2 per cent. of *solid matter;* this is conveniently estimated by evaporating the alcohol and diluting the residue with water to the original volume, when the liquid should have the specific gravity 1.007 or 1.008, and should not be less than 1.005. Grape-wines contain no *citric acid* and little or no free *tartaric acid.* The latter is best detected by agitating the wine with powdered potassium bitartrate until saturated, and adding to the filtrate potassium acetate, when in the presence of free tartaric acid a precipitate will be produced. Most pure wines yield a precipitate with tartaric acid, proving the presence of potassium salts other than bitartrate. To detect citric acid add to the wine an excess of lime, filter, acidulate with acetic acid, add excess of barium chloride, filter from the barium sulphate, and add excess of ammonia, when barium citrate will be precipitated. For the detection of free sulphuric acid strips of filtering-paper about 30 Cm. (12 inches) long are suspended in such a manner that the lower end dips into the wine, which is gradually absorbed and evaporates from the upper part, where the extractive matters and sulphuric acid become more concentrated; after twenty-four hours the paper is carefully dried, and then heated to 100° C. (212° F.), when the portion charged with extractive becomes brown or black and frequently brittle from the free sulphuric acid, the reaction being more delicate in the presence of 0.1 or 0.2 per cent. of sugar. The brown-yellow *coloring matter* of wine containing a little tannin is precipitated on agitation with egg albumen, while the color produced by caramel is not altered.

Winckler stated that cider and other fruit-wines contain lactic acid and calcium lactate, which are not found in grape-wine. Tuchschmid (1870) found the amount of calcium carbonate obtainable in the ashes of grape-wine never to exceed 0.049 per cent., while other fruit-wines yield between 0.11 and 0.40 per cent. of the same salt. The amount of sulphates in wine varies in most cases, so as to represent between .01 and .03 per cent. of sulphuric acid; Nessler found occasionally .11 per cent. Wines treated with gypsum contain a larger quantity.

The determination of alcohol is usually effected by one of the two following methods: A definite quantity of wine is distilled by means of a water-bath until one-half of the liquid has passed over; the distillate is diluted with distilled water to the original volume or weight of the wine, when its specific gravity indicates the alcoholic strength; or, the residue in the still is diluted with water to the original volume or weight of the wine; its specific gravity is now ascertained, and from this figure is deducted the specific gravity of the wine; the difference, representing the solid constituents, is deducted from 1.000 (density of water), and the figure thus obtained gives the density of the alcohol present. The method adopted by the Pharmacopœia is a modification of the last one described, and was suggested by Prof. Parsons. A number of instruments have been constructed by means of which the alcoholic strength may be determined either from the pressure or the heat of the vapors of the boiling liquid; volatile acids, if present, must be previously neutralized.

Action and Uses.—Wine, including all forms of genuine wine, is essentially a stimulant of the nervous and circulatory systems, but its mode of stimulation is unlike that of mere alcohol. In due proportion it gives to all the faculties increased activity and freedom of action, quickening and brightening the intellect and the imagination, warming the feelings, invigorating the digestive powers, and diffusing a cordial satisfaction throughout the whole being. Distilled spirits, on the other hand, tend to benumb the faculties even while stimulating them, so that they seem to be struggling under a brute force; the exhilaration they produce is usually fierce or maudlin, and they leave behind them a dull and inert dejection. (See ALCOHOL.) As already stated, the peculiar effects of wine are due to the salts, acids, sugar, and, above all, the ethereal elements, in which it abounds, and which, while they tend to mitigate the anæsthesia produced by the alcohol of the liquid, ensure a more rapid discharge of this substance from the system. The white wines, as a class, are distinguished by the rapidity with which they exhilarate and intoxicate, as well as by the relatively transient character of the excitement they produce, and by their marked diuretic action. Most of

the red wines, and especially port wine, contain a portion of tannin, which retards their absorption, and therefore lessens their immediate stimulant effects. They are, on the other hand, more or less tonic, and hence become well adapted to the convalescent stages of acute disease and to states of chronic debility. (See VINUM RUBRUM.) The effects of wine in excessive doses resemble more nearly those produced by distilled spirits, yet even then they are less extreme and debasing. Its habitual use is conducive to the health of those who drink it in moderation, and is the best corrective of the brutality and preventive of the crime which everywhere attend the consumption of ardent spirits. The very quantity of it required to produce intoxication tends to limit the mischiefs of its inordinate use; and even when "the sweet poison of the misused wine" is indulged in beyond measure, its mischievous influence upon the health is less than that of alcohol, for, while the latter tends directly to occasion fatal disease of the liver, heart, and kidneys, the intemperate use of wine is more apt to engender gout, gravel, and nervous affections. Even these results are rarely attributable to some of the wines which are most largely used, as the Rhenish, Austrian, Hungarian, Bordeaux, and most Italian wines, both white and red.

Wine is employed in the treatment of the same form of diseases for which distilled alcohol is appropriate, but, according to general usage, in the less grave forms, and for women, children, and old persons rather than for adult men. The clearest indication for its use is furnished by *adynamic fevers*, and most of all *typhus fever*, a disease in which enormous quantities of wine have sometimes been administered with the most salutary results. In a less degree it is useful in *typhoid fever* and in all febrile affections which assume the *typhoid state*, provided that symptoms of the following character are present: viz. prostration, wandering, delirium, petechiæ, stupor, and brown tongue; feebleness, irregularity, dicrotism or softness of the pulse; and particularly feebleness or absence of the first sound of the heart. When delirium, unconsciousness, and dryness of the tongue have been succeeded by a state of exhaustion, languor, and debility, with imperfect sleep and anorexia, the cordial operation of wine is a precious help toward the cure. And under these circumstances sparkling wines are often more acceptable to the stomach than others. But it is as true of wine as of distilled spirits, that the necessity for it is often more apparent than real, and that a premature and excessive use of it renders the patient insensible to its operation when it has become essential to his recovery. We have never had such good reason to be pleased with the results of treatment in typhoid fever as when in a large hospital service the use of alcohol in this disease was almost wholly omitted.

During *convalescence* from many diseases wine taken with food is often a potent aid to recovery, and it is often also of essential utility in chronic affections which waste the strength by profuse *discharges* or by *pain* or by inducing an *anæmic* condition. In all of these cases red wines are more efficacious than white. The latter, however, and in general the more stimulating wines, are best adapted to cases in which a speedy but transient influence is intended, as where *syncope* is imminent or the patient is reviving from it after powerful nervous shocks, exhausting fatigue of body or mind, severe pain, hæmorrhage, etc., and in cases of debility of the heart arising from structural alterations in it. In the milder forms of *delirium tremens*, especially as they occur in females, and notably in those of the better classes, wine is greatly to be preferred to distilled spirits. In some minor *spasmodic affections*, as the *vomiting* of pregnancy or of sea-sickness, the sparkling wines are often of great service. Infantile reflex *convulsions* may frequently be prevented or mitigated by a timely dose of wine administered by the rectum or the mouth. It is equally efficient in all other affections in which danger arises from debility and its immediate consequences, and among them *capillary bronchitis* may be particularly noted. *Tetanus* has been successfully treated by wine, and the depressing action of *tobacco* and other sedatives of the heart and nervous system may be counteracted by its means.

It seems superfluous to say a word of the special virtues of sherry wine, since it is almost impossible to procure any of it which is pure and presents that peculiar "nutty" flavor, and that "dryness," or slight acidity, which at one time were characteristic of it, and which rendered it a valuable cordial in exhaustion of the nervous system and of the heart and a wholesome aid to feeble digestion. In England, where, more than elsewhere, it was generally used by the richer classes, it was regarded as especially appropriate for dyspeptic, gouty, and rheumatic invalids. At present those who prescribe "sherry wine" should know that there is seldom any wine in the liquid at all, but that it consists usually of alcohol, water, and flavoring ingredients. It is far better to use medicinally whiskey

made from wheat or rye, which there is less temptation for the dishonest dealer to adulterate, than the mischievous compounds sold under the name of sherry. Sherry is less astringent, and, according to some analyses, slightly less, and according to others slightly more, alcoholic than port. Commercial sherry wine is less suited than pure wine for making *wine whey*, which is prepared by adding the wine to milk at the boiling temperature, in the proportion of from 2 to 8 fluidounces of the former to a pint of the latter, straining off the whey and sweetening it. It is a mild and slightly nutritious stimulant much used in cases of debility from exhaustion and in the *typhoid state*. Wine diluted with water may be given by enema with scarcely less advantage than by the stomach. (For a fuller description and history of wines the reader is referred to STILLÉ, *Therapeutics*, 4th ed., ii. 710.)

VINUM ALOES, *Br.*—WINE OF ALOES.

Vinum aloeticum.—*Vin (Œnolé) aloétique*, Fr.; *Aloewein*, G.

Preparation.—Socotrine aloes 1½ oz. av.; cardamom-seeds, freed from the pericarps and bruised, ginger, in coarse powder, each 80 grains; sherry, sufficient to make 2 pints. —*Br.* Purified Aloes 6 parts; Cardamom 1 part; Ginger 1 part; Stronger White Wine a sufficient quantity; to make 100 parts. Mix the aloes, cardamom, and ginger, and reduce them to a moderately coarse (No. 40) powder. Macerate the powder with 90 parts of stronger white wine for seven days, with occasional agitation, and filter through paper, adding, through the filter, enough stronger white wine to make the filtered liquid weigh 100 parts.—*U. S.* 1880.

Uses.—This preparation is no longer recognized in the U. S. Pharmacopœia, and is rarely used, because, like all liquid preparations of aloes, its taste is repulsive, and the pilular forms of the medicine are therefore more acceptable. Yet it probably has the advantage over them of being already a solution, and therefore of acting in a relatively smaller dose than aloes itself. It is useful in cases of habitual *constipation* from torpor of the colon and rectum, especially when associated with flatulent dyspepsia, gout, or amenorrhœa. *Dose*, as a laxative, about Gm. 16 (ʒiv).

VINUM ANTIMONII, *U. S.*—WINE OF ANTIMONY.

Vinum antimoniale, Br.; *Vinum stibiatum, s. emeticum*, P. G.—*Antimonial wine*, E.; *Vin émétique, Vin antimonié, Vin stibié*, Fr.; *Brechwein*, G.

Preparation.—Antimony and Potassium Tartrate 4 Gm.; Boiling Distilled Water 65 Cc.; Alcohol 150 Cc.; White Wine a sufficient quantity; to make 1000 Cc. Mix the alcohol with 850 Cc. of white wine. Dissolve the antimony and potassium tartrate in the boiling distilled water, and add the solution to the mixture. When the liquid is cold filter it through paper, and add enough white wine, through the filter, to make the product measure 1000 Cc.—*U. S.*

To make 1 pint of wine of antimony use 29¼ grains of antimony and potassium tartrate, 1 fluidounce of boiling distilled water, 2½ fluidounces of alcohol, and sufficient white wine to make 16 fluidounces of solution.

Each Cc. of finished product contains 0.004 Gm. (or 1 fluidrachm, about ¼ grain) of tartar emetic.

Nearly the same proportions are the following: Tartarated antimony 40 grains; sherry 1 pint (Imperial).—*Br.* Tartar emetic 1 part; sherry 250 parts.—*P. G.*

If made with good wine and judiciously preserved, antimonial wine will keep unaltered for a long time.

Uses.—The chief value of antimonial wine consists in its being a convenient addition to febrifuge solutions, and especially in association with a liquid preparation of opium and spirit of nitrous ether. In such combinations it greatly promotes the diaphoresis which is a natural crisis of *fever*. The direct sedatives of the heart have no such salutary operation. In a like manner it may be added to mixtures for promoting expectoration in febrile affections of the air-passages, as in the officinal compound liquorice mixture. It should seldom be used as an emetic, for its action in children is too depressing, and for adults the necessary dose of it is such that the stimulant action of the wine counteracts the sedative or nauseant operation of the antimonial. As a febrifuge and expectorant the *dose* of antimonial wine is about Gm. 0.60 (gtt. x), repeated at longer or shorter intervals according to its effects. This dose is preferable to the larger ones generally recommended.

VINUM AROMATICUM, *U. S. 1880, F. Cod.*—Aromatic Wine.

Vin (Œnolé) aromatique, Fr.; *Kräuterwein*, G.

Preparation.—Lavender 1 part; Origanum 1 part; Peppermint 1 part; Rosemary 1 part; Sage 1 part; Wormwood 1 part; Stronger White Wine a sufficient quantity; to make 100 parts. Mix the solid ingredients, and reduce them to a coarse (No. 20) powder. Moisten the powder with 4 parts of stronger white wine, pack it moderately in a conical glass percolator, and gradually pour enough stronger white wine upon it to make the filtered liquid weigh 100 parts.—*U. S.* 1880.

This is equivalent to the preparation, somewhat simplified, of the old French Codex. The present Codex orders vulnerary tincture 1 part, red wine 7 parts.

Tinctura vulneraria, Alcoolature (Teinture) vulnéraire, *F. Cod.*, is made by macerating 100 Gm. each of the fresh leaves and tops of eighteen plants, including the six of the above formula, and 3000 Gm. of alcohol sp. gr. 0.863.

Uses.—Aromatic wine (omitted from Pharm. 1890) is designed for topical purposes only. It represents a class of preparations which were formerly in common use as vulneraries, either as applications to recent *wounds* or to stimulate indolent *ulcers*. An almost identical preparation was used by Ricord as a dressing for *chancres*, and is now officinal in France. It is applied on charpie. The old aromatic wine of the French Codex contained, besides the herbs above enumerated, angelica, fennel, hyssop, rosemary, rue, thyme, etc., and was infused in red wine.

VINUM AURANTII, *Br.*—Orange Wine.

Wine made in Britain by the fermentation of a saccharine solution to which the fresh peel of the bitter orange has been added.—*Br.*

It is a vinous liquid, having a gold-cherry color and a taste and aroma derived from the bitter orange-peel. It contains about 12 per cent. of alcohol, and is but slightly acid to test-paper.

Uses.—Orange wine is used exclusively as a flavoring ingredient of mixtures and as an excipient in certain British officinal preparations.

VINUM COLCHICI RADICIS, *U. S.*—Wine of Colchicum-root.

Vinum colchici, Br.; *Vinum de colchico*, F. Cod.—*Vin (Œnolé) de bulbe de colchique*, Fr.; *Zeitlosenknollenwein*, G.

Preparation.—Colchicum-root, in No. 30 powder, 400 Gm.; Alcohol 150 Cc.; White Wine a sufficient quantity; to make 1000 Cc. Mix the alcohol with 850 Cc. of white wine. Moisten the powder with 100 Cc. of the menstruum, pack it moderately in a conical glass percolator, and gradually pour upon it, first, the remainder of the menstruum, and afterward enough white wine to make the product measure 1000 Cc.—*U. S.*

To make 1 pint of wine of colchicum-root use 6 av. ozs. and 300 grains of powdered colchicum-root, and moisten with 3¾ fluidounces of the menstruum (alcohol 15 volumes, white wine 85 volumes).

Colchicum, sliced, dried, and bruised, 4 oz. av.; sherry sufficient to make 1 pint (Imperial).—*Br.* Fresh colchicum-root 100 Gm., strong wine (vin de Grenache) 1000 Gm.—*F. Cod.*

This preparation is recognized in Great Britain as *wine of colchicum*, under which name in the United States the wine of colchicum-seeds is usually understood. Owing to the deterioration of colchicum-tuber when long kept, the preparation is apt to be deficient in strength, since the drug cannot be at all times obtained fresh or recently dried.

Uses.—This preparation, which is believed to possess all the virtues of colchicum, may be prescribed in *doses* of Gm. 0.60 (♏ x), and gradually increased.

VINUM COLCHICI SEMINIS, *U. S.*—Wine of Colchicum-seed.

Vinum colchici, P. G.—*Vin (Œnolé) de semence de colchique*, Fr.; *Zeitlosensamenwein*, G.

Preparation.—Colchicum-seed, in No. 30 powder, 150 Gm.; Alcohol 150 Cc.; White Wine a sufficient quantity; to make 1000 Cc. Mix the alcohol with 850 Cc. of white wine. Macerate the powder with 900 Cc. of the mixture during seven days in a closed vessel, with occasional agitation. Then filter through paper, adding, through the filter, first, the remainder of the menstruum, and afterward enough white wine to make the product measure 1000 Cc.—*U. S.*

To make 1 pint of wine of colchicum-seed use 2½ av. ozs. of powdered colchicum-seed, and macerate for seven days with 14½ fluidounces of the menstruum (alcohol 15 volumes, white wine 85 volumes); after filtration pass sufficient menstruum through the filter to make 16 fluidounces.

Bruised colchicum-seed 60 Gm., strong wine 1000 Gm.—*F. Cod.* Coarsely powdered colchicum-seed 1 part, sherry wine 10 parts.—*P. G.*

In order to extract the colchicine the seeds require to be well bruised. By passing them several times through a good drug-mill, regulating at the same time the grinding surface, they may be obtained of a sufficiently fine powder. If a suitable mill is not at hand, they should be macerated in a portion of the wine for several days, and be bruised in a mortar while damp. None of the pharmacopœias permit digestion of the unbroken seeds. 10 parts *U. S.* are equal to 15 parts *P. G.* and 25 parts *F. Cod.* of this wine.

Uses.—The commencing *dose* is about Gm. 2 (fʒss).

VINUM ERGOTÆ, *U. S.*—Wine of Ergot.

Vin de seigle ergoté, Fr.; *Mutterkornwein*, G.

Preparation.—Ergot, recently ground, in No. 30 powder, 150 Gm.; Alcohol 150 Cc.; White Wine a sufficient quantity; to make 1000 Cc. Mix the alcohol with 850 Cc. of white wine. Moisten the powder with 40 Cc. of the mixture, pack it moderately in a conical glass percolator, and gradually pour upon it, first, the remainder of the menstruum, and afterward enough white wine to make the product measure 1000 Cc.—*U. S.*

To make 1 pint of wine of ergot use 2½ av. ozs. of powdered ergot, and moisten with ¾ fluidounce of the menstruum (alcohol 15 volumes and white wine 85 volumes).

Uses.—The wine is less frequently employed than other preparations of ergot, but may be prescribed in *doses* of Gm. 4–12 (fʒj–iij).

VINUM FERRI, *Br.*—Wine of Iron.

Vinum chalybeatum, s. martiatum.—Vin chalybé, Fr.; *Eisenwein, Stahlwein*, G.

Preparation.—Take of Fine Iron Wire (about No. 35) 1 ounce; Sherry 1 pint. Macerate for thirty days in a closed vessel, the iron being almost, but not quite, wholly immersed in the wine, the vessel frequently shaken, and the stopper removed; then filter.—*Br.*

The acid potassium tartrate dissolves the iron, with the evolution of hydrogen, resulting in the formation of ferrous tartrate or of its double salt with potassium tartrate. Owing to the variable acidity of different wines, and to the necessarily variable composition of this preparation, it has very properly been discarded by most pharmacopœias, or has been replaced by one of more definite strength in iron, like the wine of citrate of iron.

Uses.—This preparation is one of the mildest of ferruginous medicines. It is, however, quite as well prepared extemporaneously by making a solution of iron and potassium tartrate in sherry or Rhenish wine, in the proportion of 10 grains to the fluidounce. The *dose* of the officinal wine is Gm. 4–16 (fʒj–iv), and of the magistral solution nearly twice as much.

VINUM FERRI AMARUM, *U. S.*—Bitter Wine of Iron.

Vinum de cinchona martiatum, F. Cod.; *Vinum chinæ ferratum.—Vin (Œnolé) de quinquina ferrugineux*, Fr.; *Chinaeisenwein*, G.

Preparation.—Soluble Iron and Quinine Citrate 50 Gm.; Tincture of Fresh Orange-peel, 150 Cc.; Syrup 300 Cc.; White Wine a sufficient quantity; to make 1000 Cc. Dissolve the soluble iron and quinine citrate in 500 Cc. of white wine. Add to this the tincture of fresh orange-peel and the syrup, and, lastly, enough white wine to make the product measure 1000 Cc. Set the mixture aside for several days, then filter, and pass enough white wine through the filter to restore the original volume.—*U. S.*

To make 1 pint of bitter wine of iron dissolve 365 grains of soluble iron and quinine citrate in 8 fluidounces of white wine; add 2½ fluidounces of tincture of fresh orange-peel, 5 fluidounces of syrup, and sufficient white wine to make 16 fluidounces of solution.

Each Cc. of the finished product contains 0.05 Gm. (or 1 fluidrachm nearly 3 grains) of the soluble scale salt of iron and quinine.

This an adaptation of the formula adopted by the American Pharmaceutical Association in 1875, and resembles that of the old French Codex, but contains more iron. The new French Codex directs 2 Gm. each of ferrous sulphate and citric acid to be dissolved in 10 Gm. of boiling water, and this solution added to 990 Gm. of wine of pale cinchona.

Uses.—This solution contains in each fluidrachm nearly 3 grains of the soluble citrate of iron and quinine. It is a mild preparation, but is very efficient in cases of moderate *anæmia* and *debility*. The ordinary *dose* is Gm. 4–8 (f℥j–ij).

VINUM FERRI CITRATIS, *U. S., Br.*—Wine of Ferric Citrate.

Vinum chalybeatum, F. Cod.—*Vin chalybé*, *Vin (Œnolé) ferrugineux*, Fr.; *Eisenwein*, G.

Preparation.—Iron and Ammonium Citrate 40 Gm.; Tincture of Fresh Orange-peel 150 Cc.; Syrup 100 Cc.; White Wine a sufficient quantity; to make 1000 Cc. Dissolve the iron and ammonium citrate in 700 Cc. of white wine. Add to this the tincture of fresh orange-peel and the syrup, and, lastly, enough white wine to make the product measure 1000 Cc. Set the mixture aside for several days, then filter, and pass enough white wine through the filter to restore the original volume.—*U. S.*

To make 1 pint of wine of ferric citrate dissolve 292 grains of iron and ammonium citrate in 11 fluidounces of white wine; add 2½ fluidounces of tincture of fresh orange-peel, 1¾ fluidounces of syrup, and sufficient white wine to make 16 fluidounces of solution.

Each Cc. of the finished product contains 0.04 Gm. (or 1 fluidrachm about 2¼ grains) of iron and ammonium citrate.

Dissolve citrate of iron and ammonia 160 grains in orange wine 1 pint (Imperial), and after three days filter.—*Br.*

Citrate of iron and ammonia 5 Gm., strong wine (vin de Grenache) 1000 Gm.—*F. Cod.*

Uses.—The wine of citrate of iron has nearly the same qualities as wine of iron, and, like it, may be used when the stomach is irritable. The *dose* is Gm. 4–16 (f℥j–iv).

VINUM IPECACUANHÆ, *U. S., Br., P. G.*—Wine of Ipecac.

Vin d'ipécacuanha, Fr.; *Brechwurzelwein*, G.

Preparation.—Fluid Extract of Ipecac 100 Cc.; Alcohol 100 Cc.; White Wine 800 Cc.; to make 1000 Cc. Mix them. Set the mixture aside for a few days, then filter.—*U. S.*

To make 1 pint of wine of ipecac mix 1 fluidounce and 288 minims, each, of fluid extract of ipecac and of alcohol, with sufficient white wine to make 16 fluidounces. Each Cc. represents 0.1 Gm. (or 1 fluidrachm very nearly 6 grains) of ipecac.

Macerate for a day ipecacuanha 1 oz. in acetic acid 1 fl. oz.; obtain with water 20 oz. of percolate; evaporate to dryness over a water-bath; powder; macerate in sherry wine 1 pint (Imp.) for two days, and filter.—*Br.* Ipecac 1 part, sherry wine 10 parts.—*P. G.*

Uses.—Wine of ipecacuanha contains all the virtues of the drug. It is a very inappropriate form for the production of emesis, since the large proportion of alcohol contained in it counteracts the emetic operation of the ipecacuanha, and may be unsuited to the febrile elements of the affection for which it is prescribed. This objection applies less forcibly to its use as a diaphoretic and expectorant. It is especially useful, when associated with spirit of nitrous ether, in favoring diaphoresis in *catarrhal fever*, *muscular rheumatism*, etc. In infantile and also in senile *bronchitis* it is very serviceable when the bronchial secretions obstruct the air-passages, and when an emetic as well as a stimulant operation is called for. It may be applied directly to the air-passages by means of the hand- or steam-atomizer, and in this manner is very efficient in *chronic bronchitis*. In the *vomiting* of pregnancy this preparation, in hourly doses of 1 drop, sometimes arrests that distressing symptom. It is probable that in doses nearly as small it would be found as useful as powdered ipecacuanha has proved in relieving atonic *dyspepsia* and *chronic diarrhœa* caused by intestinal debility.

The *dose* of wine of ipecacuanha as an emetic is stated to be Gm. 32 (f℥j) for an adult, and Gm. 4 (f℥j) for an infant, but, for the reasons assigned, it is not eligible for this purpose. As an expectorant or diaphoretic the proper dose is Gm. 0.30–0.60 (gtt. v–x), repeated every half hour or hour.

VINUM OPII, *U. S., Br.*—Wine of Opium.

Vinum opii compositum, F. Cod.; *Tinctura opii crocata*, P. G.; *Laudanum liquidum Sydenhami.—Sydenham's laudanum*, E.; *Laudanum de Sydenham, Vin d'opium composé*, Fr.; *Safranhaltige Opiumtinktur*, G.

Preparation.—Powdered Opium 100 Gm.; Cinnamon, in No. 60 powder, 10 Gm.; Cloves, in No. 30 powder, 10 Gm.; Alcohol 150 Cc.; White Wine a sufficient quantity; to make 1000 Cc. Mix the alcohol with 850 Cc. of white wine. To the mixed powders add 900 Cc. of the menstruum, and macerate the mixture during seven days with occasional agitation. Then transfer it to a filter, and when the liquid has drained off gradually pass through the filter, first the remainder of the menstruum, and afterward enough white wine to make the product measure 1000 Cc.—*U. S.*

To make 1 pint of wine of opium use 730 grains of powdered opium and 73 grains each of cloves and cassia cinnamon; macerate for seven days with 14½ fluidounces of the menstruum (alcohol 15 volumes, white wine 85 volumes). After filtration pass enough menstruum through the filter to bring the volume up to 16 fluidounces.

Each Cc. represents 0.1 Gm. (or 1 fluidrachm about 5.7 grains) of opium.

The U. S. P. requires that 100 Cc. of wine of opium, when assayed by the process given under Tinctura Opii, shall yield from 1.3 to 1.5 Gm. of crystallized morphine.

Extract of opium 1 oz. av.; cinnamon-bark, bruised, cloves, bruised, each 75 grains; sherry 1 pint (Imperial).—*Br.*

Both pharmacopœias have discarded the use of saffron, which is still retained by the French and German Pharmacopœias. Otherwise, the preparation is now practically identical as ordered by the four pharmacopœias. The wine has been replaced in the P. G. by a diluted alcohol. The other formulas are: Opium 200, saffron 100, Ceylon cinnamon 15, Cloves 15, wine 1600 Gm.—*F. Cod.* Opium 30, saffron 10, Chinese cinnamon 2, cloves 2, alcohol (sp. gr. 0.894) 150, and water 150 parts.—*P. G.* That of the French Codex, being made with a sweet wine, is denser (sp. gr. 1.05 to 1.07) than the other preparations. On keeping, this wine deposits some extractive matter and occasionally some narcotine.

Laudanum de Rousseau, *F. Cod.*, contains about one-fourth its weight of opium, and is therefore considerably stronger than the preceding: it is made by fermenting a mixture of opium 200 Gm., honey 600 Gm., water 3 liters, and beer-yeast 40 Gm.; the filtered liquor is then evaporated to 600 Gm. and mixed with alcohol (sp. gr. 0.913) 200 Gm.

Uses.—This preparation, also known as "Sydenham's laudanum," is much superior to the tinctures of opium as an internal medicine, on account of its being less apt to nauseate and less offensive in taste and smell. Gm 0.60–1 (♏ x to gtt. xvj) may be given as a full *dose*. It is sometimes used as an application to the *conjunctiva* in granular and other chronic forms of inflammation of that membrane.

VINUM QUININÆ, *Br.*—Wine of Quinine.

Vin de quinine, Fr.; *Chininwein*, G.

Preparation.—Take of Sulphate of Quinine 20 grains; Citric Acid 30 grains; Orange Wine 1 pint (Imperial). Dissolve first the citric acid, and then the sulphate of quinine in the wine; allow the solution to remain for three days in a closed vessel, shaking it occasionally; and afterward filter.—*Br.*

Allied Preparation.—Vinum de cinchona, *F. Cod.*; Vinum chinæ, *P. G.* 1882. Tincture of cinchona 100, glycerin 100, sherry wine 300 parts.—*P. G.* 1882. Cinchona 5, alcohol (sp. gr. 0.913) 10, red wine 100 parts.—*F. Cod.* The latter formula is alike for pale, red, and yellow cinchona, and in each case the cinchona wine may also be prepared with a strong wine (vin de liqueur), such as Grenache, Lunel, Malaga, Madeira, and others, in which case no alcohol is added.

Uses.—It is difficult to perceive the advantages of this preparation over an extemporaneous solution of the citrate of quinine in water. The *dose* is Gm. 16–32 (f℥iv–℥j).

VINUM RHEI, *Br.*—Wine of Rhubarb.

Tinctura rhei vinosa, P. G.; *Tinctura rhei Darelii.—Vin de rhubarbe*, Fr.; *Weinige Rhabarbertinktur*, G.

Preparation.—Rhubarb-root, in coarse powder, 1½ av. oz.; canella-bark, in coarse powder, 60 grains; sherry 1 pint. Macerate for seven days in a closed vessel, with occasional agitation; then strain, press, filter, and add sufficient sherry to make 1 pint

(Imperial).—*Br.* Rhubarb, in No. 30 powder, 10 parts; Calamus, in No. 30 powder, 1 part; Stronger White Wine a sufficient quantity; to make 100 parts. Moisten the mixed powders with 5 parts of stronger white wine, pack the mixture in a conical glass percolator, and gradually pour enough stronger white wine upon it to make the filtered liquid weigh 100 parts.—*U. S.* 1880.

Rhubarb 6 parts; Grenache wine 100 parts.—*F. Cod.* Rhubarb, finely cut, 8 parts; bitter orange-peel 2 parts; cardamom 1 part; sherry wine 100 parts; in 7 parts of the tincture dissolve 1 part of sugar.—*P. G.*

Uses.—Wine of rhubarb has the same general virtues as the tincture of rhubarb, but is less stimulant. It may be described as cordial, carminative, and *laxative*, and may be used by persons of a *constipated* habit and gouty constitution, and especially by females who add to these conditions scanty and painful menstruation and leucorrhœa. The *dose* is Gm. 4–16 (fʒj–iv).

VINUM RUBRUM, *U. S.*—Red Wine.

Vin rouge, Fr.; *Rothwein*, G.; *Vino tinto*, Sp.

An alcoholic liquid made by fermenting the unmodified juice of the fresh, colored fruits of Vitus vinifera (nat. ord. Vitaceæ) in presence of their skins. When red wine is prescribed without further specification, it is recommended that a dry red wine of domestic production (such as a native Claret, Burgundy, etc.) be employed. Red wine should be preserved in well-closed, full casks or in well-stoppered bottles in a cool place.—*U. S.*

Origin and Description.—The fruits of most cultivated varieties of the American grapevines and of numerous varieties of the European species have either an amber color or are purple, dark-blue, or nearly black. The juice of these grapes is colorless or nearly so, and if fermented alone yields a white wine, but if fermented with the pericarp or skins the coloring matter of the latter is extracted, and the wine has a red color, varying in shade with the variety of grapes, with the quantity of skins, the length of time they have been in contact with the fermenting liquid, and with the amount of alcohol and acid present. Although many white wines contain tannin, taken up from the pericarp of the fruit or from the seeds, the quantity is usually minute as compared with that present in red wines, and which comes from the same sources. It is obvious, therefore, that red wine agrees in properties and composition with white wine, except so far as these are modified by the red coloring matter and the tannin, the most striking differences being the deep-red color, the distinctly astringent taste, and the effect produced by alkalies, ferric chloride, lead acetate, and other reagents, either changing the color of, or producing precipitates with, tannin and the coloring principle.

Vinum portense.—Port wine, *E.*; Vin d'Oporto, *Fr.*; Portwein, *G.*—This is the product of the grape cultivated in the district near the river Douro in Portugal, and is chiefly exported from Oporto. When recently made it is of a red color, which by age changes to a deep reddish-brown, while at the same time a considerable portion of altered astringent matter is deposited and the wine acquires its full flavor. Port wine is considered to be best when about eight or ten years old. As exported from Portugal, it is always mixed with a certain quantity of spirit, which is added for the purpose of better preservation; its alcoholic strength is thereby increased from 18 to 22 per cent. Ripeness and strength are said to be imparted to new wine by adding brandy toward the end of fermentation, and the product, particularly the cheaper varieties of port wine, is often artificially colored with preparations containing the juice of elderberries. Port wine has a pleasant vinous odor and an agreeable, warm, sweetish, and slightly astringent taste. In the place of true port wine a variety of French wine, known in commerce as *Burgundy port wine*, is much used in the United States; it resembles port wine in appearance and flavor, and contains about 14 or 16 per cent. of alcohol. California port wine is very similar, and is the product of grapevines originally obtained from the port-wine district of Portugal, and chiefly cultivated in Los Angelos county. Similar wines are also made in other parts of the United States.

Claret is the English name of dry red wines containing a moderate amount of alcohol, and was originally used for French red wines (*vin clairet*, clarified wine), but is now applied to many wines of American growth from California, as well as from the Mississippi Valley and eastward to the Atlantic coast. Some of the most esteemed red wines of France are produced in Gironde and exported from Bordeaux, and the red wines produced in other sections of France have, like the former, been known in Europe as *Bordeaux wines*. Much of the wine exported is more or less artificial, and the handsome

red color is now sometimes due to *maqui-berries*, the fruit of Aristolelia Maqui, *L'Héritier* (nat. ord. Tiliaceæ), of which 431,392 kilos were exported from Chili to Europe in 1887, about three-fourths of which went to France (*Kew Bulletin*, Feb. 1890). (See VINUM ALBUM, process of Petiot and Gall for wine-improving.)

Constituents.—In addition to the constituents mentioned elsewhere (see VINUM ALBUM), red wine contains tannin, partly derived from the casks, but mainly from the seeds and integuments of the grape, and giving with ferric salts green-brown or green-black precipitates. The red coloring matter, *œnolin* or *œnolic acid*, is a red-brown or purplish-red powder, which is nearly insoluble in water, in carbon disulphide, and in chloroform, but soluble in dilute acids and in alcohol; it is not unlikely that the coloring principles of different grapes vary, and are more or less modified by the constituents and treatment of wine.

The following summary of analyses of American red wines by Prof. H. B. Parsons shows the variation in composition:

	64 Dry Wines.			12 Port Wines.		
	Average.	Highest.	Lowest.	Average.	Highest.	Lowest.
Specific gravity	.9933	1.0011	.9894	1.0261	1.0508	1.0116
Alcohol, per cent., weight	8.92	12.21	5.71	13.23	16.93	10.25
" " volume	11.04	15.21	7.17	17.09	21.89	13.05
Total residue	2.28	3.16	1.65	11.17	17.04	6.89
Total ash	.231	.532	.130	.283	.355	.139
Glucose	trace.	.450	none.	8.05	11.80	4.15
Total acid, as tartaric	.723	.997	.511	.632	.828	.370
Fixed acid, as tartaric	.360	.646	.226	.356	.600	.196
Volatile acid, as acetic	.290	.517	.138	.216	.386	.128

Tests.—The pharmacopœial requirements as to the quality of red wines are practically identical with those for white wines, but additional tests are prescribed for ascertaining the nature of foreign coloring matters: "Using eosin test-solution or fluorescein test-solution as indicator, 50 Cc. of red wine should require for complete neutralization not less than 3 nor more than 5.2 Cc. of normal potassium hydroxide solution (limit of free acid). If 10 Cc. of red wine be diluted with an equal volume of water, and treated with 5 drops of ferric chloride test-solution, the liquid should acquire a brownish-green color (due to tannic acid). With lead acetate test-solution red wine forms a heavy precipitate which may vary in color from bluish-green to green. If 2 Cc. of red wine be mixed, in a test-tube, with 2 drops of chloroform and 4 Cc. of normal potassium hydroxide solution, and the mixture carefully heated, the disagreeable odor of isonitril should not become perceptible (absence of various aniline colors). If 50 Cc. of red wine be treated with a slight excess of ammonia-water, the liquid should acquire a green or brownish-green color; if it be then well shaken with 25 Cc. of ether, the greater portion of the ethereal layer removed, and evaporated in a porcelain capsule with an excess of acetic acid and a few fibres of uncolored silk, the latter should not acquire a crimson or violet color (absence of fuchsine). If 25 Cc. of red wine, heated to about 45° C. (113° F.), be well agitated with 25 Gm. of manganese dioxide, the liquid filtered off and acidulated with hydrochloric acid, it should not acquire a red color (absence of sulpho-fuchsine).

"Tested by the following method, red wine should be found to contain not less than 10 nor more than 14 per cent. by weight (equivalent to 12.4 to 17.3 per cent. by volume), of absolute alcohol: Take the specific gravity (to four decimals) of a sufficient portion of the red wine at the temperature of 15.6° C. (60° F.), evaporate the wine in a tared capsule to one-third of its original weight, cool, and add water until the liquid measures its original volume at 15.6° C. (60° F.); then take the specific gravity (to four decimals) again. The difference between the two specific gravities, deducted from 1.0000, corresponds to the specific gravity of an alcohol containing the same percentage of absolute alcohol, by weight or volume, as the wine under examination, the corresponding percentage being ascertained by referring to the alcoholometric tables."—*U. S.*

On the gradual addition of ammonia the red color of wine is changed to purple, blue-green, and is destroyed, with the production of a brown tint. Many other organic coloring matters have a similar behavior, while others are changed to purple (cochineal, logwood). The precipitate produced by lead subacetate is dingy gray, with a blue or green tint; the age of the wine and the presence of tannin and other constituents influence the shade of the color. Other organic coloring matters are precipitated by the same reagent red

(Brazil-wood), green (elderberries), or blue (logwood). Similar shades of color are produced upon white filtering-paper which has been steeped in a solution of lead acetate. According to Andrée (1880), the coloring matter of huckleberries is identical with that of wine, and in order to detect the addition of the juice of these berries it is necessary to show the presence of citric acid. (See VINUM ALBUM.)

Pastrovich (1882) again recommends manganese dioxide, which was originally suggested by Facen (1870), and states that, after repeated agitation with the oxide, after fifteen minutes genuine red wine, also wine colored with huckleberries, elderberries, or cochineal, becomes nearly colorless, while the color of Brazil-wood, logwood, and orchil changes to brownish-yellow, and that of the fuchsine remains unaltered. Wine containing only .002 Gm. of fuchsine to the liter, treated in this manner, yields a rose-colored filtrate.

Action and Uses.—(The action of the alcoholic elements of wine has been treated of under ALCOHOL and VINUM ALBUM.) The essential difference between red and white wines consists in the presence of tannic acid in the former, which is derived from the crushing of the skins of purple grapes in the process of manufacturing wine. This ingredient is most abundant in port and heavy Bordeaux wines, and hence they and the other wines that resemble them, including several American varieties, differ from white wines in the relative slowness of their absorption from the stomach, and consequently in their less prompt production of intoxication. Moreover, from the same cause they act less injuriously upon the coats of the stomach. Red wines, in general, have relatively more of the tonic and less of the excitant properties possessed by white wines, and are especially to be preferred to the latter when a sustained instead of a transient stimulation is desired, and when, in addition to this, an astringent action is intended. Hence the red wines are eminently the wines of convalescence, and are of general use in all cases of excessive discharges of blood, pus, etc. in which they are not contraindicated by other reasons. Unfortunately, red wines are more generally adulterated or factitious than white wines, with the exception of sherry. In an English manual for wine-dealers it is said: "To keep wine from turning sour put in the casks 2 pounds 3 ounces of small shot." And, as if this were not villainous enough, it proceeds: "In extreme cases, when all previous recipes have been tried without any satisfactory result, take a pinch of oxalic acid and put it into the bottle" (*Brit. and For. Med.-Chir. Rev.*, Apr. 1858, p. 324). Red wines are often manufactured out of alcoholic dilutions colored by logwood, rhatany, beets, litmus, etc. Astringency is given them by means of alum, oak- or willow-bark, etc., as is elsewhere more particularly described.

The more astringent red wines are used for injecting *hydroceles*, the *vagina*, *urethra*, etc. affected with chronic profluvia, *fistulous sinuses*, etc. But the various astringent tinctures would answer equally well.

VIOLA TRICOLOR.—VIOLA TRICOLOR.

Herba violæ tricoloris, P. G.; *Herba jaceæ.—Pansy*, *Heart'sease*, E.; *Pensée sauvage*, F. Cod.; *Stiefmütterchen*, *Freisamkraut*, *Dreifaltigkeitskraut*, G.; *Trinitaria*, Sp.

The wild-grown flowering herb of Viola tricolor, *Linné*.

Nat. Ord.—Violaceæ.

Origin.—The violets are mostly perennial, or rarely annual or biennial, herbs, with alternate stipulate leaves, and with axillary flowers having five persistent auriculate sepals, five somewhat unequal petals, of which the lower one is saccate or spurred, five strongly connivent stamens, of which the two lower ones bear a spurred nectary upon the back, and one superior pistil with three placentas, ripening into a three-valved, many-seeded capsule; the globular or ovate seeds have a small caruncle and hard testa, and contain a straight embryo imbedded in fleshy albumen. The species official in the Pharmacopœia of 1880 is an annual or biennial indigenous to Europe and Northern Asia, naturalized in the United States, and frequently cultivated in many varieties as an ornamental plant. Only the wild-grown plant is to be collected.

Description.—Pansy has a thin, spindle-shaped root and an erect or ascending angular and branching, nearly smoooth stem, 10–20 Cm. (4 to 8 inches) high. The leaves vary between roundish-cordate and oval, crenate and nearly entire, are about 25 Mm. (1 inch) long, petiolate, and have prominent, leaf-like, lyrately-pinnatifid stipules. The flowers are on long peduncles, and have the corolla partly yellowish, blue, and purple, or occasionally variegated and longer than the calyx (variety vulgaris, *Koch*), or the corolla scarcely exceeds the calyx, and is yellowish or occasionally partly purplish (var. arvensis,

Murray). The last form is the only one recognized by the French Codex; it is frequent in sandy fields of North America, and apparently indigenous. The dry herb is inodorous and has a bitterish, mucilaginous, and slightly acrid taste, the acridity residing mainly in the root.

Constituents.—Boullay (1824) found in the herb a yellow coloring matter and much mucilage, but no violine; Cuseran (1847), in addition to these, sugar, bitter principle, resin, and potassium nitrate. Mandelin (1879) detected free *salicylic acid* in this plant, and subsequently (1881) determined it to amount to .1068 per cent. in the wild-grown, air-dry plant of the variety arvensis, while other varieties contained less, and the cultivated plant only .043 per cent. The acid is obtained by agitating the aqueous solution of the alcoholic extract with ether; the petals contain a minute quantity, the seeds a mere trace, of the acid. A salt of salicylic acid could not be found. Mandelin examined also the yellow coloring matter, which is the glucoside *violaquercitrin*, yielding with dilute acids 3 molecules of sugar and 1 of quercetin, besides a fluorescing compound.

Allied Species.—Viola pedata, *Linné*, Bird's foot violet. The leaves and rhizome were formerly official. It grows in sandy soil from the New England States southward, and westward to the Mississippi. It has a short, erect, and truncate rhizome, about 25 Mm. (1 inch) long and nearly as thick, and beset with slender rootlets. The leaves are radical, smooth, pedately five- or seven-parted, and have the divisions linear or narrowly spatulate, and occasionally slightly toothed at the apex. The flowers are large, about 25 Mm. (1 inch) broad, beardless, vary in color between light-blue and dark-purple, and have a very faint violet color, which is observable only with a large number of flowers. The leaves and flowers have a mucilaginous and sweet taste; the taste of the rhizome is mucilaginous, bitter, and somewhat acrid. The plant flowers in May, and frequently a second time in August and September.

Viola cucullata, *Aiton*, is the common blue violet of North America, growing in meadows and in dry grassy places and open woods. The rhizome is spreading, forms compact masses, and is covered with numerous short fleshy branches. The leaves are very variable, heart-shaped at the base, with the basal lobes rolled up. The flowers are somewhat bearded, light- or dark-blue, violet-colored, or variegated. The variety V. palmata has the later leaves palmately lobed.

Viola odorata, *Linné* (Bentley and Trimen, *Med. Plants*, 25).—Sweet-scented violet, *E.*: Violette odorante, *Fr. Cod.*: Märzveilchen, *G.*: Violeta, *Sp.*—It is indigenous to Europe and Northern Asia, is frequently cultivated, and grows to a certain extent spontaneously in various parts of North America. It has an oblique rhizome and produces long, filiform runners. The leaves are reniform or heart-shaped, obtuse, and crenate. The flowers are dark-blue or sometimes whitish, bearded, and have a very agreeable odor. For pharmaceutical purposes the dark-blue flowers alone are collected, deprived of the calyx, and only the corolla is used in the fresh state for preparing

Syrupus violæ odoratæ, *P. Cod.* Fresh violet-petals 10 parts, boiling water 20 parts; in 21 parts of the infusion dissolve 38 parts of sugar.

The rhizomes of the perennial, and more particularly the acaulescent, violets appear to contain *violine*, which Boullay (1828) obtained from all parts of the sweet-scented violet, but in largest quantity from the rhizome. It is prepared by removing from the alcoholic extract chlorophyll and fat by means of ether, boiling the residue with diluted sulphuric acid, adding to the filtrate lead oxide, evaporating, and exhausting the residue with strong alcohol. Violine is a yellowish, bitter, and fusible powder, which is more readily soluble in water than emetine, but less so in alcohol; is insoluble in ether, and appears to combine with acids to not well-defined saline compounds. It merits further investigation. The blue coloring matter of violets turns green, and afterward yellow, with alkalies.

Anchietea salutaris, *Saint-Hilaire*, s. Noisettia pyrifolia, *Martius*. The root of this shrub, which is indigenous to Brazil, is used as a cathartic and emetic. It is about the thickness of a finger, is brownish-red, and has a yellowish, nauseous, and bitter bark, covering the hard brownish wood. Peckolt (1859) found in the root starch, sugar, gum, tannin, a little resin, and about $\frac{2}{5}$ per cent. of *anchietine*, which forms crystallizable salts, crystallizes in straw-colored needles, is insoluble in ether, sparingly soluble in water, and freely soluble in alcohol, and acquires with sulphuric acid a violet color, turning black. Anchietea salutaris is believed in Brazil to be useful in *syphilis* and *skin affections*, probably upon the ground of its provoking salivation. It has been administered in powder and in tincture.

Uses.—Very little is known of the special medicinal virtues of the formerly officinal violet, V. pedata, but, as far as can be judged, it did not differ much in its qualities from the European species, which have long been used in medicine. Sweet violets (V. odorata) were anciently held to be refrigerant and astringent in "ardor of the stomach," inflammation of the eyes, and prolapse of the anus and of the uterus, and also to restrain suppuration. By the Arabians they were employed in coughs and affections of the kidneys and of the liver, and, when prepared with sugar, as a laxative. The syrup of vio-

lets, which to this day is used in France, was directed by the Arabians in pulmonary affections. It was also formerly recommended as a local remedy for *aphthæ;* internally, an infusion of the flowers was given in infantile *convulsions;* and the powder, as well as an infusion of the root, has been used in the same manner as ipecacuanha in the treatment of infantile *dysentery.*

An alkaloid procured from this species is represented to have exhibited the properties of emetine, causing vomiting, purging, and great prostration in dogs, and in man analogous effects in some cases, but not uniformly. The powdered root applied to the denuded skin has sometimes acted as an emeto-cathartic. Similar effects have been obtained from V. canina.

V. tricolor (heart'sease) also produces disturbance of the stomach and bowels, and sometimes diuresis. Its continued use is said to occasion sweating and a pustular eruption of the skin, and to impart to the urine a smell like cat's urine or that of conium. It once had a great popular repute in Europe as a purifier of the blood and as a remedy in chronic *bronchial* and *intestinal catarrh*, in *cutaneous eruptions*, and particularly in *crusta lactea* (eczema infantile). In these affections it was administered in a decoction of milk and applied in fomentations. Cazin (*Traité des Plantes médicinales indigènes de France*, 2ème éd., p. 734) sets forth at length the virtues ascribed to it in the cure of scrofulous and other cutaneous diseases by Bergius, Matthiolus, Bauhin, Boeckler, Strack, Murray, Hufeland, and many others, including the imaginative Hahnemann, and also the denial of their existence by other physicians. A similar history had long before been given by Richter (*Ausführliche Arzneim.*, ii. 235), who concludes it by observing, "After all, viola has no special virtues in these affections; at the best, it can only afford some support to other and more efficient remedies." It had also some repute in constitutional *syphilis.* In Europe the syrup of violets is sometimes employed as a laxative for infants, but its chief use is to give a fine color to mixtures. V. sagittata is a reputed antidote to snake-bites.

VISCUM.—Mistletoe.

Gui de chêne, Gillon, Fr.; *Mistel*, G.; *Visco, Muérdago*, Sp.

Viscum album, *Linné*, and Viscum (Phoradendron, *Nuttall*) flavescens, *Pursh.*

Nat. Ord.—Loranthaceæ.

Origin and Description.—The mistletoes are small parasitic evergreen shrubs, growing mostly upon deciduous-leaved trees, and penetrating with their simple roots through the bark into the wood. Viscum album is indigenous to Europe, and is chiefly found upon apple, pear, plum, and similar trees, but grows also upon poplars, birches, beeches, and others. Viscum flavescens is an American species, growing upon oaks, elms, apples, etc. in the Southern United States and northward to New Jersey, and westward in the Mississippi Valley. Both plants are of a yellowish-green color 15–60 Cm. ($\frac{1}{2}$ to 2 feet) high, much branched, jointed, and have opposite, often scale-like leaves and monœcious or diœcious flowers in small clusters or short spikes. The leaves of the European species are lanceolate or spatulate, obtuse and entire; those of the American plant are obovate or oval. The fruit of both species is a small, whitish, one-seeded berry. The branches are usually collected. They have an unpleasant heavy and rather weak odor and a mucilaginous, sweetish, bitter, and somewhat astringent taste.

Loranthus europæus, *Linné*, is the *viscum quernum* of ancient writers. It is a somewhat larger and thicker shrub, which grows upon oaks and chestnuts in Eastern and Southern Europe, and has a grayish or dark-brown bark and pale-yellow berries.

Constituents.—Mistletoe has been analyzed by Gaspard, Funcke, Winckler, Macaire, and Reinsch. It contains mucilage, sugar, an odorous principle, fixed oil, resin, traces of tannin, and various salts. The most interesting constituent is *viscin*, also called *bird-lime*, or more properly *bird-glue*, from the German name *Vogelleim.* It is insoluble in water, alcohol, and fixed oils, but dissolves in ether and oil of turpentine, and, on evaporating the solvents, remains behind as a yellowish viscous and tenacious mass. It seems to be present in the mistletoe in small proportions, but a larger quantity is formed by a kind of fermentation. The same or a similar compound may be obtained from the inner bark of the European holly, Ilex aquifolium, *Linné*, from the root of Gentiana lutea, *Linné*, and from other plants. It is employed for catching small birds; hence the name *Vogelleim.*

Action and Uses.—The operation of mistletoe is as uncertain as its virtues are doubtful. The berries are reported by some writers (Cazin) to be innocuous, but others state that they are emetic and purgative, and instances are given in which very young children have suffered convulsions, and even death, from eating large quantities of them.

It seems not impossible that these effects may have been due to indigestion alone. It is true that a case is recorded in which after several children had eaten the berries of V. flaveseens they were affected with vomiting, great thirst, tenesmus, and bloody and mucous stools. In one case death ensued in a state of collapse. In Europe, however, the dried young twigs and leaves of mistletoe have long been used in medicine for various nervous affections, including *chorea*, *asthma*, and *spasmodic colic*, but chiefly for *epilepsy*, although sometimes for *hysteria* (Richter, *Ausf. Arzneim.*, ii. 822). Long (*New Preparations*, 1878) "used mistletoe in the forms of infusion, tincture, decoction, and fluid extract in many cases of *menorrhagia* and *post-partum hæmorrhage* with gratifying results." He conceived that it incited the natural rather than the tonic contraction of the uterus. A physician in South Carolina refers to three cases of abortion in negroes produced by this growth (*Med. Record*, xvii. 276). In 1881 it was alleged to act upon the heart like digitalis (Park, *Practitioner*, xxvii. 346). It was formerly given in powder in the *dose* Gm. 0.60–4 (gr. x–lx), or in a decoction made from Gm. 16–64 in Gm. 250 (℥ss–ij in ℥viij) of water, and in tablespoonful doses several times a day.

VITELLUS, *U. S.*—Yolk (Yelk) of Egg.

Ovi vitellus, Br.; *Jaune d'œuf*, Fr.; *Eidotter, Eigelb*, G.; *Yema de huevo*, Sp.

The yolk of the egg of Gallus Bankiva, var. domestica, *Temminck*, s. Phasianus Gallus, *Linné*.

Class Aves; *order* Gallinæ.

Origin.—The domestic fowl originated from the *red jungle-fowl*, G. Bankiva, which inhabits Java and the adjacent islands, Northern India, Cochin China, and the Philippines. At the present time numerous varieties of it are found in all civilized countries. The egg (Ovum *U. S.* 1870, Ovum gallinaceum; Egg, *E.*; Œuf de poule, *Fr.*; Ei, *G.*; Huevo, *Sp.*) consists of the shell and lining membrane 10.7 parts, albumen 60.4 parts, and yelk 28.9 parts (Prout, 1822).

Description and Composition.—1. Testa ovi.—Egg-shell, *E.*; Coquille, *Fr.*; Eierschale, *G.*—It consists, according to Prout, of 97 parts calcium carbonate, 1 part calcium and magnesium phosphates, and 2 parts organic matter. Vauquelin's results were 89.6, 5.7, and 4.7 respectively.

2. Albumen ovi, *Br.*—White of egg, *E.*; Blanc d'œuf, *Fr.*; Eiweiss, *G.*; Clara de huevo, *Sp.*—It consists of two or three laminæ, the total average weight being 23.01 Gm. (Lehmann), or 24.8 Gm. (Poleck), and contains 82 to 88 per cent. of water, and on the average 13.32 of solid constituents, including 0.65 of ash, as well as minute traces of fat, sugar, and extractive. The ash of the egg albumen consists of 42 per cent. of potassium chloride, 9 of sodium chloride, 12 of carbonic acid, the remainder being phosphates and sulphates of the alkalies, silica, iron, lime, and magnesia. The organic portion of the white, the *albumen* proper, is a protein compound; the average elementary composition is 53.7 C, 15.5 N, 7.1 H, 22.1 O, and 1.6 S. Its aqueous solution rotates the plane of polarized light to the left, and may be evaporated in thin layers below 50° C. (122° F.) without change, but on being heated to near 75° C. (176° F.) it is coagulated and becomes insoluble in water. Albumen is precipitated from its solutions by most mineral and by some organic acids, but not by phosphoric or acetic acid. It is soluble in caustic alkalies, and precipitates the salts of most heavy metals, hence its value in cases of poisoning by salts of mercury, copper, etc. Albumen is also precipitated by volatile oils, camphor, phenol, and by tannin, the last precipitate being soluble in an aqueous solution of tannin. Alcohol coagulates albumen, and ether precipitates it, the precipitate being only partially soluble in water. Farsky (1878) succeeded in obtaining what appears to be a definite compound of salicylic acid with albumen, by stirring the two together for some time, washing with ether and hot water, and drying in an air-bath at about 120° C. (248° F.); it was found to contain 14.16 per cent. of salicylic acid and 85.84 of albumen, and to be as easily digestible as the uncombined albumen. When boiled with *Millon's reagent* the precipitate as well as the liquid turns red, and albumen cautiously heated with strong hydrochloric acid is colored violet-blue. Other protein compounds show a like behavior.

Albumen ovi siccum, P. G.—The dried egg-albumen is either in translucent, horny masses, similar in appearance to acacia, or in a yellowish powder, which is inodorous and tasteless, and forms with water a turbid, neutral solution, but is insoluble in alcohol and ether. 5 Cc. of an aqueous solution (1 to 1000) to which 10 drops of nitric acid have been added should yield when warmed a copious precipitate of coagulated albumen. If to 10 Cc. of the aqueous solution (1 to 100) 5 Cc. of solution of carbolic acid, and then

5 drops of nitric acid, be added and well shaken, the mixture should yield a clear filtrate. If 5 Cc. of alcohol be added to an equal volume of this filtrate, so that they form two layers, a milkiness should not make its appearance at the line of contact; 5 Cc. of the foregoing filtrate should not be colored red, but only yellow, with 1 Cc. of solution of iodine.—*P. G.*

3. Vitellus ovi.—The yolk is a viscid yellow or reddish-yellow opaque liquid, which is without odor, has a bland taste, an alkaline reaction, and must be regarded as a dense emulsion consisting of oil suspended in water by means of albumen. When triturated with water a whitish emulsion is obtained; the addition of alcohol causes it to coagulate, and when agitated with ether it separates a white mass and yields to ether an orange-yellow fat. Yolk is coagulated by heat. It contains 48 to 55 per cent. of water, 16 to 18 per cent. of *vitellin* (which is probably a proteid closely related to casein, and mixed with about one-fourth of albumen), 29 to 31 per cent. of fat (21.3 parts of which are olein and margarin, according to Gubley), 1.5 per cent. inorganic salts, coloring matter, a small portion of sugar, and 0.42 of cholesterin. Gubley has separated from the ethereal extract of yolk a substance which he named *lecithin*, and which on boiling with baryta yields *neurine* and stearic and *phosphoglyceric acids*. The fat obtained by expressing the coagulated yolk or by exhausting it with ether is occasionally used under the designation of *oleum ovi* (Oil of eggs, *E.*; Huile d'œufs, *Fr.*; Eieröl, *G.*).

Preservation.—Eggs may be preserved for a considerable length of time by covering the shell with a substance impervious to water, thus closing the pores so as to exclude the air. This may be done by wax, fat, paraffin, gum, or by similar substances. Packing them with the small end downward in dry salt, milk of lime, etc. has likewise been recommended.

Pharmaceutical Uses.—The white of egg is used for the clarification of syrups, honey, and other liquids. The yolk is employed for emulsionizing fixed and volatile oils and camphors.

Action and Uses.—*Egg-shells* were long used for the various purposes to which chalk is now applied internally. Like crabs' eyes and claws, corals, and oyster-shells, which were formerly employed, they contain a certain proportion of animal matter which mitigates the action of the calcareous constituent. They were an ingredient of a secret remedy for *gravel*, for a knowledge of which the British Parliament paid an extravagant sum of money. The *white of egg* forms with solutions of corrosive sublimate and of copper sulphate compounds which are nearly insoluble, and hence it has been used in *poisoning* with these salts, first to neutralize and then to evacuate them. Its demulcent and protective action is also advantageous. It is applied to the treatment of *burns* and *erysipelas*, either alone or emulsified with oil, or coagulated by alum in the form of alum curd. The latter is an excellent application in acute *conjunctivitis*. Diluted with water, sweetened, and flavored, fresh egg albumen forms an agreeable and useful drink in numerous cases of *gastro-intestinal* inflammation and irritation. Albumen is sometimes used as a substitute for starch in the application of fixed *bandages*. The *yolk of egg* is more nutritious and digestible than the white, and is habitually employed whenever it is desired to give the largest amount of nutriment in a small bulk and in the most digestible form. The yolk of a hard boiled fresh egg readily crumbles, and is therefore easily acted upon by the gastric juice. The fresh yolk, beaten with sugar and mixed with hot water, and with the addition of a little brandy and nutmeg or cloves, forms a customary draught at the commencement of catarrhal and rheumatic (muscular) affections. It is used also to make emulsions for the administration of castor oil, cod-liver oil, oil of turpentine, etc., either by the mouth or the rectum. Externally, it is sometimes, and very usefully, employed as a dressing for *burns*, *scalds*, *abrasions*, etc., and to soften the crusts of *cutaneous eruptions*, *cerumen* in the auditory canal, etc.

WINTERA.—Winter's Bark.

Cortex winteranus.—*Écorce de Winter*, F. Cod.; *Cannelle de Magellan*, Fr.; *Winter's Zimmt*, G.; *Corteza winterana*, Sp.

The bark of Drimys Winteri, *Forster*, s. Wintera aromatica, *Murray*.

Nat. Ord.—Magnoliaceæ, Winteræ.

Origin.—Drimys Winteri is a small tree growing in the western part of South America from the Straits of Magellan northward to Mexico. It has coriaceous, oblong and obtuse or lance-oblong, dark-green, and on the lower side pale bluish-green, entire leaves, axillary clusters of whitish flowers, and about four or eight black obovate berries

containing three or four seeds. D. mexicana, *Sessé*, s. Chilensis, *De Candolle*, and D. granatensis, *Linné filius*, are now regarded as varieties, and the last one is mentioned by the French Codex as the present source of the drug.

Description.—Winter's bark is curved or in quills, between 5 and 8 Mm. ($\frac{1}{5}$ and $\frac{1}{3}$ inch) thick, externally of a gray or whitish color with brown patches, and underneath the corky layer brown. The inner surface is brown, and marked with longitudinal ridges from the prominent bast-fibres. The bark breaks with a short fracture, and has a peculiar odor and a warm and very pungent taste. The transverse section is of a brown-red color, mottled with whitish sclerenchyma, which in the primary bark underneath the thin corky layer forms transversely-elongated groups, and in the bast-layer is seen partly in groups, partly in long radial lines; resin-cells are scattered in the outer and inner tissue.

Substitutions.—The Winter's bark of commerce has usually been an entirely different bark, occasionally that of Canella alba, *Linné*, but more frequently obtained from Cinnamodendron corticosum, *Miers* (see page 392).

Constituents.—The principal constituents of Winter's bark, as ascertained by Henry (1820), are 1.2 per cent. of volatile oil, about 10 per cent. of pungent resin, and 9 per cent. of tannin, with extractive matter and a little starch.

Allied Species.—The Australian species, Drimys axillaris, *Forster*, and D. lanceolata (Tasmania aromatica, *R. Brown*), have likewise pungently aromatic barks, and the fruit of the latter is used like pepper.

Action and Uses.—The action and uses of Winter's bark resemble those of cascarilla and canella. It is a warm tonic of the digestive organs, increasing the appetite and improving the digestion, especially when deranged by *flatulence* and *colic*. The *dose* of the powder is Gm. 2 (gr. xxx), and a vinous infusion may be prepared by displacement with Gm. 30 (℥j) of the bark to Gm. 360 (℥xij) of sherry wine.

XANTHORRHIZA.—Yellow-root.

The rhizome and root of Xanthorrhiza apiifolia, *L'Héritier*. Bentley and Trimen, *Med. Plants*, 9.

Nat. Ord.—Ranunculaceæ.

Origin.—This plant is also known as *shrub yellow-root* to distinguish it from Hydrastis canadensis. Xanthorrhiza is a shrub 30–60 Cm. (1 to 2 feet) high, growing in shady places near streams in New York and from the mountains in Pennsylvania southward to the Gulf of Mexico. The clustered stems are thin, of a grayish color externally, smooth, and annulate from the distant leaf-scars. The leaves are alternate, crowded at the ends of the branches, long-petiolate, pinnate, and have three or five ovate or lanceolate, cleft, and toothed leaflets, with wedge-shaped bases. The flowers are polygamous and in compound drooping racemes, appearing in early spring.

Description.—Yellow-root consists of a much-branched and bent rhizome several feet long. The thicker portions are about 12 Mm. ($\frac{1}{2}$ inch) in diameter, the branches thinner, some being only 1.5 Mm. ($\frac{1}{16}$ inch) thick, longitudinally wrinkled, of a light yellowish-brown color externally, and rather sparingly beset with brittle rootlets. The bark is thin, internally of a deep-yellow color, and separates readily from the bright-yellow, tough wood, which is radially striate by medullary rays and encloses a thin central pith. The rhizome breaks with a short fibrous fracture, is inodorous, and has a bitter taste, which is more marked in the cortical portion. Portions of the stems, having a larger brownish pith and yellow wood, are often present.

Constituents.—Perrins (1862) showed that yellow-root contains berberine; he obtained only 7½ grains of the nitrate from 1 pound of the drug. About the same time W. M. Merrill made a similar observation. Whether berberine is associated with a white alkaloid, as is frequently the case, has not been determined. The parenchyma contains starch. The other constituents of the drug are not known.

Uses.—Yellow-root has long been known as an indigenous *tonic* medicine, and compared either to quassia or columbo. It may be given in decoction, tincture, or powder. Of the last the *dose* is said to be Gm. 2.60 (gr. xl).

XANTHOXYLUM, *U. S.*—Prickly Ash.

Toothache tree, Angelica tree, Suterberry, E.; *Clavalier, Frêne épineux*, Fr.; *Zahnwehrinde, Zahnwehholz*, G.

The bark of Xanthoxylum americanum, *Miller*, s. X. fraxineum, *Willdenow*, and of Xanthoxylum clava-herculis, *Linné*.

Nat. Ord.—Rutaceæ, Xanthoxyleæ.

Origin.—Both species of prickly ash are indigenous to North America, and have pinnate leaves and dioecious, tetramerous or pentamerous flowers, the pistillate ones containing from three to five free ovaries, which produce thick and fleshy two-valved and one- or two-seeded capsules.

X. AMERICANUM grows in rocky woodlands and on river-banks from Canada southward to Virginia and North Carolina. It is shrubby, and attains a height of 3–3.6 M. (10 or 12 feet). The leaves have nine or eleven ovate-oblong, nearly sessile, somewhat serrulate, and on the lower surface downy, leaflets. The small greenish flowers are in umbellate, axillary clusters, appear in April before the leaves, and are destitute of a calyx. The capsules are roundish, red, and contain black, shining seeds.

X. CLAVA-HERCULIS is found near the coast from Virginia southward to Florida and westward to Texas and in the West Indies. It is a small tree, but sometimes grows to the height of 9–12 M. (30 or 40 feet). Its leaves have from seven to eleven ovate-lanceolate, crenate-serrulate, unequal-sided, and shining leaflets, the terminal one alone being equilateral. The numerous greenish flowers are in terminal cymes, appear in June after the leaves, and contain three pistils.

Description.—NORTHERN PRICKLY-ASH BARK is in small, curved, or quilled fragments, about 5 Cm. (2 inches) or less long, mostly about 1 Mm. ($\frac{1}{25}$ inch) thick, and occasionally mixed with pieces nearly 3 Mm. ($\frac{1}{8}$ inch) thick. The corky layer is very thin, of a brown-gray color, nearly smooth or faintly furrowed longitudinally, occasionally superficially fissured transversely, and marked with some scattered warts, becoming transversely elongated. Irregular whitish patches are usually observed on the surface of the bark, and numerous minute, black, and shining hemispherical dots, which are the perithecia of a lichen, probably a species of *Verrucaria*. The brown, glossy spines are not numerous, but are about 6 Mm. ($\frac{1}{4}$ inch) long, straight, two-edged, and have a narrow linear base about 18 Mm. ($\frac{3}{4}$ inch) long. The outer bark underneath the corky layer is of a green color, and the inner bark whitish or yellowish. The inner surface is smooth, or finely striate if obtained from older branches. The bark is quite brittle, breaks with a short, non-fibrous fracture, and exhibits upon transverse section a somewhat tangential arrangement of the tissue. It is inodorous, and has a slightly aromatic, bitterish, and strongly pungent taste.

SOUTHERN PRICKLY-ASH BARK resembles the preceding, except that it is about 2 Mm. ($\frac{1}{12}$ inch) thick, and bears on its surface many conical corky projections, which are 1–2 Cm. ($\frac{2}{3}$ to $\frac{4}{5}$ inch) high, and have an oblong or roundish base 25 Mm. (1 inch) or more in length. Sometimes a number of these cones are crowded together. The stout brown spines are situated upon elevated corky bases.

Substitution.—The bark of Aralia spinosa, *Linné*, which plant is known by the same common names as the two species of Xanthoxylum, is sometimes collected in place of the bark of the latter. Aralia-bark is described on p. 274.

Allied Species.—XANTHOXYLUM FLORIDANUM, *Nuttall*, is known as *satin-wood*, and considered to be identical with X. caribæum, *Lamarck*.

X. PTEROTA, *Kunth*, grows from Florida and Texas to Brazil. The wood is yellow, dense, and very hard; the bark and leaves are pungent.

X. ALATUM, *Roxburgh*, of Northern India, X. PIPERITUM, *De Candolle*, a native of Japan, and several other species, yield pungently aromatic fruits which are employed as condiments in the East. The bark, leaves, and fruits of most species are pungent or acrid.

Constituents.—Prickly-ash bark was examined by Dr. Staples (1829), who obtained from it a little volatile oil, a green-colored fixed oil, resin, and other common vegetable principles, and a crystalline body which he named *xanthoxylin*, but the nature of which was not further characterized. The bitter principle of the bark of X. clava-herculis was isolated by Chevallier and Pelletan (1827), and designated as *xanthopicrin*, but was found by Perrins (1863) to be identical with *berberine*. G. H. Colton (1880) examined southern prickly ash, and obtained an alkaloid which seems to differ from berberine; it is yellowish, bitter, soluble in alcohol and water, insoluble in benzin, ether, and chloroform, and becomes purplish-brown with sulphuric acid, and bright-red, changing to yellow, with nitric acid. Colton obtained also a trace of volatile oil, sugar, resins, a colorless and tasteless crystalline principle, and 12.4 per cent. of ash, of which 20 per cent. was soluble in water, the remainder in hydrochloric acid. Prof. Lloyd (1876) isolated from northern prickly ash a crystalline substance which is probably identical with the one previously mentioned; it is insoluble in water, soluble in boiling alcohol, is turned yellow by nitric acid, and dissolves with a deep-red color in sulphuric acid.

The fruit of X. piperitum was examined by Stenhouse (1854, 1857). On being distilled with water volatile oil is obtained, which on exposure to cold yields crystals of *xanthoxylin*, $C_{20}H_{24}O_8$. It melts at 80° C. (176° F.), has a slight odor and aromatic taste, and a neutral reaction. The liquid portion of the volatile oil is *xanthoxylene*, $C_{20}H_{16}$, is colorless, has a strong, agreeable odor, boils at 162° C. (324° F.), and yields with hydrochloric acid a liquid compound.

Action and Uses.—Xanthoxylum appears to be an arterial and nervous stimulant, which displays its virtues in producing diaphoresis, expelling *flatus*, and allaying muscular *rheumatic* pains. Locally it is an acrid irritant, and hence has been much used as a sialagogue. Its infusion may be applied on compresses or otherwise for producing revulsion. These qualities have caused it to be compared with mezereon, and, like it, to be used as a remedy for chronic constitutional *syphilis*. It has also been employed as an *emmenagogue*, like other acrid stimulants; and doubtless, like them, it will promote the *secretion of milk* when applied to the mammæ under appropriate circumstances. A decoction may be prepared by boiling Gm. 32 in Gm. 1500 (℥j in Oiij reduced to Oij). About a pint should be taken, in divided doses, within twenty-four hours. A saturated tincture may be used in the dose of Gm. 0.60 (gtt. x).

X. Naranjillo has attracted notice from its being sialagogue, sudorific, and diuretic, like jaborandi.

X. caribæum furnishes an alkaloid of which 5 Mgm. injected in watery solution beneath the skin of a frog produced rapid paralysis, followed by death in about half an hour, and similar effects were observed in rabbits and guinea-pigs (*Amer. Jour. Phar.*, lvi. 579).

XYLENUM.—Xylene.

Xylol, *Xyline*, Fr.; *Xylol*, G.

Formula $C_6H_4(CH_3)_2 = C_8H_{10}$. Molecular weight 105.76.

Origin and Preparation.—Xylene was discovered by Cahours (1850) in crude wood-spirit, and was subsequently found by Völckel (1853) in wood-tar (see Pix Liquida), and by Church (1855) in coal-tar. It is obtained from the oily liquid separating from diluted crude wood-spirit and from the light oil of wood-tar or coal-tar by treating these liquids first with sulphuric acid, and afterward subjecting them to fractional distillation, collecting only that portion which distils between 136° and 141° C. (277°–286° F.). It may also be prepared artificially from several benzene derivatives.

Properties.—Xylene is a thin, colorless, oily liquid, resembling benzene in odor, has a burning taste, and is insoluble in water, but dissolves readily in alcohol. It is *dimethylbenzene*, $C_6H_4(CH_3)_2$, and there are three modifications of it, two of which boil at 137° C. (278.6° F.), while orthoxylene boils at 141° C. (285.8° F.). The boiling-point of the isomeric *ethylbenzene*, $C_6H_5.C_2H_5$, is 134° C. (273.2° F.). Xylene unites with sulphuric acid to *xylene-sulphonic acid*, the barium salt of which crystallizes from hot water in transparent scales (Church). On treating xylene with cold concentrated nitric acid, *nitroxylene* is obtained as an oily liquid having a less agreeable odor than nitrobenzene. By oxidation xylene is converted into *toluic acid*, $C_8H_8O_2$, and *phthalic acid*, $C_8H_6O_4$.

Action and Uses.—The only purpose for which xylene appears to have been employed in medicine is to moderate the angina and eruption in the throat and to diminish the fetid exhalation from this part and from the skin in *small-pox*. Although given internally, it is said to coagulate and harden the contents of the pustules, and thereby lessen their tendency to ulceration and pitting. It seems to have been efficient, when applied to the throat in a gargle, spray, or wash, in lessening the swelling and difficulty of swallowing, and destroying the fetor when used upon the skin in a similar manner. It may also be given suspended in mucilage and syrup. The *dose* for an adult is stated to be Gm. 0.60–1 (gtt. x–xv), and for children Gm. 0.15–0.20 (gtt. iij–iv), but its topical application is to be preferred.

ZEA, *U. S.*—Zea; Corn-silk.

Stigmata maydis.—Filament de maïs, Fr.; *Maispistille*, G.

The styles and stigmas of Zea Mays. *Linné*. Bentley and Trimen, *Med. Plants*, 296. *Nat. Ord.*—Gramineæ.

Origin.—Indian corn or corn is a grass growing to the height of 1–6 M. (40 inches to 20 feet), with a solid stem from 1.3–8 Cm. (½ to 3 inches) in thickness. The stem terminates by the male inflorescence, while the female inflorescence is in the axil of the

leaves. The fruit is a caryopsis placed in eight or twenty-two lines on a thick cylindrical receptacle which is enclosed by bracts, which are similar to the leaves of the plant. The plant is very likely indigenous to tropical America, but was cultivated in America from before the Spaniards landed on these shores, so that at the present time the plant is not known in the wild state. Cultivation extends in America from 54° N. lat. to 40° S. lat., and in Europe to 52° N. lat. as long as the summer temperature amounts to 18° C. Around Lake Titicaca, in South America, 16° S. lat., Zea mays grows at an altitude of 3900 M. (12,795 feet) above the sea-level.

Description.—The caryopsis is roundish in shape, but by being placed closely on the receptacle is more or less compressed laterally, so that the sides are angular and the top only is rounded, and variable in size and color. The fruit consists of the embryo, placed at one side close to the funiculus, and albumen (endosperm) makes up the remainder of the fruit, which is covered by two seed-coats. On the side of the ripe caryopsis, just above the embryo, is noticed a slight protuberance which is the insertion of the style. This with the stigma is the official drug. It is filiform, about 15 Cm. (5.9 inches) long and 0.5 Mm. ($\frac{1}{50}$ inch) broad, yellowish or grayish in color, soft silky, finely hairy, and delicately veined longitudinally. It is without odor and has a sweetish taste.

Constituents.—Zea contains, according to Willan (1884), fixed oil, resin, tannin, sugar (in green but not in dried corn-silk), and on distillation with potassium hydroxide an alkaline liquid yielding crystals with acetic acid and precipitates with iodine and Mayer's reagent. Rademacher and Fischer (1886) isolated an acid which was called *maizenic acid* by them, decomposes alkaline carbonates, and forms crystallizable salts. The fixed oil is light-yellow in color, readily saponifies with potassium hydroxide, and solidifies at 10° C. (50° F.).

Ustilago (Uredo, *De Candolle*) Maydis, *Leveillé* (nat. ord. Fungi, Ustilagineæ). Cornsmut, Corn-ergot, *E.*; Ergot de maïs, *Fr.*; Maisbrand, Beulenbrand, *G.*; Rizon de maíz, *Sp.*—The numerous species of the genus Ustilago (smuts) grow upon living plants, the tissue of which is penetrated by the mycelium. The spores are produced in the hyphæ or their branches, which gradually form a gelatinous mass, and this is subsequently resorbed, so that finally the isolated spores remain behind. These are of a black or brown color, consist of a single cell, and have the outer membranes or exosporium either smooth or variously marked. Cornsmut forms irregular globose masses, which are somewhat lobed or obtusely branched, and sometimes 15 Cm. (6 inches) or more thick. The smooth or gelatinous membrane forming the covering of the fungus is diaphanous, and shows a blackish tint from the enclosed spores. Enclosed by this membrane is found a blackish-brown or brownish-black powder, consisting of innumerable spores, which are globular or oval, and when observed under the microscope have a nodular or spiny appearance, from the projections of the exosporium. Cornsmut has a peculiar rather heavy odor and an unpleasant taste. It should be preserved in a dry place, and should be kept on hand not longer than a year. C. H. Cressler (1881) showed the presence of a volatile base, which is probably identical with *trimethylamine*, and a sugar which crystallizes in needles, is very sweet, and does not reduce Trommer's test-solution; it is probably *mycose*; fixed oil, resin, and gummy matter were likewise obtained. Examined by J. H. Hahn (1881) and H. B. Parsons (1882), air-dry cornsmut yielded 9 to 10 per cent. of moisture, 2.5 to 4.2 per cent. of ether extract, and 4 to 5.5 per cent of ash. Alcohol takes up about 10 per cent., and water about 6.6 per cent., of soluble matter, from the latter of which Prof. Parsons obtained 5.5 per cent. of an acid compound which is probably identical with sclerotic acid, and is prepared by the same process (see p, 617).

Action and Uses.—Several cereals are subject to diseases which form products resembling ergot in their action. In 1870, Haselbach related that on several occasions cows had calved prematurely from having eaten maize affected with smut (Husemann, *Arch. f. Pathol. u. Pharmakol.*, ix. 276). In 1877, Estachy published the note of a case in which he successfully made use of smutted maize to revive suspended *labor-pains*. Afterward he employed it with advantage in the treatment of *hæmoptysis*, *seminal pollutions*, and *post-partum hæmorrhages* (*Bull. de Thérap.*, xciv. 85). From a series of experiments with it, Dr. James Mitchell (*Inaug. Thesis*, Univ. of Penna., 1883) concluded that it destroys consciousness, paralyzes first the sensory portion of the spinal cord, and, after depressing, paralyzes also the motor centres of the cord and motor nerves, and that probably the sensory nerves share in the general paralysis. Dr. Dorland states that the action of ustilago on the gravid uterus differs from that of ergot of rye, in producing clonic rather than tonic contraction of the organ during *labor*, and therefore in being safer than the latter agent. He has published several cases illustrating this statement (*Med. News*, li. 534). Others are due to Blair. The oxytocic virtues of the fluid extract have also been illustrated by Swiecicki (*Centralb. f. Med.*, vi. 628).

The *stigmata* of *maize*, or "corn silk," have for a long time had a popular reputation

in the south of France as a remedy for *strangury* and *calculous affections*, and they have also been held to possess anodyne virtues (*Bull. de Thér.*, xcvii. 377). In 1879, Dufau described this product as actively *diuretic* in cardiac and renal *dropsy*, and stated that the best effects followed its use in cases of *uric* and *phosphatic gravel*, *pyelitis*, *retention* and *incontinence of urine*, and *vesical catarrh* (*Med. Record*, xvi. 252). The diuretic action of the medicine in *cardiac dropsy* has been confirmed by Dupont (*Gaz. Méd. de Paris*, No. 9, 1884) and C. Paul (*Lancet*, Oct. 1885, p. 798). These statements have been confirmed and extended by various others, including Landrieux, who insists strongly on the diuretic action of the medicine (*Practitioner*, xxiv. 453; xxv. 379), Busey (*Med. Record*, xix. 319), Ducasse (*Amer. Jour. of Med. Sci.*, April, 1883, p. 565), and Stuver (*Med. News*, xliii. 372). It appears to be more suitable in chronic than in acute disorders of the urinary organs. According to Vauthier, maizenic acid is the active principle of the stigmata. It is recommended in *doses* of ⅛ grain. An extract of stigmata has been given in syrup to the extent of Gm. 1.30–2 (gr. xx–xxx) a day. The best preparation of maize silk appears to be the fresh infusion in the dose of a wine-glassful, and next to it the fluid extract in doses of Gm. 2–4 (f℥ss–℥ij).

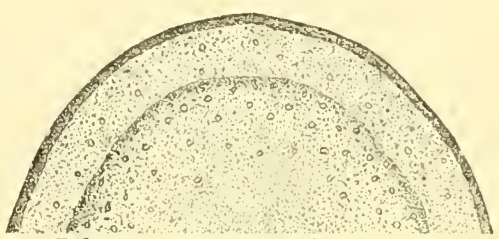
ZEDOARIA.—Zedoary.

Rhizoma (*Radix*) *zedoariæ*, P. A., P. G.—*Zédoaire longue*, Fr.; *Zittwerwurzel*, G.

The rhizome of Curcuma (Amomum, *Willdenow*) Zedoaria, *Roscoe*, s. Curcuma (Amomum, *Koenig*) Zerumbet, *Roxburgh*.

Nat. Ord.—Scitamineæ (Zingiberaceæ).

Fig. 315.



Zedoary: transverse section of one half of rhizome.

Origin.—The zedoary-plant is indigenous to India and some of the East Indian islands, has long dark-green leaves with a large purple spot in the centre, and produces a short scape bearing a raceme of yellow flowers. The tuberous ovate or pear-shaped rhizome is about 4 or 5 Cm. (1½–2 inches) long, and is usually cut into transverse sections before drying, sometimes in longitudinal slices.

Description.—Zedoary is met with in the market in the form of nearly circular disks, varying in diameter from 1 to 4 Cm. (½–1½ inches) and in thickness from 4 to 10 Mm. (⅙–⅔ inch). It is externally of a grayish-brown color, upon the transverse surface grayish, and has near the edge a dark-colored circular endoderm. The central portion contains a large number of small orange-colored resin-cells and irregularly scattered wood-bundles; both are seen also outside of the nucleus-sheaths, though in smaller number. The disk breaks with a short mealy or somewhat waxy fracture, has a peculiar aromatic odor, and a warm aromatic somewhat camphoraceous taste. The starch-granules are very similar to those of ginger.

Allied Drugs.—The French Codex recognizes also round zedoary, and refers the latter to Curcuma aromatica, *Roscoe*. The rhizome of this plant is internally yellow, and may furnish the bright-yellow disks which are occasionally seen among commercial zedoary. The rhizomes of several other species are likewise yellow.

Constituents.—Bucholz (1817) obtained from zedoary starch, mucilage, bitter extractive, a pungent soft resin, and volatile oil; the latter is pale-yellow, of a thick consistence, heavier than water, and has a bitterish, pungent, and somewhat camphoraceous taste.

Medical Action and Uses.—Zedoary is usually regarded as being almost identical in its qualities with ginger, but more agreeable, because less burning and acrid. It is used for similar purposes—viz. to promote *digestion*, expel *flatus*, etc. The powder may be prescribed in *doses* of from Gm. 0.60 to 2 (10–30 grains), or an infusion may be made with Gm. 12 or 16 (3–4 drachms) of the bruised root to Gm. 250 (½ pint) of wine or water, and given in tablespoonful doses.

ZINCI ACETAS, *U. S.*, *Br.*—Zinc Acetate.

Zincum aceticum, P. G.; *Acetas zincicus*, F. Cod.—*Acétate de zinc*, Fr.; *Zinkacetat*, *Essigsaures Zinkoxid*, G.; *Acetato de zinc*, Sp.

Formula $Zn(C_2H_3O_2)_2 2H_2O$. Molecular weight 218.74.

Preparation.—Digest for some time Commercial Zinc Oxide (or Carbonate) 2 parts in Acetic Acid and Distilled Water, each 5 parts; then heat to the boiling-point, filter

while hot, and set aside to crystallize. Drain the crystals in a funnel, and dry them upon bibulous paper. An additional quantity of crystals may be obtained by evaporating the mother-liquor to one-half, slightly acidulating with acetic acid, and crystallizing.—*Br.*

On digesting zinc oxide or carbonate with acetic acid, the zinc is dissolved, in the latter case with the evolution of carbon dioxide; $ZnO + 2HC_2H_3O_2$ yields $Zn(C_2H_3O_2)_2 + H_2O$. An excess of the zinc compound is used to avoid loss of acetic acid, and is removed by filtration. Should the acetic acid not have been diluted with too large a quantity of water, the hot filtrate, on cooling, will deposit most of the zinc acetate as crystals. The mother-liquor should be evaporated without boiling, so as to avoid loss of acetic acid and the formation of basic salt; acidulating the concentrated mother-liquor with a little acetic acid will restore the normal from the basic acetate, should the latter have been formed.

Properties.—Zinc acetate crystallizes in soft white pearly six-sided tablets or scales, which on exposure to the air lose their transparency from the evaporation of some acid and water of crystallization, and have a slight acid reaction, a slight acetous odor, and a sharp metallic taste. The salt melts readily in its water of crystallization, and on continuing the heat parts with the same, the loss amounting to 22.8 per cent., which is gradually reabsorbed in a moist atmosphere. On dry distillation acetic acid, carbon dioxide, acetone, and empyreumatic products pass over, a white pearly sublimate is formed, and zinc oxide, mixed with a little charcoal, remains behind; when strongly heated in the air upon a porcelain plate, the salt is decomposed, and burns with a greenish light and the production of a white smoke to zinc oxide. At ordinary temperatures the salt dissolves in 2.7 parts of water, and in a smaller quantity (1.5 *U. S.*, or 2 parts *P. G.*) at the boiling-point. It requires about 36 parts of cold alcohol and about 3 parts (*U. S.*) of boiling alcohol for solution. Treated with sulphuric acid, it is decomposed with the evolution of acetic acid. The aqueous solution of the salt acquires a dark-red color with ferric salts, the color being discharged on the addition of hydrochloric acid, and yields white precipitates with potassium ferrocyanide, hydrogen sulphide, ammonium sulphide, ammonia, and potassa, the precipitates with the last two reagents being soluble in an excess of the precipitant, and the colorless solution giving again a white precipitate with hydrogen sulphide.

Tests.—"The solution of the salt in 10 parts of water should give with an excess of hydrogen sulphide a purely white precipitate (absence of lead, copper, etc.), and the filtrate on being evaporated should leave no fixed residue (iron, earths, alkalies). On warming the salt with sulphuric acid it should not turn black (empyreumatic products and other organic matter). Its solution in 3 parts of water should be clear, and should remain clear on the further addition of water (absence of basic salt)."—*P. G.* The U. S. P. does not give any tests for organic impurities or basic salt, and directs testing for lead, arsenic, and copper in the acidulated aqueous solution by hydrogen sulphide, and for iron, aluminum, calcium, etc. by adding to the solution excess of ammonium carbonate, in which the hydroxides and carbonates named are insoluble. "On completely precipitating the zinc from this alkaline solution by ammonium sulphide, the filtrate should leave no fixed residue on evaporation and gentle ignition (salts of alkalies or of alkaline earths)."—*U. S.* If this precipitate, formed in the solution of the salt, has a white color, the test excludes all impurities except aluminum. "The dilute watery solution should not be affected by barium chloride or silver nitrate (sulphate and chloride)."—*U. S.*, *Br.*

Action and Uses.—Zinc acetate acts locally as an irritant and astringent. Internally, in large doses, it occasions vomiting. There is no reason to believe it poisonous in any dose. Internally, it is rarely used in this country. Some years ago it was recommended after this manner by certain German physicians in the treatment of erysipelas and other febrile affections attended with *delirium*, and occasionally it has been employed to check *diarrhœa* in typhoid fever and similar cases. Its chief use, however, is as a local substitutive and astringent application in *conjunctivitis*, *gonorrhœa*, and *leucorrhœa*. For the first-named affection a collyrium may be made with rose-water or mucilage of sassafras-pith in the proportion of about Gm. 0.06–0.12 (gr. j–ij) of the salt to the fluidounce, to which a few drops of wine of opium may be added. In gonorrhœa and leucorrhœa a customary injection is prepared by dissolving zinc sulphate and lead acetate, of each Gm. 0.80 (gr. xij) in Gm. 250 (f℥viij) of water. The salts react upon one another, producing zinc acetate and lead sulphate, the latter of which is precipitated. The value ascribed to this preparation appears to depend partly upon the modifying influence of the insoluble lead salt which sheathes the inflamed parts. When injected the

mixture should be shaken. A similar injection is prepared with zinc sulphate gr. vj; solution of lead subacetate ♏xxx; water ʒiv.

ZINCI BROMIDUM, *U. S.*—Zinc Bromide.

Zincum bromatum, *Bromuretum zincicum.*—*Bromure de zinc*, Fr.; *Zinkbromid*, G.; *Bromuro de zinc*, Sp.

Formula $ZnBr_2$. Molecular weight 224.62.

Preparation.—This salt is most conveniently prepared by digesting granulated zinc in hydrobromic acid, in which it dissolves with the evolution of hydrogen; the solution (filtered through asbestos or powdered glass) is carefully concentrated, acidulated with a little hydrobromic acid, and dried by the heat of a water-bath.

Properties.—Zinc bromide crystallizes with difficulty from its aqueous solution, and is therefore usually obtained in the form of a white granular powder. The salt is very deliquescent, has a slight acid reaction, is inodorous, and has a sweet and styptic metallic taste in diluted solution. It is freely soluble in water and in alcohol, and is also soluble in ether. Its aqueous solution yields with silver nitrate a white curdy precipitate, which is insoluble in dilute nitric acid and nearly insoluble in ammonia; it gives white precipitates with potassium ferrocyanide, ammonium sulphide, ammonia, and potassa, the precipitates with the last two reagents being soluble in an excess of the precipitant, and the colorless solution giving again a white precipitate with hydrogen sulphide. The salt melts on heating to 394° C. (741.2° F.), with partial decomposition, to a colorless or yellowish liquid which boils near 700° C. (1292° F.), and sublimes in white needles. If a few drops of copper sulphate test-solution be mixed with 5 Cc. of aqueous solution of zinc bromide, and then some sulphuric acid be carefully poured into the mixture so as to form a separate layer, a deep brownish-red color will appear at the line of contact, and will disappear on shaking the mixture.

Tests.—"If to the aqueous solution of the salt (1 in 20) a little starch test-solution be added, and then some chlorine-water drop by drop, the liquid should assume a pure yellow color, free from any shade of blue (absence of iodine). After acidulation with hydrochloric acid the aqueous solution should not be colored or rendered turbid by the addition of an equal volume of hydrogen sulphide test-solution (absence of arsenic, cadmium, lead, copper, etc.). On adding ammonium carbonate test-solution to the aqueous solution of zinc bromide, a white precipitate is produced, which should completely redissolve in an excess of the reagent (absence of iron, aluminum, calcium, etc.). If from this solution in ammonium carbonate test-solution all the zinc be precipitated by ammonium sulphide test-solution, the filtrate should leave no fixed residue on evaporation (absence of alkalies, magnesium, etc.). If 0.3 Gm. of the dry salt be dissolved in 10 Cc. of water, and 2 drops of potassium chromate test-solution be added, it should require 26.7 Cc. of decinormal silver nitrate test-solution to produce a permanent red color (corresponding to not less than 99.95 per cent. of the pure salt)."—*U. S.*

The aqueous solution of the salt should be clear (absence of basic salt), should not be precipitated by barium nitrate (sulphate), and if precipitated by silver nitrate and the mixture rendered alkaline by ammonia, the filtrate, on being acidulated with nitric acid, should merely produce a slight turbidity, but not a curdy precipitate (chloride).

Action and Uses.—It may be conjectured that in proposing zinc bromide as a medicine a vague idea was entertained of its uniting in itself the powers of two medicines, both of which are useful in spasmodic affections, and especially in chorea and epilepsy. That any dose of bromine which can be combined with a suitable dose of zinc should exert a sensible effect is quite improbable. We know of nothing that proves the clinical value of this salt, unless it be the statement that some years ago it was tested at the Salpétrière in Paris with satisfactory results in the treatment of *epilepsy*. The commencing *dose* of 1 grain daily was increased to 25 grains or more. Had its virtues been proven, it would probably have been heard of again, which has not been the case. Gowers (1880) says of it, "it seemed of small value, and is borne badly." Its *dose* may safely be that of the oxide of zinc—viz. Gm. 0.06 (gr. j) and upward.

ZINCI CARBONAS PRÆCIPITATUS, *U. S.*—Precipitated Zinc Carbonate.

Zinci carbonas, Br.; *Hydrocarbonas zincicus*, F. Cod.; *Zincum carbonicum.*—*Sous-carbonate*, *Hydrocarbonate de zinc*, Fr.; *Zinkcarbonat*, *Kohlensaures Zinkoxyd*, G.

Formula $2ZnCO_3.3Zn(OH)_2$. (?) Molecular weight 546.94. (?)

Preparation.—Take of Zinc Sulphate 10 ounces; Sodium Carbonate 10½ ounces; Boiling Distilled Water a sufficiency. Dissolve the sodium carbonate with a pint of the water in a capacious porcelain vessel, and pour into it the zinc sulphate, also dissolved in a pint of the water, stirring diligently. Boil for fifteen minutes after effervescence has ceased, and let the precipitate subside. Decant the supernatant liquor, pour on the precipitate 3 pints of boiling distilled water, agitating briskly; let the precipitate again subside, and repeat the processes of affusion of hot distilled water and subsidence till the washings are no longer precipitated by barium chloride. Collect the precipitate on calico, let it drain, and dry it with a gentle heat.—*Br.*

The French Codex has adopted a similar process, and directs adding 10 parts of zinc sulphate, dissolved in 50 parts of water, to a boiling solution of 11 parts of sodium carbonate in 50 parts of water, and drying the washed precipitate at 50° C. (122° F.).

On adding cold solutions of sodium carbonate and zinc sulphate together, neutral zinc carbonate is precipitated; $Na_2CO_3 + ZnSO_4$ yields $Na_2SO_4 + ZnCO_3$. The gelatinous precipitate rapidly undergoes decomposition, carbon dioxide being evolved; and this renders another portion of the precipitate soluble. But if the mixture is boiled, the carbon dioxide is expelled from the liquid and the whole of the zinc is precipitated. Adding the solution of zinc sulphate to that of sodium carbonate while boiling hot keeps the precipitate free from sodium compound, and the sodium sulphate which is formed at the same time is readily removed by washing with water. Potassium carbonate is not so well adapted for this process as the sodium salt, because the resulting potassium sulphate is less freely soluble in water; and ammonium carbonate is unsuitable, since a complete precipitation of the zinc cannot be effected.

Properties.—Zinc carbonate is a soft, impalpable, white, inodorous, and tasteless powder of somewhat variable chemical composition, permanent in the air, insoluble in water and other simple solvents, but dissolving readily in acetic and dilute mineral acids, with the evolution of carbon dioxide, and soluble also in aqueous solutions of ammonium salts. When heated in a crucible to redness it parts with its water and carbon dioxide, and leaves about 70 per cent. of oxide of zinc. Its solution in dilute sulphuric acid shows the chemical behavior described under Zinci Sulphas.

Composition.—According to H. Rose (1852), this is influenced by the temperature during the preparation and drying of the salt; it contains between 5 and 7 ZnO to 2 CO_2, but the proportion of water is more variable. The formula given above is that formerly recognized by the U. S. P., while $3ZnCO_3.5Zn(OH)_2.H_2O$ is given by the French Codex.

Tests.—The purity of zinc carbonate is ascertained by dissolving it in dilute sulphuric acid and testing in precisely the same manner as for zinc sulphate. The Pharmacopœia in addition directs the two following tests: No insoluble residue should be left if 0.5 Gm. of zinc carbonate be dissolved in 10 Cc. of diluted sulphuric acid (absence of lead). If 1 Gm. of the salt be placed in a flask with 10 Cc. of boiling water and 2 drops of phenolphtalein test-solution be added, not more than 1 Cc. of decinormal oxalic acid solution should be required to discharge the red color (limit of alkali).

Uses.—Zinc carbonate is seldom given internally, and its topical application is confined to those excoriated or inflamed surfaces which it is desirable to protect from the air and moderately to constringe. Hence in powder it is very useful for healing *blisters* and other superficial *sores* which resist milder applications, to prevent the friction that occasions *intertrigo* and to cure abrasions when they occur. It is most frequently applied in the form of ointment.

ZINCI CHLORIDUM, *U. S.*, *Br.*—Zinc Chloride.

Zincum chloratum, P. G.; *Chlorurétum zincicum* F. Cod.—*Chlorure de zinc*, Fr.; *Zinkchlorid*, *Chlorzink*, G.; *Cloruro de zinc*, Sp.

Formula $ZnCl_2$. Molecular weight 135.84.

Preparation.—The British Pharmacopœia repeats the directions given for preparing Liquor Zinci Chloridi (see p. 987), except that the last filtrate is to be evaporated in a porcelain basin until a portion of the liquid, withdrawn on the end of a glass rod and cooled, forms an opaque white solid; the liquid is then poured into proper moulds, and when the salt has solidified, but before it has cooled, it is placed in closely-stoppered bottles.

The reactions occurring in the preparation and purification of zinc chloride are explained on page 987. Since zinc chloride destroys vegetable fibre and transforms cellulose and

starch into soluble modifications, its solution should not be filtered through paper, but through asbestos or powdered glass; otherwise the fused salt will be black. Toward the close of the evaporation of the solution the heat should be regulated so as not to decompose the salt, and in case the fused mass should become opaque from the separation of basic salt a little hydrochloric acid should be added. If the salt is desired for solution in water, the liquid is evaporated and continually stirred until a granular powder remains, a few drops of hydrochloric acid being added toward the close of the process.

Properties.—Zinc chloride is either in the form of a white crystalline powder or in opaque tablets or rods. It is inodorous, has a strongly caustic and metallic taste, is very deliquescent on exposure, has an acid reaction, and when heated to a little over 100° C. (115° C. = 239° F., *U. S.*) it melts to a colorless liquid which congeals to a white mass; at a higher heat it is partly volatilized, forming white fumes and leaves a yellowish residue; but when heated in a current of chlorine gas the salt sublimes in acicular crystals. Zinc chloride is freely soluble in water (0.3 part, *U. S.*), but usually yields with water an opalescent solution from the presence of a little oxychloride, which is readily dissolved by a few drops of hydrochloric acid; the solution dissolves starch, paper, and other organic compounds. Zinc chloride dissolves also freely in alcohol, and somewhat less freely in ether. In contact with sulphuric acid it is converted into zinc sulphate. Its solutions yield white precipitates with ammonium sulphide, ammonia, and with silver nitrate, the last two being readily soluble in an excess of ammonia. On mixing a concentrated solution of zinc chloride with zinc oxide a plastic mass of zinc oxychloride is obtained, which soon hardens.

Tests.—The pharmacopœial requirements for the purity of zinc chloride are as follows: "The aqueous solution (1 in 20) should be clear, or at most only very slightly opalescent, and, if it be mixed with an equal volume of alcohol, a single drop of hydrochloric acid should suffice to render 10 Cc. of the mixture perfectly clear (limit of oxychloride). If to the aqueous solution, acidulated with hydrochloric acid, an equal volume of hydrogen sulphide test-solution be added, it should not become colored or turbid (absence of arsenic, cadmium, lead, copper, etc.). If ammonium carbonate test-solution be added to the solution, the precipitate should be of a pure white color, and completely redissolve in an excess of the reagent (absence of iron, aluminum, calcium, etc.). If from this solution in ammonium carbonate test-solution the zinc be completely precipitated by ammonium sulphide test-solution, the filtrate should leave no fixed residue on evaporation (absence of alkalies, magnesium, etc.). The aqueous solution should not be rendered turbid by the addition of barium chloride test-solution (absence of sulphate). If 0.3 Gm. of dry zinc chloride be dissolved in 10 Cc. of water, and 2 drops of potassium chromate test-solution be added, it should require 44.1 Cc. of decinormal silver nitrate solution to produce a permanent red color (corresponding to not less than 99.84 per cent. of the pure salt)."—*U. S.* The P. G. requires the salt to form a clear and colorless solution with an equal weight of water; on the addition of 3 parts of alcohol a flocculent precipitate may form which should dissolve on adding 1 drop of hydrochloric acid.

Pharmaceutical Uses.—Causticum cum chlorureto zincico, *F. Cod.*—Chloride-of-zinc pencils, *E.;* Pâte de Canquoin, *Fr.*—Dissolve zinc chloride 32 Gm. in cold distilled water 4 Gm.; add zinc oxide 8 Gm., previously mixed with well-dried wheat flour 24 Gm.; triturate so as to obtain a paste, and form this into cylinders or other shaped pieces, which are to be completely dried in an air-bath at a temperature gradually raised from 50° to 100° C. (122°–212° F.).

Action and Uses.—Applied externally, zinc chloride is powerfully corrosive, and, although very painful, is perhaps less so than corrosive sublimate or arsenic. Its first application produces a sense of warmth and more or less redness. Upon the denuded skin its action is more rapid as well as more painful, but it does not extend beyond the limits of the caustic. If it is made to penetrate deeply, it coagulates the blood in the vessels and converts the soft tissues into a tough, dry, and uniform mass which is not fetid, and which separates in from one to two weeks, leaving behind a clean granulating surface that tends to rapid cicatrization. The case is reported by Dr. Nichols of a man who had applied to an epithelioma of the lip, first, a strong potash lotion, and then a paste composed as follows: Zinc chloride ʒj, starch ʒiij, podophyllin ʒss. It caused extreme pain in the part, followed by gastric pain, and then by unconsciousness, stertor, dilated and fixed pupils, a small, weak pulse at 110, flushed face, cold perspiration, convulsions, coma, and death in about eight hours. No internal lesions were found to explain the cause of death (*Boston Med. and Surg. Jour.*, Oct. 1886, p. 343).

The rare occasions in which zinc chloride may be given internally have been already pointed out. (See LIQUOR ZINCI CHLORIDI.) In the same connection its uses as a disinfectant were noticed. When, owing to the timidity of patients or any other cause, the knife cannot be employed for the removal of *malignant* and other *morbid growths*, this preparation is preferred before other caustic applications, because it runs no risk of poisoning the system, and because its action is limited to the points of its contact with the tissues. It was originally alleged to be much more successful than excision in the treatment of cancer, and, indeed, to have cured four-fifths of the cases in which it was employed; it was also thought to possess the advantage of acting on the diseased rather than on the healthy tissues. These conclusions have been proved groundless, as well as the allegation that the pain produced by the application is inconsiderable. On the contrary, the pain caused by zinc chloride far exceeds that occasioned by the knife, even without the use of anæsthetics, and is of much longer duration. To what degree this caustic is capable of preventing a return of cancerous disease is still undetermined. It is very positively alleged by competent authorities that the recurrence of cancerous tumors is due mainly to their incomplete extirpation by excision, and that this and some other caustics reach and destroy the cancerous germs more effectually than a surgical operation.

The mode of action here attributed to zinc chloride was long since pointed out by Bonnet. He remarked that when applied as a paste in the neighborhood of large blood-vessels, arteries, or veins, its caustic action does not occasion hæmorrhage, but under its influence they contract and shrivel, and only remain as thin, hard, and apparently solid strings. The experiments of Gersuny and Gjorgjević on dogs and rabbits exhibited a similar result, for even when the chloride was applied to wounds in which large veins were exposed the vessels were not penetrated, there was no hæmorrhage, and their walls collapsed and shrivelled. In 1878, Dr. Carl Langenbuch treated a case of *rodent ulcer*, or of *lupus exedens*, affecting the face and neck and laying bare the large blood-vessels of the cervical region—a case in which instrumental interference was out of the question—by means of zinc chloride, with the result of arresting the ulceration, suspending the circulation through the exposed vessels, and securing a perfect cure. He also refers to a similar treatment of gangrenous ulcers in the Franco-German War of 1870–71. In these cases the pure chloride was applied in the manner described below as Cooke's. It appears, therefore, that the action of this compound is not properly a caustic action; it mummifies the tissues, but does not destroy them. Of late years zinc chloride has been used in the treatment of *cancer* and other affections of the cavity of the *uterus*. Fraenkel, after curetting the diseased surface and applying Paquelin's cautery, made use of injections of the chloride (2 : 3). Superficial sloughing and a cure followed (*Therap. Monatsh.*, iii. 34). Later on he denied that this method tended to cause adhesions between the opposite walls of the uterine cavity, provided that dilating bougies were duly employed. Czerny used 4 parts of the chloride and 1 part of the zinc oxide with 3 parts of flour enclosed in gauze and secured with a string, forming a tampon applied after the use of the curette and the cessation of hæmorrhage. It was allowed to remain in place about six hours, or less if there seemed to be any risk to the rectal or vesical septum. On its removal it was replaced by iodoform gauze (*Am. Jour. Med. Sci.*, Oct. 1888, p. 432). A similar plan was employed by Dumontpallier (*Archives gén.*, Juill. 1889, pp. 111, 369). This compound has been used for the cure of uterine and vaginal *leucorrhœa* and *gonorrhœa* and *hæmorrhagic endometritis* (*Med. News*, liii. 530; *Therap. Monatsh.*, iii. 35). Landerer has reported the successful treatment of small *cystic tumors* (ganglion, ranula, hygroma) by injecting them with a 1 per cent. solution of zinc chloride (*Centralb. f. Ther.*, vii. 738). In 1879 cases of *nasal polypi* were cured by injecting the tumors with zinc chloride, and in the following year several others were reported (*Archives gén. de Med.*, Mars, 1880, p. 353; *Med. Record*, xviii. 433). In 1881 additional cases were furnished by Dr. Reynolds of Kentucky (*Trans. Amer. Med. Assoc.*, xxxii. 237). The stronger preparations have been used to destroy anastomotic *aneurisms* and to open *abscesses* where puncture or incision might be dangerous, as abscesses of the liver. Zinc chloride has been applied to destroy the hardened tissues surrounding cavities and fistulæ following the suppuration of *scrofulous glands*, and is said to possess the advantage over other methods of local treatment of not leaving behind it irregular or unsightly scars. It has also been employed to fill the cavities of *carious teeth*, especially of the incisors.

Several modes of applying zinc chloride as a caustic have been employed. The oldest is that of Canquoin, who made use of a paste containing 1 part by weight of the

chloride to 2, 3, 4, or 5 parts of rye flour; or 5 parts of the chloride and 10 of rye flour made into a paste with 2 parts of glycerin may be used. Gluten has been used as an excipient instead of flour. Mayet's paste is made as follows: Zinc chloride 8 parts; zinc oxide 1 part; wheaten flour, dried at 212° F., 7 parts; water 1 part. Mix the zinc oxide and the flour, dissolve the zinc chloride in the water, and add to the solution the mixture of zinc oxide and flour. Rub the paste in a mortar for ten minutes. Cooke's method consists in saturating lint with the deliquesced salt, and keeping it, after it is dried, in a close box of wood or pasteboard. The lint when used must be cut with scissors that can be spared, since it ruins steel instruments. A convenience of this preparation is that it can be applied in pieces proportioned to the size of the part to be acted upon. A similar advantage is possessed by a mixture of zinc chloride and gutta-percha in equal parts; its caustic action is attenuated by the inert and insoluble portion of it. Conical or arrow-shaped bodies made with zinc chloride alone, or of this salt and potassium nitrate, are sometimes thrust into incisions made in the tumor to be acted upon. Before applying any of these mixtures the cuticle, if unbroken, must be removed by means of strong ammonia.

ZINCI IODIDUM, *U. S.*—Zinc Iodide.

Ioduretum zincicum.—Iodure de zinc, Fr.; *Zinkjodid*, G.; *Ioduro de zinc*, Sp.

Formula ZnI_2. Molecular weight 318.16.

Preparation.—This salt may be prepared by dissolving zinc oxide or carbonate in hydriodic acid, or, according to Doepp (1839), by digesting in a flask 3 parts of granulated zinc, 10 parts of iodine, and 20 parts of water until the liquid has become colorless, when it is filtered through asbestos or powdered glass, and rapidly evaporated to dryness at a moderate heat. The yield is 12½ parts. The salt should be at once put into vials, which are to be kept carefully stoppered.

Properties.—Zinc iodide resembles zinc chloride and bromide, is a white granular, crystalline, inodorous powder, and has a caustic and metallic or in diluted solution a sweetish and styptic taste and an acid reaction. On exposure it is very deliquescent, and gradually becomes colored by, and acquires the odor of, free iodine. It is freely soluble in water and alcohol, and the solution on being largely diluted with water separates a gelatinous precipitate of zinc hydroxide (Rammelsberg). It readily forms basic compounds, an oxyiodide, soluble in warm and insoluble in cold water, being produced by the prolonged digestion of iodine and zinc with water. The iodide melts when carefully heated to 446° C. (834.8° F.) to a colorless liquid, and may be sublimed in quadrangular needles, but on being heated in the air is decomposed into iodine and zinc oxide. The aqueous solution gives white precipitates with ammonium sulphide, potassium ferrocyanide, ammonia, and potassa, the last two being soluble in an excess of the precipitants, and it yields a scarlet-red precipitate with mercuric chloride, a bright-yellow one with lead acetate, and a pale-yellow one with silver nitrate, the latter being insoluble in ammonia and in nitric acid. The salt, warmed with strong sulphuric acid, liberates iodine and sulphur dioxide, zinc sulphate being formed at the same time.

Tests.—The absence of foreign metals is ascertained in precisely the same manner as in zinc chloride and bromide, and the absence of sulphate by the solution not producing a precipitate with barium chloride. The absence of other zinc salts may be ascertained as follows: 1 Gm. of the dry salt, when completely precipitated with silver nitrate, yields 1.472 + Gm. of dry silver iodide. Bromide and chloride, if present, increase the weight of the silver precipitate. The Pharmacopœia admits a salt containing 98.62 per cent. of pure zinc iodide, as seen from the following test: If 0.5 Gm. of dry zinc iodide be dissolved in 10 Cc. of water, and 2 drops of potassium chromate test-solution be added, not more than 31.4 Cc. nor less than 31.0 Cc. of decinormal silver nitrate solution should be required to produce a permanent red color (31.4 Cc. corresponding to 100 (99.9) per cent., and 31.0 Cc. to 98.62 per cent. of pure zinc iodide). This seems to be almost too strict a requirement, in view of the alterations taking place on exposure. Hager suggests the following test, which requires at least 95 per cent. of pure ZnI_2: 0.5 Gm. of the dry salt should yield with 5 Gm. of alcohol a nearly clear solution free from crystalline deposit; add to this liquid 0.6 Gm. of silver nitrate dissolved in 30 Gm. of water, afterward 5 Gm. of ammonia-water, agitate well, and filter; the precipitate when dried should weigh not less than 0.7 Gm., and the filtrate on being acidulated with nitric acid should remain clear or at most become faintly opalescent, but should not produce a curdy precipitate.

Pharmaceutical Preparation.—Syrupus zinci iodidi, Syrup of zinc iodide. Digest 2 troyounces of iodine and 5 drachms of granulated zinc in 8 ounces of water, and when the color of iodine has disappeared pass the liquid through a small filter into a bottle containing 15 troyounces of sugar; wash the filter with a little water and dissolve the sugar by agitation. The syrup should measure 20 fluidounces, and is of about the same iodine strength as the syrup of iodide of iron (A. B. Taylor, 1852). This is the most convenient form for the administration of zinc iodide.

Uses.—As long ago as 1853 this compound was recommended in hysterical chorea (*Lancet*, Dec. 1853, p. 264), and later in various scrofulous affections of the skin and eyes (Guibert, *Nouveaux Médicaments*, 1864). It resembles zinc chloride as a caustic. It was used by Lente as an application to the Eustachian tube in certain cases of deafness (*Amer. Jour. Med. Sci.*, Oct. 1859, p. 390), and by Ross as an application to enlarged and indurated *tonsils*. A solution of Gm. 0.06–0.12 in Gm. 30 (gr. i–ij in f℥j) of water has been employed as an injection in *gonorrhœa* and *leucorrhœa*. It seemed to be entirely obsolete when it was revived in the Pharmacopœia of 1880. Its *dose* is said to be Gm. 0.03–0.12 (gr. ss–ij).

ZINCI OXIDUM, *U. S., Br.*—Zinc Oxide.

Zincum oxydatum, P. G.; *Oxydum zincicum*, F. Cod.; *Flores zinci.—Oxyde de zinc*, Fr.; *Zinkoxyd*, G.; *Oxido de zinc*, Sp.

Formula ZnO. Molecular weight 81.06.

Preparation.—Place zinc carbonate in a loosely-covered Hessian crucible, and expose it to a dull red heat until a portion, taken from the centre of the contents of the crucible and cooled, no longer effervesces when dropped into diluted sulphuric acid. Let the crucible cool, and transfer the product to stoppered bottles.—*Br.*

Nearly identical is the process of the French Codex for *oxyde de zinc par voie humide*. When heated, zinc carbonate parts with its water and carbon dioxide, leaving zinc oxide behind. The operation is known to be finished when a small portion, taken from the centre of the vessel and mixed with a little water, no longer produces effervescence on being dropped into dilute sulphuric acid. A dull red heat, as directed by both pharmacopœias, is not necessary for this purpose. Mohr observed that a temperature of 280° C. (536° F.) is sufficient for obtaining the oxide, and, according to Hager, all carbon dioxide is expelled at 250° C. (482° F.). With quantities of from 6 to 12 ounces of zinc carbonate the operation is conveniently performed in a glass flask placed in a sand-bath and heated by means of gas or on a stove. The capacity of the flask should be about double the volume of the powdered carbonate. If the zinc carbonate is not previously powdered, a higher heat and a longer time are required for expelling all the carbon dioxide. If the carbon dioxide be driven off below a red heat, or if the heating to dull redness has not been prolonged unnecessarily, the cold zinc oxide has a white color, but after having been exposed to a full red heat it will retain after cooling a more or less decided yellow tint.

The French Codex recognizes also an *oxyde de zinc par voie sèche*, which is made by melting pure zinc in an inclined crucible in contact with air to a bright red heat, when it takes fire and burns to oxide, which condenses in the upper part of the crucible or in suitable vessels suspended over it, and after cooling is passed through a fine sieve. The same product, though less pure, was recognized by the U. S. P. 1870 as Zinci oxidum venale (zinc-white); Zincum oxydatum crudum, *P. G.*; Flores zinci, Pompholix, Nihil album, Lana philosophica. This was recommended by Courtois (1780) as a pigment in in place of white lead, but began to be used as such about 1844, after Leclair had elaborated a process for making it at a sufficiently low rate. At present it is usually prepared directly from zinc ores by processes identical with or similar to those recommended by W. J. Taylor (1861) and G. Darlington (1862). A mixture of zinc ore and coal is packed in a suitable furnace upon a layer of coke, previously ignited, and heated by means of a blast, and the vapors of zinc oxide, which are at first more or less mixed with particles of charcoal, are conducted into a chamber, where they condense as a gray powder. As soon as the condensing product has a white color the vapors are passed into another chamber, where they condense as zinc-white. The gray product is identical with the impure oxide of zinc, which was formerly used in medicine under the names of *tutia*, *cadmia fornacum*, or *tutty*.

Properties.—Zinc oxide is a soft, inodorous and tasteless, pale-yellowish, nearly white powder, which on being heated acquires a deep lemon-yellow color, and on cooling

becomes again nearly white. After having been heated to bright redness it continues for some time to emit light in the dark. It dissolves in dilute acetic and other acids without effervescence, is completely insoluble in simple solvents and in saccharine liquids, and is without action on test-paper. According to Daubrée, it may be obtained crystallized by heating zinc chloride in a current of steam. On exposure to the atmosphere it slowly absorbs water and gradually also carbon dioxide.

Tests.—Zinc oxide may contain traces of chloride or sulphate, which are detected in the solution in dilute nitric acid by silver nitrate and barium nitrate. The liquid obtained on boiling zinc oxide with water and filtering should not have an alkaline reaction from the presence of sodium carbonate. The solution of the oxide in hydrochloric acid should not assume a red color on the addition of potassium sulphocyanate (iron), should not be colored or precipitated by hydrogen sulphide (lead and similar metals), and should be completely precipitated with a white color by ammonium sulphide; the filtrate from this precipitate, after having been boiled, should not be disturbed on the addition of ammonium oxalate (calcium) or of ammonium phosphate (magnesium). The U. S. P. does not give any tests for acidulous radicals, and directs testing for foreign bases after dissolving the oxide in diluted sulphuric acid in the same manner as directed for zinc sulphate, but requires that if 10 Cc. of diluted sulphuric acid be added to 0.5 Gm. of zinc oxide, no effervescence should occur (absence of carbonate), and a perfectly clear solution should result (absence of lead, silicate, etc). Zinc-white should respond to the same tests, but a minute proportion of lead is permitted by the P. G. by the following test, which fails to detect about ½ per cent. of PbO: Dissolve 0.2 Gm. of the zinc oxide in 2 Gm. of acetic acid; after cooling, the solution should not be affected (become yellow and turbid) on the addition of potassium iodide.

Action and Uses.—In experiments upon healthy men repeated doses of 4 grains or more of zinc oxide occasioned nausea, eructation, vomiting, confusion of the mind and senses, heat in the epigastrium, thirst, fever, a jerking pulse, muscular spasm, etc. Sometimes, when prescribed in very large and continued doses, it has produced marasmus, œdema of the feet, diarrhœa, etc. That these effects were really due to the poisonous action of zinc is proved by the manner in which smelters of the metal are affected—viz. with cough, dyspnœa, and even hæmoptysis or dyspeptic symptoms, vomiting and diarrhœa, loss of flesh, neuralgia, muscular spasm, and debility. Besides these symptoms are observed a gradual anæsthesia of the skin, diminished reflex excitability, muscular tremors, especially of the legs; in a word, the signs of disorder of the spinal marrow (Schlochow, *Monthly Abstract*, Mar. 1880, p. 158).

Zinc oxide has been used in medicine chiefly for the cure of nervous diseases, and long before the experiments above referred to denoted its special mode of action; for it was introduced by Paracelsus, and proposed as a remedy for epilepsy by Gaubius, who learned its virtues from a charlatan. Many physicians have claimed for it a curative virtue in *epilepsy*, and among them some whose names have the weight of authority; nevertheless, a rigid scrutiny of facts has proved that it never cures, and seldom even palliates, the disease. In six out of twenty cases under the care of Russell a decided impression was made on the course of the disease by the zinc given to the extent of 18 grains three times a day (*Practitioner*, xxx. 83). The utility of zinc oxide is still less in *chorea*, a disease which as naturally tends to cure as epilepsy is rebellious to all treatment that is not merely palliative. The utility of the medicine in these affections is claimed by some physicians who have used it along with the bromides! Such a confusion of ideas is a fruitful source of error in therapeutics. Zinc oxide has also been used with alleged benefit in *hysteria* and *spasmodic asthma*. In the nervous state consequent upon *delirium tremens*, and in *chronic alcoholism* attended with want of sleep, trembling, vertigo, tinnitus aurium, muscæ volitantes, and occasional hallucinations, it sometimes is very beneficial. In such cases it may be given in doses of Gm. 0.12 (2 grains) three times a day, and gradually increased. There is little doubt that this medicine is one of the best for colliquative *sweats*, although it sometimes fails, and is not superior to zinc sulphate. It should be prescribed in Gm. 0.06 (gr. j) doses every hour for three or four hours in the evening. Murrell recommends that it be given "at bedtime in from 5- to 10-grain doses, made up into pill with extract of henbane or conium" (*Practitioner*, xxiii. 91). Such doses appear to us fitted, if continued, to produce vomiting and even poisonous effects. In *diarrhœa* and *dysentery* it was recommended by J. Waring-Curran (1868) as being their best and most speedy cure. Some time later it was advised by Gubler in diarrhœa, and in imitation of him by Bonamy (1876), who employed it successfully when other remedies had failed in an epidemic of dysenteric

diarrhœa. He mixed Gm. 3.30 (gr. l) of zinc oxide with Gm. 3.50 and Gm. 0.66 (10 grains) of sodium bicarbonate, and divided the mixture into three or four parts, which were administered during the day at intervals of three hours. The effect of the medicine is said to have been prompt and decisive even in the most chronic cases. This conclusion was subsequently confirmed in Scotland by Brakenridge and by Renton (1877), and by Jacquier in France (1878). In infantile diarrhœa the medicine was given to a child of six months in doses of Gm. 0.12 (2 grains) every two hours. It was used with advantage by James L. Tyson, although sugar was mixed with it, which Renton found to impair its efficiency. Associated with belladonna, it is more efficient than is either medicine alone. Zinc oxide with valerian in large and increasing doses is said to have cured *diabetes insipidus* (*Amer. Jour. Med. Sci.*, Jan. 1882, p. 276). In fine powder it forms an admirable application for promoting the healing of *intertrigo*, superficial *burns* and *scalds*, *fissures* of the *nipples* or *anus*, *balano-posthitis*, *chancroids*, flabby *ulcers*, *leucorrhœa*, and moist *eruptions of the skin*. For some of these purposes it may be mixed with powdered starch, acacia, or lycopodium. The official ointment is used for similar purposes. The sore or surface should be washed with a carbolic-acid solution before the powder or paste of zinc is applied. A paste made with linseed oil has been used in *erysipelas* instead of the more usual white-lead paint. The following preparation has also been recommended: Glycerin 16 parts, starch 8 parts, zinc oxide 4 parts. Warm the glycerin and starch in a porcelain capsule until they form a jelly, and then stir in the zinc oxide.

Zinc oxide may be administered in powder or in pill, and in *doses* of Gm. 0.06–0.30 (gr. j–v). It is best given after meals.

Zinc oleate made into an ointment with 1 part of vaseline or olive oil, or 2 parts of lard or simple ointment—vaseline being preferable, as not liable to change—has been used with excellent results in the treatment of *eczema*, especially during the stage of active secretion (Crocker, 1879). Haslam has recommended a mixture of this oleate with iodoform as an application to *uterine ulcers*, etc.

Commercial zinc oxide may be used in powder as an external application in the various local affections mentioned above, to diminish secretion and protect parts from the action of the air.

ZINCI PHOSPHIDUM, *U. S.*—Zinc Phosphide.

Phosphoretum zincicum, F. Cod.—*Phosphuret of zinc*, E.; *Phosphure de zinc*, Fr.; *Phosphorzink*, G.; *Fosfuro de zinc*, Sp.

Formula Zn_3P_2. Molecular weight 257.22.

Preparation.—If zinc is fused in a crucible, and phosphorus is added in small pieces at a time, the crucible being kept covered as much as possible, a union of the two elements takes place, but it is difficult to obtain the compound of uniform composition. According to Schrötter (1849), finely-divided zinc is heated to dull redness while the vapor of phosphorus is being passed over it. Vigier's modification of this process consists in heating the zinc in a current of hydrogen; after all atmospheric air has been expelled vapors of phosphorus are passed over the zinc. On account of the great danger connected with this process, owing to the liability to violent explosions, Proust (1869) proposed the following process: Nitrogen gas is evolved by heating ammonium nitrite, and the gas is passed through a bottle in which hydrogen phosphide is prepared by introducing calcium phosphide through a wide tube into diluted hydrochloric acid contained in the bottle. The mixed gases are passed through a wash-bottle into a porcelain tube in which zinc is heated to redness, when the metal will combine with the phosphorus and the liberated hydrogen will escape together with the nitrogen. If the apparatus is filled with nitrogen gas before the hydrogen phosphide is generated, there is no danger of an explosion.

Properties.—Zinc phosphide is stated to be permanent in the air, but the slight phosphorus odor emitted by it indicates its gradual oxidation; it should therefore be preserved in well-stoppered vials. It forms a gray crystalline or friable mass, having upon the fractured surface a bright metallic lustre. Vigier (1875) recommends it to be powdered and freed by sifting from metallic zinc which may be present; in this state it resembles iron reduced by hydrogen, has a blackish-gray color and a slight taste of phosphorus, is readily soluble in dilute sulphuric or hydrochloric acid, with the copious evolution of hydrogen phosphide, and by concentrated nitric acid is converted into zinc phosphate. It melts at a higher temperature than zinc, and volatilizes unchanged, con-

densing in needles if the air be excluded; but when heated in contact with air it is oxidized to zinc phosphate.

Composition.—Pure zinc phosphide consists of 24.12 per cent. of phosphorus and 75.88 per cent. of zinc.

Tests.—"1.171 Gm. of zinc phosphide in contact with official hydrochloric acid should evolve 200 Cc. of hydrogen phosphide, which should be completely absorbed by a concentrated solution of copper sulphate."—*F. Cod.* This test proves the absence of metallic zinc, which would evolve hydrogen; hydrogen phosphide produces in the copper solution a black precipitate of copper phosphide. The U. S. P. directs testing only for foreign metals after dissolving the compound in diluted hydrochloric acid, and demands the absence of insoluble impurities by directing that 0.5 Gm. of zinc phosphide shall form a clear solution with 15 Cc. of diluted hydrochloric acid, heat being applied to expel all of the hydrogen phosphide.

Action and Uses.—Zinc phosphide has been used principally in nervous disorders attributed to defective nutrition of the brain and spinal marrow. Among these *locomotor ataxia* and *general paralysis* are especially to be mentioned. It is alleged that in certain cases of the former affection co-ordination of the movements has been restored and the evidences of sexual power revived; but the paucity of reports of its success in a disease which is ordinarily rebellious to all medicinal treatment would argue badly in its favor, even if its total want of curative power in other cases of the same disease were not well established. An almost identical statement may be made respecting the other affection mentioned, for only one or two cases of paralysis, ascribed to disseminated sclerosis of the cord, and an equal number of cases of *mercurial* tremor, are recorded in which any advantage appears to have been derived from the medicine. A very similar summary may be given of its effects in *anaphrodisia*. Several persons have published accounts of its curative virtues in *neuralgia*, *spinal irritation*, *hysteria*, and *cerebral disorders*, with an excessive elimination of phosphates with the urine, in *chlorosis*, *anæmia*, *amenorrhœa*, *dysmenorrhœa*, and *metrorrhagia*. But these reports, dating as far back as 1868, have not been sufficiently confirmed. Mercier (1878), indeed, found the medicine useful in neuralgia, capable of retarding the progress of locomotor ataxia, almost certain in relieving anaphrodisia, and efficient in dysmenorrhœa and amenorrhœa. But his results do not accord with general experience. It was claimed (1874) to be an efficient remedy for the neuralgic pains of *herpes zoster*, but the claim has not been confirmed.

Zinc phosphide may be given in the dose of Gm. 0.004–0.008 (gr. $\frac{1}{16}$ to $\frac{1}{8}$), which is estimated to equal $\frac{1}{65}$ to $\frac{1}{32}$ gr. of phosphorus, but some of those who have most recommended it direct doses of Gm. 0.02 (gr. $\frac{1}{3}$) every two hours. It may be prescribed in pills with liquorice powder and syrup or in powder with starch. It is best given when the stomach does not contain food, for it is then less apt to disengage hydrogen phosphide.

Dr. R. W. Gardner objected to zinc phosphide that, as no oxygen enters into its composition, it must produce in the stomach the same irritant effects as uncombined phosphorus. He therefore proposed in its stead *zinc hypophosphite*, as not irritant and as admitting the use of such doses as fully to meet all indications for either phosphorus or zinc. The salt is perfectly soluble, and therefore readily absorbable. Its administration is recommended in a syrup containing 8 grains of the salt to a fluidounce, of which a teaspoonful is suggested as an average dose.

ZINCI SULPHAS, *U. S.*, *Br.*—Zinc Sulphate.

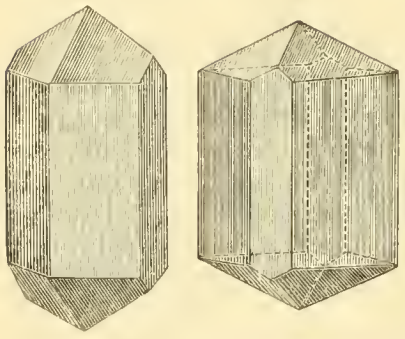
Zincum sulfuricum, P. G.; *Sulfas zincicus*, F. Cod.; *Vitriolum album.*—*White vitriol*, E.; *Sulfate de zinc*, *Vitriol blanc*, *Couperose blanche*, Fr.; *Zinksulfat*, *Schwefelsaures Zinkoxyd*, *Weisser Vitriol*, *Galitzenstein*, G.; *Sulfato de zinc*, Sp.

Formula $ZnSO_4.7H_2O$. Molecular weight 286.64.

Preparation.—Take of Granulated Zinc 16 ounces; Sulphuric Acid 12 fluidounces; Distilled Water 4 pints; Solution of Chlorine a sufficiency; Zinc Carbonate $\frac{1}{2}$ ounce or a sufficiency. Pour the sulphuric acid, previously mixed with the water, on the zinc contained in a porcelain basin, and when effervescence has nearly ceased aid the action by a gentle heat. Filter the fluid into a gallon bottle, and add gradually, with constant agitation, a solution of chlorine, until the fluid acquires a permanent odor of chlorine. Add now, with continued agitation, the zinc carbonate until a brown precipitate appears; let it settle, filter the solution, evaporate till a pellicle forms on the surface, and set aside

to crystallize. Dry the crystals by exposure to the air on filtering-paper placed on porous tiles. More crystals may be obtained by again evaporating the mother-liquor.—*Br.*

Fig. 316.



Crystals of Zinc Sulphate.

Zinc dissolves in dilute sulphuric acid with the evolution of hydrogen, forming zinc sulphate: $Zn_2 + 2H_2SO_4$ yields $2ZnSO_4 + 2H_2$. Arsenic, copper, and lead, which are sometimes present in commercial zinc, are removed by the continued digestion with an excess of the metal, as ordered in the above process: but iron will dissolve, together with the zinc, to ferrous sulphate. This is converted into ferric salt by chlorine-water, and ferric hydroxide is now precipitated on agitating the liquid with precipitated zinc oxide or carbonate. The filtered liquid is free from the metals named, and on being sufficiently concentrated will yield crystals of pure zinc sulphate.

The same salt is economically prepared on the large scale from zinc-white, or by roasting the native zinc sulphide, ZnS, called *blende*, whereby this compound is oxidized to sulphate; this is extracted with hot water, and the clear solution, evaporated, yields *crude white vitriol*, which should be purified by redissolving it in water, boiling with zinc, treating with chlorine and zinc carbonate, filtering, and evaporating to crystallization; magnesium and alkali sulphates are not removed by this treatment.

Properties.—Zinc sulphate crystallizes readily in large transparent rhombic prisms, which are isomorphous with those of magnesium sulphate. As seen in commerce, it is in small prisms or prismatic needles, obtained by disturbed crystallization from concentrated solutions. On exposure the crystals become slowly opaque from the loss of water of crystallization. When rapidly heated the salt melts. At a higher temperature it is partly decomposed, losing both water and sulphuric acid. When very gradually heated to 50° C. (122° F.) it loses 5 molecules of its water (31.3 per cent.) without melting. At 100° C. (212° F.) a sixth molecule is lost, while the last may be removed by a current of dry air at 110° C. (230° F.). Zinc sulphate is inodorous and has a strongly styptic and nauseous metallic taste and an acid reaction. According to Poggiale, 1 part of the crystallized salt dissolves

at	10°	20°	30°	50°	100° C.,
in	.724	.620	.585	.380	.153 parts of water.

The pharmacopœias give the solubility for 1 part of the salt at 15° C. (59° F.) in 0.74 part (*F. Cod.*), 0.6 part (*U. S.*, *P. G.*), and at 100° C. in 0.2 part (*U. S.*), 0.15 part (*F. Cod.*) of water; also in 0.86 part of glycerin (*F. Cod.*), 3 parts (*U. S.*). Supersaturated solutions are easily obtained, particularly in contact with air which has been previously filtered through cotton. 100 parts of 40 per cent. alcohol dissolve, according to Schiff, only 3.48 parts of the salt, and in strong alcohol it is insoluble. The aqueous solution of zinc sulphate yields white precipitates with barium chloride, with ammonium sulphide, and with potassium ferrocyanide.

Tests.—Commercial or crude zinc sulphate is not sufficiently pure for medicinal purposes; it contains iron, occasionally also copper, aluminum, and calcium sulphate, and sometimes cadmium. These salts and the alkali sulphates cannot be removed by recrystallization. Lead cannot be present in this salt if completely soluble in water, owing to the insolubility of its sulphate; yet the Pharmacopœia mentions it among the possible impurities. If 1 Gm. of zinc sulphate be shaken for some time with 10 Cc. of alcohol, the filtrate should not redden moistened blue litmus-paper, showing the absence of free acid. If a large proportion of chloride be present, the salt will be hygroscopic; a 5 per cent. solution of the salt, acidulated with nitric acid, should not be rendered turbid by silver nitrate. Other possible impurities are detected as follows: The aqueous solution, on being acidulated with hydrochloric acid and treated with hydrogen sulphide, should yield neither a yellow, brown, nor black coloration or precipitate (cadmium, arsenic, copper, and similar metals). In case iron be present the solution will afford with a little potassium ferrocyanide a more or less deep-blue precipitate. An excess of ammonia added to the aqueous solution should yield a clear and colorless liquid; in the presence of copper the color of the solution would be blue, and iron and aluminum would remain undissolved. The solution of the salt, after having been precipitated by ammonium sulphide, or the ammoniacal solution after treatment with hydrogen sulphide, yields a filtrate which on evaporation to dryness and ignition should leave no fixed residue (potassium, sodium, magnesium, and

calcium). Ammonium sulphate is detected by the ammoniacal odor given off on the addition of an excess of potassa or soda. Nitrate is detected by adding to the solution sulphuric acid, test zinc, gelatinized starch, and a little potassium iodide, when the nascent hydrogen will cause the reduction of nitric to nitrous acid, and the latter will liberate the iodine, causing a blue color with the starch.

Composition.—Zinc sulphate has the formula given above, and contains 43.9 per cent. of water, 28.22 per cent. of zinc oxide, and 27.88 per cent. of SO_3. The sulphate may also be obtained with less water by crystallizing from its solution above 30° C. (86° F.).

Action and Uses.—Externally and locally, zinc sulphate acts as a stimulant astringent; it is commonly applied to quicken vital action as well as to check secretion. It enters into a paste which is very useful in *cancrum oris*, and contains, besides, extract of cinchona, catechu, and honey of roses. A similar preparation is to be recommended for *aphthæ*. In *conjunctivitis* and in *gonorrhœa*, in the forming stage, or again on the decline, a solution may be employed containing about Gm. 0.06 in Gm. 32 (gr. j–ʒj). In *ophthalmia neonatorum* the following has been used as a collyrium: R. Zinc sulphate gr. xx; water fʒx; solution of lead subacetate fʒss; tincture of camphor fʒj–ij.—A small portion of this solution may be injected between the eyelids several times a day. A solution applied with a brush or sponge to the *throat* or *larynx* should not exceed the strength of Gm. 0.60 to Gm. 32 (10 grains to the ounce); an atomized solution for inhalation may contain Gm. 0.06 to Gm. 32 (gr. j–ij to fʒj). In the first-named form it is useful in commencing inflammation of the fauces. To arrest *hæmorrhage* it is often used in solution and injected into the bladder, uterus, rectum, or nostrils, though for all except the first-mentioned ease it is more efficient when applied upon a sponge. In powder this salt has been employed by insufflation in the treatment of *polypi* of the nostrils, and in solution applied to the seat of these growths after evulsion and to prevent their reproduction. Sir J. Y. Simpson recommended a paste made with lard and the sulphate Gm. 8 to Gm. 32 (ʒij in ℥j), or a glycerite made with glycerin and the same amount of the sulphate Gm. 2.60 to Gm. 32 (gr. xl and ℥j), for the treatment of ulcers and soft *tumors* about the vagina, anus, etc., which it dries and shrivels; and if the part be very soft and of feeble vitality, it may produce a superficial eschar. The same preparations have been applied to *lupus exedens*, *tumors* of the female *urethra*, etc., and even to *cancer* of the breast (*Med. News*, xl. 401). They will not act upon parts covered with cuticle or epithelium. The application causes severe pain, which may be palliated or prevented by chloral hydrate; its action does not tend to spread, and the eschar, if any, separates more rapidly than that of most other caustics. Zinc sulphate may be used in weak solution to lessen the secretion in *eczema* and appease the *itching* in that and other cutaneous affections.

Internally, zinc sulphate is given chiefly as an *emetic* to empty the stomach of indigestible or poisonous ingesta, especially such as are not themselves local irritants, and notably narcotic poisons, such as opium, strychnine, mushrooms, rhus toxicodendron, etc. As it is a mechanical and not a sedative emetic, it is greatly to be preferred before tartarized antimony in these cases, and also when the *air-passages* are obstructed by foreign bodies or by *false membrane*, as in *croup* and occasionally in *diphtheria*. It was claimed in 1879 by Fukala that he cured sixty-two out of seventy-two cases of *pseudo-membranous croup* by repeated applications of a 2½ per cent. solution of zinc sulphate to the interior of the larynx by means of a syringe with a long curved pipe (*Bull. de Thérap.*, xcvii. 143). Evidently the statement is inadmissible. This medicine has been used alone or combined in *dysentery* and *typhoid fever*, but it is only in the chronic form of the first-named disease, and in greatly prolonged cases of the latter with predominant intestinal symptoms, that it is indicated. In *atonic dyspepsia*, with flatulent distension of the digestive canal, it is certainly of use, perhaps by its stimulant and astringent operation. It is reported to be efficacious in nervous *palpitation* of the heart, but probably in dyspeptic cases only. Possibly, a similar explanation may be applied to its alleged success in *spasmodic asthma*, but when this affection is associated with bronchorrhœa the efficiency of the medicine is more probable. In *whooping cough* it has enjoyed a certain reputation which may have been due to a similar mode of action—*i. e.* to its influence in eliminating the catarrhal element. Certainly, when associated with belladonna its usefulness is increased. The efficacy claimed for it in *chorea* is not sufficiently demonstrated. Very often it was associated with valerian, which of itself is at least as potent as the zinc. (Compare *Med. News*, xli. 261.) The latter is, however, as much to be depended upon as any other single medicine.

As an emetic zinc sulphate may be prescribed in *doses* of Gm. 0.60–4 (gr. x–lx) dissolved in tepid water. Internally, Gm. 0.06–0.18 (gr. j–iij) may be given several times a day, and gradually increased. In the treatment of chorea it has been so given until more than 20 grains a day were taken, and without injurious effects. It is best administered in pill and after meals, except when it is intended to act upon the stomach itself.

A solution of *zinc sulphide* has been prepared by dissolving equal parts of zinc sulphate and potassium sulphide in water. Such a solution, containing from 5 to 15 grains of each salt in an ounce of water, with the addition of a few drops of alcohol, is recommended by Duhring in the superficial inflammatory form of *lupus erythematosus* and in *seborrhœa* of the face. The lotion should be shaken before being applied by means of a sponge or rag mop, and its sediment should be allowed to adhere to the surface. Its immediate effect is said to be soothing and cooling in the first-named disease, and its permanent influence more favorable than that of the numerous applications which are apt to be fruitlessly made in this affection (*Med. News*, xliii. 507).

ZINCI VALERIANAS, *U. S., Br.*—Zinc Valerianate.

Valeras zincicus, F. Cod.; *Zincum valerianicum*.—*Valérianate* (*Valérate*) *de zinc*, Fr.; *Zinkvalerianat, Baldriansaures Zinkoxyd*, G.; *Valerianato de zinc*, Sp.

Formula $Zn(C_5H_9O_2)_2.2H_2O$. Molecular weight 302.56.

Preparation.—Take of Sodium Valerianate 5 oz. av.; Zinc Sulphate 5½ oz. av.; Distilled Water a sufficient quantity. Dissolve the salts separately, each in 2 pints (Imperial) of distilled water; raise both solutions to near the boiling-point, mix them, cool, and skim off the crystals which are produced. Evaporate the mother-water at a heat not exceeding 200° F. to 4 fluidounces, cool again, remove the crystals which have formed, and add them to those which have already been obtained. Drain the crystals on a paper filter, and wash them with a small quantity of cold distilled water till the washings give but a very feeble precipitate with barium chloride. Let them now be again drained and dried on filtering-paper at ordinary temperatures.—*Br.*

The above process was originally proposed by Trommsdorff. On mixing hot solutions of sodium valerianate and zinc sulphate the salts are mutually decomposed, resulting in the formation of sodium sulphate, which remains dissolved, and zinc valerianate, which crystallizes partly on cooling, the remainder being obtained on concentrating the liquid.

The salt of the French Codex is obtained by adding freshly-prepared moist zinc carbonate to valerianic acid, diluted with 30 parts of water, and when the acid is nearly saturated warming the mixture slightly, filtering, and carefully evaporating the liquid.

Properties.—Zinc valerianate crystallizes in soft white pearly scales, which are not deliquescent, and have a slight odor of valerianic acid, and a sweet styptic and metallic taste. It has an acid reaction on litmus-paper, melts at about 140° C. (284° F.), at a higher heat gives off white inflammable vapors, and finally burns with a bluish flame, leaving zinc oxide. The salt is stated to be soluble at 15° C. in 90 (*P. G.* 1872), 100 (*U. S.*), 160 (Wittstein) parts of water; the salt used in France, which contains $12H_2O$, dissolves in 50 parts of cold water (*F. Cod.*); on being boiled with water it loses water of crystallization. But, according to Lieben and Rossi (1871), 100 parts of water dissolve at 25° C. (77° F.) 2.54 parts of anhydrous zinc valerianate. On heating the solution moderately it becomes turbid, and clear again on cooling; but after the saturated solution has been boiled it does not become entirely clear after cooling, in consequence of the production of a basic salt, which is less freely soluble in water. The salt is also soluble in 40 (*U. S.*), 60 (Wittstein) parts of cold alcohol, and this solution is likewise rendered turbid by heat. Hot ether, however, dissolves it more freely than cold ether. When kept over sulphuric acid the salt becomes anhydrous.

Tests.—Zinc valerianate should be completely soluble in ammonia-water. Its aqueous solution yields a white precipitate with hydrogen sulphide, and when an excess of the reagent has been used the filtrate on being evaporated should leave no fixed residue. Zinc acetate, being freely soluble in water, if present as an adulteration would impart a red color to solution of ferric chloride. Zinc butyrate resembles the valerianate closely; it is detected, according to the British Pharmacopœia, by distilling the suspected salt with dilute sulphuric acid and adding the distillate to a solution of copper acetate, when, if the valerianate be pure, it does not immediately affect the transparency of the fluid, but forms after a little time oily drops, which gradually pass into a bluish-white crystalline deposit. This is the test suggested by Larocque and Huraut, who first directed

attention (1846) to the similar physical properties of the two salts. The U. S. P. has adopted Hager's test, using cold concentrated solutions of zinc valerianate and copper acetate.

Action and Uses.—Zinc valerianate was originally supposed to unite in itself the peculiar virtues of both of its two elements. This illogical and unscientific judgment did not prevent it from being largely used in spite of its high price and excessively offensive smell. It is very doubtful whether valerianic acid possesses any medicinal virtues; those belonging to valerian seem to reside in its oil. For a time zinc valerianate was lauded in *neuralgia*, both external and internal, in *nervous headache*, *nervous vertigo*, *whooping cough*, infantile *convulsions*, and a variety of nervous and *hysterical* affections, including *chorea*. It was even declared to be a remedy for *cholera!* The only real merit it possesses consists in its sometimes alleviating neuralgic pains and headache occurring in very excitable or hysterical persons. A case is recorded of its having cured *diabetes insipidus*, but as valerian alone is recognized as one of the best remedies for that disease, and as the patient was also taking opium, the influence of the zinc salt cannot be regarded as proved. A more recent case, however, has given some color to this alleged virtue of the salt (*Lancet*, Oct. 1881, p. 662). The *dose* of this preparation is variously stated at from half a grain to several grains. Probably Gm. 0.06 (gr. j) should be the average dose. It may best be given in pill with mucilage or conserve of roses.

ZINCUM, *U. S.*, *Br.*—Zinc.

Speltrum.—Zinc, Fr.; *Zink*, G.

Symbol Zn. Atomicity bivalent. Atomic weight 65.10.

Origin.—The metal zinc has been known in the isolated state only since about the beginning of the eighteenth century, when Stahl showed it to be obtainable from calamine; some of its compounds, however, have been long known. Brass was used in ancient times, but no other metal, besides copper, was supposed to exist therein. The oxide was likewise known at an early date, and, like the ore from which it was obtained, was called *cadmia*. White vitriol appears to have been prepared by Valentinus in the fifteenth century, who was also acquainted with blende, in which Brandt (1735) showed the presence of zinc, and Glauber (1648) prepared "oleum lapidis calaminaris" and studied some of the properties of zinc chloride.

The metal is rather abundant, and exists most generally in combination either as silicate or carbonate, known as *calamine*, or as sulphide, known as *blende*. Zinc ores have been found in Pennsylvania and Missouri, in Great Britain, Belgium, and different parts of Germany, particularly in Silesia. They are frequently associated with lead and other metals.

Calamina præparata, *Br.* (Lapis calaminaris præparata), is native zinc carbonate, calcined in a covered earthen crucible at a moderate temperature, powdered, and freed from gritty particles by elutriation. It is a pale pinkish-brown powder, almost entirely soluble with effervescence in acids. The mineral varies in color from whitish to reddish or greenish, and is sometimes crystalline, or more frequently amorphous.

Preparation.—On smelting lead and other ores containing zinc an impure zinc oxide is condensed in the cooler portions of the furnace. By the long-continued roasting of blende or calamine, oxide is likewise obtained. This is mixed with powdered charcoal, and the mixture heated nearly to whiteness in shallow iron retorts, when the zinc distils, and is collected in suitable condensers. The impure metal is purified by a descending distillation in crucibles furnished with an open tube reaching to the upper half of the crucible and passing through its bottom.

Properties and Tests.—Zinc is a bluish-white metal, having a lamellar or a granular structure. Its density varies between 6.9 and 7.2, rolled zinc being the heaviest. Ordinarily, it is rather brittle, but between 120° and 150° C. (248° and 302° F.) it is ductile, and may be rolled into sheets and converted into wire. Heated to 205° C. (401° F.), it becomes so brittle that it may be reduced to powder. It melts at about 415° C. (779° F.), and at 940° C. (1724° F.) it boils and volatilizes, and in the presence of air burns with a bluish-green flame to oxide. Melted zinc on congealing expands in volume 0.2 per cent. (Nies and Winkelmann 1882), and afterward contracts considerably. On bending, zinc emits a slight cracking noise, weaker than that of tin. It has a bright metallic lustre, but on exposure becomes superficially tarnished. It is not much acted on by cold concentrated sulphuric acid, but on heating unites with it, evolving sulphur dioxide. Diluted sulphuric and hydrochloric acids dissolve it readily, with the evolution

of hydrogen. While the Pharmacopœia permits the presence of traces of iron, lead, and copper, it demands the absence of arsenic, antimony, and phosphorus, as shown by the following tests: When zinc is dissolved in diluted hydrochloric acid, the hydrogen gas which is evolved should not have any disagreeable odor, nor should it color a strip of paper moistened with lead acetate test-solution (absence of sulphur), or with silver nitrate test-solution (absence of arsenic, antimony, phosphorus). If ammonia-water be added to the solution, a white precipitate should form, which should completely redissolve in an excess of the reagent, yielding a clear, colorless solution (absence of more than traces of iron, lead, copper, etc.).

Zinc is extensively used in the arts for roofing and other purposes; melted together with copper it forms *brass*. It is useful in protecting surfaces of iron and copper from oxidation; iron having its surface coated with zinc is known as *galvanized iron*.

The *salts of zinc* are usually colorless, soluble in water, have an acid reaction, and a disagreeable metallic taste, and by prolonged heating are mostly converted into oxide. Their aqueous solutions, acidulated with hydrochloric acid, are not precipitated by hydrogen sulphide, but they yield with ammonia and potassa white precipitates soluble in an excess of the alkali. White precipitates are also obtained with ammonium sulphide, alkali carbonates, and potassium ferrocyanide; potassium ferricyanide yields an orange-red precipitate.

Pharmaceutical Uses.—ZINCUM GRANULATUM, *Br.* Granulated zinc is obtained by melting commercial zinc in an earthen crucible and pouring the liquid metal in a thin stream into cold water. The congealed zinc is drained and dried.

Unofficial Zinc Salts.—ZINCI CYANIDUM, Cyanuretum zincicum, *F. Cod.*, Zinc cyanide, $Zn(CN)_2$. It is obtained by precipitating a solution of zinc acetate with hydrocyanic acid, whereby acetic acid is liberated, which retains a portion of the zinc cyanide in solution; the liquid should therefore be kept nearly neutral by the occasional cautious addition of an alkali. Zinc cyanide is a white, inodorous, and tasteless powder, which is insoluble in water and alcohol, but dissolves in potassa, ammonia, and in dilute acids. When long kept it undergoes decomposition and acquires a sweetish and metallic taste.

ZINCI ET POTASSII CYANIDUM, K_2ZnCy_4. On dissolving zinc cyanide in a solution of pure potassium cyanide a slightly alkaline liquid is obtained, which on evaporation yields colorless or white octahedrons of a sweet and metallic taste. Small quantities of acids precipitate from its solution zinc cyanide.

ZINCI FERROCYANIDUM, Zincum ferrocyanatum, Zinc ferrocyanide. It is prepared by precipitating a soluble zinc salt with potassium ferrocyanide, and forms a white tasteless powder, which is insoluble in water, alcohol, and dilute acids, and evolves hydrocyanic acid on being heated with dilute sulphuric acid.

ZINCI LACTAS, Lactas zincicus, *F. Cod.*, Zincum lacticum, Zinc lactate, $Zn(C_3H_5O_3)_2.3H_2O$. It is prepared as described on page 70, or by dissolving zinc carbonate in dilute lactic acid with the aid of heat. It crystallizes in short quadrangular crystals which have an acid reaction and an acidulous metallic taste. The salt is not fusible, requires about 58 parts of cold and 6 parts of boiling water for solution, and is nearly insoluble in alcohol. It yields 27.1 per cent. of oxide of zinc.

ZINCI SALICYLAS, Zinc salicylate $Zn(C_7H_5O_3)_2.3H_2O$. Vigier (1878) prepares this salt by heating salicylic acid with distilled water, adding gradually zinc oxide suspended in a little water, and, when the oxide is no longer dissolved, filtering the solution. The salt crystallizes in long satiny needles, has a sweet somewhat styptic and bitter taste, dissolves in about 20 parts of cold water, and is freely soluble in hot water, alcohol, ether, and methylic alcohol. The crystals represent 20.6, and the anhydrous salt 23.9, per cent. ZnO.

ZINCI SULPHOCARBOLAS, *Br.*, Zincum sulfocarbolicum (s. sulphophenylicum), Zinc sulphocarbolate, $Zn(SO_3C_6H_4OH)_2.8H_2O$. It is prepared, like the sodium salt (see page 1486), by decomposing a solution of barium sulphocarbolate with zinc sulphate: the precipitate of barium sulphate is filtered off, and the clear liquid evaporated to crystallization. Zinc sulphocarbolate crystallizes in reddish, or if the solution has been acidulated with sulphuric acid in colorless, inodorous prisms or tablets, which are soluble in twice their weight of water or alcohol, have an acid reaction, and when heated are decomposed without melting. The aqueous solution acquires a violet color with ferric chloride, should yield with barium nitrate merely a slight turbidity (sulphate), should not be affected by ammonium oxalate or sulphuric acid (barium, etc.), and after precipitation with excess of ammonium sulphide yields a filtrate which on evaporation and ignition should leave no residue. When heated to redness the salt yields 14.6 per cent. ZnO.

Action and Uses.—Zinc is never used as a medicine in the metallic state. Sheet zinc

has been used to make hollowed and curved splints for fractured limbs, especially for such as are treated by suspension.

Zinc cyanide, according to some early experimenters, occasioned, in doses of half a grain repeated at intervals, cephalic congestion, anxiety, somnolence, nervous tremors, etc. Given in large doses to animals, its effects are identical with those of hydrocyanic acid and its alkaline compounds. It has been used in *epilepsy*, *chorea*, and other convulsive affections, and also in *gastralgia* and other forms of *neuralgia*. In the last-named affection, and especially in neuralgia of the fifth pair produced by cold, its good effects appear to be proven. Lashkewich praises its virtues in *cardiac neuroses* with pain in the heart, palpitation, and disordered rhythm. It may be prescribed in such cases in doses of about Gm. 0.016 (gr. ¼) suspended in mucilage, or preferably in pill, to ensure its more precise administration. It should be given at intervals of an hour or two, since its physiological operation is transient. This salt has also been used with alleged benefit in acute articular *rheumatism*, but the evidence in its favor appears to be inconclusive.

Potassium and zinc cyanide, which is permanent, and also perfectly soluble in cold water, has been proposed, and is to be preferred to zinc cyanide on account of its solubility; it was prescribed in the doses already mentioned in sweetened aromatic water.

Zinc lactate is reputed to be efficacious in the same affections for which the oxide is used, and to be less apt than the latter to disagree with the stomach. Its *dose* is stated to be Gm. 0.03–0.08 (gr. ½–1) several times a day.

Zinc salicylate is believed to be a valuable astringent and antiseptic agent. It has been applied to cancerous and other *ulcers*, and used for the treatment of *ophthalmia* and *gonorrhœa*, in a solution containing from ½ to 1 per cent. of the salt.

Zinc sulphocarbolate has been employed externally as a substitute for carbolic acid in surgical dressings, for the prevention of *septicæmia*, and as an injection in *gonorrhœa*, *leucorrhœa*, etc. It is less liable than carbolic acid itself to act as an irritant. A solution in water of the strength of from 1 to 5 per cent. is used as a topical application, and for injections one of from 1 to 5 parts in 1000.

ZINGIBER, *U. S.*, *Br.*—Ginger.

Rhizoma (*Radix*) *zingiberis*, P. A., P. G.—*Gingembre* (*gris et blanc*, Cod.), Fr.; *Ingwer*, G.; *Zengibre*, Sp.

The rhizome of Zingiber officinale, *Roscoe*, s. Amomum Zingiber, *Linné*. Woodville, *Med. Bot.*, plate 11; Bentley and Trimen, *Med. Plants*, 270.

Nat. Ord.—Scitamineæ (Zingiberaceæ).

Origin.—The ginger-plant is a perennial herb indigenous to tropical Asia, and at the present time cultivated in most tropical countries, but it is not known in the wild state. It has numerous stems, about 1 M. (40 inches) high, and covered with elongated leaf-sheaths, of which the upper ones have a lancelinear spreading blade 20 to 30 Cm. (8–12 inches) long. The flowering stems are much shorter, have a few loose leaf-sheaths, and are terminated by a short thick spike of bracted yellow and variegated flowers. The rhizome is the part employed. 4,277,110 pounds of ginger were imported into the United States in 1886.

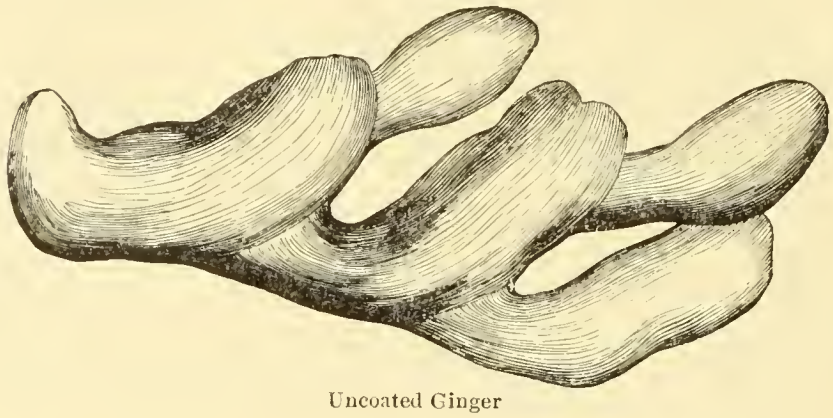
Description.—Ginger is seen in commerce in two forms—either with the outer integuments present or else removed by scraping. The former kind is called *coated*, the latter kind *uncoated* or *scraped* ginger; and this variety is recognized by the pharmacopœias. Commercial ginger consists of flattened branches of the horizontal rhizome, which are somewhat palmately lobed, are known in commerce as *races* or *hands*, and bear at the somewhat thickened end of each lobe a scar from the overground stem. The coated variety has simply been washed and dried, or slightly scraped upon the flattened sides; it is externally of a brown or yellowish-brown color, wrinkled, somewhat annulate from the leaf-bases, and has a more or less shrivelled appearance. The uncoated ginger is of handsomer appearance, of a pale-buff color, striated, and nearly smooth externally, or somewhat fibrous from detached fibro-vascular bundles; it breaks with a mealy and rather fibrous fracture, which is of a whitish or yellowish color. Well-dried coated ginger is slightly darker internally, but some varieties are quite dark-colored and break with a horny fracture. Coated ginger is often designated as *black ginger*, though this name

Fig. 317.

Coated Ginger.

is sometimes restricted to the horny kind, which appears to have been dried by artificial heat or after having been scalded in boiling water. Uncoated ginger is sometimes called *white ginger;* and this name is also used for certain varieties which have been artificially bleached, it is stated, by exposure to the fumes of burning sulphur, whereby they acquire

Fig. 318.



Uncoated Ginger

a chalky color, or by immersion in chlorinated lime or in milk of lime or gypsum. The calcareous coating protects ginger for a long time against the attacks of insects, to which the other, more particularly the coated, varieties of the drug are subject. Ginger has an agreeable aromatic odor and a warm, pungent taste. A transverse section shows near the surface an endoderm, and outside of this numerous small cells containing oil and resin; the central portion contains in the rather compact parenchyma many scattered small fibro-vascular bundles and a somewhat smaller number of oil-cells. The starch-granules of ginger are flat, vary in shape between narrow and broadly elliptical or ovate, have a small hilum near the narrow end, and are marked by numerous fine lines. They resemble the starch-granules of East India arrowroot, but are smaller. (See the article *Amylum.*)

The variety of ginger preferred in the United States is known as *Jamaica ginger*, comes chiefly from Jamaica, and is distinguished by being longer and having more slender lobes than the African and East Indian varieties. Jamaica ginger affords a yellowish powder; that of the other varieties is darker-colored. Scraped ginger is directed by the U. S. and British, the unscraped or partly scraped rhizome by the Austrian and German pharmacopœias, while the French Codex recognizes the two varieties.

Constituents.—The analysis of ginger by Bucholz (1817) proved the presence of volatile oil, a pungent soft resin, starch, and gummy and extractive matters. *Oil of ginger* is obtained to the amount of about ¾ to 1½ or 2 per cent., has a pale-yellow color, the specific gravity 0.88 or 0.90, and has the peculiar odor of ginger, but rather a mild taste. According to Paposek. it is a hydrate of $C_{10}H_{16}$. J. C. Thresh (1881) found the oil to boil between 150° and 300° C. (302°–572° F.), and to contain hydrocarbons of the formula $C_{15}H_{24}$, cymene, a little formic and acetic acids, and various oxygenated compounds, without notable quantities of ethers and aldehydes. Thresh (1879–82) recognized in ginger the presence of traces of an alkaloid, and named the pungent principle *gingerol.* It is a straw-colored, viscid, odorless fluid, has an extremely pungent taste, is sparingly soluble in petroleum benzin, freely soluble in alcohol, diluted alcohol, benzene, volatile oils, carbon disulphide, alkalies, and glacial acetic acid. It is not a glucoside, has an alkaline reaction, gives precipitates with lead, barium, and magnesium salts, slowly loses weight at 100° C., is decomposed by boiling water and alkali, and readily oxidized; its isolation is a matter of great difficulty. Jamaica ginger yields the smallest, and African ginger the largest, amount of volatile oil, resins, and gingerol, and the former variety yielded the largest percentage of mucilage, metarabin, starch, and albuminoids. F. M. Siggins (1888) obtained from bleached and unbleached Jamaica ginger 4.8 and 5 per cent.; from East India ginger, 6.6 per cent.; and from African ginger, 6.2 to 7 per cent. of alcoholic extract. Stenhouse and Groves (1877) obtained a little protocatechuic acid on melting the resinous extract with soda. Thresh ascertained that the greater portion of the resin is a neutral compound, and the remainder consists of two

Fig. 319.

Ginger Starch-Granules.

Fig. 320.

Transverse section, magnified 3 diam.

acid resins. According to E. W. T. Jones (1886), ginger contains fully 50 per cent. of starch. The ash of air-dry ginger varies between 3.5 and 4.8 per cent., and the moisture between 13.4 and 14.5 per cent.

Other Products of Zingiberaceæ.—Zingiber (Amomum, *Linné*) Zerumbet, *Roscoe*, yields the *zerumbet-root* of Java. The rhizome is tuberous, somewhat flattened, spongy, internally yellowish, with pale-brown fibro-vascular bundles, and has an agreeable odor and a ginger-like, somewhat bitter taste.

Zingiber Cassumunar, *Roxburgh*. The cassumunar-root of India is about 5 Cm. (2 inches) in diameter, jointed, compressed, with numerous white fleshy radicles and some white tubers; it is externally scaly and light-brown, internally yellow and rather woody, and has a camphoraceous odor and a hot, aromatic taste.

Grana paradisi, Grains of paradise. Under this name the seeds of two plants are met with in commerce which resemble cardamom-seeds in size and appearance, but are destitute of the furrow seen on the latter. One variety is about 2 Mm. ($\frac{1}{12}$ inch) in diameter, is irregularly roundish and angular, reddish-brown, somewhat glossy and finely warty on the surface, and has a rather broad and depressed hilum; it has been referred to Amomum Granum-paradisi, *Afzelius*, a native of Sierra Leone. The other variety is obtained from Amomum Melegueta, *Roscoe*, which is likewise indigenous to Western Africa; the seeds are rather larger, 2 or 3 Mm. ($\frac{1}{12}$–$\frac{1}{8}$ inch) in length, and are distinguished from the preceding by the conical gray-brown tufted hilum; they are also known as *melegueta pepper* and *Guinea grains*. Both varieties are feebly aromatic and have a very pungent and burning taste. They yield about 0.3 per cent. of aromatic volatile oil, and contain acrid resin, starch, gum, etc. Grains of paradise are a constituent of some cattle powders, but are chiefly used for imparting artificial strength to liquors.

See also Cardamomum, Curcuma, Galanga, and Zedoaria.

Medical Action and Uses.—Ginger was introduced from Asia through Arabia into Greece and Europe generally, and the Arabian and the later Greek physicians employed it as a condiment and carminative, and also as an aphrodisiac and general stimulant. They also recognized the effect of its excessive use in debilitating the stomach. It is a carminative stimulant when taken internally, and when applied to the skin it occasions redness, heat, and tingling. Snuffed into the nostrils, its powder is a powerful sternutatory, and when the rhizome is chewed it causes a copious secretion of saliva. Ginger is largely employed in cooking, as the spices proper are, to render more digestible various preparations of flour, sugar, and certain vegetables, and also to expel the flatus produced by the decomposition of food in the digestive canal. In *flatulent colic* ginger is prescribed in powder or in tincture as a carminative and anodyne. It may be given in powder mixed with hot water, but the tincture is preferable. The infusion and tincture have been largely used to correct *diarrhœa* occasioned by cold, and even for a similar purpose in the forming stage of epidemic *cholera*. Ginger has also been recommended in *chronic bronchitis*.

As a rubefacient and anodyne it is much employed in cataplasms and fomentations for the relief of *colic*, *muscular rheumatism*, *neuralgia*, *toothache*, *headache*, etc. The infusion is of use in recent cases of relaxation of the *uvula*, and of *aphonia* from a similar condition of the larynx. The rhizome may be used as a masticatory in *paralysis* of the tongue, cheek, and parts supplied by the portio dura of the fifth pair.

The *dose* of powdered ginger is from Gm. 0.60 to 2 (grs. x–xxx). The infusion, tincture, fluid extract, syrup, and oleoresin are officinal.

Grains of paradise are generally ranked with cardamom-seeds, but their acrid and exciting qualities are akin to those of ginger, for which they may in most cases be substituted.

APPENDIX.

List of Reagents and Tests

Employed in Chemical Testing, according to the United States Pharmacopœia.

The insertion of all the official methods as well as solutions, both for qualitative and quantitative tests, is rendered imperative by the frequent reference to the pharmacopœial requirements in the preceding pages.

Strictly pure (distilled) water is to be used in the preparation of the test-solutions as well as in the application of tests; the former should be perfectly transparent and kept in well-stoppered bottles, protected against extremes of temperature.

1. General Reagents and Test-solutions.

Absolute Alcohol.—Use the official absolute alcohol (see page 147).

Acetic Acid.—Use the official acetic acid (see page 20).

Albumen Test-solution.—Carefully separate the white of a hen's egg from the yolk, shake it thoroughly with 100 Cc. of water, and filter. This solution should be freshly made when required.

Aluminum.—Metallic aluminum in the form of foil, wire, or ribbon. It should be tested for arsenic by Fleitmann's method, when no color should be imparted to the silver nitrate within two hours.

Ammonia-water.—Use the official ammonia-water (see page 248).

Ammonium Carbonate Test-solution.—Dissolve 10 Gm. of official ammonium carbonate in a mixture of 10 Cc. of ammonia-water and 40 Cc. of water. For detecting arsenic sulphide in presence of antimony sulphide, the addition of ammonia-water is omitted, and 10 Gm. of the salt are dissolved in a sufficient quantity of water to make 100 Cc.

Ammonium Chloride Test-solution.—Dissolve 10 Gm. of pure ammonium chloride in enough water to make 100 Cc.

Ammonium Molybdate Test-solution.—Dissolve 1 Gm. of finely powdered ammonium molybdate in 6.7 Cc. of hot water, using a little ammonia-water, if necessary, to effect solution. Then gradually pour the liquid into a mixture of 3.3 Cc. of nitric acid (spec. grav. 1.414) and 3.4 Cc. of water. Preserve the test-solution in the dark, and, if a sediment should form in it after some days, carefully decant the clear solution from it.

Ammonium Oxalate Test-solution.—Dissolve 4 Gm. of pure, crystallized ammonium oxalate in enough water to make 100 Cc. Or dissolve 4 Gm. of pure oxalic acid in 100 Cc. of water, add 20 Cc. of ammonia-water, boil to expel excess of ammonia, and bring the volume to 113 Cc.

On evaporating a portion of the test-solution and igniting the residue, it should be completely volatilized (absence of fixed impurities). The test-solution should not be rendered turbid by hydrogen sulphide nor by ammonium sulphide (absence of metals). The precipitate produced in it by silver nitrate or by barium chloride should dissolve without residue upon addition of nitric acid (absence of chloride and sulphate, respectively).

Ammonium Phosphate Test-solution.—Dissolve 1 Gm. of ammonium phosphate, together with 2 Cc. of ammonia-water, in enough water to make 100 Cc. This solution does not keep well. It should be freshly made when required, or frequently renewed.

Ammonium Sulphide Test-solution.—Saturate 3 parts of pure ammonia-water with pure, washed hydrogen sulphide, and add to the solution (which now contains ammonium sulphhydrate) 2 parts of ammonia-water, which converts the greater portion of the ammonium sulphhydrate into ammonium sulphide. The solution should be perfectly clear and colorless, and, on being evaporated, leave no residue. It should not be rendered turbid either by magnesium sulphate (absence of free ammonia) or by calcium chloride (absence of ammonium carbonate). It should be protected against air and light by being kept in small, dark amber-colored bottles in a dark place. As soon as a notable deposit of sulphur has made its appearance in the solution, it should be rejected.

Ammonium polysulphide test-solution is occasionally required. This is a yellow liquid, prepared by dissolving a small quantity of pure sulphur in the preceding colorless ammonium sulphide test-solution.

Arsenic Test, Bettendorff's.—To a small quantity of the liquid to be tested, which should contain much pure, concentrated hydrochloric acid, or should be a solution of the substance to be tested in pure, concentrated hydrochloric acid, add an equal volume of a saturated solution of freshly prepared stannous chloride in pure, concentrated hydrochloric acid, together with a small piece of pure tin-foil. The presence of arsenic is revealed by the production of a brown color or brown precipitate, the appearance of which is hastened by a gentle heat. (See *Stannous Chloride*).

Arsenic Test, Fleitmann's.—Into a test-tube of at least 15 Cm. in length and 15 to 18 Mm. in diameter place a single, solid piece of zinc (see below), weighing about 1 to 1.25 Gm., and add about 5 Cc. of potassium hydroxide test-solution, both ingredients having previously been proven free from arsenic by having been subjected, *alone*, to the test about to be described, during at least two hours, with negative result. Now add the liquid to be tested, which must not contain any free acid nor very materially increase the

volume of the contents of the test-tube. Immediately secure over the mouth of the test-tube a previously prepared cap made of three thicknesses of pure filter-paper free from dust, and apply to the upper filter-paper a drop of a saturated, aqueous solution of silver nitrate acidulated with nitric acid. (See Silver Nitrate test-solution.) Then place the tube at once, upright, into a box containing sand heated to about 90° C. (194° F.), and fitted with a cover, so as to exclude light and dust, and permit the reaction to proceed for such a time as may be specially prescribed in each case. The presence of arsenic (but not of antimony) is revealed by the production, upon the moistened paper cap, of a brown or black stain. In absence of arsenic, if the test has been carefully conducted, the spot will remain colorless.

In place of zinc, metallic aluminum, best in form of wire cut into small pieces, may be employed (*Gatehouse's* modification). The method of testing and the results are the same as in Fleitmann's test.

Arsenic Test, Gutzeit's.—Into a test-tube of at least 15 Cm. in length and 15 to 18 Mm. in diameter place a single, solid piece of zinc (see below) weighing about 1 to 1.25 Gm., and add about 5 Cc. of a mixture, previously prepared and kept in readiness for this purpose, of 10 Cc. of pure sulphuric acid of spec. grav. 1.835, and 190 Cc. of water, the ingredients having previously been proven free from arsenic by having been subjected, *alone*, to the test about to be described, during at least two hours, with negative result. Now add the liquid to be tested, which should not be alkaline nor exceed 1 Cc. About 1 Cm. below the open end of the test-tube insert a loose plug, about 1 Cm. long, of glass-wool or cotton, which has been moistened with 0.5 Cc. of lead acetate test-solution. Then secure over the mouth a cap made of three thicknesses of clean filter-paper, and apply to the upper one a drop of a saturated, aqueous solution of silver nitrate, acidulated with nitric acid. (See Silver Nitrate test-solution.) Place the tube into a box to exclude light, and let the reaction proceed as long as may be prescribed in each case. The presence of arsenic is revealed by the production, upon the moistened paper cap, of a bright yellow stain, which becomes black or brown by application of water. Antimony colors the spot black or brown at once without a previous yellow color. In this case traces of arsenic may be overlooked; it is therefore advisable to subject a fresh specimen of the solution to be tested to Fleitmann's test, which responds only to arsenic. If the plug moistened with lead acetate solution be strongly colored, so that doubt exists whether the coloration be due to metallic silver reduced by arsenic, or to silver sulphide produced by an escape of hydrogen sulphide through the plug, moisten the silver stain with diluted nitric acid, which will dissolve the metallic silver reduced by arsenic, but will not affect the black silver sulphide. Or else put on a new cap of filtering paper, moistened with a drop of lead acetate test-solution. If this remains colorless, sulphide is absent.

Barium Carbonate.—Pure barium carbonate, prepared by dissolving 12 parts of pure, crystallized barium chloride in 20 parts of boiling water, then adding a solution of 5 parts of ammonium carbonate in 10 parts of boiling water, and afterward 5 parts of ammonia-water; finally washing the precipitate thoroughly and drying it.

Barium Chloride Test-solution.—Prepared from pure barium chloride. The aqueous solution of the salt should be perfectly neutral, and should not yield a precipitate with hydrogen sulphide or ammonium sulphide (absence of metals, etc.). The aqueous solution, after being precipitated by diluted sulphuric acid in slight excess, yields a filtrate which should not leave any permanent residue when evaporated and heated on platinum-foil (absence of other fixed bases and salts). Diluted alcohol, after remaining in contact with it for several hours, should, upon ignition, show a pure yellowish-green colored flame, without red streaks (absence of traces of strontium). To prepare the *test-solution*, dissolve 12.2 Gm. of the salt in enough water to make 100 Cc. (This solution is of normal strength, so as to permit of its use for volumetric purposes also.)

Barium Hydroxide Test-solution.—A saturated solution of barium hydroxide in water. This solution rapidly absorbs carbon dioxide from the air. It is preferably prepared freshly as wanted.

Barium Nitrate Test-solution.—Prepared from pure barium nitrate. This salt should respond to the same tests as barium chloride. In addition, its aqueous solution, slightly acidulated with nitric acid, should not be rendered turbid by silver nitrate (absence of chloride). To prepare the *test-solution* dissolve 1 Gm. of the salt in water, to make 15.3 Cc. (This solution is of half normal strength, so as to permit of its use for volumetric purposes also:)

Benzin, or **Petroleum Ether.**—Use the official benzin (see page 333).

Benzene, or **Benzol,** C_6H_6, is a colorless, transparent liquid of a peculiar, aromatic odor, of a spec. grav. of 0.8846 at 15° C. (59° F.), congealing at 0° C. (32° F), and boiling at 80.37° C. (176.7° F.). It is insoluble in water, but soluble in 4 parts of alcohol and in ether. In concentrated sulphuric acid it should dissolve without producing a color. On shaking 2 Cc. of benzene with 0.5 Cc. of sulphuric acid and 1 drop of fuming nitric acid no green or blue tint should be produced (absence of thiophene).

Brazil-wood Test-solution.—See under *Indicators.*

Bromine-water (Bromine Test-solution).—An aqueous solution of bromine prepared by dissolving 1 Cc. of bromine in enough water to make 100 Cc.

Calcium Chloride Test-solution.—Dissolve 10.925 Gm. of crystallized calcium chloride in enough water to make 100 Cc. (This solution is of normal strength, so as to permit of its use for volumetric purposes also.)

Calcium Hydroxide Test-solution (Lime-water).—Use the official lime-water (see page 952).

Calcium Sulphate Test-solution.—Introduce transparent crystals of native gypsum (selenite), $CaSO_4 + 2H_2O$, into a flask filled with water, and decant the clear, saturated solution when required. 1 part of gypsum requires, at 15° C. (59° F.), 398 parts of water for solution.

Carbon Disulphide.—Use the official carbon disulphide (see page 409).

Chlorine-water (Chlorine Test-solution).—Use the official chlorine-water. Since it rapidly deteriorates by keeping, it should be frequently renewed or freshly prepared when required.

Chloroform.—Use the official chloroform (see page 463).

Cobaltous Nitrate Test-solution.—The crystallized, commercial salt is sufficiently pure if, after it is dissolved in water and the cobalt completely precipitated by ammonium sulphide, the filtrate leaves no residue on evaporation. To make the *test-solution* dissolve 1 Gm. of the salt in 10 Cc. of water.

Cochineal Test-solution.—See under *Indicators.*

Copper (Metallic Copper), in form of wire, foil, or turnings. The commercial article, brightened, if

necessary, by scouring with diluted hydrochloric acid, is suitable for all purposes except testing for arsenic. If required for this purpose, the absence of arsenic must first be proven. A small portion (about 0.5 Gm.) of the copper is to be dissolved in hot, concentrated sulphuric acid, and this solution subjected to Gutzeit's test (see above). No color should be imparted to the silver nitrate within two hours (absence of arsenic).

Cupric Ammonium Sulphate Test-solution.—A solution of cupri-tetrammonium sulphate, $Cu(NH_3)_4SO_4 + H_2O$. To copper sulphate add ammonia-water until the precipitate first formed is nearly, but not completely, redissolved; then filter. This solution is apt to decompose on keeping. It should be made freshly when required.

Cupric Sulphate Test-solution.—Dissolve 10 Gm. of cupric sulphate in enough water to make 100 Cc.

Cupric Tartrate Test-solution.—See under *Volumetric Solutions.*

Corallin Test-solution.—See under *Indicators.*

Diphenylamine, and **Diphenylamine Test-solution.**—See under *Indicators.*

Eosin Test-solution.—See under *Indicators.*

Ether.—Use the official ether. It should be strictly neutral to litmus-paper.

Ferric Ammonium Sulphate Test-solution.—Dissolve 10 Gm. of ferric ammonium sulphate in enough water to make 100 Cc.

Ferric Chloride Test-solution.—Dissolve 10 Gm. of ferric chloride in enough water to make 100 Cc.

Ferrous Sulphate Test-solution.—Dissolve a clear crystal of ferrous sulphate in about 10 parts of water previously boiled to expel air. This solution should be freshly prepared immediately before use.

Ferrous Sulphide.—A heavy solid, in form of black or brownish-black irregular masses or fused into sticks, soluble in sulphuric or hydrochloric acid with copious evolution of hydrogen sulphide. On dissolving 2 Gm. of ferrous sulphide in pure nitro-hydrochloric acid diluted with a little water, evaporating the solution to dryness, and testing the residue for arsenic by Gutzeit's method (see above), no color should be imparted to the silver nitrate within two hours.

Fluorescein Test-solution.—See under *Indicators.*

Gelatin Test-solution.—Dissolve 1 Gm. of isinglass [*Ichthyocolla*, U. S. P.] in 50 Cc. of water by the aid of a gentle heat, and filter if necessary. This solution should be freshly made when wanted for use.

Gold Chloride Test-solution.—The commercial chloride of gold, usually prepared by dissolving gold in nitro-hydrochloric acid and carefully evaporating to dryness, mostly consists of aurochloric acid, $HAuCl_4 + 2H_2O$, which is converted into neutral auric chloride, $AuCl_3$, by fusing it at a temperature not exceeding 150° C. (302° F.), moistening the residue (now consisting of auric and aurous chloride) with enough hot water to produce a syrupy liquid (whereby the aurous chloride is decomposed into auric chloride and metallic gold), and then pouring off the clear liquid from the precipitate. To prepare the *test-solution* dissolve the liquid finally obtained in the before-mentioned process in 20 volumes of water. Or dissolve 1 Gm. of dry auric chloride in 30 Cc. of water.

Hydrochloric Acid, Pure.—In addition to the tests prescribed for this acid by the Pharmacopœia (see page 62), it is required to conform to the following more rigorous tests before it can be employed as a reagent: The addition of 1 Cc. of barium chloride test-solution to 1 Cc. of the acid diluted with 9 Cc. of water should cause no turbidity within twenty-four hours (absence of sulphuric acid). A crystal of diphenylamine dropped into the acid should not turn blue (absence of free chlorine). On substituting it for sulphuric acid in Gutzeit's test, as described above, no color should be imparted to the silver nitrate within two hours (absence of arsenic or antimony).

Hydrogen Sulphide.—A gas generated by treating ferrous sulphide with diluted sulphuric acid, and washing the gas by passing it through water.

Hydrogen Sulphide Test-solution, or Hydrosulphuric Acid.—A saturated, aqueous solution of hydrogen sulphide. To prepare about 1 liter of the solution, treat 20 Gm. of ferrous sulphide, in a suitable apparatus, with a mixture of 20 Cc. of pure sulphuric acid, spec. grav. 1.835, and 250 Cc. of water, pass the gas through a wash-bottle containing a small quantity of water, and conduct it into a bottle of the capacity of about 1½ liters, containing 1 liter of water. When the gas is no longer absorbed, transfer the solution to small, dark amber-colored bottles, to be filled nearly to the top, pass a stream of hydrogen sulphide for a few minutes through each, and then at once stopper them tightly, and preserve them afterward in a cool and dark place. Before putting them aside introduce into one of these bottles a few drops of pure hydrochloric acid, and keep it in a warm place during twenty-four hours, after which time no precipitate should be found in it (absence of arsenic). Before any of the solution is used, it should be ascertained that it retains a strong odor of hydrogen sulphide, and that, when it is added to an equal volume of ferric chloride test-solution, a copious precipitate of sulphur is formed at once.

Indigo Test-solution.—Place 6 Gm. (3.3 Cc.) of fuming sulphuric acid into a beaker well cooled by immersion in water, and stir into it, very gradually, 1 Gm. of finely-powdered Bengal indigo. Set the mixture aside for two days, then pour it into 20 Cc. of water, and decant. Or dissolve 1 Gm. of commercial indigo-carmine (the sodium or potassium salt of sulphindigotic acid) in 150 Cc. of water.

Iodine Test-solution.—For preparing the ordinary test-solution (as a reagent for starch, alcohol by iodoform test, etc.) iodine fulfilling the requirements of the Pharmacopœia is sufficiently pure. For this purpose dissolve 1 Gm. of iodine and 3 Gm. of potassium iodide in 50 Cc. of water.

For use in volumetric analysis, or in other cases where the ordinary impurities present in official iodine are objectionable, *Purified Iodine* must be employed.

Iron, Metallic.—Bright and perfectly clean iron in the form of wire, sheet, or filings, according to the uses to be made of it. For making solutions of pure iron salts, fine, thin, bright wire (so-called florists' wire) should be used. For detecting copper, bright pieces of sheet iron or knitting-needles are used; for detecting nitric acid by reduction to ammonia, iron-filings are preferable.

Lead Acetate Test-solution.—Dissolve 10 Gm. of clear, transparent crystals of lead acetate, free from adhering lead carbonate, in enough water to make 100 Cc. Preserve the solution in well-stoppered bottles.

Basic Lead Acetate Test-solution.—Use the official solution of lead subacetate.

Litmus-Paper and **Test-solution.**—See under *Indicators.*

Magnesia Mixture.—Dissolve 10 Gm. of magnesium sulphate and 20 Gm. of ammonium chloride in 80 Cc. of water, add 42 Cc. of ammonia-water, set the mixture aside for a few days in a well-stoppered vessel, and filter. It should never be used freshly made.

Magnesium Sulphate Test-solution.—Dissolve 10 Gm. of magnesium sulphate in enough water to make 100 Cc.

Mercuric Chloride Test-solution.—Dissolve 5 Gm. of mercuric chloride in enough water to make 100 Cc.

Mercuric Potassium Iodide Test-solution.—Use the decinormal mercuric potassium iodide volumetric solution.

Alkaline Mercuric Potassium Iodide Test-solution. (*Nessler's Solution.*)—Dissolve 5 Gm. of potassium iodide in 5 Cc. of hot water, and add to this a hot solution of 2.5 Gm. of mercuric chloride [U. S. P.] in 10 Cc. of water. To the turbid, red mixture add 16 Gm. of potassium hydroxide [*Potassa*, U. S. P.], dissolved in 40 Cc. of water, and finally make up the volume to 100 Cc. A surplus of red mercuric iodide deposits on cooling, and may be left in the bottle, the clear solution being decanted as needed.

Mercurous Nitrate Test-solution, $Hg_2(NO_3)_2 + 2H_2O$.—Into a porcelain capsule put 1 Gm. of pure mercury with 0.5 Cc. of pure nitric acid and 0.5 Cc. of distilled water, and place it for twenty-four hours into a cool, dark room. Separate and drain the crystals, and dissolve them in 100 Cc. of water. Preserve the solution in a dark amber-colored bottle, into which a small globule of mercury has been placed.

Methyl Alcohol, CH_3OH.—For the identification of salicylic acid, the rectified, commercial wood-alcohol, having a specific gravity of about 0.820, is sufficiently pure, if it forms a clear, transparent mixture with an equal volume of distilled water.

Methyl-Orange Test-solution.—See under *Indicators.*

Nitric Acid, Pure.—In addition to the tests prescribed for this acid by the Pharmacopœia (see page 75) it is required to conform to the following more rigorous test before it can be used as a reagent: On supersaturating 0.5 Cc. of the acid with pure potassium hydroxide test-solution, and testing a portion of this solution by Fleitmann's method (see above), no color should be imparted to the silver nitrate within two hours (absence of arsenic).

Fuming Nitric Acid (Red Fuming Nitric Acid).—The commercial acid will answer, if it is of specific gravity of 1.450 or over. It should be carefully kept in glass-stoppered bottles in a cool place.

Oxalic Acid Test-solution.—Use the decinormal volumetric solution.

Phenolphtalein Test-solution.—See under *Indicators.*

Picric Acid Test-solution.—Dissolve 1 Gm. of pure, distinctly crystalline picric acid (trinitrophenol), $C_6H_2(NO_2)_3OH$, in 100 Cc. of water, cool the solution, and filter, if necessary.

Platinic Chloride Test-solution.—Heat 1 Gm. of pure platinum, in chips, with 6 Cc. of concentrated hydrochloric acid to 80° C. (186° F.), and very gradually add 1 Cc. of strong nitric acid (spec. grav. 1.414) until very nearly all the platinum is dissolved. Evaporate the solution to dryness on a water-bath, moisten the residue with a few drops of hydrochloric acid, and again evaporate to expel the excess of acid. Dissolve the residue in 20 Cc. of water. The *test-solution* may also be prepared by dissolving 1.7 Gm. of neutral platinic chloride, $PtCl_4$, or 2.6 Gm. of chloroplatinic acid, $H_2PtCl_6 + 6H_2O$ in 20 Cc. of water. On evaporating a small portion of the solution to dryness and igniting the residue, pure, metallic platinum should be left behind, which should yield nothing soluble to nitric acid.

Potassium Carbonate Test-solution.—Dissolve 10 Gm. of pure anhydrous potassium carbonate [prepared from *Potassii Carbonas*, U. S. P.] in enough water to make 100 Cc.

Potassium Chromate Test-solution.—Dissolve 1 Gm. of potassium chromate, K_2CrO_4, in enough water to make 10 Cc. On adding silver nitrate to a little of the solution, a red precipitate is produced, which should be completely dissolved by nitric acid (absence of chloride). Another portion of the solution, mixed with an equal volume of diluted hydrochloric acid, should yield no precipitate with barium chloride (absence of sulphate).

Potassium Cyanide Test-solution.—This should be freshly prepared, when required, by dissolving 1 Gm. of official potassium cyanide in 4 parts of water.

Potassium Dichromate.—Use the official potassium dichromate.

Potassium Dichromate Test-solution.—Dissolve 10 Gm. of official potassium dichromate in enough water to make 100 Cc.

Potassium Ferricyanide Test-solution.—Dissolve 1 part of potassium ferricyanide in about 10 parts of water. This solution should be made freshly when required, as it is rapidly decomposed by light. A freshly prepared, aqueous solution, when mixed with some ferric chloride test-solution and diluted with water, should show a brown tint, free from turbidity or a shade of green.

Potassium Ferrocyanide Test-solution.—Dissolve 10 Gm. of official potassium ferrocyanide in enough water to make 100 Cc.

Potassium Hydroxide Test-solution.—Use the official solution of potassa (see page 975). For use in Fleitmann's test for arsenic (see above), it should have previously been subjected, by itself, to this test for at least two hours, with negative result (absence of arsenic).

Potassium Iodide Test-solution.—Dissolve 16.556 Gm. of official potassium iodide in enough water to make 100 Cc., and keep the solution in dark amber-colored, well-stoppered bottles to prevent the formation of iodate. The solution should be frequently renewed, or freshly prepared when required. (This solution is of normal strength, so as to permit of its use for volumetric and gasometric purposes also.)

Potassium Nitrate.—The dry salt responding to the tests of purity required by the Pharmacopœia, particularly to those for absence of chloride and sulphate.

Potassium Permanganate Test-solution.—Use the decinormal volumetric solution.

Potassium Sulphate Test-solution.—Dissolve 1 Gm. of official potassium sulphate in enough water to make 115 Cc. (This solution is of decinormal strength, so as to permit of its use for volumetric

purposes also, as a substitute for decinormal sulphuric acid, when it is desired not to disturb the neutrality of a liquid.)

Potassium Sulphocyanate Test-solution.—Use the decinormal volumetric solution.

Pyrogallol.—Use the official pyrogallol, $C_6H_3(OH)_3$ (see page 1335).

Rosolic Acid.—See under *Indicators.*

Silver Ammonium Nitrate Test-solution.—Dissolve 1 Gm. of official silver nitrate in 20 Cc. of water, and add ammonia-water, drop by drop, until the precipitate first produced is almost, but not entirely, redissolved. Filter the solution, and preserve it in dark amber-colored and well-stoppered bottles.

Silver Nitrate Test-solution.—For ordinary purposes use the decinormal volumetric solution. For Gutzeit's test use a saturated solution of silver nitrate in water acidulated with about 1 per cent. of nitric acid.

Silver Sulphate Test-solution.—Dissolve 1 Gm. of official silver nitrate in 0.5 Cc. of warm water, and add 1.5 Cc. of pure, concentrated sulphuric acid. On cooling, small transparent crystals of silver sulphate separate. Carefully pour off the acid liquid, wash the crystals repeatedly, by decantation, with cold water, transfer them to a bottle, add 100 Cc. of water, and agitate so as to produce a saturated solution. For use decant a sufficient quantity of the latter.

Sodium Acetate Test-solution.—Dissolve 10 Gm. of official sodium acetate in enough water to make 100 Cc.

Sodium Bitartrate Test-solution.—Dissolve 150 Gm of tartaric acid in 100 Cc. of hot water, and divide the solution into two equal portions. Neutralize one of these accurately with sodium bicarbonate (which will require about 84 Gm. of this salt), and then add the other portion of the acid solution. On cooling, crystals of sodium bitartrate, $NaHC_4H_4O_6 + H_2O$, will separate. Remove these, dry them, and keep them in well-stoppered bottles. The *test-solution* is freshly prepared, when required, by dissolving 1 Gm. of the salt in 4 Cc. of water.

Sodium Carbonate.—The anhydrous salt, Na_2CO_3, conforming to the tests of purity prescribed by the Pharmacopœia for *Sodii Carbonas*, but absolutely free from chloride or sulphate.

Sodium Carbonate Test-solution.—Dissolve 10.6 Gm. of anhydrous sodium carbonate in enough water to make 100 Cc. (This solution is of double normal strength, so as to permit of its use for volumetric purposes also.)

Sodium Cobaltic Nitrite Test-solution.—$Co_2(NO_2)_6 6NaNO_2 + H_2O$. Dissolve 4 Gm. of cobaltous nitrate, $Co(NO_3)_2 + 6H_2O$ and 10 Gm. of sodium nitrite, $NaNO_2$, in about 50 Cc. of water, add 2 Cc. of acetic acid, and dilute with enough water to make 100 Cc. Should any of the nitrous acid be lost by keeping the solution, a few drops of acetic acid may be added.

Sodium Hydroxide Test-solution.—Use the official solution of soda (see page 981).

Sodium Thiosulphate (Hyposulphite).—Use the decinormal volumetric solution.

Sodium Nitrite, $NaNO_2$.—The purest commercial salt, generally in form of pencils, is sufficiently pure.

Sodium Nitro-prusside Test-solution.—Dissolve 1 part of sodium nitro-prusside, $Na_2Fe(NO)(CN)_5 + 2H_2O$ in 10 parts of water immediately before using.

Sodium Phosphate Test-solution.—Dissolve 10 Gm. of official sodium phosphate, $Na_2HPO_4 + 12H_2O$, in enough water to make 100 Cc.

Stannous Chloride Test-solution.—Heat pure tin, in form of foil or granules, with concentrated hydrochloric acid, taking care that the metal be in excess. When the acid is saturated, crystals of stannous chloride, $SnCl_2 + 2H_2O$, begin to form. Remove and drain these, dissolve them in 10 parts of water, and preserve the solution in well-stoppered bottles, into each of which a granule of pure tin or a piece of pure tin-foil has previously been introduced.

For Bettendorff's test (see above) pure concentrated hydrochloric acid is saturated with the freshly-prepared crystals.

Starch Test-solution.—Mix 1 Gm. of starch with 10 Cc. of cold water, and then add enough boiling water, under constant stirring, to make about 200 Cc. of a thin, transparent jelly. If it is desired to preserve this test-solution for any length of time, 10 Gm. of zinc chloride, $ZnCl_2$, should be added to it, and the solution transferred to small bottles, which should be well stoppered.

Sulphuric Acid, Pure.—The sulphuric acid of the Pharmacopœia, which may have a specific gravity as low as 1.835, will answer as a reagent for most purposes, provided it is of the required degree of purity. But when "concentrated" sulphuric acid is specially directed in a test, it is intended that the strongest obtainable pure acid, of a specific gravity of not less than 1.840, be employed.

In addition to the tests prescribed for this acid by the Pharmacopœia (see page 101), it is required to conform to the following more rigorous tests before it can be employed as a reagent: If 1 Cc. of diphenylamine test-solution be carefully poured, as a separate layer, upon 5 Cc. of sulphuric acid contained in a test-tube, no distinct blue color should appear in the zone of contact (absence of nitric acid). If a few crystals of pyrogallol be dissolved in about 1 Cc. of pure water, and this solution be carefully poured, as a separate layer, upon some of the sulphuric acid contained in a test-tube, no brown color should appear in the zone of contact (absence of nitric or nitrous acid). If a small portion of the acid be subjected to Gutzeit's test, no color should be imparted to the silver nitrate within two hours (absence of arsenic, etc.).

If it is impossible to obtain any sulphuric acid which will comply with each of these requirements, two kinds of the acid may be kept, one absolutely free from arsenic, for making the arsenic tests; the other free nitrose (nitric and nitrous acids), for the detection of nitric acid.

Tannic Acid Test-solution.—Dissolve 1 Gm. of tannic acid in 1 Cc. of alcohol and enough water to make 10 Cc., immediately before use.

Tartaric Acid Test-solution.—Dissolve 1 part of tartaric acid in 3 parts of water. In the volumetric estimation of soda in potassa directed by the Pharmacopœia, the tartaric acid test-solution employed for precipitating the potassa should contain 3 Gm. of the acid in 20 Cc. Since fungous growths rapidly destroy the solution of tartaric acid, it should be prepared only as wanted.

Tin.—Pure metallic tin in form of granules. Its solution in hydrochloric acid should not be precipi-

tated by potassium sulphate test-solution (absence of lead), and, when examined by Gutzeit's test, it should not cause silver nitrate to become colored within two hours (absence of arsenic).

Turmeric Paper and Tincture.—See under *Indicators.*

Zinc.—Metallic zinc, preferably in the form of thin pencils (about 5 Mm. in diameter), prepared by fusing the metal and casting it in moulds, or in form of thin sheets. It should respond to all the tests required by the Pharmacopœia, and in addition, when examined by Gutzeit's test, it should not cause the silver nitrate to become colored within two hours (absence of arsenic).

Zinc-Iodide-Starch Test-solution.—To 100 Cc. of freshly prepared starch test-solution add 5 Gm. of official zinc chloride and 3 Gm. of official zinc iodide. Preserve the colorless solution carefully in small, dark amber-colored and well-stoppered vials.

2. Indicators for Acidimetry, Alkalimetry, etc.

NOTE.—Each test-solution used as *indicator* should be examined as soon as prepared, and afterward from time to time, as to its neutrality. If necessary, it should be brought, by the cautious addition of diluted sulphuric acid, or of a dilute solution of an alkali, to such a point that, when a few drops of it are added to 25 Cc. of water, a single drop of a centinormal acid or alkali solution, respectively, will distinctly develop the corresponding tints.

Since many of the colored test-solutions are injured by exposure to light, it is best to preserve them in dark, amber-colored vials. Papers prepared with them should be kept in dark bottles or paper boxes.

Brazil-Wood Test-solution.—Boil 50 Gm. of finely-cut Brazil-wood [the heart-wood of Peltophorum dubium (*Sprengel*) *Britton*, nat. ord. Leguminosæ] with 100 Cc. of water during half an hour, replacing the water from time to time. Allow the mixture to cool, strain, wash the contents of the strainer with water until 100 Cc. of strained liquid are obtained, add 25 Cc. of alcohol, and filter. This solution turns purplish-red with alkalies, and yellow with acids.

Cochineal Test-solution.—Macerate 1 Gm. of unbroken cochineal during four days with 20 Cc. of alcohol and 60 Cc. of water. Then filter. The color of this test-solution turns violet with alkalies, and yellowish-red with acids. As an indicator it is used chiefly when ammonia or alkaline earths are present.

Corallin Test-solution.—Dissolve 1 Gm. of Corallin (a coloring matter derived from coal-tar, and containing rosolic and pararosolic acids) in 10 Cc. of alcohol and enough water to make 100 Cc.

Diphenylamine $(C_6H_5)_2NH$ is in form of grayish-white or colorless crystals, of a peculiar, aromatic odor, melting at 54° C. (129.2° F.), slightly soluble in water, more soluble in acids. It is used either in the dry state, or in solution in dilute sulphuric acid, as a test for nitric acid (in sulphuric acid, water, etc.), or for chlorine (in hydrochloric acid). To test a solution for the presence of nitric acid, a small portion of it is mixed with 1 or 2 drops of diphenylamine test-solution, and then concentrated sulphuric acid, *free from nitrose*, is poured in, so as to form a layer beneath the solution. The presence of nitric acid is shown by a deep blue color at the zone of contact.

Diphenylamine test-solution is prepared by dissolving 0.1 Gm. of diphenylamine in 50 Cc. of diluted sulphuric acid. The solution should be colorless.

Eosin Test-solution.—Dissolve 1 Gm. of commercial "yellowish" eosin [$K_2C_{20}H_6Br_4O_5$] in 30 Cc. of water. This solution is red by transmitted light, and shows a strong green fluorescence by reflected light. Acids destroy the fluorescence, and alkalies restore it.

Fluorescein Test-solution.—Agitate 1 Gm. of fluorescein [$C_{20}H_{12}O_5$] with 100 Cc. of diluted alcohol until the latter is saturated; then filter. This solution shows a strong green fluorescence, by reflected light, in presence of the least excess of an alkali.

Litmus-Paper and **Test-solution.**—Exhaust coarsely-powdered litmus with boiling alcohol (which removes a peculiar, red coloring matter, erythrolitmin), and digest the residue with about an equal weight of cold water, so as to dissolve the excess of alkali present. The blue solution thus obtained, after being acidulated, may be used to make *red litmus-paper*. Finally extract the residue with about five times its weight of boiling water, and filter. Preserve the filtrate, as *test-solution*, in wide-mouthed bottles stoppered with loose plugs of cotton to exclude dust, but to admit air.

Litmus-Paper, Blue.—Impregnate, with the test-solution just described, strips of white, unsized paper, free from wood-pulp, but not too porous, and dry them by suspending them on strings of clean twine.

Litmus-Paper, Red.—Prepare this with the same kind of paper and in the same manner as described in the preceding paragraph. To impregnate the paper, either use the blue solution obtained from litmus, by treating the mass, after extraction of alcohol, with cold water, acidulating the same with just enough hydrochloric acid to impart to it a distinctly red tint; or use the regular test-solution, after acidulating it in the same manner.

Neither blue nor red litmus-paper should have a very intense color.

Preserve the test-paper in paper boxes or bottles, so as to exclude dust and acid or ammoniacal vapors.

Methyl-orange Test-solution.—Dissolve 1 Gm. of methyl-orange [the sodium or ammonium salt of dimethylamidoazobenzenesulphonic acid, $HC_{14}H_{14}N_3SO_3$; also known as helianthin, or tropæolin D, or Poirrier's Orange III] in 1000 Cc. of water. Add to it carefully, diluted sulphuric acid, in drops, until the liquid turns red and just ceases to be transparent. Then filter.

The solution acquires a yellow color when brought in contact with alkali hydroxides, carbonates, or bicarbonates. Carbonic acid does not affect it, but sulphuric, hydrochloric, and other acids change its color to crimson. It is not suited for use with organic acids.

Phenolphtalein Test-solution.—Dissolve 1 Gm of phenolphtalein [$C_{20}H_{14}O_4$] in 100 Cc. of diluted alcohol. The solution is colored deep purplish-red by alkali hydroxides or carbonates; bicarbonates and most other salts do not produce such color; acids render the reddened solution colorless. It is not suitable as an indicator for ammonia or bicarbonates. *Phenolphtalein Paper* is prepared by impregnating white, unsized paper with the test-solution and drying it.

Rosolic Acid Test-solution.—Dissolve 1 Gm. of commercial rosolic acid [chiefly methylaurin, $C_{20}H_{16}O_3$] in 10 Cc. of diluted alcohol, and add enough water to make 100 Cc. The solution turns violet-red with alkalies, yellow with acids. In place of rosolic acid, commercial pæonin (also known as aurin R) [chiefly $C_{19}H_{14}O_3$] may be employed.

Turmeric Tincture.—Digest any convenient quantity of ground curcuma-root [from Curcuma longa, *Linné*, nat. ord. Scitamineæ] repeatedly with small quantities of water and throw this liquid, away. Then digest the dried residue for several days with six times its weight of alcohol, and filter. *Turmeric Paper.*—Impregnate white, unsized paper with the tincture, and dry it. The tincture, as well as the paper, turns brown with alkalies, and the yellow color is restored by acids. Boric acid, however, even in presence of hydrochloric acid, turns the color to reddish-brown, and this is changed to bluish-black by ammonia.

3. Volumetric Solutions for Quantitative Tests.

Volumetric solutions are designated as normal $\left(\frac{N}{1}\right)$ when they contain in 1 liter the molecular weight of the active reagent, expressed in grammes, and reduced to the equivalent of 1 atom of hydrogen.

Thus hydrochloric acid, HCl = 36.37, having but one H atom replaceable by a basic element, has 36.37 Gm. of HCl in 1000 Cc. of the normal volumetric solution; while sulphuric acid, $H_2SO_4 = 97.82$, having two replaceable H atoms, contains only one-half this number, or 48.91 grammes of H_2SO_4 in 1000 Cc. of its normal solution. Potassium hydroxide, KOH = 55.99, has but one K to replace one H in acids; hence its normal solution contains 55.99 grammes of KOH in 1 liter; potassium dichromate, $K_2Cr_2O_7 = 293.78$, having 2 K atoms in the molecule, requires one-half its molecular weight, or 146.89 grammes, for 1 liter of normal solution.

Solutions containing in 1 liter one-tenth of the quantity of the active reagent in the normal solution are called decinormal $\left(\frac{N}{10}\right)$; those containing one one-hundredth, centinormal $\left(\frac{N}{100}\right)$; those containing twice the amount, double normal $\left(\frac{2}{N}\right)$; half the amount, seminormal $\left(\frac{N}{2}\right)$.

Solutions containing quantities of the active reagent having *no* simple relation to the molecular weight are called empirical.

Alkaline Cupric Tartrate Volumetric Solution, U. S.

[Fehling's Solution.]

A. The Copper Solution.—Dissolve 34.64 Gm. of carefully selected, small crystals of pure cupric sulphate, showing no trace of efflorescence or of adhering moisture, in a sufficient quantity of water to make the solution measure, at or near 15° C. (59° F.), exactly 500 Cc. *B. The Rochelle Salt Solution.*—Dissolve 173 Gm. of potassium and sodium tartrate and 125 Gm. of potassium hydroxide in a sufficient quantity of water to make the solution measure, at or near 15° C. (59° F.), exactly 500 Cc.

Keep the solutions in small, rubber-stoppered bottles. For use, mix exactly equal volumes of the solutions at the time required.

One Cubic Centimeter of the mixed solution is the equivalent of:

	Gramme.
Cupric Sulphate, crystallized, $CuSO_4 + 5H_2O$	0.03464
Cupric Tartrate, $CuC_4H_4O_6 + 3H_2O$	0.03685
Glucose, anhydrous, $C_6H_{12}O_6$	0.00500

Decinormal Bromine Volumetric Solution, U. S.

[Koppeschaar's Solution.]

Br = 79.76. 7.976 Gm. in 1 Liter.

($NaBrO_3 = 150.64$. − NaBr = 102.76.)

($KBrO_3 = 166.67$. − KBr = 118.79.)

Dissolve 3 Gm. of sodium bromate and 50 Gm. of sodium bromide (or 3.2 Gm. of potassium bromate and 50 Gm. of potassium bromide) in enough water to make, at or near 15° C. (59° F.), 900 Cc. Of this solution transfer 20 Cc., by means of a pipette, into a bottle having a capacity of about 250 Cc., provided with a glass stopper; add 75 Cc. of water, next 5 Cc. of pure hydrochloric acid, and immediately insert the stopper. Shake the bottle a few times, then remove the stopper just sufficiently to quickly introduce 5 Cc. of potassium iodide test-solution, taking care that no bromine vapor escape, and immediately stopper the bottle. Agitate the bottle thoroughly, remove the stopper and rinse it and the neck of the bottle with a little water, so that the washings flow into the bottle, and then add from a burette decinormal sodium thiosulphate solution until the iodine tint is exactly discharged, using toward the end a few drops of starch test-solution as indicator. Note the number of Cc. of the sodium thiosulphate solution thus consumed, and then dilute the bromine solution so that equal volumes of it and of decinormal sodium thiosulphate solution will exactly correspond to each other under the conditions mentioned above.

Example.—Assuming that the 20 Cc. of the bromine solution have required 25.2 Cc. of the thiosulphate to completely discharge the iodine tint, the bromine solution must be diluted in the proportion of 20 to 25.2. Thus, if 850 Cc. of it are remaining, they must be diluted with water to measure 1071 Cc.

After the solution is thus diluted, a new trial should be made in the manner above described, in which 25 Cc. of the decinormal sodium thiosulphate solution should exactly discharge the tint of the iodine liberated by the bromine set free from the 25 Cc. of bromine solution.

Keep the solution in dark amber-colored, glass-stoppered bottles.

One Cubic Centimeter of Decinormal Bromine Solution is the equivalent of:

	Gramme.
Bromine, Br.	0.007976
Carbolic Acid, C_6H_5OH	0.001563

The following article is tested with this solution: Acidum Carbolicum.

Normal Hydrochloric Acid.

HCl = 36.37. 36.37 Gm. in 1 Liter.

Mix 130 Cc. of hydrochloric acid of specific gravity 1.163 with enough water to make it measure, at or near 15° C. (59° F.), 1000 Cc. Of this liquid (which is still too concentrated) carefully measure 10 Cc.

into a flask, add a few drops of phenolphtalein test-solution, and gradually add, from a burette, potassium hydroxide solution, until the red tint produced by it no longer disappears on vigorous shaking, but is not deeper than pale pink. Note the number of Cc. of potassium hydroxide solution consumed, and then dilute the acid solution so that equal volumes of this and of the potassium hydroxide solution neutralize each other.

EXAMPLE.—Assuming that 10 Cc. of the acid solution first prepared required exactly 11 Cc. of potassium hydroxide solution, each 10 Cc. of the former must be diluted to 11 Cc., or the whole of the remaining acid solution in the same proportion. Thus, if 950 Cc. are remaining, 95 Cc. of water must be added.

After the liquid is thus diluted, a new trial should be made in the manner above described, in which 50 Cc. of the acid solution should require for neutralization exactly 50 Cc. of potassium hydroxide solution. If necessary, a new adjustment should then be made to render the correspondence perfect.

One Cubic Centimeter of Normal Hydrochloric Acid is the equivalent of:

	Gramme.
Hydrochloric Acid, alsolute, HCl	0.03637

NOTE.—Normal hydrochloric acid is in every respect equivalent in neutralizing power to normal sulphuric acid, and may be employed, if more convenient, for the same purposes.

Decinormal Iodine Volumetric Solution, U. S.

$I = 126.53$. 12.653 Gm. in 1 Liter.

Dissolve 12.653 Gm. of pure iodine (see below) in a solution of 18 Gm. of pure potassium iodide in 900 Cc. of water. Then add enough water to make the solution measure, at or near 15° C. (59 F.), exactly 1000 Cc. Transfer the solution to small, glass-stoppered vials, which should be kept in a dark place.

Preparation of Pure Iodine.—Heat powdered iodine in a porcelain dish placed over a boiling water-bath, and stir it constantly with a glass rod, so that the adhering moisture, together with any cyanogen iodide and most of the iodine bromide and chloride that may be present may be vaporized. After twenty minutes transfer the iodine to a porcelain or other non-metallic mortar, and triturate it with about 5 per cent. of its weight of pure, dry potassium iodide, so as to decompose any remaining iodine bromide and chloride. Then return the mass to the dish, cover it with a clean glass funnel, and heat the dish on a sand-bath. Detach the sublimed, pure iodine, and keep it in well-stoppered bottles in a cool place.

One Cubic Centimeter of Decinormal Iodine Solution is the equivalent of:

	Gramme.
Iodine, I	0.012653
Arsenic Trioxide (arsenous acid), As_2O_3	0.004942
Potassium Sulphite, crystallized, $K_2SO_3 + 2H_2O$	0.009692
Sodium Bisulphite, $NaHSO_3$	0.005193
Sodium Thiosulphate (Hyposulphite), crystals, $Na_2S_2O_3 + 5H_2O$	0.024764
Sodium Sulphite, crystallized, $Na_2SO_3 + 7H_2O$	0.012579
Sulphur Dioxide, SO_2	0.003195
Antimony and Potassium Tartrate, cryst., $2K(SbO)C_4H_4O_6 + H_2O$	0.016560

The following articles are tested with this solution: Acidum Arsenosum, Acidum Sulphurosum, Antimonii et Potassii Tartras (cryst.), Liquor Acidi Arsenosi, Liquor Potassii Arsenitis, Sodii Bisulphis, Sodii Thiosulphas (Hyposulphis), Sodii Sulphis.

Decinormal Mercuric Potassium Iodide Volumetric Solution, U. S.

[MAYER'S SOLUTION.]

$HgI_2 + 2KI = 783.98$. 39.2 Gm. in 1 Liter.

Dissolve 13.546 Gm. of pure mercuric chloride in 600 Cc. of water, and 49.8 Gm. of pure potassium iodide in 100 Cc. of water. Mix the two solutions, and then add enough water to make the mixture measure, at or near 15° C. (59° F.), exactly 1000 Cc.

One Cubic Centimeter of Decinormal Mercuric Potassium Iodide Solution is the equivalent of:

	Gramme.
Mercuric Potassium Iodide, $HgI_2 + 2KI$	0.0392

Normal Oxalic Acid Volumetric Solution, U. S.

$H_2C_2O_4 + 2H_2O = 125.7$ 62.85 Gm. in 1 Liter.

Dissolve 62.85 Gm. of pure oxalic acid (see below) in enough water to make, at or near 15° C. (59 F.), exactly 1000 Cc.

Pure Oxalic Acid, crystallized, is in form of colorless, transparent, clinorhombic crystals which, on ignition upon platinum-foil, leave no residue. 1 part of it is completely soluble in 14 parts of water at 15° C. (59° F.). Oxalic acid which leaves a residue on ignition, or on solution in water, must be purified, which may be done as follows: To 1 part of the acid add 10 parts of cold water, and shake until the latter is saturated. Filter off the solution from the undissolved crystals, evaporate the filtrate to about three-fourths of its volume, and set it aside so that the fixed salts which it contains may crystallize out. Carefully decant the liquid from the crystals, concentrate it by evaporation, and set it aside to crystallize, stirring occasionally to prevent the formation of large crystals which might enclose moisture. Drain the crystals in a funnel, dry them carefully on blotting-paper, and preserve them in well-stoppered bottles.

NOTE.—Normal oxalic acid volumetric solution is in every respect equivalent in neutralizing power to *normal sulphuric acid* or *normal hydrochloric acid*, and may be employed, if more convenient, for the same purposes. The solution, however, has a tendency to crystallize at the point of the burette.

One Cubic Centimeter of Normal Oxalic Acid Solution is the equivalent of:

	Gramme.
Oxalic Acid, crystallized, $H_2C_2O_4 + 2H_2O$	0.06285
Ammonia Gas, NH_3	0.01701
Sodium Hydroxide, NaOH	0.03996
Potassium Hydroxide, KOH	0.05599
Potassium Permanganate, $KMnO_4$	0.03153

Decinormal Oxalic Acid Volumetric Solution, U. S.

$H_2C_2O_4 + 2H_2O = 125.7$. 6.285 Gm. in 1 Liter.

Dissolve 6.285 Gm. of pure oxalic acid (see above) in enough water to make, at or near 15° C. (59° F.), exactly 1000 Cc.

One Cubic Centimeter of Decinormal Oxalic Acid Solution is the equivalent of:

	Gramme.
Oxalic Acid, crystallized, $H_2C_2O_4 + 2H_2O$	0.006285
Ammonia Gas, NH_3	0.001701
Calcium Hydroxide, $Ca(OH)_2$	0.003691
Potassium Hydroxide, KOH	0.005599
Potassium Permanganate, $KMnO_4$	0.003153
Sodium Hydroxide, NaOH	0.003996

The following articles are tested with this solution: Liquor Calcis, Potassii Iodidum (alkalinity), Potassii Permanganas.

Decinormal Potassium Dichromate Volumetric Solution, U. S.

$K_2Cr_2O_7 = 293.78$. 14.689 Gm. in 1 Liter.

Dissolve 14.689 Gm. of pure potassium dichromate (see below) in enough water to make, at or near 15° C. (59° F.), exactly 1000 Cc.

Pure Potassium Dichromate for use in volumetric analysis, besides responding to the tests given by the Pharmacopœia (see page 0000), must conform to the following tests: In a solution of 0.5 Gm. of the salt in 10 Cc. of water rendered acid by 0.5 Cc. of nitric acid, no visible change should be produced either by barium chloride test-solution (absence of sulphate), or by silver nitrate test-solution (absence of chloride). In a mixture of 10 Cc. of the aqueous solution (1 in 20) with 1 Cc. of ammonia-water no precipitate should be produced by ammonium oxalate test-solution (absence of calcium).

When used with phenolphtalein as indicator to neutralize alkalies, the volumetric solution of potassium dichromate is decinormal when it contains 14.689 Gm. in 1 liter. It is then the exact equivalent of any decinormal acid, corresponding to the amounts of alkalies quoted, for instance, under Decinormal Oxalic Acid Solution.

When used as an oxidizing agent to convert ferrous into ferric salts, or to liberate iodine from potassium iodide, the solution just mentioned (containing 14.689 Gm. in 1 liter) has the effect of a $\frac{N}{10}$ volumetric solution, and a solution of one-third of this strength, containing 4.896 Gm. in 1 liter, has the value of a decinormal solution, and is the equivalent of equal volumes of decinormal potassium permanganate solution, or, in the case of iodine liberated from potassium iodide, it is the equivalent of equal volumes of decinormal sodium thiosulphate solution. For titrating iron in *ferrous* compounds it is used in the following manner: Introduce the aqueous solution of the ferrous salt into a flask, and, if it is not already acid, render it so with sulphuric acid. Now add gradually decinormal potassium dichromate solution from a burette, until a drop taken out upon a white surface no longer shows a blue color with a drop of freshly prepared potassium ferricyanide test-solution.

Decinormal potassium dichromate solution may also be used in conjunction with potassium iodide (from which it liberates iodine) and sulphuric acid for adjusting the titer of sodium thiosulphate (hyposulphite) solution, and, by its means, that of the iodine solution.

One Cubic Centimeter of Decinormal Potassium Dichromate Solution is the equivalent of:

	Gramme.
Potassium Dichromate, $K_2Cr_2O_7$	0.014689
Iron, in ferrous compounds	0.016764
Ferrous Carbonate, $FeCO_3$	0.034719
Ferrous Sulphate, anhydrous, $FeSO_4$	0.045510
Ferrous Sulphate, crystallized, $FeSO_4 + 7H_2O$	0.083226
Ferrous Sulphate, dried, $2FeSO_4 + 3H_2O$	0.053592
Barium Hydroxide, $Ba(OH)_2$	0.008541
Iodine, I	0.037959
Potassium Hydroxide, KOH	0.005599
Sodium Thiosulphate (Hyposulphite), $Na_2S_2O_3 + 5H_2O$	0.074292

The following articles may be tested with this solution: Ferri Carbonas Saccharatus, Ferri Sulphas, Ferri Sulphas Granulatus.

Normal Potassium Hydroxide Volumetric Solution, U. S.

$KOH = 55.99$. 55.99 Gm. in 1 Liter.

Dissolve 75 Gm. of potassium hydroxide [*Potassa*, U. S. P.] in enough water to make, at or near 15° C. (59° F.), about 1050 Cc., and fill a burette with a portion of this liquid.

Put 0.6285 Gm. of pure oxalic acid into a flask of the capacity of about 100 Cc., and dissolve it with about 10 Cc. of water. Add a few drops of phenolphtalein test-solution, and then carefully add, from the burette, the potassium hydroxide solution, frequently agitating the flask, and regulating the flow to drops toward the end of the operation, until the red color produced by its influx no longer disappears on shaking, but is not deeper than pale pink. Note the number of Cc. of the potassium hydroxide solution consumed, and then dilute the remainder of the solution, so that exactly 10 Cc. of the diluted liquid shall be required to neutralize 0.6285 Gm. of oxalic acid.

EXAMPLE.—Assuming that 8.0 Cc. of the stronger solution of potassium hydroxide first prepared had been consumed in the trial, then each 8.0 Cc. must be diluted to 10 Cc., or the whole of the remaining solution in the same proportion. Thus, if 1000 Cc. should be still remaining, this must be diluted with water to 1250 Cc.

After the liquid is thus diluted a new trial should be made in the manner above described, in which 10 Cc. of the diluted solution should exactly neutralize 0.6285 Gm. of oxalic acid. If necessary, a new adjustment should then be made to render the correspondence perfect.

NOTE.—Solutions of caustic alkalies are very prone to absorb carbon dioxide from the atmosphere, and thereby become liable to occasion errors when used with litmus test-solution or phenolphtalein test-solution as indicator (methyl-orange test-solution is not affected by the presence of carbonic acid). Hence the volumetric solutions should be preserved in small vials provided with well-fitting corks or rubber stoppers, or, better still, they should have tubes filled with a mixture of soda and lime attached to their stoppers, so as to absorb the carbon dioxide and prevent its access to the solution.

In place of potassium hydroxide solution sodium hydroxide solution may be used in the same manner and in the same quantity. Potassium hydroxide solution, however, is preferable, since it foams less and attacks glass more slowly and less energetically.

One Cubic Centimeter of Normal Potassium Hydroxide Solution is the equivalent of:

	Gramme.
Potassium Hydroxide, KOH	0.05599
Sodium Hydroxide, NaOH	0.03996
Ammonia Gas, NH_3	0.01701
Ammonium Chloride, NH_4Cl	0.05338
Acetic Acid, absolute, $HC_2H_3O_2$	0.05986
Citric Acid, crystallized, $H_3C_6H_5O_7 + H_2O$	0.06983
Hydrobromic Acid, absolute, HBr	0.08076
Hydrochloric Acid, absolute, HCl	0.03637
Hydriodic Acid, absolute, HI	0.12753
Hypophosphorous Acid, HPH_2O_2	0.06588
Lactic Acid, absolute, $HC_3H_5O_3$	0.08989
Nitric Acid, absolute, HNO_3	0.06289
Oxalic Acid, crystallized, $H_2C_2O_4 + 2H_2O$	0.06285
Phosphoric Acid, H_3PO_4 (to form K_2HPO_4; with phenolphtalein)	0.0489
Phosphoric Acid, H_3PO_4 (to form KH_2PO_4; with methyl-orange)	0.0978
Potassium Dichromate, $K_2Cr_2O_7$	0.14689
Sulphuric Acid, absolute, H_2SO_4	0.04891
Tartaric Acid, crystallized, $H_2C_4H_4O_6$	0.07482

The following articles are tested with this solution: Acidum Aceticum, Acidum Aceticum Dilutum, Acidum Aceticum Glaciale, Acidum Citricum, Acidum Hydrobromicum Dilutum, Acidum Hydrochloricum, Acidum Hydrochloricum Dilutum, Acidum Hypophosphorosum Dilutum, Acidum Lacticum, Acidum Nitricum, Acidum Nitricum Dilutum, Acidum Phosphoricum, Acidum Phosphoricum Dilutum, Acidum Sulphuricum, Acidum Sulphuricum Aromaticum, Acidum Sulphuricum Dilutum, Acidum Tartaricum, Vinum Album, Vinum Rubrum.

Centinormal Potassium Hydroxide Volumetric Soluion, U. S.

$KOH = 55.99$. 0.5599 Gm. in 1 Liter.

Dilute 10 Cc. of normal potassium hydroxide volumetric solution with enough distilled water to make 1000 Cc.

One Cubic Centimeter of Centinormal Potassium Hydroxide Solution is the equivalent of:

	Gramme.
Potassium Hydroxide, KOH	0.0005599
Sulphuric Acid, H_2SO_4	0.0004891
Combined Alkaloids of Nux Vomica[1]	0.00364

Decinormal Potassium Permanganate Volumetric Solution, U. S.

$2KMnO_4 = 315.34$. 3.1534 Gm.[2] in 1 Liter.

1. Place 3.5 Gm. of pure, crystallized potassium permanganate in a flask, add 1000 Cc. of boiling water, and boil until the crystals are dissolved. Close the flask and set it aside for two days, so that any suspended matters may deposit. This is the *stronger solution*. Prepare another, *weaker solution*, in the same manner, using 6.6 Gm. of the salt and 2200 Cc. of water, and set this also aside for two days. After the lapse of this time pour off the clear portion of each solution into separate vessels provided with glass stoppers, and then proceed to test each separately.

Introduce into a flask 10 Cc. of decinormal oxalic acid solution, add 1 Cc. of pure, concentrated sulphuric acid, and, before this mixture cools, gradually add from a burette small quantities of the weaker permanganate solution, shaking the flask after each addition and reducing the flow to drops toward the end of the operation. When the last drop of the permanganate solution added is no longer decolorized, but imparts a pinkish tint to the liquid, note the number of Cc. consumed. In the same manner ascertain the titer of the stronger solution, and likewise note down the number of Cc. of the latter consumed. Finally mix the two solutions in such proportions that 50 Cc. of the mixture will exactly correspond to an equal volume of decinormal oxalic acid solution.

NOTE.—To obtain the accurate proportions for mixing the two solutions, deduct 10 from the number of Cc. of the weaker solution required to decompose 10 Cc. of decinormal oxalic acid solution. With this difference multiply the number of Cc. of the stronger solution required for the same purpose. The product shows the number of Cc. of the *stronger solution* needed for the mixture.

[1] Assumed to consist of equal parts of strychnine and brucine. Centinormal potassium hydroxide solution (in place of which centinormal sodium hydroxide solution, prepared in the same manner, may be employed) is used in the assay of Extract of Nux Vomica to neutralize the excess of decinormal sulphuric acid employed.

[2] This quantity is never directly weighed, but adjusted either by Oxalic Acid or by Iron; in calculations it is often abbreviated.

Next deduct the number of Cc. of the stronger solution required to decompose 10 Cc. of decinormal oxalic acid solution from 10, and with the difference multiply the number of Cc. of the weaker solution required for the same purpose. The product shows the number of Cc. of the *weaker solution* needed for the mixture.

Or, designating by S the number of Cc. of the stronger solution, and by W the number of Cc. of the weaker solution required to decompose 10 Cc. of decinormal oxalic acid solution, the following formula will give the proportions in which the solutions must be mixed:

Stronger Solution: Weaker Solution:
$$(W - 10)\ S \quad + \quad (10 - S)\ W$$

EXAMPLE.—Assuming that 9 Cc. of the stronger (S) and 10.5 of the weaker (W) solution had been required, then, substituting these values in the above-given formula, we obtain:

$$(10.5 - 10)\ 9 + (10 - 9)\ 10.5$$
$$\text{or, } 4.5 \quad + 10.5$$

making 15 Cc. of final solution.

The bulk of the two solutions is now mixed in the same proportion, 450 Cc. of the stronger and 1050 Cc. of the weaker, or 900 Cc. of the stronger and 2100 Cc. of the weaker solution.

After the mixture is thus prepared, a new trial should be made, when 10 Cc. of the solution should exactly decompose 10 Cc. of the decinormal oxalic acid solution. If necessary, a new adjustment should be made to render the correspondence perfect.

This solution should be kept in small, dark-amber-colored and glass-stoppered bottles (or in bottles provided with tubes, especially designed for the purpose). Thus prepared, this solution will hold its *titer* for months; yet it should be tested occasionally, and, when it is found reduced, the liquid should be brought back to normal strength by the addition of such an amount of the stronger solution as may be determined in the manner above described.

II. When potassium permanganate solution is to be prepared for immediate use, this may be done in the following manner: Dissolve 3.5 Gm. of pure, crystallized potassium permanganate in 1000 Cc. of pure water, recently boiled and cooled. Introduce 10 Cc. of decinormal oxalic acid solution into a beaker, add 1 Cc. of pure concentrated sulphuric acid, and proceed as directed above for the weaker permanganate solution. Note the number of Cc. of the solution consumed, and then dilute the remainder with pure water recently boiled and cooled, until 50 Cc. will exactly correspond to 50 Cc. of decinormal oxalic acid solution.

EXAMPLE.—Assuming that 9.1 Cc. of the permanganate solution first prepared had been required to produce a permanent pink tint, then every 9.1 Cc. of the solution must be diluted to 10 Cc., or the whole of the remaining solution in the same proportion. A new trial should then be made to verify the agreement.

NOTE.—Potassium permanganate solution thus prepared is liable to deteriorate more readily and quickly than that prepared by the preceding method.

One Cubic Centimeter of Decinormal Potassium Permanganate Solution is the equivalent of:

	Gramme.
Potassium Permanganate, $KMnO_4$	0.0031531
Barium Dioxide, BaO_2	0.008441
Calcium Hypophosphite, $Ca(PH_2O_2)_2$	0.0021209
Ferric Hypophosphite, $Fe_2(PH_2O_2)_6$	0.0020877
Iron, in ferrous compounds, Fe	0.005588
Ferrous Carbonate, $FeCO_3$	0.011573
Ferrous Oxide, FeO	0.007195
Ferrous Sulphate, anhydrous, $FeSO_4$	0.015170
Ferrous Sulphate, crystals, $FeSO_4 + 7H_2O$	0.027742
Ferrous Sulphate, dried, $2FeSO_4 + 3H_2O$	0.017861
Hydrogen Dioxide, H_2O_2	0.001696
Hypophosphorous Acid, HPH_2O_2	0.001647
Oxalic Acid, crystallized, $H_2C_2O_4 + 2H_2O$	0.006285
Oxygen, O	0.000798
Potassium Hypophosphite, KPH_2O_2	0.002598
Sodium Hypophosphite, $NaPH_2O_2 + H_2O$	0.002646

The following articles are tested with this solution: Acidum Hypophosphorosum Dilutum, Aqua Hydrogenii Dioxidi, Barii Dioxidum, Calcii Hypophosphis, Ferri Carbonas Saccharatus, Ferri Hypophosphis, Ferri Sulphas, Ferri Sulphas Granulatus, Ferrum Reductum, Potassii Hypophosphis, Sodii Hypophosphis.

Centinormal Potassium Permanganate Volumetric Solution, U. S.

$2KMnO_4 = 315.34$. 0.31534 Gm. in 1 Liter.

Dilute 10 Cc. of the decinormal potassium permanganate solution, after having ascertained that it possesses its exact titer, with enough distilled water, strictly complying with the tests given in the text of the Pharmacopœia for *Aqua Destillata*, to make 100 Cc.

This solution should be freshly made when required.

One Cubic Centimeter of Centinormal Potassium Permanganate Solution is the equivalent of:

	Gramme.
Potassium Permanganate, $KMnO_4$	0.00031534
Oxalic Acid, crystallized, $H_2C_2O_4 + 2H_2O$	0.0006285
Oxygen (derived from the permanganate) available for oxidation	0.0000798

Decinormal Potassium Sulphocyanate Volumetric Solution, U. S.

[VOLHARD'S SOLUTION.]

$KSCN = 96.99$. 9.699 Gm. in 1 Liter.

Dissolve 10 Gm. of crystals of pure potassium sulphocyanate in 1000 Cc. of water. This solution is yet too concentrated, and has to be adjusted so as to correspond in strength exactly with decinormal

silver nitrate solution. For this purpose, introduce into a flask 10 Cc. of decinormal silver nitrate solution, together with 0.5 Cc. of ferric ammonium sulphate test-solution and 5 Cc. of diluted nitric acid. To this mixture add, from a burette, in small portions at a time, the sulphocyanate solution. At first a white precipitate of silver sulphocyanate appears, then every drop falling from the burette is surrounded by a deep brownish-red color of ferric sulphocyanate, which disappears on vigorous shaking of the flask as long as any of the silver nitrate remains unchanged. When all the silver has been converted into sulphocyanate, a single additional drop of the potassium sulphocyanate solution produces a brownish-red color which no longer disappears on shaking, but communicates a perceptible pale brownish or reddish tint to the contents of the flask. Note the number of Cc. of the potassium sulphocyanate solution used, and dilute the whole of the remaining solution so that equal volumes of this and of the decinormal silver nitrate solution will be required to produce the permanent brownish or reddish tint. (The same depth of pale brownish or reddish tint to which the volumetric solution is adjusted must be attained when the solution is used for volumetric assays.)

After the dilution, a new trial should be made, in which 50 Cc. of decinormal silver nitrate solution, 2.5 Cc. of ferric ammonium sulphate test-solution, and 25 Cc. of diluted nitric acid are used, and there should be required exactly 50 Cc. of the sulphocyanate solution to produce the same depth of a permanent pale brownish or reddish tint. If necessary, a new adjustment should be made, to render the correspondence perfect.

One Cubic Centimeter of Decinormal Potassium Sulphocyanate Solution is the equivalent of:

	Gramme.
Potassium Sulphocyanate, KSCN	0.009699
Silver, Ag	0.010766
Silver Nitrate, $AgNO_3$	0.016955

The following articles are tested with this solution: Ferri Iodidum Saccharatum, Syrupus Ferri Iodidi.

Decinormal Silver Nitrate Volumetric Solution, U. S.

$AgNO_3 = 169.55$. 16.955 Gm. in 1 Liter.

Dissolve 16.955 Gm. of pure silver nitrate in enough water to make, at or near 15° C. (59° F.), exactly 1000 Cc. Keep the solution in small, dark-amber-colored, glass-stoppered vials, carefully protected against the access of dust.

NOTE.—Titration by decinormal silver nitrate solution may be managed in various ways, adapted to the special preparation to be tested:

a. In most cases it is directed by the U. S. P. to be used in presence of a small quantity of potassium chromate test-solution, which serves to indicate the end of the reaction by the appearance of the red color of silver chromate.

b. In some cases (potassium cyanide, hydrocyanic acid) it is added until the first appearance of a permanent precipitate.

c. It may be used in *all* cases without indicator by observing the exact point when no further precipitate occurs. This may be practised in the case of ferrous iodide, where the addition of potassium chromate would be improper, but it consumes much time in waiting for the precipitate to subside so as to render the liquid sufficiently clear to recognize whether a further precipitate is produced by addition of the silver solution.

d. It may be added in definite amount, known to be in excess of the quantity required, and the excess of the decinormal silver solution measured back by the addition of decinormal potassium sulphocyanate solution (residual titration).

One Cubic Centimeter of Decinormal Silver Nitrate Solution is the equivalent of:

	Gramme.
Silver Nitrate, $AgNO_3$	0.016955
Ammonium Bromide, NH_4Br	0.009777
Ammonium Chloride, NH_4Cl	0.005338
Calcium Bromide, $CaBr_2$	0.0099715
Ferrous Bromide, $FeBr_2$	0.010770
Ferrous Iodide, FeI_2	0.015447
Hydrocyanic Acid, absolute, HCN, with indicator	0.002698
Hydrocyanic Acid, absolute, HCN, to first formation of precipitate	0.005396
Hydriodic Acid, HI	0.012753
Hydrobromic Acid, HBr	0.008076
Lithium Bromide, LiBr	0.008677
Potassium Bromide, KBr	0.011879
Potassium Chloride, KCl	0.007440
Potassium Cyanide, KCN, with indicator	0.006501
Potassium Cyanide, KCN, to the first formation of precipitate	0.013002
Potassium Iodide, KI	0.016556
Potassium Sulphocyanate, KSCN	0.009699
Sodium Bromide, NaBr	0.010276
Sodium Chloride, NaCl	0.005837
Sodium Iodide, NaI	0.014953
Strontium Bromide, $SrBr_2$ (anhydrous)	0.012341
Strontium Iodide, SrI_2 (anhydrous)	0.017018
Zinc Bromide, $ZnBr_2$	0.011231
Zinc Chloride, $ZnCl_2$	0.006792
Zinc Iodide, ZnI_2	0.015908

The following articles are tested with this solution: Acidum Hydrocyanicum Dilutum, Ammonii Bromidum, Calcii Bromidum, Ferri Iodidum Saccharatum, Lithii Bromidum, Potassii Bromidum, Potassii Cyanidum (to first precip.), Potassii Iodidum, Sodii Bromidum, Sodii Chloridum, Sodii Iodidum, Strontii Bromidum (dry), Strontii Iodidum (dry), Syrupus Acidi Hydriodici, Syrupus Ferri Iodidi, Zinci Bromidum, Zinci Chloridum, Zinci Iodidum.

Decinormal Sodium Chloride Volumetric Solution, U. S.

$NaCl = 58.37$. 5.837 Gm. in 1 Liter.

Dissolve 5.837 Gm. of pure sodium chloride in enough water to make, at or near 15° C. (59° F.), exactly 1000 Cc.

Pure Sodium Chloride may be prepared by passing a current of dry hydrochloric acid gas into a saturated aqueous solution of the purest commercial sodium chloride, separating the crystalline precipitate, and drying it at a temperature sufficiently high to expel all traces of free acid. In place of this, transparent crystals of pure rock-salt may be employed.

One Cubic Centimeter of Decinormal Sodium Chloride Solution is the equivalent of:

	Gramme.
Sodium Chloride, NaCl	0.005837
Silver, Ag	0.010766
Silver Nitrate, $AgNO_3$	0.016955
Silver Oxide, Ag_2O	0.011564

The following articles are tested with this solution: Argenti Nitras, Argenti Nitras Dilutus, Argenti Nitras Fusus.

Normal Sodium Hydroxide Volumetric Solution, U. S.

$NaOH = 39.96$. 39.96 Gm. in 1 Liter.

Dissolve 51 Gm. of sodium hydroxide (*Soda*, U. S. P.) in enough water to make, at or near 15° C. (59° F.), about 1050 Cc., and fill a burette with a portion of this liquid.

Put 0.6285 Gm. of pure oxalic acid into a flask of the capacity of about 100 Cc., and dissolve it with about 10 Cc. of water. Add a few drops of phenolphtalein test-solution, and then carefully add from the burette the sodium hydroxide solution, frequently agitating the flask and regulating the flow to drops toward the end of the operation, until the red color produced by its influx no longer disappears on shaking, but is not deeper than pale pink. Note the number of Cc. of the sodium hydroxide solution consumed, and then dilute the remainder of it so that exactly 10 Cc. of the diluted liquid will be required to neutralize 0.6285 Gm. of oxalic acid.

EXAMPLE.—Assuming that 7.8 Cc. of the stronger solution of sodium hydroxide first prepared had been consumed in the trial, then each 7.8 Cc. must be diluted to 10 Cc., or the whole of the remaining solution in the same proportion. Thus, if 980 Cc. should be still remaining, this must be diluted with water to 1258 Cc.

After the liquid is thus diluted a new trial should be made in the manner above described, in which 10 Cc. of the diluted solution should exactly neutralize 0.6285 Gm. of oxalic acid. If necessary, a new adjustment should then be made to render the correspondence perfect.

NOTE.—The same precautions should be taken for protecting this solution from the carbon dioxide of the air as are prescribed for normal potassium hydroxide solution.

This solution may be employed in place of the normal potassium hydroxide solution, volume for volume.

Decinormal Sodium Thiosulphate (Hyposulphite) Volumetric Solution, U. S.

$Na_2S_2O_3.5H_2O = 247.64$. 24.764 Gm. in 1 Liter.

Dissolve 30 Gm. of selected crystals of sodium thiosulphate (sodium hyposulphite) in enough water to make, at or near 15° C. (59° F.), 1100 Cc. Of this solution transfer 10 Cc. into a flask, add a few drops of starch test-solution, and then gradually add from a burette decinormal iodine solution in small portions at a time, shaking the flask after each addition, and regulating the flow to drops toward the end of the operation. As soon as the color produced by the influx of the iodine solution no longer disappears on shaking, but is not deeper than very pale blue, note the number of Cc. of the iodine solution consumed. Then dilute the sodium thiosulphate solution so that equal volumes of it and of decinormal iodine solution will exactly correspond to each other under the conditions mentioned above.

EXAMPLE.—Assuming that 10 Cc. of the stronger sodium thiosulphate solution first prepared had required 10.7 Cc. of decinormal iodine solution to produce a faint reaction with starch, the thiosulphate solution must be diluted in the proportion of 10 Cc. to 10.7 Cc., or 1000 Cc. to 1070 Cc.

After the solution is thus diluted a new trial should be made in the manner above described, in which 50 Cc. of the decinormal sodium thiosulphate solution should require exactly 50 Cc. of decinormal iodine solution to produce a faint reaction with starch. If necessary, a new adjustment should then be made to render the correspondence perfect.

Keep the solution in small, dark-amber-colored, glass-stoppered bottles, carefully protected against the access of dust.

NOTE.—When this solution is to be used, fill a burette with it, place the liquid to be tested either for the free iodine it already contains or for that which it liberates from an excess of potassium iodide added to it into a flask, and gradually add small portions of the solution from the burette, shaking after each addition, and regulating the flow to drops toward the end of the operation until the brown color of the iodine has nearly disappeared. Now add a few drops of starch test-solution, which will produce a blue color, and then continue to add the thiosulphate solution in drops until the blue tint is exactly discharged.

One Cubic Centimeter of Decinormal Sodium Thiosulphate Solution is the equivalent of:

	Gramme.
Sodium Thiosulphate (Hyposulphite), $Na_2S_2O_3 + 5H_2O$	0.024764
Bromine, Br	0.007976
Chlorine, Cl	0.003537
Iodine, I	0.012653
Iron, Fe, in ferric salts	0.005588

The following articles are tested with this solution: Aqua Chlori, Calx Chlorata, Ferri Chloridum, Ferri Citras, Ferri et Ammonii Citras, Ferri et Ammonii Sulphas, Ferri et Ammonii Tartras, Ferri et Potassii Tartras, Ferri et Quininæ Citras, Ferri et Quininæ Citras Solubilis, Ferri et Strychninæ Citras, Ferri Phosphas Solubilis, Ferri Pyrophosphas Solubilis, Ferri Valerianas, Ferrum Reductum, Iodum, Liquor

Ferri Acetatis, Liquor Ferri Chloridi, Liquor Ferri Citratis, Liquor Ferri Nitratis, Liquor Ferri Subsulphatis, Liquor Ferri Tersulphatis, Liquor Iodi Compositus, Liquor Sodæ Chloratæ, Tinctura Ferri Chloridi, Tinctura Iodi.

Normal Sulphuric Acid.

$H_2SO_4 = 97.82$. 48.91 Gm. in 1 Liter.

Carefully mix 30 Cc. of pure, concentrated sulphuric acid (of specific gravity 1.835) with enough water to make about 1050 Cc., and allow the liquid to cool to about 15° C. (59° F.). Place 10 Cc. of this liquid (which is yet too concentrated) into a flask, add a few drops of phenolphtalein test-solution, and afterward, from a burette, normal potassium hydroxide solution, shaking after each addition, and regulating the flow to drops toward the end of the operation, until the red color produced by its influx no longer disappears on shaking, but is not deeper than pale pink. Note the number of Cc. of potassium hydroxide solution consumed. Then dilute the sulphuric acid solution so that equal volumes of this and of normal potassium hydroxide solution exactly neutralize each other.

EXAMPLE.—Assuming that 10 Cc. of the acid solution first prepared had required exactly 11.2 Cc. of normal potassium hydroxide solution, each 10 Cc. of the former must be diluted to 11.2 Cc., or each 1000 Cc. to 1120 Cc. After the liquid is thus diluted a new trial should be made in the manner above described, in which 50 Cc. of the acid solution should require for neutralization exactly 50 Cc. of potassium hydroxide solution. If necessary, a new adjustment should be made to render the correspondence perfect.

NOTE.—It is recommended that in alkalimetric determinations, when an acid of normal strength is required, normal sulphuric acid be employed in place of normal oxalic acid solution.

One Cubic Centimeter of Normal Sulphuric Acid is the equivalent of:

	Gramme.
Sulphuric Acid, absolute, H_2SO_4	0.04891
Ammonia Gas, NH_3	0.01701
Ammonium Carbonate, $(NH_4)_2CO_3$	0.042935
Ammonium Carbonate [U. S. P.], $NH_4HCO_3.NH_4NH_2CO_2$	0.05226
Lead Acetate, crystallized, $Pb(C_2H_3O_2)_2 + 3H_2O$	0.18900
Lead Subacetate, assumed as $Pb_2O(C_2H_3O_2)_2$	0.13662
Lithium Benzoate, $LiC_7H_5O_2$ (to be ignited)	0.12772
Lithium Carbonate, Li_2CO_3	0.036935
Lithium Citrate, $Li_3C_6H_5O_7$ (to be ignited)	0.0698566
Lithium Salicylate, $LiC_7H_5O_3$ (to be ignited)	0.14368
Potassium Acetate, $KC_2H_3O_2$ (to be ignited)	0.09789
Potassium Bicarbonate, $KHCO_3$	0.09988
Potassium Bitartrate, $KHC_4H_4O_6$ (to be ignited)	0.18767
Potassium Carbonate, anhydrous, K_2CO_3	0.068955
Potassium Citrate, crystallized, $K_3C_6H_5O_7 + H_2O$ (to be ignited)	0.10786
Potassium Hydroxide, KOH	0.05599
Potassium and Sodium Tartrate, $KNaC_4H_4O_6 + 4H_2O$ (to be ignited)	0.14075
Sodium Acetate, $NaC_2H_3O_2 + 3H_2O$ (to be ignited)	0.13574
Sodium Benzoate, $NaC_7H_5O_2$ (to be ignited)	0.14371
Sodium Bicarbonate, $NaHCO_3$	0.08385
Sodium Borate, crystallized, $Na_2B_4O_7 + 10H_2O$	0.19046
Sodium Carbonate, anhydrous, Na_2CO_3	0.052925
Sodium Carbonate, crystallized, $Na_2CO_3 + 10H_2O$	0.142725
Sodium Hydroxide, NaOH	0.03996
Strontium Lactate, $Sr(C_3H_5O_3)_2$ (to be ignited)	0.13244

The following articles are tested with this solution: Ammonii Carbonas; Aqua Ammoniæ; Aqua Ammoniæ Fortior; Liquor Plumbi Subacetatis; Liquor Potassæ; Liquor Sodæ; Lithii Benzoas, after ignition; Lithii Carbonas; Lithii Citras, after ignition; Lithii Salicylas, after ignition; Potassa; Potassa Acetas, after ignition; Potassii Bicarbonas; Potassii Bitartras, after ignition; Potassii Carbonas; Potassii Citras, after ignition; Potassii et Sodii Tartras, after ignition; Soda; Sodii Acetas, after ignition; Sodii Benzoas, after ignition; Sodii Bicarbonas; Sodii Carbonas, anhydrous; Sodii Carbonas Exsiccatus; Spiritus Ammoniæ; Strontii Lactas, after ignition.

Decinormal Sulphuric Acid, U. S.

$H_2SO_4 = 97.82$. 4.891 Gm. in 1 Liter.

Dilute 10 Cc. of normal sulphuric acid with enough water to make 100 Cc.

One Cubic Centimeter of Decinormal Sulphuric Acid is the equivalent of:

	Gramme.
Sulphuric Acid, absolute, H_2SO_4	0.004891
Combined Alkaloids of Nux Vomica, assumed to consist of equal parts of Strychnine and Brucine	0.0364
Potassium Hydroxide, KOH	0.005599

The following article is tested with this solution: Extractum Nucis Vomicæ.

4. Gasometric Estimations.

In certain cases the Pharmacopœia directs the strength of a product or chemical substance to be determined by the volume of some gas (nitrogen dioxide) given off during a definite reaction. This volume is to be determined by the nitrometer in the following manner:

Arrange a nitrometer consisting of a measuring tube (graduated for at least 50 Cc.) and connected by stout rubber tubing with an open equilibrium-tube (both tubes, preferably, provided with a globular expansion near the lower end) in such a manner, by suitable clamps attached to

a stand, that either tube may be readily and quickly clamped at a higher or lower level. The stopcock of the measuring tube having been opened, and the open equilibrium-tube having been raised to a higher level, pour into the latter a saturated aqueous solution of sodium chloride until the measuring tube, including the bore of the stopcock, is completely filled. Then close the latter and fix the equilibrium-tube at a low level. Having ascertained that the stopcock is closed air-tight, and having, if necessary, wiped out the graduated funnel-tube of the nitrometer, introduce into it the prescribed quantity of the liquid to be tested, and allow this to flow slowly into the measuring tube, being careful not to admit any air. Follow it by the prescribed quantities of the several reagents (potassium iodide test-solution and normal sulphuric acid). When the reaction, which takes place at once, moderates, remove the measuring tube from its clamp, and, being careful to hold it constantly so that the liquid contained in it stands at a higher level than that in the equilibrium-tube, shake its contents, without permitting any gas to pass into the open tube. When the reaction has completely ceased restore the tube to its fastening, and allow the apparatus and contents to acquire the ordinary temperature of the room, which is assumed to be at or about 25° C. (77° F.). Then adjust the two tubes so that the liquid columns are exactly the same level, and read off the volume of gas in the measuring tube. Multiply this figure by the weight of the substance yielding 1 Cc. of nitrogen dioxide (see below). The result will be the weight of the pure substance (nitrite) contained in the amount taken for the assay.

For pharmacopœial purposes the determination will be sufficiently exact if the evolved gas be measured at or near 25° C. (77° F.). If it be desired to ascertain the volume which the gas would occupy at any other temperature between 0° C. and 40° C. (32°–104° F.), this may be done with the aid of the table below printed.

EXAMPLE.—Assuming that the volume of gas read off was 44.5 Cc. at 27° C. (80.6° F.), and that it be desired to ascertain the corresponding volume at 0° C. (32° F.), barometric pressure not being taken into consideration, then the 44.5 Cc. must be reduced in the proportion of 1.098901 to 1; or 44.5 must be divided by 1.098901. The result will be 40.5 Cc.

The following table shows the expansion which 1 Cc. of a gas will undergo when it is raised from 0° C. (32° F.) to 40° C. (104° F.):

EXPANSION OF 1 CC. OF A GAS BETWEEN 0° AND 40° C.

°C.	Cc.	°C.	Cc.	°C.	Cc.
0	1.000000	14	1.051282	28	1.102564
1	1.003663	15	1.054945	29	1.106227
2	1.007326	16	1.058608	30	1.109890
3	1.010989	17	1.062271	31	1.113553
4	1.014652	18	1.065934	32	1.117216
5	1.018315	19	1.069597	33	1.120879
6	1.021978	20	1.073260	34	1.124542
7	1.025641	21	1.076923	35	1.128205
8	1.029304	22	1.080586	36	1.131868
9	1.032967	23	1.084249	37	1.135531
10	1.036630	24	1.087912	38	1.139194
11	1.040293	25	1.091575	39	1.142857
12	1.043956	26	1.095238	40	1.146520
13	1.047619	27	1.098901		

Estimation of Nitrogen Dioxide.

NO = 29.97; 1 Liter { at 0° C. and 760 Mm. = 1.3423 Gm.
at 25° C. and 760 Mm. = 1.2297 Gm.

One Cubic Centimeter of Nitrogen Dioxide is the equivalent of:

	At 0° C. and 760 Mm. Gramme.	At 25° C. and 760 Mm. Gramme.
Nitrogen Dioxide, NO	0.0013423	0.0012297
Amyl Nitrite, $C_5H_{11}NO_2$	0.0052305	0.0047923
Ethyl Nitrite, $C_2H_5NO_2$	0.0033529	0.0030716
Sodium Nitrite, $NaNO_2$	0.0030873	0.0028283

The following articles are tested gasometrically by the volume of Nitrogen Dioxide evolved and measured at or near 25° C. (77° F.): Amyl Nitris, Sodii Nitris, Spiritus Ætheris Nitrosi.

Alphabetical List of Volumetric Assays directed by the U. S. Pharmacopœia.

Name.	Gm. taken.	Cc. required.	Volumetric Solution.	Indicator.	Percentage of Strength.	
Acidum Aceticum	6.0	36.0	Normal KOH	Phenolphtalein	36	of absolute acid.
Acidum Aceticum Dilutum	24.0	24.0	Normal KOH	Phenolphtalein	6	of absolute acid.
Acidum Aceticum Glaciale	3.0	49.5	Normal KOH	Phenolphtalein	99	of absolute acid.
Acidum Arsenosum	0.1	20.0	Decinormal Iodine	Starch	98.8	of As_2O_3.
Acidum Carbolicum	0.039	24.0	Decinormal Bromine*		96	of pure phenol.
Acidum Citricum	3.5	50.0	Normal KOH	Phenolphtalein	100	of pure acid.
Acidum Hydrobromicum Dilutum	8.08	10.0	Normal KOH	Phenolphtalein	10	of absolute acid.
Acidum Hydrochloricum	3.64	31.9	Normal KOH	Phenolphtalein	31.9	of absolute acid.
Acidum Hydrochloricum Dilutum	3.64	10.0	Normal KOH	Phenolphtalein	10	of absolute acid.
Acidum Hydrocyanicum Dilutum	1.35	10.0	Decinormal $AgNO_3$	K_2CrO_4	2	of absolute acid.
Acidum Hypophosphorosum Dilutum	0.5	★30.3	Decinormal $KMnO_4$		★10	of absolute acid.
	6.6	★10.0	Normal KOH	Phenolphtalein	★10	of absolute acid.
Acidum Lacticum	4.5	37.5	Normal KOH	Phenolphtalein	75	of absolute acid.
Acidum Nitricum	3.145	34.0	Normal KOH	Phenolphtalein	68	of absolute acid.
Acidum Nitricum Dilutum	6.29	10.0	Normal KOH	Phenolphtalein	10	of absolute acid.
Acidum Phosphoricum	0.978	17.0	Normal KOH	Phenolphtalein	85	of absolute acid.
	0.978	8.5	Normal KOH	Methyl-Orange	85	of absolute acid.
Acidum Phosphoricum Dilutum	4.89	10.0	Normal KOH	Phenolphtalein	10	of absolute acid.
	4.89	5.0	Normal KOH	Methyl-Orange	10	of absolute acid.
Acidum Sulphuricum	0.489	9.25	Normal KOH	Phenolphtalein	92.5	of absolute acid.
Acidum Sulphuricum Aromaticum	4.89	★18.5	Normal KOH	Phenolphtalein	★18.5	of absolute acid.
Acidum Sulphuricum Dilutum	4.89	10.0	Normal KOH	Phenolphtalein	10	of absolute acid.
Acidum Sulphurosum	2.0	40.0	Decinormal Iodine	Starch	6.4	of SO_2.
Acidum Tartaricum	3.75	50.0	Normal KOH	Phenolphtalein	100	of pure acid.
Ammonii Bromidum	0.3	30.9	Decinormal $AgNO_3$	K_2CrO_4	99	of NH_4Br.
Ammonii Carbonas	2.613	50.0	Normal H_2SO_4	Rosolic Acid	100	of pure salt.
Antimonii et Potassii Tartras	0.331	20.0	Decinormal Iodine	Starch	100	of pure salt.
Aqua Ammoniæ	3.4	20.0	Normal H_2SO_4	Rosolic Acid	10	of NH_3.
Aqua Ammoniæ Fortior	1.7	28.0	Normal H_2SO_4	Rosolic Acid	28	of NH_3.
Aqua Chlori	17.7	20.0	Decinormal $Na_2S_2O_3$	Starch	0.4	of chlorine.
Aqua Hydrogenii Dioxidi	1.7 Cc.	30.0	Decinormal $KMnO_4$		3	of H_2O_2.
Argenti Nitras	0.34	20.0	Decinormal NaCl	K_2CrO_4	99.97	of $AgNO_3$.
Argenti Nitras Dilutus	1.0	19.5	Decinormal NaCl	K_2CrO_4	33.14	of $AgNO_3$.
Argenti Nitras Fusus	0.34	19.0	Decinormal NaCl	K_2CrO_4	95	of $AgNO_3$.
Barii Dioxidum	0.422	40.0	Decinormal $KMnO_4$		80	of pure BaO_2.
Calcii Bromidum	0.25	25.0	Decinormal $AgNO_3$	K_2CrO_4	99.7	of pure salt.
Calcii Hypophosphis	0.1	47.0	Decinormal $KMnO_4$		99.68	of pure salt.
Calx Chlorata	0.354	35.0	Decinormal $Na_2S_2O_3$	Starch	35	of chlorine.
Extractum Nucis Vomicæ	0.4	1.65	Decinormal H_2SO_4	Phenolphtalein	15	of total alkaloids.
Ferri Carbonas Saccharatus	3.47	★15.0	Decinormal $K_2Cr_2O_7$	Ferricyanide	★15	of $FeCO_3$.

★ About.

* Determined by residual titration with decinormal sodium thiosulphate solution.

Ferri Carbonas Saccharatus	1.16	★15.0	Decinormal $KMnO_4$	★15	of $FeCO_3$.
Ferri Chloridum	0.56	20.0	Decinormal $Na_2S_2O_3$ . . . Starch	20	of iron.
Ferri Citras	0.56	★16.0	Decinormal $Na_2S_2O_3$ . . . Starch	★16	of iron.
Ferri et Ammonii Citras	0.56	★16.0	Decinormal $Na_2S_2O_3$ . . . Starch	★16	of iron.
Ferri et Ammonii Sulphas	0.56	11.6	Decinormal $Na_2S_2O_3$ . . . Starch	11.6	of iron.
Ferri et Ammonii Tartras	0.56	★17.0	Decinormal $Na_2S_2O_3$ . . . Starch	★17	of iron.
Ferri et Potassii Tartras	0.56	★15.0	Decinormal $Na_2S_2O_3$ . . . Starch	★15	of iron.
Ferri et Quininæ Citras	0.56	★14.5	Decinormal $Na_2S_2O_3$ . . . Starch	★14.5	of iron.
Ferri et Quininæ Citras Solubilis	0.56	★14.5	Decinormal $Na_2S_2O_3$ . . . Starch	★14.5	of iron.
Ferri et Strychninæ Citras	0.56	★16.0	Decinormal $Na_2S_2O_3$ . . . Starch	★16	of iron.
Ferri Hypophosphis	0.1	47.0	Decinormal $KMnO_4$	98.1	of pure salt.
Ferri Iodidum Saccharatum	1.55	★20.0	Decinormal $AgNO_3$*	★20	of FeI_2.
Ferri Phosphas Solubilis	0.56	★12.0	Decinormal $Na_2S_2O_3$ . . . Starch	★12	of iron.
Ferri Pyrophosphas Solubilis	0.56	★10.0	Decinormal $Na_2S_2O_3$ . . . Starch	★10	of iron.
Ferri Sulphas (cryst. and gran.)	1.39	50.0	Decinormal $KMnO_4$	100	of pure crystals.
Ferri Valerianas	0.56	15.0 to 20.0	Decinormal $Na_2S_2O_3$ . . . Starch	15 to 20	of iron.
Ferrum Reductum	0.056	8.0	Decinormal $KMnO_4$	80	of iron.
Ferrum Reductum	0.056	8.0	Decinormal $Na_2S_2O_3$ . . . Starch	80	of iron.
Iodum	0.32	25.0	Decinormal $Na_2S_2O_3$ . . . Starch	98.85	of iodine.
Liquor Acidi Arsenosi	24.7 Cc.	49.4 to 50.	Decinormal Iodine . . . Starch	1 Gm.	of As_2O_3 in 100 Cc.
Liquor Calcis	50.0	★20.0	Decinormal $H_2C_2O_4$ . . . Phenolphtalein	★ 0.14	of $Ca(OH)_2$.
Liquor Ferri Acetatis	1.12	★15.0	Decinormal $Na_2S_2O_3$ . . . Starch	★ 7.5	of iron.
Liquor Ferri Chloridi	1.12	★26.0	Decinormal $Na_2S_2O_3$ . . . Starch	★13	of iron.
Liquor Ferri Citratis	1.12	★15.0	Decinormal $Na_2S_2O_3$ . . . Starch	★ 7.5	of iron.
Liquor Ferri Nitratis	1.12	★ 2.8	Decinormal $Na_2S_2O_3$ . . . Starch	★ 1.4	of iron.
Liquor Ferri Subsulphatis	1.12	★27.2	Decinormal $Na_2S_2O_3$ . . . Starch	★13.6	of iron.
Liquor Ferri Tersulphatis	1.12	★16.0	Decinormal $Na_2S_2O_3$ . . . Starch	★ 8	of iron.
Liquor Iodi Compositus	12.66	49.3 to 50.	Decinormal $Na_2S_2O_3$ . . . Starch	5	of iodine.
Liquor Plumbi Subacetatis	13.67	★25.0	Normal H_2SO_4 . . . Methyl-Orange	★25	of basic salt.
Liquor Potassæ	28.0	★25.0	Normal H_2SO_4 . . . Phenolphtalein	★ 5	of KOH.
Liquor Potassii Arsenitis	24.7 Cc.	49.4 to 50	Decinormal Iodine . . . Starch	1 Gm.	of As_2O_3 in 100 Cc.
Liquor Sodæ	20.0	★25.0	Normal H_2SO_4 . . . Phenolphtalein	★5	of NaOH.
Liquor Sodæ Chloratæ	6.7	50.0	Decinormal $Na_2S_2O_3$ . . . Starch	2.6	of chlorine.
Lithii Benzoas (to be ignited)	1.0	7.8	Normal H_2SO_4 . . . Methyl-Orange	99.6	of pure salt.
Lithii Bromidum	0.3	35.3	Decinormal $AgNO_3$ . . . K_2CrO_4	98	of pure salt.
Lithii Carbonas	0.5	13.4	Normal H_2SO_4 . . . Methyl-Orange	98.98	of pure salt.
Lithii Citras (to be ignited)	1.0	14.2	Normal H_2SO_4 . . . Methyl-Orange	99.2	of pure salt.
Lithii Salicylas (to be ignited)	2.0	13.8	Normal H_2SO_4 . . . Methyl-Orange	99.13	of pure salt.
Potassa	0.56	9.0	Normal H_2SO_4 . . . Phenolphtalein	90	of KOH.

★ About.

* Determined by residual titration with decinormal potassium sulphocyanate solution, ferric ammonium sulphate test-solution being used as indicator.

Alphabetical List of Volumetric Assays directed by the U. S. Pharmacopœia.—*Continued.*

Name.	Gm. taken.	Cc. required.	Volumetric Solution.	Indicator.	Percentage of Strength.	
Potassii Acetas (to be ignited)	1.0	10.0	Normal H_2SO_4	Methyl-Orange	98	of pure salt.
Potassii Bicarbonas	1.0	10.0	Normal H_2SO_4	Methyl-Orange	100	of pure salt.
Potassii Bitartras (to be ignited)	1.88	9.9	Normal H_2SO_4	Methyl-Orange	99	of pure salt.
Potassii Bromidum	0.5	42.85	Decinormal $AgNO_3$	K_2CrO_4	97	of pure salt.
Potassii Carbonas	0.69	9.5	Normal H_2SO_4	Methyl-Orange	95	of pure salt.
Potassii Citras (to be ignited)	1.08	10.0	Normal H_2SO_4	Methyl-Orange	100	of pure salt.
Potassii Cyanidum	0.65	45.0	Decinormal $AgNO_3$	To first Precipitate	90	of pure salt.
Potassii et Sodii Tartras (to be ignited)	1.41	10.0	Normal H_2SO_4	Methyl-Orange	100	of pure salt.
Potassii Hypophosphis	0.1	38.0	Decinormal $KMnO_4$		98.7	of pure salt.
Potassii Iodidum	0.5	30.25	Decinormal $AgNO_3$	K_2CrO_4	99.5	of pure salt.
Potassii Iodidum (alkalinity, K_2CO_3)	1.0	0.05	Decinormal $H_2C_2O_4$	Phenolphtalein	0.034	of alkali.
Potassii Permanganas	0.1	31.3	Decinormal $H_2C_2O_4$		98.7	of $KMnO_4$.
Soda	0.4	9.0	Normal H_2SO_4	Phenolphtalein	90	of NaOH.
Sodii Acetas (to be ignited)	1.36	10.0	Normal H_2SO_4	Methyl-Orange	100	of pure salt.
Sodii Benzoas (to be ignited)	2.0	13.9	Normal H_2SO_4	Methyl-Orange	99.8	of pure salt.
Sodii Bicarbonas	0.85	10.0	Normal H_2SO_4	Methyl-Orange	98.6	of pure salt.
Sodii Bisulphis	0.26	45.0	Decinormal Iodine	Starch	90	of pure salt.
Sodii Bromidum	0.3	29.8	Decinormal $AgNO_3$	K_2CrO_4	97.29	of pure salt.
Sodii Carbonas, anhydrous	1.0	18.7	Normal H_2SO_4	Methyl-Orange	98.9	of pure salt.
Sodii Carbonas Exsiccatus	1.0	13.8	Normal H_2SO_4	Methyl-Orange	★73	of dry salt.
Sodii Chloridum	0.195	33.4	Decinormal $AgNO_3$	K_2CrO_4	99.9	of pure salt.
Sodii Hypophosphis	0.1	37.0	Decinormal $KMnO_4$		97.9	of pure salt.
Sodii Hyposulphis (Thiosulphas)	0.25	9.9	Decinormal Iodine	Starch	98.1	of pure salt.
Sodii Iodidum	0.5	34.5 to 33.4	Decinormal $AgNO_3$	K_2CrO_4	★98	of pure salt.
Sodii Sulphis	0.63	48.0	Decinormal Iodine	Starch	96	of pure salt.
Spiritus Ammoniæ	3.4	20 0	Normal H_2SO_4	Rosolic Acid	10	of NH_3.
Strontii Bromidum	0.3	24.6	Decinormal $AgNO_3$	$K_2Cr_2O_7$	★98	of pure salt.
Strontii Iodidum	0.3	18.0	Decinormal $AgNO_3$	$K_2Cr_2O_7$	★98	of pure salt.
Strontii Lactas (to be ignited)	1.33	9.9	Normal H_2SO_4	Methyl-Orange	98.6	of pure salt.
Syrupus Acidi Hydriodici	32.0	★25.0	Decinormal $AgNO_3$	K_2CrO_4	★ 1	of HI.
Syrupus Ferri Iodidi	1.55	★10.0	Decinormal $AgNO_3$*		★10	of FeI_2.
Tinctura Ferri Chloridi	1.12	★ 9.4	Decinormal $Na_2S_2O_3$	Starch	★ 4.7	of iron.
Tinctura Iodi	6.3 Cc.	★35.0	Decinormal $Na_2S_2O_3$	Starch	★ 7 Gm.	of I in 100 Cc.
Vinum Album	50.0	3. to	Normal KOH	Phenolphtalein	0.45	to 0.78 of acid.
Vinum Rubrum	50.0	5.1	Normal KOH	Eosin, or Fluorescein	0.45	to 0.78 of acid.
Zinci Bromidum	0.3	26.7	Decinormal $AgNO_3$	K_2CrO_4	99.95	of pure salt.
Zinci Chloridum	0.3	44.1	Decinormal $AgNO_3$	K_2CrO_4	99.84	of pure salt.
Zinci Iodidum	0.5	31.0	Decinormal $AgNO_3$	K_2CrO_4	98.62	of pure salt.

* Determined by residual titration with decinormal silver nitrate solution and decinormal potassium sulphocyanate solution, ferric ammonium sulphate test-solution being used as indicator.

★ About.

Table showing the Quantity of Official Acids required to Saturate 100 Parts of an Official Alkali, together with the Quantity of Product.

ACIDS.

ALKALIES.		ACETIC.				ARSENOUS.		BENZOIC.		CITRIC.		HYDROBROMIC.		HYDROCHLORIC.		
		36 %.	6 %.	99 %.	Product.	98.8 %.	Product	100 %.	Product.	100 %.	Product.	10 %.	Product.	31.9 %.	10 %.	Product.
	Of Per cent.															
Ammonium Carbonate	100	318.17	1909.04	115.70	147.09	191.45	238.89	232.89	265.44	133.63	166.19	1545.35	187.08	218.16	695.94	102.14
Ammonia-water	10	97.75	586.52	35.55	45.19	58.81	73.40	71.55	81.55	41.05	51.05	474.78	57.48	67.03	213.82	31.38
Ammonia-water, Stronger	28	273.71	1642.25	99.53	126.53	164.68	205.48	200.35	228.35	114.95	142.95	1329.38	160.94	187.68	598.68	87.87
Potassa	90	267.22	1603.68	97.19	157.35	160.81	234.44	195.64	343.38	112.25	173.38	1298.16	190.95	183.27	584.62	119.59
Solution of Potassa	5	14.85	89.09	5.40	8.74	8.93	13.02	10.87	19.08	6.24	9.63	72.12	10.61	10.18	32.48	6.64
Potassium Bicarbonate	100	166.48	998.86	60.54	98.01	100.16	146.03	121.86	213.88	69.92	107.99	808.57	118.93	114.15	364.14	74.49
Potassium Carbonate	95	229.10	1374.59	83.31	134.87	137.84	200.95	167.69	294.33	96.22	148.61	1112.72	163.67	157.09	501.11	102.51
Soda	90	374.50	2247.00	136.18	305.72	225.32	292.57	274.12	323.67	157.28	267.51	1818.92	231.44	256.78	819.14	131.46
Solution of Soda	5	20.81	124.83	7.57	16.98	12.52	16.25	15.22	17.98	8.82	15.00	101.05	12.86	14.26	45.51	7.30
Sodium Bicarbonate	98.6	195.53	1173.17	71.10	159.62	117.64	152.75	143.12	168.99	82.12	139.67	949.66	120.84	134.07	427.68	68.64
Sodium Carbonate	98.9	115.22	691.35	41.90	94.06	69.32	90.02	84.34	99.59	48.39	82.31	559.64	71.21	79.01	252.03	40.45

ACIDS.

ALKALIES.		LACTIC.		NITRIC.			PHOSPHORIC.			SALICYLIC.		SULPHURIC.			TARTARIC.	
		75 %.	Product.	68 %.	10 %.	Product.	85 %.	10 %.	Product.	100 %.	Product.	92.5 %.	10 %.	Product.	100 %.	Product.
	Of Per cent.															
Ammonium Carbonate	100	229.08	204.36	176.97	1203.41	152.89	110.09	935.80	126.13	263.43	295.98	101.19	935.99	126.15	143.18	175.73
Ammonia-water	10	70.38	62.79	54.37	369.72	46.97	33.82	287.48	38.75	80.93	90.93	31.08	287.54	38.75	43.99	53.99
Ammonia-water, Stronger	28	197.07	175.80	152.24	1035.23	131.52	94.70	804.91	108.49	226.62	254.62	87.04	805.10	108.51	123.16	151.16
Potassa	90	192.44	205.46	148.66	1010.91	162.22	92.47	786.03	139.73	221.29	282.42	84.99	786.19	139.75	120.27	188.61
Solution of Potassa	5	10.69	11.41	8.26	56.16	9.01	5.14	43.67	7.76	12.29	15.69	4.72	43.68	7.76	6.68	10.48
Potassium Bicarbonate	100	119.86	127.97	92.60	629.65	101.04	57.60	489.59	87.03	137.83	175.91	52.94	489.69	87.04	74.91	117.48
Potassium Carbonate	95	164.95	176.11	147.43	866.50	139.05	79.26	673.75	119.77	189.68	242.08	72.85	673.89	119.79	103.09	161.67
Soda	90	269.64	251.78	208.30	1416.44	191.19	129.57	1101.35	402.39	310.07	359.62	119.09	1101.58	361.96	168.52	258.51
Solution of Soda	5	14.98	13.99	11.57	78.69	10.62	7.20	61.19	22.35	17.23	19.98	6.62	61.20	20.11	9.36	14.36
Sodium Bicarbonate	98.6	140.78	131.45	108.75	739.53	99.82	67.65	575.02	210.09	161.89	187.76	62.18	575.14	188.98	87.98	134.97
Sodium Carbonate	98.9	82.96	77.47	64.09	435.81	58.83	39.87	338.86	123.81	95.40	110.65	36.64	338.93	111.37	51.85	79.54

Tables Showing the Quantity of Official Alkalies and Acids Required to make 100 Parts of the Corresponding Salts.

AMMONIUM SALTS.

AMMONIUM SALTS.	Parts of Alkali Required. Ammonium Carbonate, 100 %.	Ammonia-water, 10 %.	Ammonia-water, 28 %.	Parts.	Parts of Acid Required.	Of Percent.
Ammonium Acetate, $NH_4C_2H_3O_2$	67.99	221.28	79.03	216.31	Acetic Acid	36
				1297.86	" " Diluted	36
				78.65	" " Glacial	99
" Arsenite (Meta), NH_4AsO_2	41.86	136.27	48.67	80.14	Arsenous Acid	98.8
" Benzoate, $NH_4C_7H_5O_2$	37.67	122.62	43.79	87.74	Benzoic Acid	100
" Bromide, NH_4Br	53.45	173.98	62.13	826.02	Hydrobromic Acid, Diluted	10
" Chloride, NH_4Cl	97.90	318.66	113.81	213.59	Hydrochloric Acid	31.9
				681.34	" " Diluted	10
" Citrate, $(NH_4)_3C_6H_5O_7$	60.17	195.87	69.95	80.41	Citric Acid	100
" Lactate, $NH_4C_3H_5O_3$	48.93	159.27	56.88	112.10	Lactic Acid	75
" Nitrate, NH_4NO_3	65.41	212.89	76.03	115.75	Nitric Acid	68
				787.11	" " Diluted	10
" Phosphate, $(NH_4)_2HPO_4$	79.28	258.08	92.17	87.28	Phosphoric Acid	85
				741.92	" " Diluted	10
" Salicylate, $NH_4C_7H_5O_3$	33.79	109.97	39.27	89.00	Salicylic Acid	100
" Sulphate, $(NH_4)_2SO_4$	79.27	258.04	92.16	80.21	Sulphuric Acid	92.5
				741.96	" " Diluted	10
" Tartrate, $(NH_4)_2C_4H_4O_6$	56.90	185.23	66.15	81.48	Tartaric Acid	100

POTASSIUM SALTS.

POTASSIUM SALTS.	Parts of Alkali Required. Potassa, 90 %.	Solution of Potassa, 5 %.	Potassium Bicarbonate, 100 %.	Potassium Carbonate, 95 %.	Parts.	Parts of Acid Required.	Of Percent.
Potassium Acetate, $KC_2H_3O_2$	63.55	1143.93	102.03	74.14	169.86	Acetic Acid	36
					1019.17	" " Diluted	6
					61.77	" " Glacial	99
" Arsenite (Meta), $KAsO_2$	42.66	767.78	68.48	49.76	68.59	Arsenous Acid	98.8
" Benzoate, $KC_7H_5O_2+3H_2O$	29.12	524.20	46.76	33.97	56.97	Benzoic Acid	100
" Bromide, KBr	52.37	942.67	84.08	61.10	679.85	Hydrobromic Acid, Diluted	10
" Chloride, KCl	83.62	1505.11	134.25	97.55	153.24	Hydrochloric Acid	31.9
					488.84	" " Diluted	10
" Citrate, $K_3C_6H_6O_7+H_2O$	57.68	1038.17	92.60	67.29	61.74	Citric Acid	100
" Lactate, $KC_3H_5O_3$	48.67	876.08	78.14	56.78	93.66	Lactic Acid	75
" Nitrate, KNO_3	61.64	1109.59	98.97	71.92	91.64	Nitric Acid	68
					623.17	" " Diluted	10
" Phosphate, K_2HPO_4	71.56	1288.16	114.90	83.49	66.18	Phosphoric Acid	85
					562.52	" " Diluted	10
" Salicylate, $KC_7H_5O_3$	35.41	637.34	56.85	41.31	78.36	Salicylic Acid	100
" Sulphate, K_2SO_4	71.55	1288.01	114.88	83.48	60.82	Sulphuric Acid	92.5
					562.57	" " Diluted	10
" Tartrate, $2K_2C_4H_4O_6+H_2O$	52.02	954.32	85.12	61.85	63.76	Tartaric Acid	100

SODIUM SALTS.

SODIUM SALTS.	Parts of Alkali Required. Soda, 90 %.	Solution of Soda, 5 %.	Sodium Bicarbonate, 98.6 %.	Sodium Carbonate, 98.9 %.	Parts.	Parts of Acid Required.	Of Percent.
Sodium Acetate, $NaC_2H_3O_2+3H_2O$	32.71	588.77	62.65	106.31	122.50	Acetic Acid	36
					734.98	" " Diluted	6
					44.54	" " Glacial	99
" Arsenite (Meta), $NaAsO_2$	34.18	615.24	65.17	111.09	77.01	Arsenous Acid	98.8
" Benzoate, $NaC_7H_5O_2$	30.90	556.12	59.17	100.42	84.69	Benzoic Acid	100
" Bromide, $NaBr$	43.21	777.73	82.76	140.43	785.91	Hydrobromic Acid, Diluted	10
" Chloride, $NaCl$	76.07	1369.20	145.69	247.23	195.33	Hydrochloric Acid	31.9
					623.09	" " Diluted	10
" Citrate, $2Na_3C_6H_5O_7+11H_2O$	37.38	666.71	71.60	121.50	58.80	Citric Acid	100
" Lactate, $NaC_3H_5O_3$	39.72	714.91	76.07	129.09	107.09	Lactic Acid	75
" Nitrate, $NaNO_3$	52.30	941.15	100.18	169.99	108.95	Nitric Acid	68
					740.84	" " Diluted	10
" Phosphate, $Na_2HPO_4+12H_2O$	24.29	447.33	47.60	80.77	32.20	Phosphoric Acid	85
					273.70	" " Diluted	10
" Salicylate, $NaC_7H_5O_3$	27.81	500.53	53.26	90.38	86.22	Salicylic Acid	100
" Sulphate, $Na_2SO_4+10H_2O$	27.63	497.29	52.92	89.79	32.90	Sulphuric Acid	92.5
					304.34	" " Diluted	10
" Tartrate, $Na_2C_4H_4O_6+2H_2O$	38.68	696.29	74.09	125.73	65.19	Tartaric Acid	100

Note.—On page 1041 will be found complete Saturation Tables, showing the quantity of official alkalies required to saturate 100 parts of an official acid.

Table of Elements.

The atomic weights, as determined by L. Meyer and K. Seubert, are those adopted by the U. S. Pharmacopœia.

	Symbols.	Atomic value.	Atomic weight.		Symbols.	Atomic value.	Atomic weight.
Aluminum	Al	III	27.04	Mercury (Hydrargyrum)	Hg	II	199.8
Antimony (Stibium)	Sb	III, V	119.6	Molybdenum	Mo	II, IV, VI	95.9
Arsenic	As	III, V	74.9	Nickel	Ni	II, VI	58.6
Barium	Ba	II, IV	136.9	Nitrogen	N	I, III, V	14.01
Beryllium (Glucinum)	Be	II	9.03	Osmium	Os	II, IV, VI, VIII	190.3
Bismuth	Bi	III, V	208.9	Oxygen	O	II	15.96
Boron	B	III	10.9	Palladium	Pd	II, IV	106.35
Bromine	Br	I, III, V, VII	79.76	Phosphorus	P	III, V	30.96
Cadmium	Cd	II	111.5	Platinum	Pt	II, IV	194.3
Cæsium	Cs	I	132.7	Potassium (Kalium)	K	I	39.03
Calcium	Ca	II	39.91	Rhodium	Rh	II, III, IV	102.9
Carbon	C	II, IV	11.97	Rubidium	Rb	I	85.2
Cerium	Ce	III, IV	139.9	Ruthenium	Ru	II, IV, VI, VIII	101.4
Chlorine	Cl	I, III, V, VII	35.37	Samarium	Sm		149.62
Chromium	Cr	III, VI	52.0	Scandium	Se	III	43.97
Cobalt	Co	II, III, VI	58.6	Selenium	Se	II, IV, VI	78.87
Columbium (Niobium)	Cb	III, V	93.7	Silicium	Si	IV	28.3
Copper (Cuprum)	Cu	I, II	63.18	Silver (Argentum)	Ag	I	107.66
Didymium	D	III	142.0	Sodium (Natrium)	Na	I	23.0
Erbium	Eb	III	166.0	Strontium	Sr	II, IV	87.3
Fluorine	F	I	19.0	Sulphur	S	II, IV, VI	31.98
Gallium	Ga	III	69.9	Tantalum	Ta	V	182.0
Germanium	Ge	II, IV	72.3	Tellurium	Te	II, IV, VI	125.0
Gold (Aurum)	Au	I, III	196.7	Terbium	Tb		159.1
Hydrogen	H	I	1.0	Thallium	Tl	I, III	203.7
Indium	In	III	113.6	Thorium	Th	IV	231.9
Iodine	I	I, III, V, VII	126.53	Tin (Stannum)	Sn	II, IV	118.8
Iridium	Ir	II, IV, VI	192.5	Titanium	Ti	IV	48.0
Iron (Ferrum)	Fe	II, III, VI	55.88	Tungsten or Wolfram	W	II, IV, VI	183.6
Lanthanum	La	III	138.2	Uranium	U	IV, VI	238.8
Lead (Plumbum)	Pb	II, IV	206.4	Vanadium	V	III, V	51.1
Lithium	Li	I	7.01	Ytterbium	Yb	III	172 6
Magnesium	Mg	II	24.3	Yttrium	Y	III	88.9
Manganese	Mn	II, IV, VI	54.8	Zinc	Zn	II	65.1
				Zirconium	Zr	IV	90.4

In addition to the above, the discovery of the following elements has been announced, but little is known of their properties: Actinium (Ac), Decipium (Dp), Holmium (Ho), Ilmenium (Il), Lavœsium (Lv), Mosandrium (Mo), Neptunium (Np), Philippium (Pp), and Thulium (Tu).

Alphabetical List of Formulas and Molecular Weights of the Principal Chemicals and Reagents.

		Mol. Weight.
Acetanilid	$C_6H_5NH.C_2H_3O$	134.73
Acid, Acetic	$HC_2H_3O_2$	59.86
" Antimonic	H_3SbO_4	186.44
" Antimonous	H_3SbO_3	170.48
" Arsenic	H_3AsO_4	141.74
" Arsenous. (See Arsenic Trioxide.)		
" Aurochloric	$HAuCl_4 + 2H_2O$	375.10
" Benzoic	$HC_7H_5O_2$	121.71
" Boric	H_3BO_3	61.78
" Carbolic	C_6H_5OH	93.78
" Chloroplatinic	$H_2PtCl_6 + 6H_2O$	516.28
" Chromic (Chromium Trioxide)	CrO_3	99.88
" Citric	$H_3C_6H_5O_7 + H_2O$	209.50
" " dry	$H_3C_6H_5O_7$	191.54
" Gallic	$HC_7H_5O_5 + H_2O$	187.55
" " dry	$HC_7H_5O_5$	169.59

		Mol. Weight.
Acid, Hydriodic	HI	127.53
" Hydrobromic	HBr	80.76
" Hydrochloric	HCl	36.37
" Hydrocyanic	HCN	26.98
" Hydroferricyanic	$H_6Fe_2Cy_{12}$	429.52
" Hydroferrocyanic	H_4FeCy_6	215.76
" Hydrofluoric	HFl	20.0
" Hydrosulphuric. (See Hydrogen Sulphide.)		
" Hypophosphorous	HPH_2O_2	65.88
" Kinic	$HC_7H_{11}O_6$	191.55
" Lactic	$HC_3H_5O_3$	89.79
" Meconic	$C_7H_4O_7$	199.51
" Metaphosphoric	HPO_3	79.84
" Molybdic (crystallized)	$H_2MoO_4 + H_2O$	179.70
" Nitric	HNO_3	62.89
" Nitrous	HNO_2	46.93
" Oleic	$HC_{18}H_{33}O_2$	281.38
" Oxalic	$H_2C_2O_4 + 2H_2O$	125.70
" " dry	$H_2C_2O_4$	89.78
" Palmitic	$HC_{16}H_{31}O_2$	255.44
" Phosphoric	H_3PO_4	97.80
" Phosphorous	H_2HPO_3	81.84
" Picric	$C_6H_2(NO_2)_3OH$	228.57
" Pyroboric	$H_2B_4O_7$	157.32
" Pyrogallic. (See Pyrogallol.)		
" Pyrophosphoric	$H_4P_2O_7$	177.64
" Salicylic	$HC_7H_5O_3$	137.67
" Silicic	H_2SiO_3	78.18
" Stearic	$HC_{18}H_{35}O_2$	283.38
" Succinic	$H_2C_4H_4O_4$	117.72
" Sulphuric	H_2SO_4	97.82
" Sulphurous	H_2SO_3	81.86
" Tannic	$HC_{14}H_9O_9$	321.22
" Tartaric	$H_2C_4H_4O_6$	149.64
" Tetraboric (Pyroboric)	$H_2B_4O_7$	157.32
" Tungstic (crystallized)	$H_2WO_4 + H_2O$	267.4
" Uric	$C_5H_4N_4O_3$	167.77
" Valerianic	$HC_5H_9O_2$	101.77
Alcohol, amylic	$C_5H_{11}OH$	87.81
" ethylic	C_2H_5OH	45.90
" methylic	CH_3OH	31.93
Aldehyde, benzoic	C_7H_6O	105.75
" ethylic	C_2H_4O	43.90
Alum. (See Aluminum and Potassium Sulphate.)		
Aluminum Hydroxide (Hydrate)	$Al_2(OH)_6$	155.84
" and Ammonium Sulphate	$Al_2(NH_4)_2(SO_4)_4 + 24H_2O$	904.42
" " Potassium Sulphate	$Al_2K_2(SO_4)_4 + 24H_2O$	946.46
" " " " dry	$Al_2K_2(SO_4)_4$	515.42
" Sulphate	$Al_2(SO_4)_3 + 16H_2O$	628.90
" " dry	$Al_2(SO_4)_3$	341.54
Ammonia	NH_3	17.01
Ammonium Acetate	$NH_4C_2H_3O_2$	76.87
" Arsenite (Metarsenite)	NH_4AsO_2	124.83
" Benzoate	$NH_4C_7H_5O_2$	138.72
" Bromide	NH_4Br	97.77
" Carbonate (normal)	$(NH_4)_2CO_3$	95.87
" " (U. S. P.)	$NH_4HCO_3.NH_4NH_2CO_2$	156.77
" Chloride	NH_4Cl	53.38
" Citrate	$(NH_4)_3C_6H_5O_7$	242.57
" Iodide	NH_4I	144.54
" Lactate	$NH_4C_3H_5O_3$	106.80
" Molybdate	$(NH_4)_2MoO_4$	195.76
" Nitrate	NH_4NO_3	79.90
" Oxalate	$(NH_4)_2C_2O_4 + H_2O$	141.76
" " dry	$(NH_4)_2C_2O_4$	123.80
" Phosphate	$(NH_4)_2HPO_4$	131.82
" Salicylate	$NH_4C_7H_5O_3$	154.68
" Sulphate	$(NH_4)_2SO_4$	131.84
" Sulphydrate	NH_4HS	50.99
" Sulphide	$(NH_4)_2S$	68.00
" Tartrate	$(NH_4)_2C_4H_4O_6$	183.66
" Valerianate	$NH_4C_5H_9O_2$	118.78
Amyl Acetate	$C_5H_{11}C_2H_3O_2$	129.71
" Nitrite	$C_5H_{11}NO_2$	116.78

		Mol. Weight.
Antimony Oxide (Trioxide)	Sb_2O_3	287.08
" and Potassium Tartrate	$2K(SbO)C_4H_4O_6 + H_2O$	662.42
" " " " dry	$K(SbO)C_4H_4O_6$	322.23
Antimony Sulphide	Sb_2S_3	335.14
Antipyrine	$C_6H_5(CH_3)_2C_3HN_2O$	187.65
Apomorphine Hydrochlorate	$C_{17}H_{17}NO_2HCl$	302.79
Arsenic Iodide	AsI_3	454.49
" Trioxide	As_2O_3	197.68
Atropine	$C_{17}H_{23}NO_3$	288.38
" Sulphate	$(C_{17}H_{23}NO_3)_2H_2SO_4$	674.58
Barium Carbonate	$BaCO_3$	196.75
" Chloride	$BaCl_2 + 2H_2O$	243.56
" " dry	$BaCl_2$	207.64
" Dioxide	BaO_2	168.82
" Hydroxide (Hydrate)	$Ba(OH)_2$	170.82
" Nitrate	$Ba(NO_3)_2$	260.68
Benzene (Benzol)	C_6H_6	77.82
Benzoic Sulphinide	$C_6H_4COSO_2NH$	182.66
Bismuth Carbonate	$Bi_2(CO_3)_3$	597.35
" Citrate	$BiC_6H_5O_7$	397.44
" Nitrate	$Bi(NO_3)_3$	394.57
" Oxide	Bi_2O_3	465.68
" Oxychloride	$BiOCl$	260.23
" Subcarbonate (approximately)	$(BiO)_2CO_3$	509.57
" Subnitrate (approximately)	$BiONO_3.H_2O$	304.71
Boron Trioxide	B_2O_3	69.68
Brucine	$C_{23}H_{26}N_2O_4 + 4H_2O$	465.01
" dry	$C_{23}H_{26}N_2O_4$	393.17
Cadmium Iodide	CdI_2	364.56
" Sulphate	$CdSO_4$	207.32
Caffeine	$C_8H_{10}N_4O_2 + H_2O$	211.68
" dry	$C_8H_{10}N_4O_2$	193.72
Calcium Acetate	$Ca(C_2H_3O_2)_2$	157.63
" Bromide	$CaBr_2$	199.43
" Carbonate	$CaCO_3$	99.76
" Chloride	$CaCl_2 + 6H_2O$	218.41
" " dry	$CaCl_2$	110.65
" Hydroxide (Hydrate)	$Ca(OH)_2$	73.83
" Hypophosphite	$Ca(PH_2O_2)_2$	169.67
" Hypochlorite	$Ca(ClO)_2$	142.57
" Iodide	CaI_2	292.97
" Oxalate	CaC_2O_4	127.69
" Oxide	CaO	55.87
" Phosphate	$Ca_3(PO_4)_2$	309.33
" Sulphate (Gypsum)	$CaSO_4 + 2H_2O$	171.65
" " dry	$CaSO_4$	135.73
" Sulphide (Monosulphide)	CaS	71.89
" Sulphite	$CaSO_3 + 2H_2O$	155.69
" Tartrate	$CaC_4H_4O_6$	187.55
Camphor	$C_{10}H_{16}O$	151.66
" Monobromated	$C_{10}H_{15}BrO$	230.42
Carbon Dioxide	CO_2	43.89
" Disulphide	CS_2	75.93
Cerium Oxalate	$Ce_2(C_2O_4)_3 + 9H_2O$	704.78
" " dry	$Ce_2(C_2O_4)_3$	543.14
Chloral Hydrate	$C_2HCl_3O + H_2O$	164.97
" Anhydrous	C_2HCl_3O	147.01
Chloroform	$CHCl_3$	119.08
Chrome Alum	$Cr_2K_2(SO_4)_4 + 24H_2O$	996.38
Chromium Sesquioxide	Cr_2O_3	151.88
Cinchonidine	$C_{19}H_{22}N_2O$	293.41
" Sulphate	$(C_{19}H_{22}N_2O)_2H_2SO_4 + 3H_2O$	738.52
" " dry	$(C_{19}H_{22}N_2O)_2H_2SO_4$	684.64
Cinchonine	$C_{19}H_{22}N_2O$	293.41
" Sulphate	$(C_{19}H_{22}N_2O)_2H_2SO_4 + 2H_2O$	720.56
" " dry	$(C_{19}H_{22}N_2O)_2H_2SO_4$	684.64
Cobaltous Nitrate	$Co(NO_3)_2 + 6H_2O$	290.14
Cocaine Hydrochlorate	$C_{17}H_{21}NO_4HCl$	338.71
Codeine	$C_{18}H_{21}NO_3 + H_2O$	316.31
" dry	$C_{18}H_{21}NO_3$	298.35
Coniine	$C_8H_{17}N$	126.77
Cupric Acetate	$Cu(C_2H_3O_2)_2 + H_2O$	198.86
" " basic	$Cu(C_2H_3O_2)_2CuO + 6H_2O$	367.80
" Ammonium Sulphate	$Cu(NH_3)_4SO_4 + H_2O$	245.00

		Mol. Weight.
Cupric Oxide	CuO	79.14
" Sulphate	$CuSO_4 + 5H_2O$	248.80
" " dry	$CuSO_4$	159.00
" Tartrate	$CuC_4H_4O_6 + 3H_2O$	264.70
Cuprous Oxide	Cu_2O	142.32
Cyanogen	$(CN)_2$	51.96
Diphenylamine	$(C_6H_5)_2NH$	168.65
Elaterin	$C_{20}H_{28}O_5$	347.20
Ether. (See Ethyl Oxide.)		
Ethyl Acetate	$C_2H_5C_2H_3O_2$	87.80
" Nitrite	$C_2H_5NO_2$	74.87
" Oxide (Æther, U. S. P.)	$(C_2H_5)_2O$	73.84
Eucalyptol	$C_{10}H_{18}O$	153.66
Ferric Acetate	$Fe_2(C_2H_3O_2)_6$	464.92
" Ammonium Sulphate	$Fe_2(NH_4)_2(SO_4)_4 + 24H_2O$	962.10
" " " dry	$Fe_2(NH_4)_2(SO_4)_4$	531.06
" Chloride	$Fe_2Cl_6 + 12H_2O$	539.50
" " dry	Fe_2Cl_6	323.98
" Hydroxide (Hydrate)	$Fe_2(OH)_6$	213.52
" Hypophosphite	$Fe_2(PH_2O_2)_6$	501.04
" Nitrate	$Fe_2(NO_3)_6$	483.10
" Oxide	Fe_2O_3	159.64
" Phosphate (normal, not U. S. P.)	$Fe_2(PO_4)_2$	301.36
" Pyrophosphate (normal, not U. S. P.)	$Fe_4(P_2O_7)_3$	744.44
" Subsulphate (variable).		
" Sulphate	$Fe_2(SO_4)_3$	399.22
" Valerianate (variable).		
Ferrous Bromide	$FeBr_2$	215.40
" Carbonate	$FeCO_3$	115.73
" Iodide	FeI_2	308.94
" Lactate	$Fe(C_3H_5O_3)_2 + 3H_2O$	287.34
" Oxalate	$FeC_2O_4 + H_2O$	161.62
" Sulphate	$FeSO_4 + 7H_2O$	277.42
" " dry	$FeSO_4$	151.70
" Sulphide	FeS	87.86
Glucose. (See Sugar, Grape.)		
Glycerin	$C_3H_5(OH)_3$	91.79
Glyceryl Trinitrate	$C_3H_5(NO_3)_3$	226.58
Gold Chloride	$AuCl_3$	302.81
Homatropine Hydrobromate	$C_{16}H_{21}NO_3HBr$	355.17
Hydrastinine Hydrochlorate	$C_{11}H_{11}NO_2HCl$	224.97
Hydrogen Dioxide	H_2O_2	33.92
" Sulphide	H_2S	33.98
Hyoscine Hydrobromate	$C_{17}H_{21}NO_4HBr + 3H_2O$	436.98
" " dry	$C_{17}H_{21}NO_4HBr$	383.10
Hyoscyamine Hydrobromate	$C_{17}H_{23}NO_3HBr$	369.14
" Sulphate	$(C_{17}H_{23}NO_3)_2H_2SO_4$	674.58
Iodoform	CHI_3	392.56
Lead Acetate	$Pb(C_2H_3O_2)_2 + 3H_2O$	378.00
" " dry	$Pb(C_2H_3O_2)_2$	324.12
" Carbonate (official)	$(PbCO_3)_2Pb(OH)_2$	772.82
" " pure	$PbCO_3$	266.25
" Iodide	PbI_2	459.46
" Nitrate	$Pb(NO_3)_2$	330.18
" Oxide	PbO	222.36
" Subacetate (approximately)	$Pb_2O(C_2H_3O_2)_2$	546.48
Lime. (See Calcium Oxide.)		
Lithium Benzoate	$LiC_7H_5O_2$	127.72
" Bromide	$LiBr$	86.77
" Carbonate	Li_2CO_3	73.87
" Citrate	$Li_3C_6H_5O_7$	209.57
" Salicylate	$LiC_7H_5O_3$	143.68
Magnesia. (See Magnesium Oxide.)		
Magnesium Carbonate (approximately)	$(MgCO_3)_4Mg(OH)_2 + 5H_2O$	484.62
" " pure	$MgCo_3$	84.15
" Lactate, dry	$Mg(C_3H_5O_3)_2$	201.88
" Oxide	MgO	40.26
" Sulphate	$MgSO_4 + 7H_2O$	245.84
" " dry	$MgSO_4$	120.12
" Sulphite	$MgSO_3 + 6H_2O$	211.92
Manganese Dioxide	MnO_2	86.72
Manganous Sulphate	$MnSO_4 + 4H_2O$	222.46
" " dry	$MnSO_4$	150.62
Menthol	$C_{10}H_{19}OH$	155.66

		Mol. Weight.
Mercuric Ammonium Chloride	NH_2HgCl	251.18
" Chloride	$HgCl_2$	270.54
" Cyanide	$Hg(CN)_2$	251.76
" Iodide	HgI_2	452.86
" Nitrate	$Hg(NO_3)_2$	323.58
" Oxide	HgO	215.76
" Potassium Iodide	$HgI_2 + 2KI$	783.98
" Subsulphate	$Hg(HgO)_2SO_4$	727.14
" Sulphate	$HgSO_4$	295.62
" Sulphide	HgS	231.78
Mercurous Chloride	Hg_2Cl_2	470.34
" Iodide	Hg_2I_2	652.66
" Nitrate	$Hg_2(NO_3)_2 + 2H_2O$	559.30
" Sulphate	Hg_2SO_4	495.42
Methyl Salicylate	$CH_3C_7H_5O_3$	151.64
Molybdenum Trioxide	MoO_3	143.78
Morphine	$C_{17}H_{19}NO_3 + H_2O$.	302.34
" dry	$C_{17}H_{19}NO_3$	284.38
" Acetate	$C_{17}H_{19}NO_3C_2H_4O_2 + 3H_2O$	398.12
" Hydrochlorate	$C_{17}H_{19}NO_3HCl + 3H_2O$	374.63
" " dry	$C_{17}H_{19}NO_3HCl$	320.75
" Sulphate	$(C_{17}H_{19}NO_3)_2H_2SO_4 + 5H_2O$	756.38
" " dry	$(C_{17}H_{19}NO_3)_2H_2SO_4$	666.58
Naphtalin	$C_{10}H_8$	127.70
Naphtol	$C_{10}H_7(OH)$	143.66
Narceine	$C_{23}H_{23}NO_9$	461.96
Narcotine	$C_{22}H_{23}NO_7$	412.07
Nickel Bromide	$NiBr_2 + 3H_2O$	272.00
" Sulphate	$NiSO_4 + 7H_2O$	280.14
Nicotine	$C_{10}H_{14}N_2$	161.72
Nitrogen Dioxide	NO	29.97
Nitro-glycerin. (See Glyceryl Trinitrate.)		
Paracyanogen	$(CN)_3$	77.94
Paraldehyde	$C_6H_{12}O_3$	131.70
Phenacetin	$C_{10}H_{13}NO_2$	178.63
Phenol. (See Acid, Carbolic.)		
Phosphorus Oxychloride	$POCl_3$	153.03
" Pentachloride	PCl_5	207.81
" Trichloride	PCl_3	137.07
Physostigmine Salicylate	$C_{15}H_{21}N_3O_2C_7H_6O_3$	412.17
" Sulphate	$(C_{15}H_{21}N_3O_2)_2H_2SO_4$	934.28
Picrotoxin	$C_{30}H_{34}O_{13}$	600.58
Pilocarpine Hydrochlorate	$C_{11}H_{16}N_2O_2HCl$	243.98
Piperin	$C_{17}H_{19}NO_3$	284.38
Platinic Chloride	$PtCl_4$	335.78
Potassa. (See Potassium Hydroxide.)		
Potassium Acetate	$KC_2H_3O_2$	97.89
" Arsenite (Metarsenite)	$KAsO_2$	145.85
" Benzoate	$KC_7H_5O_2 + 3H_2O$	213.62
" " dry	$KC_7H_5O_2$	159.74
" Bicarbonate	$KHCO_3$	99.88
" Bichromate. (See Dichromate.)		
" Bitartrate	$KHC_4H_4O_6$	187.67
" Bromate	$KBrO_3$	166.67
" Bromide	KBr	118.79
" Carbonate	K_2CO_3	137.91
" Chlorate	$KClO_3$	122.28
" Chloride	KCl	74.40
" Chromate	K_2CrO_4	193.90
" Citrate	$K_3C_6H_5O_7 + H_2O$	323.59
" " dry	$K_3C_6H_5O_7$	305.63
" Cyanide	KCN	65.01
" Dichromate	$K_2Cr_2O_7$	293.78
" Ferricyanide	$K_6Fe_2(CN)_{12}$	657.70
" Ferrocyanide	$K_4Fe(CN)_6 + 3H_2O$	421.76
" " dry	$K_4Fe(CN)_6$	367.88
" Hydroxide (Hydrate)	KOH	55.99
" Hypophosphite	KPH_2O_2	103.91
" Iodide	KI	165.56
" Lactate	$KC_3H_5O_3$	127.82
" Nitrate	KNO_3	100.92
" Permanganate	$KMnO_4$	157.67
" Phosphate	K_2HPO_4	173.86
" Salicylate	$KC_7H_5O_3$	175.70

		Mol. Weight.
Potassium and Sodium Tartrate	$KNaC_4H_4O_6 + 4H_2O$	281.51
" " " dry	$KNaC_4H_4O_6$	209.67
" Sulphate	K_2SO_4	173.88
" Sulphite	$K_2SO_3 + 2H_2O$	193.84
" " dry	K_2SO_3	157.92
" Sulphocyanate	$KSCN$	96.99
" Tartrate	$2K_2C_4H_4O_6 + H_2O$	469.36
" " dry	$K_2C_4H_4O_6$	225.70
Propenyl Trinitrate. (See Glyceryl Trinitrate.)		
Pyrogallol	$C_6H_3(OH)_3$	125.70
Quinidine	$C_{20}H_{24}N_2O_2$	323.34
" Sulphate	$(C_{20}H_{24}N_2O_2)_2H_2SO_4 + 2H_2O$	780.42
" " dry	$(C_{20}H_{24}N_2O_2)_2H_2SO_4$	744.50
Quinine	$C_{20}H_{24}N_2O_2 + 3H_2O$	377.22
" dry	$C_{20}H_{24}N_2O_2$	323.34
" Bisulphate	$C_{20}H_{24}N_2O_2H_2SO_4 + 7H_2O$	546.88
" " dry	$C_{20}H_{24}N_2O_2H_2SO_4$	421.16
" Hydrobromate	$C_{20}H_{24}N_2O_2HBr + H_2O$	422.06
" " dry	$C_{20}H_{24}N_2O_2HBr$	404.10
" Hydrochlorate	$C_{20}H_{24}N_2O_2HCl + 2H_2O$	395.63
" " dry	$C_{20}H_{24}N_2O_2HCl$	359.71
" Sulphate	$(C_{20}H_{24}N_2O_2)_2H_2SO_4 + 7H_2O$	870.22
" " dry	$(C_{20}H_{24}N_2O_2)_2H_2SO_4$	744.50
" Valerianate	$C_{20}H_{24}N_2O_2C_5H_{10}O_2 + H_2O$	443.07
Resorcin	$C_6H_4(OH)_2$	109.74
Saccharin (Benzoic Sulphinide)	$C_6H_4COSO_2NH$	168.65
Salicin	$C_{13}H_{18}O_7$	285.33
Salol	$C_6H_5C_7H_5O_3$	213.49
Santonin	$C_{15}H_{18}O_3$	245.43
Silica (Silicic Oxide)	SiO_2	60.22
Silver Bromide	$AgBr$	187.42
" Chloride	$AgCl$	143.03
" Cyanide	$AgCN$	133.64
" Iodide	AgI	234.19
" Nitrate	$AgNO_3$	169.55
" Oxide	Ag_2O	231.28
" Sulphate	Ag_2SO_4	311.14
Soda. (See Sodium Hydroxide.)		
Sodium Acetate	$NaC_2H_3O_2 + 3H_2O$	135.74
" " dry	$NaC_2H_3O_2$	81.86
" Arsenate	$Na_2HAsO_4 + 7H_2O$	311.46
" " dry	Na_2HAsO_4	185.74
" Arsenite (Metarsenite)	$NaAsO_2$	129.82
" Benzoate	$NaC_7H_5O_2$	143.71
" Bicarbonate	$NaHCO_3$	83.85
" Bisulphite	$NaHSO_3$	103.86
" Bitartrate	$NaHC_4H_4O_6 + H_2O$	189.60
" Borate	$Na_2B_4O_7 + 10H_2O$	380.92
" " dry	$Na_2B_4O_7$	201.32
" Bromate	$NaBrO_3$	150.64
" Bromide	$NaBr$	102.76
" Carbonate	$Na_2CO_3 + 10H_2O$	285.45
" " dry	Na_2CO_3	105.85
" Chlorate	$NaClO_3$	106.25
" Chloride	$NaCl$	58.37
" Citrate	$2Na_3C_6H_5O_7 + 11H_2O$	712.64
" " dry	$Na_3C_6H_5O_7$	257.54
" Cobaltic Nitrite	$Co_2(NO_2)_6 6NaNO_2 + H_2O$	824.32
" Hydroxide (Hydrate)	$NaOH$	39.96
" Hypophosphite	$NaPH_2O_2 + H_2O$	105.84
" Hyposulphite. (See Thiosulphate.)		
" Iodide	NaI	149.53
" Lactate	$NaC_3H_5O_3$	111.79
" Molybdate	$Na_2MoO_4 + H_2O$	221.70
" Nitrate	$NaNO_3$	84.89
" Nitrite	$NaNO_2$	68.93
" Nitro-prusside	$Na_2Fe(NO)(CN)_5 + 2H_2O$	297.67
" Phosphate	$Na_2HPO_4 + 12H_2O$	357.32
" " dry	Na_2HPO_4	141.80
" Pyrophosphate	$Na_4P_2O_7 + 10H_2O$	445.24
" " dry	$Na_4P_2O_7$	265.64
" Salicylate	$NaC_7H_5O_3$	159.67
" Santoninate	$2NaC_{15}H_{19}O_4 + 7H_2O$	696.50
" Sulphate	$Na_2SO_4 + 10H_2O$	321.42

		Mol. Weight.
Sodium Sulphate, dry	Na_2SO_4	141.82
" Sulphite	$Na_2SO_3 + 7H_2O$	251.58
" " dry	Na_2SO_3	125.86
" Sulphocarbolate	$NaSO_3C_6H_4(OH) + 2H_2O$	231.56
" Tartrate	$Na_2C_4H_4O_6 + 2H_2O$	229.56
" Thiosulphate (Hyposulphite)	$Na_2S_2O_3 + 5H_2O$	247.64
" " " dry	$Na_2S_2O_3$	157.84
Sparteine Sulphate	$C_{15}H_{26}N_2H_2SO_4 + 4H_2O$	403.23
" " dry	$C_{15}H_{26}N_2H_2SO_4$	331.39
Stannous Chloride	$SnCl_2 + 2H_2O$	225.46
Strontium Bromide	$SrBr_2 + 6H_2O$	354.58
" " dry	$SrBr_2$	246.82
" Carbonate	$SrCO_3$	147.15
" Iodide	$SrI_2 + 6H_2O$	448.12
" " dry	SrI_2	340.36
" Lactate	$Sr(C_3H_5O_3)_2 + 3H_2O$	318.76
" " dry	$Sr(C_3H_5O_3)_2$	264.88
" Nitrate	$Sr(NO_3)_2 + 4H_2O$	282.92
Strychnine	$C_{21}H_{22}N_2O_2$	333.31
" Nitrate	$C_{21}H_{22}N_2O_2.HNO_3$	396.20
" Sulphate	$(C_{21}H_{22}N_2O_2)_2H_2SO_4 + 5H_2O$	854.24
" " dry	$(C_{21}H_{22}N_2O_2)_2H_2SO_4$	764.44
Sugar, Cane	$C_{12}H_{22}O_{11}$	341.20
" Grape	$C_6H_{12}O_6$	179.58
" Milk	$C_{12}H_{22}O_{11} + H_2O$	359.16
Sulphonal	$(CH_3)_2C(SO_2C_2H_5)_2$	251.53
Sulphur Dioxide	SO_2	63.90
Terebene	$C_{10}H_{16}$	135.70
Terpin Hydrate	$C_{10}H_{18}(OH)_2 + H_2O$	189.58
Thiosinamine	$CS.N_2H_3(C_3H_5)$	115.88
Thymol	$C_{10}H_{14}O$	149.66
Tungsten Trioxide	WO_3	231.48
Water	H_2O	17.96
Zinc Acetate	$Zn(C_2H_3O_2)_2 + 2H_2O$	218.74
" " dry	$Zn(C_2H_3O_2)_2$	182.82
" Bromide	$ZnBr_2$	224.62
" Carbonate (normal, not U. S. P.)	$ZnCO_3$	124.95
" Chloride	$ZnCl_2$	135.84
" Iodide	ZnI_2	318.16
" Oxide	ZnO	81.06
" Phosphide	Zn_3P_2	257.22
" Sulphate	$ZnSO_4 + 7H_2O$	286.64
" " dry	$ZnSO_4$	160.92
" Sulphide	ZnS	97.08
" Valerianate	$Zn(C_5H_9O_2)_2 + 2H_2O$	302.56

Equivalents of Weights and Measures, U. S. P.

Customary and Metric.

The values given in the following tables for the relation of weight to measure apply to water at its greatest density (temperature 4° C. or 39.2° F.) *in vacuo*, and for ordinary purposes may be used without correction. If intended to be applied to liquids having a higher or lower specific gravity than water, the weight in grammes of such liquid must be divided by the specific gravity of the liquid in order to ascertain the volume in cubic centimeters corresponding to the given weight; the customary fluid measure can then be found by reference to the tables. For instance, to find the volume in fluidounces of 875 grammes of official alcohol, divide 875 by 0.820, which yields 1067.07 cubic centimeters, and 1067.07 Cc. of water at 4° C. equal 36.082 fluidounces, for 1000 : 33.814 : : 1067.07 : *x*. $x = 36.082$; hence 875 Gm. of alcohol U. S. P. measure practically 36.082 fluidounces.

Weights, customary.						Metric Weight and Measure.	Measures, customary.		
Grains.	Troy		Avoirdupois				Fluid		Fluidounces and fractions.
	oz.	grains.	lbs.	oz.	grains.	Gm.] [Cm.	ounces.	minims.	
15432.4	32	72.4	2	3	119.9	**1000**	33	390.6	33.814
15360	**32**	. .	2	3	47.5	995.312	33	314.5	33.655
15061.1	31	181.1	2	. .	101.1	975.932	**33**	. .	**33**
15046.6	31	166.6	2	2	171.6	**975**	32	464.9	32.968
14880	**31**	. .	2	2	5	964.208	32	289.7	32.604
14660.7	30	260.7	2	1	223.2	**950**	32	59.1	32.123
14604.5	30	204.5	2	1	167	946.358	**32**	. .	**32**
14400	**30**	. .	2	. .	400	933.105	31	264.9	31.552
14274.9	29	354.9	2	. .	274.9	**925**	31	109.3	31.278
14148.2	29	228.2	2	. .	148.2	916.785	**31**	. .	**31**
14000	29	80.	**2**	. .	. .	907.185	30	324.2	30.676
13920	**29**	. .	1	15	357.5	902.000	30	240	30.500
13889.1	28	449.1	1	15	326.6	**900**	30	207.6	30.432
13691.8	28	251.8	1	15	129.3	887.211	**30**	. .	**30**
13562.5	28	122.5	**1**	**15**	. .	878.635	29	344.1	29.717
13503.3	28	63.3	1	14	378.3	**875**	29	281.8	29.587
13440	**28**	. .	1	14	315	870.898	29	215.2	29.448
13235.4	27	275.4	1	14	10.4	857.637	**29**	. .	**29**
13125	27	165	**1**	**14**	. .	850.486	28	363.9	28.759
13117.5	27	157.5	1	13	430	**850**	28	356	28.742
12960	**27**	. .	1	13	272.5	839.794	28	190.4	28.397
12779	26	299	1	13	91.5	828.064	**28**	. .	**28**
12731.7	26	251.7	1	13	44.2	**825**	27	430.3	27.896
12687.5	26	207.5	**1**	**13**	. .	822.136	27	383.8	27.800
12480	**26**	. .	1	12	230	808.691	27	165.6	27.345
12345.9	25	345.9	1	12	95.9	**800**	27	24.5	27.051
12322.6	25	322.6	1	12	72.6	798.490	**27**	. .	**27**
12250	25	250	**1**	**12**	. .	793.787	26	403.7	26.841
12000	**25**	. .	1	11	187.5	777.587	26	140.7	26.293
11960.1	24	440.1	1	11	147.6	**775**	26	98.7	26.206
11866.2	24	346.2	1	11	53.7	768.916	**26**	. .	**26**
11812.5	24	292.5	**1**	**11**	. .	765.437	25	423.6	25.883
11574.3	24	54.3	1	10	199	**750**	25	173	25.360
11520	**24**	. .	1	10	145	746.484	25	115.9	25.241
11409.8	23	369.8	1	10	34.8	739.343	**25**	. .	**25**
11375	23	335	**1**	**10**	. .	737.087	24	443.4	24.924
11188.5	23	148.5	1	9	151	**725**	24	247.2	24.515
11040	**23**	. .	1	9	102.5	715.380	24	91.1	24.190
10953.4	22	393.4	1	9	15.9	709.769	**24**	. .	**24**
10937.5	22	377.5	**1**	**9**	. .	708.738	23	463.3	23.966
10802.6	22	242.6	1	8	302.6	**700**	23	321.4	23.670
10560	**22**	. .	1	8	60	684.277	23	66.2	23.138
10500	21	420	**1**	**8**	. .	680.388	23	3.1	23.007
10497.0	21	417	1	7	434.5	680.195	**23**	. .	**23**
10416.8	21	336.8	1	7	354.3	**675**	22	395.7	22.824
10080	**21**	. .	1	7	17.5	653.173	22	41.4	22.086
10062.5	20	462.5	**1**	**7**	. .	652.039	22	23.0	22.048
10040.6	20	440.6	1	6	415.6	650.621	**22**	. .	**22**
10031.0	20	431	1	6	406	**650**	21	469.9	21.979
9645.2	20	45.2	1	6	20.2	**625**	21	64.1	21.134
9625	20	25	**1**	**6**	. .	623.689	21	42.9	21.09
9600	**20**	. .	1	5	412.1	622.070	21	16.6	21.035
9584.2	19	464.2	1	5	396.7	621.048	**21**	. .	**21**

EQUIVALENTS OF WEIGHTS AND MEASURES.—*Continued.*

Weights, customary.						Metric Weight and Measure.	Measures, customary.		
Grains.	Troy		Avoirdupois				Fluid		Fluidounces and fractions.
	oz.	grains.	lbs.	oz.	grains.	Gm.] [Cm.	ounces.	minims.	
9259.4	19	139.4	1	5	71.9	**600**	20	138.4	20.288
9187.5	19	67.5	**1**	**5**	. .	595.340	20	62.7	20.131
9127.8	19	7.8	1	4	377.8	591.474	**20**	. .	**20**
9120	**19**	. .	1	4	370	590.966	19	471.8	19.983
8873.6	18	31.4	1	4	123.6	**575**	19	212.6	19.443
8750	18	110	**1**	**4**	. .	566.990	19	82.6	19.172
8671.4	18	31.4	1	3	358.9	561.900	**19**	. .	**19**
8640	**18**	. .	1	3	327.5	559.863	18	447	18.931
8487.8	17	327.8	1	3	175	**550**	18	286.8	18.598
8312.5	17	152.5	**1**	**3**	. .	538.641	18	102.5	18.214
8215.1	17	55.1	1	2	340.1	532.327	**18**	. .	**18**
8160	**17**	. .	1	2	285	528.759	17	422.1	17.880
8102	16	422	1	2	227	**525**	17	361.1	17.752
7875	16	195.1	**1**	**2**	. .	510.291	17	122.4	17.255
7758.7	16	78.7	1	1	321.2	502.753	**17**	. .	**17**
7716.2	16	27.2	1	1	278.7	**500**	16	435.3	16.907
7680	**16**	. .	1	1	242.5	497.656	16	397.2	16.828
7437.5	15	237.5	**1**	**1**	. .	481.942	16	142.2	16.297
7330.4	15	130.4	1	. .	330.4	**475**	16	29.6	16.062
7302.3	15	102.3	1	. .	302.3	473.179	**16**	. .	**16**
7200	**15**	. .	1	. .	200	466.552	15	372.4	15.776
7000	14	280	**1**	. .	. .	453.592	15	162.1	15.338
6944.6	14	174.6	. .	15	382.1	**450**	15	103.8	15.216
6845.9	14	125.9	. .	15	283.4	443.606	**15**	. .	**15**
6720	**14**	. .	. .	15	157.5	435.449	14	347.6	14.724
6562.4	13	322.5	. .	**15**	. .	425.243	14	182	14.379
6558.8	13	318.8	. .	14	433.8	**425**	14	178.0	14.371
6389.5	13	149.5	. .	14	264.5	414.032	**14**	. .	**14**
6240	**13**	. .	. .	14	115	404.345	13	322.8	13.672
6172.9	12	412.9	. .	14	47.9	**400**	13	252.3	13.526
6125	12	365	. .	**14**	. .	396.893	13	201.8	13.421
5933.1	12	173.1	. .	13	245.6	384.458	**13**	. .	**13**
5787.1	12	27.1	. .	13	99.6	**375**	12	326.5	12.680
5760	**12**	. .	. .	13	72.5	373.242	12	298	12.621
5687.5	11	407.5	.	**13**	. .	368.544	12	221.7	12.462
5476.7	11	196.7	. .	12	226.7	354.884	**12**	. .	**12**
5401.3	11	121.3	. .	12	151.3	**350**	11	400.7	11.835
5280	**11**	. .	. .	12	30	342.138	11	273.1	11.570
5250	10	450	. .	**12**	. .	340.194	11	241.6	11.503
5020.3	10	220.3	. .	11	207.8	325.311	**11**	. .	**11**
5015.5	10	215.5	. .	11	203	**325**	10	475	10.989
4812.5	10	12.5	.	**11**	. .	311.845	10	261.4	10.545
4800	**10**	. .	. .	10	425	311.035	10	248.3	10.517
4629.7	9	399.7	. .	10	254.7	**300**	10	69.2	10.144
4563.9	9	243.9	. .	10	188.9	295.737	**10**	. .	**10**
4375	9	55	. .	**10**	. .	283.495	9	281.3	9.586
4320	**9**	. .	. .	9	382.5	279.930	9	223.5	9.466
4244	8	404	. .	9	306.5	**275**	9	143.4	9.299
4107.5	8	267.5	. .	9	170	266.163	**9**	. .	**9**
3937.5	8	97.5	. .	**9**	. .	255.146	8	301.2	8.628
3858.1	8	18.1	. .	8	358.1	**250**	8	217.7	8.453
3840	**8**	. .	. .	8	340	248.828	8	198.6	8.414
3651.1	7	291.1	. .	8	151.1	236.590	**8**	. .	**8**
3500	7	140	. .	**8**	. .	226.796	7	321.0	7.669
3472.3	7	112.3	. .	7	409.8	**225**	7	291.9	7.608
3360	**7**	. .	. .	7	297.5	217.724	7	173.8	7.362
3194.7	6	314.7	. .	7	132.2	207.016	**7**	. .	**7**

Equivalents of Weights and Measures.—*Continued.*

Weights, customary.						Metric Weight and Measure.	Measures, customary.		
Grains.	Troy		Avoirdupois				Fluid		Fluidounces and fractions.
	oz.	grains.	lbs.	oz.	grains.	Gm.] [Cm.	ounces.	minims.	
3086.5	6	206.5	. .	7	24	**200**	6	366.1	6.763
3062.5	6	182.5	. .	**7**	. .	198.447	6	340.9	6.710
2880	**6**	. .	. .	6	255	186.621	6	149	6.310
2738.4	5	338.4	. .	6	113.4	177.442	**6**	. .	**6**
2700.7	5	300.7	. .	6	75.7	**175**	5	440.4	5.917
2625	5	225	. .	**6**	. .	170.097	5	360.8	5.752
2400	**5**	. .	. .	5	212.5	155.517	5	124.1	5.259
2314.9	4	394.9	. .	5	127.4	**150**	5	34.6	5.072
2282	4	362	. .	5	94.5	147.869	**5**	. .	**5**
2187.5	4	267.5	. .	**5**	. .	141.748	4	380.7	4.793
1929	4	9	. .	4	179	**125**	4	108.8	4.227
1920	**4**	. .	. .	4	170	124.414	4	99.3	4.207
1825.6	4	385.6	. .	4	75.6	118.295	**4**	. .	**4**
1720	3	310	. .	**4**	. .	113.398	3	400.5	3.834
1543.2	3	103.2	. .	3	230.7	**100**	3	183.1	3.381
1440	**3**	. .	. .	3	127.5	93.310	3	74.5	3.155
1388.9	2	428.9	. .	3	76.4	**90**	3	20.8	3.043
1369.2	2	409.2	. .	3	46.7	88.721	**3**	. .	**3**
1312.5	2	352.5	. .	**3**	. .	85.049	2	420.4	2.876
1234.6	2	274.6	. .	2	359.6	**80**	2	338.5	2.705
1157.4	2	197.4	. .	2	282.4	**75**	2	257.3	2.536
1080.3	2	120.3	. .	2	205.3	**70**	2	176.1	2.367
960	**2**	. .	. .	2	85	62.207	2	49.7	2.103
925.9	1	445.9	. .	2	50.9	**60**	2	13.8	2.029
912.8	1	432.8	. .	2	37.8	59.147	**2**	.	**2**
875	1	395	. .	**2**	. .	56.699	1	440.3	1.917
771.6	1	291.6	. .	1	334.1	**50**	1	331.5	1.691
617.3	1	137.3	. .	1	179.8	**40**	1	169.2	1.353
480	**1**	. .	. .	1	42.5	31.1035	1	24.8	1.052
462.9	. .	. .	. .	1	25.4	**30**	1	6.9	1.014
456.392	. .	. .	. .	1	18.89	29.574	**1**	. .	**1**
437.5	. .	. .	. .	**1**	. .	28.350	. .	460.1307	0.959
385.8	. .	. .	. .	. .	.	**25**	. .	405.8	0.845
308.6	. .	. .	. .	. .	. .	**20**	. .	324.61	0.676
154.3	. .	. .	. .	. .	. .	**10**	. .	162.31	0.338
15.4324	. .	. .	. .	. .	. .	**1**	. .	16.23	0.034
1	. .	. .	. .	. .	. .	0.06479	. .	1.0517	0.0022
0.9508	. .	. .	. .	. .	. .	0.06161	. .	**1**	0.0021

Equivalents of Weights from 1 Troy Ounce Down.

Grains.	Metric Weight and Measure. Gm.] [Cc.	Minims (of Water at 4° C.).	Grains.	Metric Weight and Measure. Gm.] [Cc.	Minims (of Water at 4° C.).
480 [1 ℥	31.103	504.8	**420** [7 ʒ	27.214	441.7
478.4	**31**	503.1	416.7	**27**	438.2
475.4	30.805	**500**	401.2	**26**	422
463.0	**30**	486.9	399.3	25.876	**420**
456.4	29.573	**480**	**390**	25.271	410.2
450	29.159	473.3	385.8	**25**	405.7
447.5	**29**	470.7	380.3	24.644	**400**
437.5 [1 av. oz.	28.350	460.1	370.8	24.028	**390**
432.1	**28**	454.4	370.4	**24**	389.5
427.9	27.724	**450**			

EQUIVALENTS OF WEIGHTS AND MEASURES.—*Continued.*

Grains.	Metric Weight and Measure. Gm.] [Cc.	Minims (of Water at 4° C.).
360 [6 ʒ	23.327	378.6
354.9	**23**	373.3
342.3	22.180	**360**
339.5	**22**	357.1
330	21.383	347.1
324.1	**21**	340.8
313.8	20.331	**330**
308.6	**20**	324.6
300 [5 ʒ	19.440	315.5
293.2	**19**	308.4
285.2	18.483	**300**
277.8	**18**	292.1
270	17.495	284.0
262.3	**17**	275.9
256.7	16.635	**270**
246.9	**16**	259.7
240 [4 ʒ	15.551	252.4
231.5	**15**	243.4
228.2	14.786	**240**
218.75 [½ av. oz.	14.175	230.1
216.1	**14**	227.2
210	13.607	220.9
200.6	**13**	211
199.7	12.938	**210**
185.2	**12**	194.8
180 [3 ʒ	11.663	189.3
171.1	11.090	**180**
169.8	**11**	178.5
154.3	**10**	162.3
150	9.719	157.8
142.6	9.241	**150**
138.9	**9**	146.1
123.5	**8**	129.8
120 [2 ʒ	7.775	126.2
114.1	7.393	**120**
109.37 [¼ av. oz.	7.088	115.9
108.0	**7**	113.6
100	6.480	105.2
95.1	6.161	**100**
92.6	**6**	97.4
80	5.184	84.1
77.2	**5**	81.1
76.1	4.928	**80**
61.7	**4**	64.9

Grains.	Metric Weight and Measure. Gm.] [Cc.	Minims (of Water at 4° C.).
60 [1 ʒ	3.888	63.1
57.0	3.696	**60**
54.69 [⅛ av. oz.	3.544	57.5
47.5	3.080	**50**
50	3.240	52.6
46.3	**3**	48.7
42.8	2.772	**45**
40	2.592	42.1
38.0	2.464	**40**
33.3	2.156	**35**
30.9	**2**	32.5
30 [½ ʒ	1.944	31.6
28.5	1.848	**30**
23.8	1.540	**25**
20	1.296	21.0
19.0	1.232	**20**
15.4324	**1**	16.23
15	0.972	15.9
14.3	0.924	**15**
14	0.907	14.7
13.3	0.862	**14**
13	0.842	13.7
12.4	0.801	**13**
12	0.775	12.6
11.4	0.739	**12**
11	0.713	11.6
10.5	0.678	**11**
10	0.648	10.5
9.5	0.616	**10**
9	0.583	9.5
8.6	0.554	**9**
8	0.518	8.4
7.7	**0.5**	8.1
7.6	0.493	**8**
7	0.454	7.4
6.7	0.431	**7**
6	0.389	6.3
5.7	0.370	**6**
5	0.324	5.3
4.8	0.308	**5**
4	0.259	4.2
3.8	0.246	**4**
3	0.194	3.2
2.9	0.185	**3**
2	0.130	2.1
1.9	0.123	**2**
1	0.065	1.0517
0.9508	0.06161	**1**

Equivalents of Weights and Measures.—*Concluded.*

Equivalents of Weights from 5 Grains Down.

Grammes.	Grains		Grammes.	Grains	
	in decimal fractions.	in common fractions (approximate).		in decimal fractions.	in common fractions (approximate).
0.324	**5**	**5**	0.028	0.43	$\frac{7}{16}$
0.291	4.5	$4\frac{1}{2}$	0.025	0.39	$\frac{2}{5}$
0.259	**4**	**4**	0.024	0.37	$\frac{3}{8}$
0.226	3.5	$3\frac{1}{2}$	0.020	0.31	$\frac{5}{16}$
0.194	**3**	**3**	0.016	0.24	$\frac{1}{4}$
0.162	2.5	$2\frac{1}{2}$	0.012	0.18	$\frac{3}{16}$
0.130	**2**	**2**	0.008	0.12	$\frac{1}{8}$
0.097	1.5	$1\frac{1}{2}$	0.004	0.06	$\frac{1}{16}$
0.065	**1**	**1**	0.0032	0.05	$\frac{1}{20}$
			0.0027	0.04	$\frac{1}{25}$
0.061	0.94	$\frac{15}{16}$	0.0022	0.033	$\frac{1}{30}$
0.060	0.93	$\frac{9}{10}$	0.0018	0.028	$\frac{1}{36}$
0.057	0.88	$\frac{7}{8}$	0.0016	0.025	$\frac{1}{40}$
0.053	0.82	$\frac{13}{16}$	0.0013	0.02	$\frac{1}{50}$
0.050	0.77	$\frac{4}{5}$	0.0011	0.017	$\frac{1}{60}$
0.049	0.76	$\frac{3}{4}$	0.001	0.015	$\frac{1}{65}$
0.045	0.69	$\frac{11}{16}$	0.0006	0.01	$\frac{1}{100}$
0.040	0.62	$\frac{10}{16}$	0.0005	0.008	$\frac{1}{128}$
0.036	0.56	$\frac{9}{16}$	0.0004	0.0065	$\frac{1}{150}$
0.032	**0.5**	$\frac{1}{2}$	0.0003	0.005	$\frac{1}{200}$
			0.0002	0.003	$\frac{1}{320}$
			0.0001	0.0015	$\frac{1}{640}$

Tables of Weights and Measures.

Apothecaries' or Troy Weight, U. S.

One pound,	℔	= 12 troyounces	= 5760 grains	= 13 ounces avoirdupois 72.5 grains.
One troyounce,	℥	= 8 drachms	= 480 "	= 1 ounce " 42.5 "
One drachm,	ʒ	= 3 scruples	= 60 "	
One scruple,	℈		= 20 "	
One grain,	gr.		= 1 grain.	

Apothecaries' or Wine Measure, U. S.

					Cubic inches.	Troy grains of water at 60° F.
1 minim, ♏					0.00376	0.95
60 minims =	1 fluidrachm, ʒ				0.2256	56.96
480 " =	8 fluidrachms =	1 fluidounce, f ℥			1.8047	455.69
7680 " =	128 " =	16 fluidounces =	1 pint, O		28.875	7291.11
61440 " =	1024 " =	128 " =	8 pts. =	1 gal., Cong. 231.		58328.88

Weights and Measures of the British Pharmacopœia.

One pound,	lb	= 16 ounces	= 7000 troy grains	= lbi ℥ij ʒiv gr. xl.
One ounce,	oz.	= 437.5 "	= ℥ vij gr. xvijss.
One grain,	gr.	= 1 grain.	

The pound and ounce of the British Pharmacopœia are identical with the same denominations of *avoirdupois weight*. The avoirdupois ounce is subdivided into 16 drachms (1 drachm = 27.34 troy grains); but the British Pharmacopœia recognizes no subdivisions between the ounce and grain. It is, however, optional with the physician *in prescribing* to use the symbols ℈ and ʒ, the former representing 20 and the latter 60 grains, if such be found to conduce to accuracy or convenience.

						Troy grains.	Avoirdupois.
1 minim, *min.*						0.91	
60 minims =	1 fluidrachm, *fldr.*					54.7	
480 " =	8 fluidrachms =	1 fluidounce, *floz.*				437.5 =	1 ounce.
9600 " =	160 " =	20 fluid ozs. =	1 pint, O			8750. =	1.25 pound.
76800 " =	1280 " =	160 " =	8 pints =	70000. =	10 pounds.

Metric Weights and Measures.

				Troy weight.
1 milligram (Mgm.) =	0.001 gram (Gm.)			.015 grain.
10 milligrams =	1 centigram (Cgm.) =	0.010 gram (Gm.)		.154 "
100 " =	10 centigrams " =	1 decigram (Dgm.) =	0.100 gram (Gm.)	1.543 "
1000 " =	100 " " =	10 decigrams " =	1.000 "	15.432 "

				Troy grains.	Av. weight.
1 gram (weight of 1 cubic centimeter of water at 40° C.).					
10 grams =	1 dekagram			154.323	.3527 ounce.
100 " =	10 dekagrams =	1 hektogram		1543.235	3.5274 ounces.
1000 " =	100 " =	10 hektograms =	1 kilogram (Kgm.).	15432.350	35.274 "
10 kilograms =	1 myriagram =	22.046 lb. av.			
100 " =	1 quintal =	220.46 "			
1000 " =	1 millier or tonneau =	2204.6 "			

				Apothecaries' measure.
1 milliliter (or 1 cubic centimeter, Ccm.) =	0.001 liter			16.23 minims.
10 milliliters =	1 centiliter =	0.010 "		2.71 fluidrachms.
100 " =	10 centiliters =	1 deciliter =	0.100 liter	3.38 fluidounces.
1000 " =	100 " =	10 deciliters =	1.000 "	33.81 "

				Wine measure.
1 liter (or 1 cubic decimeter)				1.0567 quarts.
10 liters =	1 dekaliter			2.6417 gallons.
100 " =	10 dekaliters =	1 hektoliter		26.417 "
1000 " =	100 " =	10 hektoliters =	1 kiloliter or stere	264.17 "

The unit of all metric measures is the *meter* (French, *mètre*), and this is the ten-millionth part of the quadrant or fourth part of the terrestrial meridian, the quadrant being the distance from the equator to the pole. The cube of the tenth part of a meter, denominated *liter* (Fr. *litre*), was adopted as the unit of measures of capacity. The weight of the one-thousandth part of a liter of distilled water at its greatest density (4° C.) was denominated *gram* (Fr. *gramme*), and adopted as the unit of weight. The subdivisions of all measures are named by prefixing to the name of the unit the Latin numerals *deci* (.1), *centi* (.01), and *milli* (.001), and the larger denominations by prefixing the Greek numerals *deka* (10), *hekto* (100), *kilo* (1000), and *myria* (10000).

Relative Value of Wine or Apothecaries' and Imperial Measures.

Wine measure.	Imperial measure. Pints.	Floz.	Fldr.	Minims.	Imperial measure.	Wine measure. Galls.	Pints.	f3.	f3.	Minims.
1 minim	...	...	...	1.04	1 minim	...	...	...	...	0.96
1 fluidrachm	...	...	1	2.5	1 fluidrachm	...	...	...	...	58
1 fluidounce	...	1	0	20.	1 fluidounce	...	...	...	7	41
1 pint	...	16	5	19.	1 pint	...	1	3	1	38
1 gallon	6	13	2	32.	1 gallon	1	1	9	5	4

24 fluidounces wine measure = 25 fluidounces Imperial measure (difference 1 grain).

Approximate Measures.

In Great Britain prescriptions are compounded by weighing the solids and measuring the liquids, and the same course is very generally followed in the United States; but on the continent of Europe weights alone are employed in the making of preparations as well as in the compounding of prescriptions. Medicines are, however, taken by familiar domestic measures, which are subject to considerable variations, but are usually estimated as having the following capacity:

	In the United States.	In France.
A teaspoonful	1 fluidrachm	5 grams of water.
A desertspoonful	2 fluidrachms	10 " " "
A tablespoonful	½ fluidounce	15 " " "
A wineglassful	2 fluidounces	———
A glassful	———	150 grams of water.
A teacupful	4 fluidounces	———
A tumblerful	8 fluidounces	———

The approximate measures by the *handful* (Fr. *poignée*) and pinch (Fr. *pincée*) are almost completely discarded, or employed only for the least active drugs.

The measuring of small quantities of liquids by drops gives very uncertain and variable results, which are influenced by the viscidity of the liquid, the size, shape, and fulness of the vessel, the curvature of the lip, the temperature, the rapidity of dropping, and probably by other circumstances. As a rule, it may be said that aqueous liquids yield larger drops than those containing little or no water; but very different results are obtained with the same liquid dropped from different bottles, or even from the same bottle under different conditions; the differences amount frequently to 50, and occasionally to 200, per cent. For these reasons medicated liquids should not be ordered in drops, but preferably by weight or measure; and whenever it is desirable for the patient to take a medicine by drops, the dose may be approximated by estimating each minim to contain of—

Ether and ethereal solutions	2½ to 3 drops.
Tinctures, alcoholic solutions, and volatile oils	1½ to 2 or 2½ drops.
Medicated wines	1 to 1½ drops.
Water and aqueous solutions	¾ to 1 drop.

In order to avoid to some extent the discrepancies resulting from the dropping of liquids under various conditions, dropping-measures (*compte-gouttes*) have been constructed in France, yielding at 15° C. drops of distilled water, 20 of which weigh 1 Gm., at least within a limit of 2 per cent. The French Codex gives a table containing the weight of 1 drop, and the number of drops for 1 Gm. of various liquids, dropped under the conditions stated, which may be summarized as follows:

Number of drops	for 1 Gm. of the following liquids:
20	Hydrocyanic acid, Diluted sulphuric acid, Aqueous solutions of the salts of metals and the alkaloids.
21–26	Mineral acids, Ammonia-water, Glycerin, Fowler's solution, Vinegars.
31	Solution of chloral (¼).
33	Wine (Grenache) and medicated wines.
43	Creasote.
48	Fixed oils.
50–57	Glacial acetic acid, Carbolic acid (alcoholic solution), Alcohol (sp. gr. .864 and over), Chloroform, Volatile oils, Tinctures, Spirit of nitrous ether.
61	Alcohol (sp. gr. .834), Tincture of iodine.
72	Spirit of ether.
90	Ether.

Equivalents of Measures of Length.

CUSTOMARY AND METRIC.

CENTIMETERS.	Inches.	CENTIMETERS.	Inches.	MILLIMETERS.	Inches in decimal fractions.	Inches in 32ds.
150	59.06	**55**	21.65	25.4	1.	$\frac{32}{32}$
145	57.09	53.3	**21**	**25**	0.98	
140	55.12	50.8	**20**	24	0.94	
139.7	**55**	**50**	19.69	23.8	0.94	$\frac{30}{32}$
135	53.15	48.3	**19**	23	0.90	$\frac{29}{32}$
130	51.18	45.7	**18**	22.2	0.87	$\frac{28}{32}$
127.0	**50**	**45**	17.72	22	0.87	
125	49.21	43.2	**17**	21	0.83	
120	47.24	40.6	**16**	20.6	0.81	$\frac{26}{32}$
115	45.28	**40**	15.75	**20**	0.79	
114.3	**45**	38.1	**15**	19.1	0.75	$\frac{24}{32}$
110	43.31	35.6	**14**	19	0.75	
105	41.34	**35**	13.78	18	0.71	
101.6	**40**	33.0	**13**	17.5	0.69	$\frac{22}{32}$
100	39.37	30.5	**12**	17	0.67	
99.0	**39**	**30**	11.81	16	0.63	
96.5	**38**	27.9	**11**	15.9	0.62	$\frac{20}{32}$
95	37.40	25.4	**10**	**15**	0.59	
93.9	**37**	**25**	9.84	14.3	0.56	$\frac{18}{32}$
91.4	**36**	22.9	**9**	14	0.55	
90	35.43	20.3	**8**	13	0.51	
88.9	**35**	**20**	7.87	12.7	0.50	$\frac{16}{32}$
86.4	**34**	17.8	**7**	12	0.47	
85	33.46	15.2	**6**	11.1	0.44	$\frac{14}{32}$
83.8	**33**	**15**	5.91	11	0.43	
81.3	**32**	12.7	**5**	**10**	0.39	
80	31.50	10.2	**4**	9.5	0.37	$\frac{12}{32}$
78.7	**31**	**10**	3.94	**9**	0.35	
76.2	**30**	**9**	3.54	8.7	0.34	$\frac{11}{32}$
75	29.53	**8**	3.15	**8**	0.31	
73.6	**29**	7.6	**3**	7.9	0.31	$\frac{10}{32}$
71.1	**28**	**7**	2.76	7.1	0.28	$\frac{9}{32}$
70	27.56	**6**	2.36	**7**	0.28	
68.6	**27**	5.1	**2**	6.4	0.25	$\frac{8}{32}$
66.0	**26**	**5**	1.97	**6**	0.24	
65	25.59	**4**	1.57	5.6	0.22	$\frac{7}{32}$
63.5	**25**	**3**	1.18	**5**	0.20	
61.0	**24**	2.54	**1**	4.8	0.19	$\frac{6}{32}$
60	23.62	**2**	0.78	**4**	0.16	
58.4	**23**	**1**	0.39	3.2	0.13	$\frac{4}{32}$
55.9	**22**			**3**	0.12	
				2.4	0.09	$\frac{3}{32}$
				2	0.08	
				1.6	0.06	$\frac{2}{32}$
				1	0.04	
				0.8	0.03	$\frac{1}{32}$
				0.1	0.0039	

Measures of Length.

METRIC.

		Inches.
1 millimeter (Mm.)		.039370
10 millimeters " =	1 centimeter (Cm.)	.393704
100 " " =	10 centimeters " = 1 decimeter (Dm.)	3.937043
1000 " " =	100 " " = 10 decimeters " = 1 meter (M.)	39.370432
10 meters =	1 dekameter	32 feet 9.7 inches.
100 " =	10 dekameters = 1 hektometer	328 " 1 inch.
1000 " =	100 " = 10 hektometers = 1 kilometer	3280 " 10.4 inches.

1 kilometer = 4 furlongs 213 yards 1 foot 10.43 inches.

10 kilometers = 1 myriameter = 6.2137 miles.

ENGLISH.

1 inch							0.0254	meter.
12 inches	= 1	foot					0.3048	"
36 "	= 3	feet	= 1	yard			0.9144	"
198 "	= 16½	"	= 5½	yards	= 1	rod	5.0292	meters.
220 yards	= 40	rods	= 1	furlong			201.1662	"
1760 "	= 320	"	= 8	furlongs	= 1	mile	1609.3297	"

Measures of Surface.

METRIC.

Hektare	10,000 square meters	= 2.471	acres.
Are	100 "	= 119.6	square yards.
Centare	1 square meter	= 1550	square inches.

TABLE SHOWING THE RELATION OF THE DEGREES OF BAUME'S HYDROMETERS TO SPECIFIC GRAVITIES.

The hydrometers most frequently used in the United States are those constructed upon the plan of Baumé. For liquids *heavier* than water the point to which the instrument sinks in pure water is 0, and the point to which it sinks in a solution of 15 parts of dry table-salt in 85 parts of water is marked 15, the distance between the two points being divided into 15 equal parts, and the scale continued with divisions of the same size. For liquids *lighter* than water the instrument is floated in a solution of 10 parts of dry table-salt in 90 parts of water, and afterward in pure water, the distance being divided into 10 equal parts, and the scale continued in like manner; the point indicating the density of water is marked 10. The hydrometers were originally constructed at a *medium* temperature. In the United States they are made for the temperature of 60° F. (15.55° C.), and the scales as originally published by Henry Pemberton (1852) are recognized. They agree closely with the determinations made by Schober and Pescher for liquids heavier than water, and differ but little for liquids lighter than water.

Cartier's hydrometer, which is occasionally employed in France, agrees with Baumé's scale for liquids lighter than water, except that 16° of the latter are equal to 15° Cartier.

For Liquids Heavier than Water.

Deg.	Sp. grav.	Deg.	Sp. grav.	Deg.	Sp. grav.	Deg.	Sp. grav.	Deg.	Sp. grav.
0	1.0000	16	1.1240	32	1.2831	48	1.4949	64	1.7901
1	1.0069	17	1.1328	33	1.2946	49	1.5104	65	1.8125
2	1.0139	18	1.1417	34	1.3063	50	1.5263	66	1.8354
3	1.0211	19	1.1507	35	1.3181	51	1.5425	67	1.8589
4	1.0283	20	1.1600	36	1.3302	52	1.5591	68	1.8831
5	1.0357	21	1.1693	37	1.3425	53	1.5760	69	1.9079
6	1.0431	22	1.1788	38	1.3551	54	1.5934	70	1.9333
7	1.0507	23	1.1885	39	1.3679	55	1.6111	71	1.9595
8	1.0583	24	1.1983	40	1.3809	56	1.6292	72	1.9863
9	1.0661	25	1.2083	41	1.3942	57	1.6477	73	2.0139
10	1.0740	26	1.2184	42	1.4077	58	1.6666	74	2.0422
11	1.0820	27	1.2288	43	1.4215	59	1.6860	75	2.0714
12	1.0902	28	1.2393	44	1.4356	60	1.7058		
13	1.0984	29	1.2500	45	1.4500	61	1.7261		
14	1.1068	30	1.2608	46	1.4646	62	1.7469		
15	1.1153	31	1.2719	47	1.4795	63	1.7682		

For Liquids Lighter than Water.

Deg.	Sp. grav.	Deg.	Sp. grav.	Deg.	Sp. grav.	Deg.	Sp. grav.	Deg.	Sp. grav.
10	1.0000	23	0.9150	36	0.8433	49	0.7821	62	0.7290
11	0.9929	24	0.9090	37	0.8383	50	0.7777	63	0.7253
12	0.9859	25	0.9032	38	0.8333	51	0.7734	64	0.7216
13	0.9790	26	0.8974	39	0.8284	52	0.7692	65	0.7179
14	0.9722	27	0.8917	40	0.8235	53	0.7650	66	0.7142
15	0.9655	28	0.8860	41	0.8187	54	0.7608	67	0.7106
16	0.9589	29	0.8805	42	0.8139	55	0.7567	68	0.7070
17	0.9523	30	0.8750	43	0.8092	56	0.7526	69	0.7035
18	0.9459	31	0.8695	44	0.8045	57	0.7486	70	0.7000
19	0.9395	32	0.8641	45	0.8000	58	0.7446	71	0.6965
20	0.9333	33	0.8588	46	0.7954	59	0.7407	72	0.6930
21	0.9271	34	0.8536	47	0.7909	60	0.7368	73	0.6896
22	0.9210	35	0.8484	48	0.7865	61	0.7329	74	0.6863

Table of Thermometric Equivalents

according to the Centigrade and Fahrenheit Scales.

C.°	F.°	C.°	F.°	C.°	F.°	C.°	F.
—40	—40	—14.4444	6	5.5556	42	30.5556	87
—39.4444	—39	—14	6.8	6	42.8	31	87.8
—39	—38.2	—13.8889	7	6.1111	43	31.1111	88
—38.8889	—38	—13.3333	8	6.6667	44	31.6667	89
—38.3333	—37	—13	8.6	7	44.6	32	89.6
—38	—36.4	—12.7778	9	7.2222	45	32.2222	90
—37.7778	—36	—12.2222	10	7.7778	46	32.7778	91
—37.2222	—35	—12	10.4	8	46.4	33	91.4
—37	—34.6	—11.6667	11	8.3333	47	33.3333	92
—36.6667	—34	—11.1111	12	8.8889	48	33.8889	93
—36.1111	—33	—11	12.2	9	48.2	34	93.2
—36	—32.8	—10.5556	13	9.4444	49	34.4444	94
—35.5556	—32	—10	14	10	50	35	95
—35	—31						
—34.4444	—30	—9.4444	15	10.5556	51	35.5556	96
—34	—29.2	—9	15.8	11	51.8	36	96.8
—33.8889	—29	—8.8889	16	11.1111	52	36.1111	97
—33.3333	—28	—8.3333	17	11.6667	53	36.6667	98
—33	—27.4	—8	17.6	12	53.6	37	98.6
—32.7778	—27	—7.7778	18	12.2222	54	37.2222	99
—32.2222	—26	—7.2222	19	12.7778	55	37.7778	100
—32	—25.6	—7	19.4	13	55.4	38	100.4
—31.6667	—25	—6.6667	20	13.3333	56	38.3333	101
—31.1111	—24	—6.1111	21	13.8889	57	38.8889	102
—31	—23.8	—6	21.2	14	57.2	39	102.2
—30.5556	—23	—5.5556	22	14.4444	58	39.4444	103
—30	—22	—5	23	15	59	40	104
—29.4444	—21	—4.4444	24	15.5556	60	40.5556	105
—29	—20.2	—4	24.8	16	60.8	41	105.8
—28.8889	—20	—3.8889	25	16.1111	61	41.1111	106
—28.3333	—19	—3.3333	26	16.6667	62	41.6667	107
—28	—18.4	—3	26.6	17	62.6	42	107.6
—27.7778	—18	—2.7778	27	17.2222	63	42.2222	108
—27.2222	—17	—2.2222	28	17.7778	64	42.7778	109
—27	—16.6	—2	28.4	18	64.4	43	109.4
—26.6667	—16	—1.6667	29	18.3333	65	43.3333	110
—26.1111	—15	—1.1111	30	18.8889	66	43.8889	111
—26	—14.8	—1	30.2	19	66.2	44	111.2
—25.5556	—14	—0.5556	31	19.4444	67	44.4444	112
—25	—13	0	32	20	68	45	113
—24.4444	—12			20.5556	69	45.5556	114
—24	—11.2			21	69.8	46	114.8
—23.8889	—11			21.1111	70	46.1111	115
—23.3333	—10			21.6667	71	46.6667	116
—23	—9.4			22	71.6	47	116.6
—22.7778	—9			22.2222	72	47.2222	117
—22.2222	—8			22.7778	73	47.7778	118
—22	—7.6			23	73.4	48	118.4
—21.6667	—7			23.3333	74	48.3333	119
—21.1111	—6			23.8889	75	48.8889	120
—21	—5.8			24	75.2	49	120.2
—20.5556	—5			24.4444	76	49.4444	121
—20	—4			25	77	50	122
—19.4444	—3	0.5556	33	25.5556	78	50.5556	123
—19	—2.2	1	33.8	26	78.8	51	123.8
—18.8889	—2	1.1111	34	26.1111	79	51.1111	124
—18.3333	—1	1.6667	35	26.6667	80	51.6667	125
—18	—0.4	2	35.6	27	80.6	52	125.6
—17.7778	0	2.2222	36	27.2222	81	52.2222	126
—17.2222	1	2.7778	37	27.7778	82	52.7778	127
—17	1.4	3	37.4	28	82.4	53	127.4
—16.6667	2	3.3333	38	28.3333	83	53.3333	128
—16.1111	3	3.8889	39	28.8889	84	53.8889	129
—16	3.2	4	39.2	29	84.2	54	129.2
—15.5556	4	4.4444	40	29.4444	85	54.4444	130
—15	5	5	41	30	86	55	131

TABLE OF THERMOMETRIC EQUIVALENTS.—*Continued.*

C.°	F.°	C.°	F.°	C.°	F.°	C.°	F.°
55.5556	**132**	80.5556	**177**	105.5556	**222**	130.5556	**267**
56	132.8	**81**	177.8	**106**	222.8	**131**	267.8
56.1111	**133**	81.1111	**178**	106.1111	**223**	131.1111	**268**
56.6667	**134**	81.6667	**179**	106.6667	**224**	131.6667	**269**
57	134.6	**82**	179.6	**107**	224.6	**132**	269.6
57.2222	**135**	82.2222	**180**	107.2222	**225**	132.2222	**270**
57.7778	**136**	82.7778	**181**	107.7778	**226**	132.7778	**271**
58	136.4	**83**	181.4	**108**	226.4	**133**	271.4
58.3333	**137**	83.3333	**182**	108.3333	**227**	133.3333	**272**
58.8889	**138**	83.8889	**183**	108.8889	**228**	133.8889	**273**
59	138.2	**84**	183.2	**109**	228.2	**134**	273.2
59.4444	**139**	84.4444	**184**	109.4444	**229**	134.4444	**274**
60	**140**	**85**	**185**	**110**	**230**	**135**	**275**
60.5556	**141**	85.5556	**186**	110.5556	**231**	135.5556	**276**
61	141.8	**86**	186.8	**111**	231.8	**136**	276.8
61.1111	**142**	86.1111	**187**	111.1111	**232**	136.1111	**277**
61.6667	**143**	86.6667	**188**	111.6667	**233**	136.6667	**278**
62	143.6	**87**	188.6	**112**	233.6	**137**	278.6
62.2222	**144**	87.2222	**189**	112.2222	**234**	137.2222	**279**
62.7778	**145**	87.7778	**190**	112.7778	**235**	137.7778	**280**
63	145.4	**88**	190.4	**113**	235.4	**138**	280.4
63.3333	**146**	88.3333	**191**	113.3333	**236**	138.3333	**281**
63.8889	**147**	88.8889	**192**	113.8889	**237**	138.8889	**282**
64	147.2	**89**	192.2	**114**	237.2	**139**	282.2
64.4444	**148**	89.4444	**193**	114.4444	**238**	139.4444	**283**
65	**149**	**90**	**194**	**115**	**239**	**140**	**284**
65.5556	**150**	90.5556	**195**	115.5556	**240**	140.5556	**285**
66	150.8	**91**	195.8	**116**	240.8	**141**	285.8
66.1111	**151**	91.1111	**196**	116.1111	**241**	141.1111	**286**
66.6667	**152**	91.6667	**197**	116.6667	**242**	141.6667	**287**
67	152.6	**92**	197.6	**117**	242.6	**142**	287.6
67.2222	**153**	92.2222	**198**	117.2222	**243**	142.2222	**288**
67.7778	**154**	92.7778	**199**	117.7778	**244**	142.7778	**289**
68	154.4	**93**	199.4	**118**	244.4	**143**	289.4
68.3333	**155**	93.3333	**200**	118.3333	**245**	143.3333	**290**
68.8889	**156**	93.8889	**201**	118.8889	**246**	143.8889	**291**
69	156.2	**94**	201.2	**119**	246.2	**144**	291.2
69.4444	**157**	94.4444	**202**	119.4444	**247**	144.4444	**292**
70	**158**	**95**	**203**	**120**	**248**	**145**	**293**
70.5556	**159**	95.5556	**204**	120.5556	**249**	145.5556	**294**
71	159.8	**96**	204.8	**121**	249.8	**146**	294.8
71.1111	**160**	96.1111	**205**	121.1111	**250**	146.1111	**295**
71.6667	**161**	96.6667	**206**	121.6667	**251**	146.6667	**296**
72	161.6	**97**	206.6	**122**	251.6	**147**	296.6
72.2222	**162**	97.2222	**207**	122.2222	**252**	147.2222	**297**
72.7778	**163**	97.7778	**208**	122.7778	**253**	147.7778	**298**
73	163.4	**98**	208.4	**123**	253.4	**148**	298.4
73.3333	**164**	98.3333	**209**	123.3333	**254**	148.3333	**299**
73.8889	**165**	98.8889	**210**	123.8889	**255**	148.8889	**300**
74	165.2	**99**	210.2	**124**	255.2	**149**	300.2
74.4444	**166**	99.4444	**211**	124.4444	**256**	149.4444	**301**
75	**167**	**100**	**212**	**125**	**257**	**150**	**302**
75.5556	**168**	100.5556	**213**	125.5556	**258**	150.5556	**303**
76	168.8	**101**	213.8	**126**	258.8	**151**	303.8
76.1111	**169**	101.1111	**214**	126.1111	**259**	151.1111	**304**
76.6667	**170**	101.6667	**215**	126.6667	**260**	151.6667	**305**
77	170.6	**102**	215.6	**127**	260.6	**152**	305.6
77.2222	**171**	102.2222	**216**	127.2222	**261**	152.2222	**306**
77.7778	**172**	102.7778	**217**	127.7778	**262**	152.7778	**307**
78	172.4	**103**	217.4	**128**	262.4	**153**	307.4
78.3333	**173**	103.3333	**218**	128.3333	**263**	153.3333	**308**
78.8889	**174**	103.8889	**219**	128.8889	**264**	153.8889	**309**
79	174.2	**104**	219.2	**129**	264.2	**154**	309.2
79.4444	**175**	104.4444	**220**	129.4444	**265**	154.4444	**310**
80	**176**	**105**	**221**	**130**	**266**	**155**	**311**

TABLE OF THERMOMETRIC EQUIVALENTS.—*Continued.*

C.°	F.°	C.°	F.°	C.°	F.°	C.°	F.°
155.5556	**312**	180.5556	**357**	205.5556	**402**	230.5556	**447**
156	312.8	**181**	357.8	**206**	402.8	**231**	447.8
156.1111	**313**	181.1111	**358**	206.1111	**403**	231.1111	**448**
156.6667	**314**	181.6667	**359**	206.6667	**404**	231.6667	**449**
157	314.6	**182**	359.6	**207**	404.6	**232**	449.6
157.2222	**315**	182.2222	**360**	207.2222	**405**	232.2222	**450**
157.7778	**316**	182.7778	**361**	207.7778	**406**	232.7778	**451**
158	316.4	**183**	361.4	**208**	406.4	**233**	451.4
158.3333	**317**	183.3333	**362**	208.3333	**407**	233.3333	**452**
158.8889	**318**	183.8889	**363**	208.8889	**408**	233.8889	**453**
159	318.2	**184**	363.2	**209**	408.2	**234**	453.2
159.4444	**319**	184.4444	**364**	209.4444	**409**	234.4444	**454**
160	**320**	**185**	**365**	**210**	**410**	**235**	**455**
160.5556	**321**	185.5556	**366**	210.5556	**411**	235.5556	**456**
161	321.8	**186**	366.8	**211**	411.8	**236**	456.8
161.1111	**322**	186.1111	**367**	211.1111	**412**	236.1111	**457**
161.6667	**323**	186.6667	**368**	211.6667	**413**	236.6667	**458**
162	323.6	**187**	368.6	**212**	413.6	**237**	458.6
162.2222	**324**	187.2222	**369**	212.2222	**414**	237.2222	**459**
162.7778	**325**	187.7778	**370**	212.7778	**415**	237.7778	**460**
163	325.4	**188**	370.4	**213**	415.4	**238**	460.4
163.3333	**326**	188.3333	**371**	213.3333	**416**	238.3333	**461**
163.8889	**327**	188.8889	**372**	213.8889	**417**	238.8889	**462**
164	327.2	**189**	372.2	**214**	417.2	**239**	462.2
164.4444	**328**	189.1444	**373**	214.4444	**418**	239.4444	**463**
165	**329**	**190**	**374**	**215**	**419**	**240**	**464**
165.5556	**330**	190.5556	**375**	215.5556	**420**	240.5556	**465**
166	330.8	**191**	375.8	**216**	420.8	**241**	465.8
166.1111	**331**	191.1111	**376**	216.1111	**421**	241.1111	**466**
166.6667	**332**	191.6667	**377**	216.6667	**422**	241.6667	**467**
167	332.6	**192**	377.6	**217**	422.6	**242**	467.6
167.2222	**333**	192.2222	**378**	217.2222	**423**	242.2222	**468**
167.7778	**334**	192.7778	**379**	217.7778	**424**	242.7778	**469**
168	334.4	**193**	379.4	**218**	424.4	**243**	469.4
168.3333	**335**	193.3333	**380**	218.3333	**425**	243.3333	**470**
168.8889	**336**	193.8889	**381**	218.8889	**426**	243.8889	**471**
169	336.2	**194**	381.2	**219**	426.2	**244**	471.2
169.4444	**337**	194.1444	**382**	219.4444	**427**	244.4444	**472**
170	**338**	**195**	**383**	**220**	**428**	**245**	**473**
170.5556	**339**	195.5556	**384**	220.5556	**429**	245.5556	**474**
171	339.8	**196**	384.8	**221**	429.8	**246**	474.8
171.1111	**340**	196.1111	**385**	221.1111	**430**	246.1111	**475**
171.6667	**341**	196.6667	**386**	221.6667	**431**	246.6667	**476**
172	341.6	**197**	386.6	**222**	431.6	**247**	476.6
172.2222	**342**	197.2222	**387**	222.2222	**432**	247.2222	**477**
172.7778	**343**	197.7778	**388**	222.7778	**433**	247.7778	**478**
173	343.4	**198**	388.4	**223**	433.4	**248**	478.4
173.3333	**344**	198.3333	**389**	223.3333	**434**	248.3333	**479**
173.8889	**345**	198.8889	**390**	223.8889	**435**	248.8889	**480**
174	345.2	**199**	390.2	**224**	435.2	**249**	480.2
174.4444	**346**	199.4444	**391**	224.4444	**436**	249.4444	**481**
175	**347**	**200**	**392**	**225**	**437**	**250**	**482**
175.5556	**348**	200.5556	**393**	225.5556	**438**	250.5556	**483**
176	348.8	**201**	393.8	**226**	438.8	**251**	483.8
176.1111	**349**	201.1111	**394**	226.1111	**439**	251.1111	**484**
176.6667	**350**	201.6667	**395**	226.6667	**440**	251.6667	**485**
177	350.6	**202**	395.6	**227**	440.6	**252**	485.6
177.2222	**351**	202.2222	**396**	227.2222	**441**	252.2222	**486**
177.7778	**352**	202.7778	**397**	227.7778	**442**	252.7778	**487**
178	352.4	**203**	397.4	**228**	442.4	**253**	487.4
178.3333	**353**	203.3333	**398**	228.3333	**443**	253.3333	**488**
178.8889	**354**	203.8889	**399**	228.8889	**444**	253.8889	**489**
179	354.2	**204**	399.2	**229**	444.2	**254**	489.2
179.4444	**355**	204.4444	**400**	229.4441	**445**	254.4444	**490**
180	**356**	**205**	**401**	**230**	**446**	**255**	**491**

TABLE OF THERMOMETRIC EQUIVALENTS.—*Concluded.*

C.°	F.°	C.°	F.°	C.°	F.°	C.°	F.°
255.5556	**492**	275.5556	**528**	295.5556	**564**	315.5556	**600**
256	492.8	**276**	528.8	**296**	564.8	**316**	600.8
256.1111	**493**	276.1111	**529**	296.1111	**565**	316.1111	**601**
256.6667	**494**	276.6667	**530**	296.6667	**566**	316.6667	**602**
257	494.6	**277**	530.6	**297**	566.6	**317**	602.6
257.2222	**495**	277.2222	**531**	297.2222	**567**	317.2222	**603**
257.7778	**496**	277.7778	**532**	297.7778	**568**	317.7778	**604**
258	496.4	**278**	532.4	**298**	568.4	**318**	604.4
258.3333	**497**	278.3333	**533**	298.3333	**569**	318.3333	**605**
258.8889	**498**	278.8889	**534**	298.8889	**570**	318.8889	**606**
259	498.2	**279**	534.2	**299**	570.2	**319**	606.2
259.4444	**499**	279.4444	**535**	299.4444	**571**	319.4444	**607**
260	**500**	**280**	**536**	**300**	**572**	**320**	**608**
260.5556	**501**	280.5556	**537**	300.5556	**573**	320.5556	**609**
261	501.8	**281**	537.8	**301**	573.8	**321**	609.8
261.1111	**502**	281.1111	**538**	301.1111	**574**	321.1111	**610**
261.6667	**503**	281.6667	**539**	301.6667	**575**	321.6667	**611**
262	503.6	**282**	539.6	**302**	575.6	**322**	611.6
262.2222	**504**	282.2222	**540**	302.2222	**576**	322.2222	**612**
262.7778	**505**	282.7778	**541**	302.7778	**577**	322.7778	**613**
263	505.4	**283**	541.4	**303**	577.4	**323**	613.4
263.3333	**506**	283.3333	**542**	303.3333	**578**	323.3333	**614**
263.8889	**507**	283.8889	**543**	303.8889	**579**	323.8889	**615**
264	507.2	**284**	543.2	**304**	579.2	**324**	615.2
264.4444	**508**	284.4414	**544**	304.4444	**580**	324.4144	**616**
265	**509**	**285**	**545**	**305**	**581**	**325**	**617**
265.5556	**510**	285.5556	**546**	305.5556	**582**	325.5556	**618**
266	510.8	**286**	546.8	**306**	582.8	**326**	618.8
266.1111	**511**	286.1111	**547**	306.1111	**583**	326.1111	**619**
266.6667	**512**	286.6667	**548**	306.6667	**584**	326.6667	**620**
267	512.6	**287**	548.6	**307**	584.6	**327**	620.6
267.2222	**513**	287.2222	**549**	307.2222	**585**	327.2222	**621**
267.7778	**514**	287.7778	**550**	307.7778	**586**	327.7778	**622**
268	514.4	**288**	550.4	**308**	586.4	**328**	622.4
268.3333	**515**	288.3333	**551**	308.3333	**587**	328.3333	**623**
268.8889	**516**	288.8889	**552**	308.8889	**588**	328.8889	**624**
269	516.2	**289**	552.2	**309**	588.2	**329**	624.2
269.4444	**517**	289.4444	**553**	309.4444	**589**	329.4441	**625**
270	**518**	**290**	**554**	**310**	**590**	**330**	**626**
270.5556	**519**	290.5556	**555**	310.5556	**591**	330.5556	**627**
271	519.8	**291**	555.8	**311**	591.8	**331**	627.8
271.1111	**520**	291.1111	**556**	311.1111	**592**	331.1111	**628**
271.6667	**521**	291.6667	**557**	311.6667	**593**	331.6667	**629**
272	521.6	**292**	557.6	**312**	593.6	**332**	629.6
272.2222	**522**	292.2222	**558**	312.2222	**594**	332.2222	**630**
272.7778	**523**	292.7778	**559**	312.7778	**595**	332.7778	**631**
273	523.4	**293**	559.4	**313**	595.4	**333**	631.4
273.3333	**524**	293.3333	**560**	313.3333	**596**	333.3333	**632**
273.8889	**525**	293.8889	**561**	313.8889	**597**	333.8889	**633**
274	525.2	**294**	561.2	**314**	597.2	**334**	633.2
274.4444	**526**	294.4444	**562**	314.4444	**598**	334.4444	**634**
275	**527**	**295**	**563**	**315**	**599**	**335**	**635**

ALPHABETICAL LIST OF OFFICIAL DRUGS

SHOWING THE PREPARATIONS OF THE U. S. AND BR. PHARMACOPŒIAS CONTAINING THEM.

Acaciæ.
- Emulsum Amygdalæ, *U. S.*
- Mistura Amygdalæ, *Br.*
  - Cretæ, *U. S., Br.*
  - Glycyrrhizæ Composita, *U. S.*
  - Guaiaci, *Br.*
- Mucilago Acaciæ, *U. S., Br.*
- Pulvis Amygdalæ Compositus, *Br.*
  - Cretæ Compositus, *U. S.*
  - Tragacanthæ Compositus, *Br.*
- Syrupus Acaciæ, *U. S., Br.*
- Trochisci, *U. S., Br.*

Acidum Aceticum.
- Acetum Cantharidis, *Br.*
  - Opii, *U. S.*
  - Scillæ, *U. S., Br.*
- Acidum Aceticum Dilutum, *U. S., Br.*
- Emplastrum Ammoniaci cum Hydrargyro, *U. S.*
- Extractum Colchici Aceticum, *U. S., Br.*
  - Conii, *U. S.*
    - Fluidum, *U. S.*
  - Ergotæ Fluidum, *U. S.*
  - Nucis Vomicæ, *U. S.*
    - Fluidum, *U. S.*
  - Sanguinariæ Fluidum, *U. S.*
- Liquor Ammonii Acetatis, *U. S.*
  - Fortior, *Br.*
  - Ferri et Ammonii Acetatis, *U. S.*
  - Morphinæ Acetatis, *Br.*
- Oxymel, *Br.*
  - Scillæ, *Br.*
- Syrupus Allii, *U. S.*
  - Scillæ, *U. S., Br.*
- Tinctura Ferri Acetatis, *Br.*
  - Sanguinariæ, *U. S.*

Acidum Aceticum Glaciale.
- Acetum Cantharidis, *Br.*
- Linimentum Terebinthinæ Aceticum, *Br.*
- Liquor Ferri Acetatis, *U. S.*
- Mistura Creasoti, *Br.*

Acidum Arsenosum.
- Liquor Acidi Arsenosi, *U. S.*
  - Arsenicalis, *Br.*
  - Arsenici Hydrochloricus, *Br.*
  - Potassii Arsenitis, *U. S.*

Acidum Benzoicum.
- Tinctura Camphoræ Composita, *Br.*
  - Opii Ammoniata, *Br.*
    - Camphorata, *U. S.*
- Trochisci Acidi Benzoici, *Br.*

Acidum Boricum.
- Glyceritum Boroglycerini, *U. S.*
- Unguentum Acidi Borici, *Br.*

Acidum Carbolicum.
- Acidum Carbolicum Liquefactum, *Br.*
- Glyceritum Acidi Carbolici, *U. S., Br.*
- Suppositoria Acidi Carbolici cum Sapone, *Br.*
- Unguentum Acidi Carbolici, *U. S., Br.*

Acidum Chromicum.
- Liquor Acidi Chromici, *Br.*

Acidum Citricum.
- Bismuthi Citras, *U. S., Br.*
- Ferri et Quininæ Citras, *U. S., Br.*
  - Solubilis, *U. S.*
- Strychninæ Citras, *U. S.*
- Liquor Ferri Citratis, *U. S.*
  - Magnesii Citratis, *U. S., Br.*
  - Potassii Citratis, *U. S.*
- Lithii Citras Effervescens, *U. S.*
- Magnesii Citras Effervescens, *U. S.*
- Sodii Citro-tartras Effervescens, *Br.*
- Syrupus Acidi Citrici, *U. S.*
- Vinum Quininæ, *Br.*

Acidum Gallicum.
- Glyceritum Acidi Gallici, *Br.*

Acidum Hydrochloricum.
- Acidum Hydrochloricum Dilutum, *U. S., Br.*
  - Nitrohydrochloricum, *U. S.*
    - Dilutum, *U. S., Br.*
- Liquor Antimonii Chloridi, *Br.*
  - Acidi Arsenosi, *U. S.*
  - Arsenici Hydrochloricus, *Br.*
  - Ferri Chloridi, *U. S.*
    - Perchloridi, *Br.*
  - Zinci Chloridi, *U. S., Br.*

Acidum Hydrocyanicum Dilutum.
- Tinctura Chloroformi et Morphinæ, *Br.*
- Vapor Acidi Hydrocyanici, *Br.*

Acidum Hypophosphorosum Dilutum.
- Syrupus Hypophosphitum Compositus, *U. S.*

Acidum Lacticum.
- Acidum Lacticum Dilutum, *Br.*
- Syrupus Calcii Lactophosphatis, *U. S.*

Acidum Nitricum.
- Acidum Nitricum Dilutum, *U. S., Br.*
  - Nitrohydrochloricum, *U. S.*
    - Dilutum, *U. S., Br.*
- Liquor Ferri Nitratis, *U. S.*
  - Pernitratis, *Br.*
  - Hydrargyri Nitratis Acidus, *Br.*
- Unguentum Hydrargyri Nitratis, *U. S., Br.*

Acidum Oleicum.
- Oleatum Hydrargyri, *U. S., Br.*
  - Veratrinæ, *U. S.*
  - Zinci, *U. S., Br.*

Acidum Phosphoricum.
- Acidum Phosphoricum Dilutum, *U. S., Br.*
- Syrupus Ferri Phosphatis, *Br.*
  - Quininæ et Strychninæ Phosphatum, *U. S.*

Acidum Salicylicum.
- Unguentum Acidi Salicylici, *Br.*

Acidum Stearicum.
- Suppositoria Glycerini, *U. S.*

Acidum Sulphuricum.
- Acidum Sulphuricum Aromaticum, *U. S., Br.*
  - Dilutum, *U. S., Br.*
- Infusum Cinchonæ, *U. S.*
  - Rosæ Acidum, *Br.*

Acidum Tannicum.
- Collodium Stypticum, *U. S.*
- Glyceritum Acidi Tannici, *U. S., Br.*

Acidum Tannicum.
Suppositoria Acidi Tannici, *Br.*
cum Sapone, *Br.*
Trochisci Acidi Tannici, *U. S., Br.*
Unguentum Acidi Tannici, *U. S.*

Aconitum.
Extractum Aconiti.
Fluidum.
Linimentum Aconiti, *Br.*
Tinctura Aconiti, *U. S., Br.*

Aconitina.
Unguentum Aconitinæ, *Br.*

Adeps.
Adeps Benzoinatus, *U. S., Br.*
Ceratum, *U. S.*
Camphoræ, *U. S.*
Cantharidis, *U. S.*
(Unguentum, *Br.*) Resinæ, *U. S.*
Emplastrum Resinæ, *Br.*
Unguentum, *U. S.*
Acidi Carbolici, *U. S.*
Tannici, *U. S.*
Aconitinæ, *Br.*
Antimonii Tartarati, *Br.*
Atropinæ, *Br.*
Belladonnæ, *U. S., Br.*
Calaminæ, *Br.*
Chrysarobini, *U. S., Br.*
Creasoti, *Br.*
Elemi, *Br.*
Gallæ, *U. S., Br.*
Hydrargyri, *U. S., Br.*
Ammoniati, *U. S., Br.*
Iodidi Rubri, *Br.*
Nitratis, *Br.*
Oxidi Flavi, *U. S.*
Rubri, *U. S.*
Subchloridi, *Br.*
Iodi, *U. S., Br.*
Iodoformi, *U. S., Br.*
Picis Liquidæ, *U. S.*
Plumbi Acetatis, *Br.*
Carbonatis, *U. S., Br.*
Iodidi, *U. S., Br.*
Potassii Iodidi, *U. S., Br.*
Sabinæ, *Br.*
Simplex, *Br.*
Staphisagriæ, *Br.*
Stramonii, *U. S.*
Sulphuris, *U. S., Br.*
Terebinthinæ, *Br.*
Veratrinæ, *U. S.*
Zinci Oxidi, *U. S., Br.*

Æther.
Collodium, *U. S., Br.*
Cantharidatum, *U. S.*
Flexile, *U. S., Br.*
Stypticum, *U. S.*
Oleoresinæ, *U. S., Br.*
Oleum Æthereum, *U. S.*
Phosphoratum, *U. S.*
Spiritus Ætheris, *U. S., Br.*
Compositus, *U. S., Br.*
Tinctura Chloroformi et Morphinæ, *Br.*

Æther Aceticus.
Liquor Epispasticus, *Br.*

Alcohol.
Alcohol Dilutum, *U. S.*
Spiritus Tenuior, *Br.*

Allium.
Syrupus Allii.

Aloe Barbadensis.
Enema Aloes, *Br.*
Extractum Aloes Barbadensis, *Br.*
Pilula Aloes Barbadensis, *Br.*

Aloe Barbadensis.
Pilula Aloes et Ferri, *Br.*
Cambogiæ Composita, *Br.*
Pilula Colocynthidis Composita, *Br.*
et Hyoscyami, *Br.*

Aloe Socotrina.
Aloes Purificata.
Decoctum Aloes Compositum, *Br.*
Extractum Aloes, *U. S., Br.*
Colocynthidis Compositum, *U. S., Br.*
Pilulæ Aloes, *U. S., Br.*
et Asafœtidæ, *U. S., Br.*
et Ferri, *U. S.*
et Mastiches, *U. S.*
et Myrrhæ, *U. S., Br.*
Rhei Compositæ, *U. S., Br.*
Tinctura Aloes, *U. S., Br.*
et Myrrhæ, *U. S.*
Benzoini Composita, *U. S., Br.*
Vinum Aloes, *Br.*

Althæa.
Massa Hydrargyri, *U. S.*
Pilulæ Ferri Carbonatis, *U. S.*
Phosphori, *U. S.*
Syrupus Althææ, *U. S.*

Alumen.
Alumen Exsiccatum, *U. S., Br.*
Glycerinum Aluminis, *Br.*

Ammoniacum.
Emplastrum Ammoniaci cum Hydrargyro, *U. S., Br.*
Galbani, *Br.*
Emulsum Ammoniaci, *U. S.*
Mistura Ammoniaci, *Br.*
Pilula Scillæ Composita, *Br.*
Ipecacuanhæ cum Scillæ, *Br.*

Ammonii Carbonas.
Liquor Ammonii Acetatis, *U. S., Br.*
Spiritus Ammoniæ Aromaticus, *U. S., Br.*

Ammonii Chloridum.
Liquor Ammoniæ Fortior, *Br.*
Hydrargyri Perchloridi, *Br.*
Trochisci Ammonii Chloridi, *U. S.*

Amygdala Amara.
Oleum Amygdalæ Amaræ, *U. S.*
Syrupus Amygdalæ, *U. S.*

Amygdala Dulcis.
Emulsum Amygdalæ, *U. S.*
Oleum Amygdalæ Dulcis, *U. S., Br.*
Pulvis Amygdalæ Compositus, *Br.*
Syrupus Amygdalæ, *U. S.*

Amylum.
Glyceritum Amyli, *U. S., Br.*
Mucilago Amyli, *Br.*
Pulvis Tragacanthæ Compositus, *Br.*
Suppositoria Acidi Tannici cum Sapone, *Br.*
Morphinæ cum Sapone, *Br.*

Anisum.
Aqua Anisi, *Br.*

Anthemis.
Extractum Anthemidis, *Br.*
Infusum Anthemidis, *Br.*
Oleum Anthemidis, *Br.*

Antimonii et Potassii Tartras (Antimonii Tartaratum, *Br.*).
Syrupus Scillæ Compositus, *U. S.*
Unguentum Antimonii Tartarati, *Br.*
Vinum Antimonii, *U. S., Br.*

Antimonii Oxidum.
Pulvis Antimonialis, *U. S., Br.*

Antimonii Sulphidum.
Antimonii Sulphidum Purificatum, *U. S.* (Antimonium Nigrum Purificatum, *Br.*).
Antimonium Sulphuratum, *U. S., Br.*
Liquor Antimonii Chloridi, *Br.*

Antimonium Sulphuratum.
Pilulæ Antimonii Compositæ, *U. S.* (Pilula Hydrargyri Subchloridi Composita, *Br.*).
Apocynum.
Extractum Apocyni Fluidum, *U. S.*
Apomorphinæ Hydrochloras.
Injectio Apomorphinæ Hypodermica, *Br.*
Aqua.
Aqua Destillata, *U. S.*, *Br.*
Aquæ Medicatæ, *Br.*
Aqua Ammoniæ.
Linimentum Ammoniæ, *U. S.*, *Br.*
Spiritus Ammonii Aromaticus, *U. S.*
Aqua Ammoniæ Fortior.
Linimentum Camphoræ Compositum, *Br.*
Liquor Ammonii Citratis Fortior, *Br.*
Spiritus Ammoniæ, *U. S.*
Aromaticus, *Br.*
Fœtidus, *Br.*
Tincturæ Opii Ammoniata, *Br.*
Aqua Aurantii Florum Fortior.
Aqua Aurantii Florum, *U. S.*
Syrupus Aurantii Florum, *U. S.*, *Br.*
Aqua Camphoræ.
Injectio Apomorphinæ Hypodermica. *Br.*
Ergotinæ Hypodermica, *Br.*
Aqua Menthæ Piperitæ.
Mistura Ferri Aromatica, *Br.*
Aqua Rosæ Fortior.
Aqua Rosæ, *U. S.*
Unguentum Aquæ Rosæ, *U. S.*
Argenti Cyanidum.
Acidum Hydrocyanicum Dilutum, *U. S.*
Argenti Nitras.
Argenti Nitras Dilutus, *U. S.*, *Br.*
Fusus, *U. S.*
Arnicæ Flores.
Tinctura Arnicæ Florum, *U. S.*
Arnicæ Radix (Rhizoma, *Br.*).
Emplastrum Arnicæ, *U. S.*
Extractum Arnicæ, *U. S.*
Radicis Fluidum, *U. S.*
Tinctura Arnicæ Radicis, *U. S.*, *Br.*
Arseni Iodidum.
Liquor Arseni et Hydrargyri Iodidi, *U. S.*, *Br.*
Asafœtida.
Emulsum Asafœtidæ, *U. S.*
Enema Asafœtidæ, *Br.*
Pilulæ Aloes et Asafœtidæ, *U. S.*, *Br.*
Asafœtidæ, *U. S.*
Compositæ, *Br.*
Spiritus Ammoniæ Fœtidus, *Br.*
Tinctura Asafœtidæ, *U. S.*, *Br.*
Asclepias.
Extractum Asclepiadis Fluidum, *U. S.*
Aspidium.
Extractum Filicis Liquidum, *Br.*
Oleoresina Aspidii, *U. S.*
Aspidosperma.
Extractum Aspidospermatis Fluidum, *U. S.*
Atropina.
Unguentum Atropinæ, *Br.*
Atropinæ Sulphas.
Lamellæ Atropinæ, *Br.*
Liquor Atropinæ Sulphatis, *Br.*
Aurantii Amari Cortex (Aurantii Cortex, *Br.*).
Extractum Aurantii Amari Fluidum, *U. S.*
Infusum Aurantii, *Br.*
Compositum, *Br.*
Gentianæ Compositum, *Br.*
Spiritus Armoraciæ Compositus, *Br.*
Tinctura Aurantii Amari, *U. S.*, *Br.*
Cinchonæ Composita, *U. S.*, *Br.*
Gentianæ Composita, *U. S.*, *Br.*
Aurantii Dulcis Cortex.
Oleum Aurantii, *U. S.*, *Br.*
Syrupus Aurantii, *U. S.*
Tinctura Aurantii Dulcis, *U. S.*
Aurantii Florum.
Oleum Aurantii Florum, *U. S.*, *Br.*

Balsamum Tolutanum.
Pilulæ Phosphori, *Br.*
Syrupus Tolutanus, *U. S.*, *Br.*
Tinctura Benzoini Composita, *U. S.*, *Br.*
Tolutana, *U. S.*, *Br.*
Barii Dioxidum.
Aqua Hydrogenii Dioxidi, *U. S.*
Belladonnæ Folia.
Extractum Belladonnæ (Foliorum Alcoholicum, *U. S.*), *Br.*
Emplastrum Belladonnæ, *U. S.*
Unguentum Belladonnæ, *U. S.*
Succus Belladonnæ, *Br.*
Tinctura Belladonnæ Foliorum, *U. S.*, *Br.*
Belladonnæ Radix.
Emplastrum Belladonnæ, *Br.*
Extractum Belladonnæ Alcoholicum, *Br.*
Belladonnæ Radicis Fluidum, *U. S.*
Linimentum Belladonnæ, *U. S.*, *Br.*
Unguentum Belladonnæ, *Br.*
Benzoinum.
Adeps Benzoinatus, *U. S.*, *Br.*
Tinctura Benzoini, *U. S.*
Composita, *U. S.*, *Br.*
Unguentum Cetacei, *Br.*
Bismuthi Citras.
Bismuthi et Ammonii Citras, *U. S.*, *Br.*
Liquor Bismuthi et Ammonii Citratis, *Br.*
Bismuthi Subnitras.
Trochisci Bismuthi, *Br.*
Borax, *Br.* (Sodii Boras, *U. S.*).
Glycerinum Boracis, *Br.*
Mel Boracis, *Br.*
Unguentum Aquæ Rosæ, *U. S.*
Bryonia.
Tinctura Bryoniæ, *U. S.*
Buchu.
Extractum Buchu Fluidum, *U. S.*
Infusum Buchu, *Br.*
Tinctura Buchu, *Br.*

Caffeina.
Caffeina Citrata, *U. S.* (Citras, *Br.*).
Effervescens, *U. S.*
Calamus.
Extractum Calami Fluidum, *U. S.*
Calcii Carbonas Præcipitatus.
Pulvis Morphinæ Compositus, *U. S.*
Syrupus Calcii Lactophosphatis, *U. S.*
Trochisci Bismuthi, *Br.*
Calcii Chloridum.
Liquor Calcii Chloridi, *Br.*
Calcii Hypophosphis.
Syrupus Hypophosphitum, *U. S.*
Calcii Phosphas Præcipitatus.
Pulvis Antimonialis, *U. S.*, *Br.*
Calcii Sulphas Exsiccatus.
Calx Sulphurata, *U. S.*, *Br.*
Calendula.
Tinctura Calendulæ, *U. S.*
Calumba.
Extractum Calumbæ, *Br.*
Fluidum, *U. S.*
Infusum Calumbæ, *Br.*
Mistura Ferri Aromatica, *Br.*
Tinctura Calumbæ, *U. S.*, *Br.*
Calx.
Calcii Hydras, *Br.*

Calx.
Liquor Calcis, *U. S.*, *Br.*
Syrupus Calcis, *U. S.* (Liquor Calcis Saccharatus, *Br.*).
Calx Chlorata (Chlorinata, *Br.*).
Liquor Calcis Chlorinatæ, *Br.*
Cambogia.
Pilula Cambogiæ Composita, *Br.*
Pilulæ Catharticæ Compositæ, *U. S.*
Camphora.
Aqua Camphoræ, *U. S.*, *Br.*
Linimentum Aconiti, *Br.*
Belladonnæ, *U. S.*, *Br.*
Camphoræ, *U. S.*, *Br.*
Compositum, *Br.*
Chloroformi, *U. S.*, *Br.*
Hydrargyri, *Br.*
Opii, *Br.*
Saponis, *U. S.*, *Br.*
Sinapis Compositum, *U. S.*, *Br.*
Terebinthinæ, *Br.*
Aceticum, *Br.*
Pulvis Morphinæ Compositus, *U. S.*
Spiritus Camphoræ, *U. S.*, *Br.*
Tinctura Opii Camphorata (Tinctura Camphoræ Composita, *Br.*).
Unguentum Hydrargyri Compositum, *Br.*
Cannabis Indica.
Extractum Cannabis Indicæ, *U. S.*, *Br.*
Fluidum, *U. S.*
Tinctura Cannabis Indicæ, *U. S.*, *Br.*
Cantharis.
Acetum Cantharidis, *Br.*
Ceratum Cantharidis, *U. S.*
Charta Epispastica, *Br.*
Collodium Cantharidatum, *U. S.*
Emplastrum Calefaciens, *Br.*
Cantharidis, *Br.*
Liquor Epispasticus, *Br.*
Tinctura Cantharidis, *U. S.*, *Br.*
Unguentum Cantharidis, *Br.*
Capsicum.
Extractum Capsici Fluidum, *U. S.*
Oleoresina Capsici, *U. S.*
Tinctura Capsici, *U. S.*, *Br.*
Carbo Animalis.
Carbo Animalis Purificatus, *U. S.*, *Br.*
Carbo Ligni.
Cataplasma Carbonis, *Br.*
Cardamomum.
Extractum Colocynthidis Compositum, *U. S.*, *Br.*
Pulvis Aromaticus, *U. S.* (Cinnamomi Compositus, *Br.*).
Cretæ Aromaticus, *Br.*
Tinctura Cardamomi, *U. S.*
Composita, *U. S.*, *Br.*
Gentianæ Composita, *U. S.*, *Br.*
Rhei, *U. S.*, *Br.*
Vinum Aloes, *Br.*
Carum.
Aqua Carui, *Br.*
Confectio Opii, *Br.*
Piperis, *Br.*
Oleum Cari, *U. S.*, *Br.*
Pulvis Opii Compositus, *Br.*
Tinctura Cardamomi Composita, *U. S.*, *Br.*
Sennæ, *Br.*
Caryophyllus.
Infusum Aurantii Compositum, *Br.*
Caryophylli, *Br.*
Mistura Ferri Aromatica, *Br.*
Oleum Caryophylli, *U. S.*, *Br.*
Tinctura Lavandulæ Composita, *U. S.*
Vinum Opii, *U. S.*, *Br.*
Cascarilla.
Infusum Cascarillæ, *Br.*
Tinctura Cascarillæ, *Br.*
Cassia Fistula.
Confectio Sennæ, *U. S.*, *Br.*
Castanea.
Extractum Castaneæ Fluidum, *U. S.*
Catechu.
Infusum Catechu, *Br.*
Pulvis Catechu Compositus, *Br.*
Tinctura Catechu Composita, *U. S.*, *Br.*
Trochisci Catechu, *U. S.*, *Br.*
Cera Alba.
Ceratum, *U. S.*
Camphoræ, *U. S.*
Cetacei, *U. S.*
Plumbi Subacetatis, *U. S.*
Charta Epispastica, *Br.*
Unguentum Cetacei, *Br.*
Simplex, *Br.*
Cera Flava.
Ceratum Cantharidis, *U. S.*
Resinæ, *U. S.*
Emplastrum Calfaciens, *Br.*
Cantharidis, *Br.*
Galbani, *Br.*
Picis, *Br.*
Burgundicæ, *U. S.*
Resinæ, *U. S.*
Saponis Fuscum, *Br.*
Pilula Phosphori, *Br.*
Unguentum, *U. S.*
Acidi Carbolici, *U. S.*
Cantharidis, *Br.*
Hydrargyri Compositum, *Br.*
Oxidi Flavi, *U. S.*
Rubri, *U. S.*
Picis Liquidæ, *U. S.*, *Br.*
Resinæ, *Br.*
Sabinæ, *Br.*
Terebinthinæ, *Br.*
Cetaceum.
Ceratum Cetacei, *U. S.*
Charta Epispastica, *Br.*
Unguentum Aquæ Rosæ, *U. S.*
Cetacei, *Br.*
Cetrariæ.
Decoctum Cetrariæ, *U. S.*, *Br.*
Chimaphila.
Extractum Chimaphilæ Fluidum, *U. S.*
Chirata.
Extractum Chiratæ Fluidum, *U. S.*
Infusum Chiratæ, *Br.*
Tinctura Chiratæ, *U. S.*, *Br.*
Chloral.
Syrupus Chloral, *Br.*
Chloroformum.
Aqua Chloroformi, *U. S.*, *Br.*
Emulsum Chloroformi, *U. S.*
Linimentum Chloroformi, *U. S.*, *Br.*
Spiritus Chloroformi, *U. S.*, *Br.*
Tinctura Chloroformi Composita, *Br.*
et Morphinæ, *Br.*
Chrysarobinum.
Unguentum Chrysarobini, *U. S.*, *Br.*
Cimicifuga.
Extractum Cimicifugæ, *U. S.*
Fluidum, *U. S.*, *Br.*
Tinctura Cimicifugæ, *U. S.*, *Br.*
Cinchona.
Extractum Cinchonæ, *U. S.*
Fluidum, *U. S.*
Tinctura Cinchonæ, *U. S.*
Cinchona Rubra.
Decoctum Cinchona, *Br.*

Cinchona Rubra.
Extractum Cinchonæ Liquidum, *Br.*
Infusum Cinchonæ Acidum, *Br.*
Mistura Ferri Aromatica, *Br.*
Tinctura Cinchonæ, *Br.*
Composita, *U. S.*, *Br.*
Cinnamomum Cassia.
Oleum Cinnamomi, *U. S.*
Tinctura Cardamomi Composita, *U. S.*
Catechu Composita, *U. S.*
Lavandulæ Composita, *U. S.*
Vinum Opii, *U. S.*
Cinnamomum Zeylanicum.
Aqua Cinnamomi, *Br.*
Decoctum Hæmatoxyli, *Br.*
Infusum Catechu, *Br.*
Oleum Cinnamomi, *Br.*
Pulvis Aromaticus, *U. S.* (Cinnamomi Compositus, *Br.*).
Catechu Compositus, *Br.*
Cretæ Aromaticus, *Br.*
Kino Compositus, *Br.*
Tinctura Cardamomi Composita, *Br.*
Catechu, *Br.*
Cinnamomi, *U. S.*, *Br.*
Lavandula Composita, *Br.*
Vinum Opii, *Br.*
Coca.
Extractum Cocæ Fluidum, *U. S.*, *Br.*
Cocainæ Hydrochloras.
Lamellæ Cocainæ, *Br.*
Coccus.
Tinctura Cardamomi Composita, *U. S.*, *Br.*
Cinchona Composita, *Br.*
Cocci, *Br.*
Colchici Radix.
Extractum Colchici (Radicis, *U. S.*), *Br.*
Aceticum, *Br.*
Radicis Fluidum, *U. S.*
Vinum Colchici (Radicis, *U. S.*), *Br.*
Colchici Semen.
Extractum Colchici Seminis Fluidum, *U. S.*
Tinctura Colchici Seminis, *U. S.*, *Br.*
Vinum Colchici Seminis, *U. S.*
Colocynthis.
Extractum Colocynthidis, *U. S.*
Compositum, *U. S.*, *Br.*
Pilula Colocynthidis Composita, *Br.*
et Hyoscyami, *Br.*
Pilulæ Catharticæ Composita, *U. S.*
Catharticæ Vegetabilis, *U. S.*
Conii Fructus.
Extractum Conii, *U. S.*
Fluidum, *U. S.*
Tinctura Conii, *Br.*
Convallaria.
Extractum Convallariæ Fluidum, *U. S.*
Copaiba.
Massa Copaibæ, *U. S.*
Coriandrum.
Confectio Sennæ, *U. S.*, *Br.*
Oleum Coriandri, *U. S.*, *Br.*
Syrupus Rhei, *Br.*
Tinctura Rhei, *Br.*
Sennæ, *Br.*
Creosotum.
Aqua Creosoti, *U. S.*
Mistura Creasoti, *Br.*
Unguentum Creasoti, *Br.*
Vapor Creasoti, *Br.*
Creta Præparata.
Hydrargyrum cum Creta, *U. S.*, *Br.*
Mistura Cretæ, *U. S.*, *Br.*
Pulvis Cretæ Aromaticus, *Br.*
cum Opio, *Br.*
Creta Præparata.
Pulvis Cretæ Compositus, *U. S.*
Trochisci Cretæ, *U. S.*
Crocus.
Decoctum Aloes Compositum, *Br.*
Pilulæ Aloes et Myrrhæ, *Br.*
Pulvis Cretæ Aromaticus, *Br.*
Tinctura Cinchonæ Composita, *Br.*
Croci, *U. S.*, *Br.*
Opii Ammoniata, *Br.*
Rhei, *Br.*
Cubeba.
Extractum Cubebæ Fluidum, *U. S.*
Oleoresina Cubebæ, *U. S.*, *Br.*
Tinctura Cubebæ, *U. S.*, *Br.*
Cusso.
Extractum Cusso Fluidum, *U. S.*
Infusum Cusso, *Br.*
Cypripedium.
Extractum Cypripedii Fluidum, *U. S.*

Digitalis.
Extractum Digitalis, *U. S.*
Fluidum, *U. S.*
Infusum Digitalis, *U. S.*, *Br.*
Tinctura Digitalis, *U. S.*, *Br.*
Dulcamara.
Extractum Dulcamaræ Fluidum, *U. S.*

Elaterinum.
Pulvis Elaterinii Compositus, *Br.*
Trituratio Elaterini, *U. S.*
Ergota.
Ergotinum, *Br.*
Extractum Ergotæ, *U. S.*
Fluidum, *U. S.*, *Br.*
Infusum Ergotæ, *Br.*
Tinctura Ergotæ, *Br.*
Vinum Ergotæ, *U. S.*
Eriodictyon.
Extractum Eriodictyi Fluidum, *U. S.*
Eucalyptus.
Extractum Eucalypti Fluidum, *U. S.*
Oleum Eucalypti, *U. S.*, *Br.*
Euonymus.
Extractum Euonymi, *U. S.*, *Br.*
Eupatorium.
Extractum Eupatorii Fluidum, *U. S.*
Extractum Glycyrrhizæ.
Trochisci Ammonii Chloridi, *U. S.*
Glycyrrhizæ et Opii, *U. S.*
Extractum Glycyrrhizæ Purum.
Mistura Glycyrrhizæ Composita, *U. S.*

Farina Tritici.
Cataplasma Fermenti, *Br.*
Fel Bovis.
Fel Bovis Purificatum, *U. S.*, *Br.*
Ferri Carbonas Saccharatus.
Pilula Ferri Carbonatis, *Br.*
Ferri Citras.
Ferri et Quininæ Citras, *U. S.*
Solubilis, *U. S.*
Vinum Ferri Amarum, *U. S.*
Ferri et Ammonii Citras.
Ferri et Strychninæ Citras.
Vinum Ferri Citratis, *U. S.*, *Br.*
Ferri Lactas.
Syrupus Hypophosphitum cum Ferro, *U. S.*
Ferri Oxidum Hydratum.
Emplastrum Ferri, *U. S.*, *Br.*
Trochisci Ferri, *U. S.*
Ferri Phosphas Solubilis.
Syrupus Ferri, Quininæ et Strychninæ Phosphatum, *U. S.*

Ferri Sulphas.
Ferri Carbonas Saccharatus, *U. S.*
Sulphas Exsiccatus, *U. S.*
Granulatus, *U. S.*
Liquor Ferri Subsulphatis, *U. S.*
Tersulphatis (Persulphatis, *Br.*), *U. S.*
Massa Ferri Carbonatis, *U. S.*
Mistura Ferri Composita, *U. S.*
Pilula Ferri, *Br.*
Pilulæ Aloes et Ferri, *U. S., Br.*
Ferri Carbonatis, *U. S.*
Syrupus Ferri Phosphatis, *Br.*

Ferrum.
Ferri Iodidum Saccharatum, *U. S.*
Liquor Ferri Chloridi (Perchloridi, *Br.*), *U. S.*
Pernitratis, *Br.*
Mistura Ferri Aromatica, *Br.*
Pilulæ (Pilula, *Br.*) Ferri Iodidi, *U. S.*
Syrupus Ferri Iodidi, *U. S., Br.*
Vinum Ferri, *Br.*

Ferrum Reductum.
Pilulæ Ferri Iodidi, *U. S.*
Trochisci Ferri Redacti, *Br.*

Ficus.
Confectio Sennæ, *U. S., Br.*

Fœniculum.
Aqua Fœniculi, *Br.*
Oleum Fœniculi, *U. S., Br.*
Pulvis Glycyrrhizæ Compositus, *Br.*

Frangula.
Extractum Frangulæ Fluidum, *U. S.*
Rhamni Frangulæ, *Br.*
Liquidum, *Br.*

Galbanum.
Emplastrum Galbani, *Br.*
Pilula Asafœtidæ Composita, *Br.*

Galla.
Tinctura Gallæ, *U. S., Br.*
Unguentum Gallæ, *U. S., Br.*
cum Opio, *Br.*

Gelsemium.
Extractum Gelsemii Alcoholicum, *Br.*
Fluidum, *U. S.*
Tinctura Gelsemii, *U. S., Br.*

Gentiana.
Extractum Gentianæ, *U. S., Br.*
Fluidum, *U. S.*
Infusum Gentianæ Compositum, *Br.*
Tinctura Gentianæ Composita, *U. S. Br.*

Geranium.
Extractum Geranii Fluidum, *U. S.*

Glycerinum.
Elixir Phosphori, *U. S.*
Extractum Apocyni Fluidum, *U. S.*
Aspidospermatis Fluidum, *U. S.*
Castaneæ Fluidum, *U. S.*
Cinchonæ Fluidum, *U. S., Br.*
Geranii Fluidum, *U. S.*
Gossypii Radicis Fluidum, *U. S.*
Hamamelidis Fluidum, *U. S.*
Hydrastis Fluidum, *U. S.*
Krameriæ Fluidum, *U. S.*
Pareiræ Fluidum, *U. S.*
Pruni Virginianæ Fluidum, *U. S.*
Rhois Glabræ Fluidum, *U. S.*
Rosæ Fluidum, *U. S.*
Rubi Fluidum, *U. S.*
Sarsaparillæ Fluidum Compositum, *U. S.*
Uvæ Ursi Fluidum, *U. S.*
Glycerinum Acidi Carbolici, *Br.*
Gallici, *Br.*
Tannici, *Br.*
Aluminis, *Br.*
Amyli, *Br.*

Glycerinum.
Glycerinum Boracis, *Br.*
Plumbi Subacetatis, *Br.*
Tragacanthæ, *Br.*
Glyceritum Acidi Carbolici, *U. S.*
Tannici, *U. S.*
Amyli, *U. S.*
Boroglycerini, *U. S.*
Hydrastis, *U. S.*
Vitelli, *U. S.*
Lamellæ, *Br.*
Linimentum Iodi, *Br.*
Potassii Iodidi cum Sapone, *Br.*
Liquor Ferri et Ammonii Acetatis, *U. S.*
Massa Hydrargyri, *U. S.*
Mel Boracis, *Br.*
Pilula Aloes et Myrrhæ, *Br.*
Rhei Composita, *Br.*
Saponis Composita, *Br.*
Pilulæ Phosphori, *U. S.*
Suppositoria Glycerinæ, *U. S.*
Syrupus Althææ, *U. S.*
Ferri Quininæ et Strychninæ Phosphatum, *U. S.*
Ipecacuanhæ, *U. S.*
Picis Liquidæ, *U. S.*
Pruni Virginianæ, *U. S.*
Rhei, *U. S.*
Tinctura Cardamomi Composita, *U. S.*
Cinchonæ, *U. S.*
Composita, *U. S.*
Cinnamomi, *U. S.*
Gallæ, *U. S.*
Kino, *U. S., Br.*
Lactucarii, *U. S.*
Opii Camphorata, *U. S.*
Rhei, *U. S.*
Aromatica, *U. S.*
Dulcis, *U. S.*
Unguentum Iodi, *Br.*

Glycyrrhiza.
Confectio Terebinthinæ, *Br.*
Decoctum Sarsaparillæ Compositum, *U. S., Br.*
Extractum Glycyrrhizæ, *U. S., Br.*
Fluidum, *U. S., Br.*
Purum, *U. S.*
Sarsaparillæ Fluidum Compositum, *U. S.*
Glycyrrhizinum Ammoniatum, *U. S.*
Infusum Lini, *Br.*
Massa (Pilula, *Br.*) Hydrargyri, *U. S.*
Mistura Sennæ Composita, *Br.*
Pilula Ferri Iodidi, *U. S., Br.*
Pulvis Glycyrrhizæ Compositus, *U. S., Br.*
Morphinæ Compositus, *U. S.*
Syrupus Sarsaparillæ Compositus, *U. S.*
Tinctura Aloes, *U. S.*
et Myrrhæ, *U. S.*

Gossypii Radicis Cortex.
Extractum Gossypii Radicis Fluidum, *U. S.*

Gossypium Purificatum.
Pyroxylinum, *U. S., Br.*

Granati Radicis Cortex.
Decoctum Granati Radicis, *Br.*

Grindeliæ.
Extractum Grindeliæ Fluidum, *U. S.*

Guaiaci Lignum.
Decoctum Sarsaparillæ Compositum, *U. S., Br.*

Guaiaci Resina.
Mistura Guaiaci, *Br.*
Pilulæ Antimonii Compositæ, *U. S.* (Pilula Hydrargyri Subchloridi Composita, *Br.*).
Tinctura Guaiaci, *U. S.*
Ammoniata, *U. S., Br.*

Guarana.
Extractum Guaranæ Fluidum, *U. S.*

Gutta Percha.
Liquor Gutta Percha, *Br.*

Hæmatoxylon.
Decoctum Hæmatoxyli, *Br.*
Extractum Hæmatoxyli, *U. S., Br.*

Hamamelis.
Extractum Hamamelidis Fluidum, *U. S., Br.*

Humulus.
Extractum Lupuli, *Br.*
Infusum Lupuli, *Br.*
Lupulinum, *U. S., Br.*
Tinctura Humuli, *U. S.*
Lupuli, *Br.*

Hydrargyri Chloridum Corrosivum.
Liquor Hydrargyri Perchloridi, *Br.*
Lotio Hydrargyri Flava, *Br.*

Hydrargyri Chloridum Mite.
Lotio Hydrargyri Nigra, *Br.*
Pilulæ Antimonii Compositæ, *U. S.* (Pilula Hydrargyri Subchloridi Composita, *Br.*).
Catharticæ Compositæ, *U. S.*
Unguentum Hydrargyri Subchloridi, *Br.*

Hydrargyri Iodidum Rubrum.
Liquor Arseni et Hydrargyri Iodidi, *U. S., Br.*
Unguentum Hydrargyri Iodidi Rubri, *Br.*

Hydrargyri Oxidum Flavum.
Oleatum Hydrargyri, *U. S., Br.*
Unguentum Hydrargyri Oxidi Flavi, *U. S.*

Hydrargyri Oxidum Rubrum.
Liquor Hydrargyri Nitratis, *U. S.*
Unguentum Hydrargyri Oxidi Rubri, *U. S., Br.*

Hydrargyrum.
Emplastrum Ammoniaci cum Hydrargyro, *U. S., Br.*
Hydrargyri, *U. S., Br.*
Hydrargyrum cum Creta, *U. S., Br.*
Linimentum Hydrargyri, *Br.*
Liquor Hydrargyri Nitratis Acidus, *Br.*
Massa (Pilula, *Br.*) Hydrargyri, *U. S.*
Suppositoria Hydrargyri, *Br.*
Unguentum Hydrargyri, *U. S., Br.*
Compositum, *Br.*

Hydrargyrum Ammoniatum.
Unguentum Hydrargyri Ammoniati, *U. S., Br.*

Hydrastis.
Extractum Hydrastis Fluidum, *U. S., Br.*
Glyceritum Hydrastis, *U. S.*
Tinctura Hydrastis, *U. S., Br.*

Hyoscyamus.
Extractum Hyoscyami, *U. S., Br.*
Fluidum, *U. S.*
Pilulæ Catharticæ Vegetabiles, *U. S.*
Colocynthidis et Hyoscyami, *Br.*
Succus Hyoscyami, *Br.*
Tinctura Hyoscyami, *U. S., Br.*

Ichthyocolla.
Emplastrum Ichthyocollæ, *U. S.*

Iodoformum.
Suppositoria Iodoformi, *Br.*
Unguentum Iodoformi, *U. S., Br.*

Iodum.
Linimentum Iodi, *Br.*
Liquor Iodi, *Br.*
Compositus, *U. S.*
Sulphuris Iodidum, *U. S., Br.*
Syrupus Ferri Iodidi, *U. S., Br.*
Tinctura Iodi, *U. S., Br.*
Unguentum Iodi, *U. S., Br.*
Vapor Iodi, *Br.*

Ipecacuanha.
Extractum Ipecacuanhæ Fluidum, *U. S.*
Pilula Conii Composita, *Br.*

Ipecacuanha.
Pilula Ipecacuanhæ cum Scilla, *Br.*
Pulvis Ipecacuanhæ et Opii, *U. S.*
Compositus, *Br.*
Syrupus Ipecacuanhæ, *U. S.*
Tinctura Ipecacuanhæ et Opii, *U. S.*
Trochisci Ipecacuanhæ, *U. S., Br.*
Morphinæ et Ipecacuanhæ, *U. S., Br.*
Vinum Ipecacuanhæ, *U. S., Br.*

Iris.
Extractum Iridis, *U. S.*
Fluidum, *U. S.*

Jalapa.
Extractum Jalapæ, *U. S., Br.*
Pilula Scammonii Composita, *Br.*
Pilulæ Catharticæ Compositæ, *U. S.*
Vegetabiles, *U. S.*
Pulvis Jalapæ Compositus, *U. S., Br.*
Scammonii Compositus, *Br.*
Resina Jalapæ, *U. S., Br.*
Tinctura Jalapæ, *Br.*

Juglans.
Extractum Juglandis, *U. S.*

Kino.
Pulvis Catechu Compositus, *Br.*
Kino Compositus, *Br.*
Tinctura Kino, *U. S., Br.*

Krameria.
Extractum Krameriæ, *U. S., Br.*
Fluidum, *U. S.*
Infusum Krameriæ, *Br.*
Pulvis Catechu Compositus, *Br.*
Tinctura Krameriæ, *U. S., Br.*

Lactucarium.
Syrupus Lactucarii, *U. S.*
Tinctura Lactucarii, *U. S.*

Lappa.
Extractum Lappæ Fluidum, *U. S.*

Leptandra.
Extractum Leptandræ, *U. S.*
Fluidum, *U. S.*
Pilulæ Catharticæ Vegetabiles, *U. S.*

Limonis Cortex.
Infusum Aurantii Compositum, *Br.*
Gentianæ Compositum, *Br.*
Oleum Limonis, *U. S., Br.*
Spiritus Limonis, *U. S.*
Syrupus Limonis, *Br.*
Tinctura Limonis, *Br.*

Limonis Succus.
Syrupus Limonis, *Br.*

Linum.
Cataplasma Lini, *Br.*
Infusum Lini, *Br.*
Lini Farina, *Br.*
Oleum Lini, *U. S., Br.*

Liquor Calcis.
Linimentum Calcis, *U. S., Br.*
Lotio Hydrargyri Flava, *Br.*
Nigra, *Br.*

Liquor Ferri Chloridi.
Tinctura Ferri Chloridi, *U. S.*

Liquor Ferri Citratis.
Ferri Citras, *U. S.*
et Ammonii Citras, *U. S., Br.*

Lithii Carbonas.
Liquor Lithiæ Effervescens, *Br.*
Lithii Citras Effervescens, *U. S.*

Lobelia.
Extractum Lobeliæ Fluidum, *U. S.*
Tinctura Lobeliæ, *U. S., Br.*
Ætherea, *Br.*

Lupulinum.
Extractum Lupulini Fluidum, *U. S.*
Oleoresina Lupulini, *U. S.*

Magnesia.
Massa Copaibæ, *U. S.*
Pulvis Rhei Compositus, *U. S., Br.*
Magnesii Carbonas.
Liquor Magnesii Carbonatis, *Br.*
Citratis, *U. S., Br.*
Magnesia, *U. S., Br.*
Trochisci Bismuthi, *Br.*
Magnesii Sulphas.
Enema Magnesii Sulphatis, *Br.*
Infusum Sennæ Compositum, *U. S.*
Magnesii Sulphas Effervescens, *Br.*
Mistura Sennæ Composita, *Br.*
Manna.
Infusum Sennæ Compositum, *U. S.*
Mastiche.
Pilulæ Aloes et Mastiches, *U. S.*
Matico.
Extractum Matico Fluidum, *U. S.*
Infusum Maticæ, *Br.*
Tinctura Matico, *U. S.*
Mel.
Confectio Piperis, *Br.*
Rosæ, *U. S.*
Scammonii, *Br.*
Terebinthinæ, *Br.*
Massa Ferri Carbonatis, *U. S.*
Mel Boracis, *Br.*
Despumatum, *U. S., Br.*
Rosæ, *U. S.*
Oxymel, *Br.*
Scillæ, *Br.*
Mentha Piperita.
Oleum Menthæ Piperitæ, *U. S., Br.*
Spiritus Menthæ Piperitæ, *U. S., Br.*
Mentha Viridis.
Oleum Menthæ Viridis, *U. S., Br.*
Spiritus Menthæ Viridis, *U. S.*
Mezereum.
Decoctum Sarsaparillæ Compositum, *U. S., Br.*
Extractum Mezerei Æthereum, *Br.*
Fluidum, *U. S.*
Sarsaparillæ Fluidum Compositum, *U. S.*
Morphinæ Acetas.
Injectio Morphinæ Hypodermica, *Br.*
Liquor Morphinæ Acetatis, *Br.*
Morphinæ Hydrochloras.
Liquor Morphinæ Bimeconatis, *Br.*
Hydrochloratis, *Br.*
Suppositoria Morphinæ, *Br.*
cum Sapone, *Br.*
Tinctura Chloroformi et Morphinæ, *Br.*
Trochisci Morphinæ, *Br.*
et Ipecacuanhæ, *Br.*
Morphinæ Sulphas.
Pulvis Morphinæ Compositus, *U. S.*
Trochisci Morphinæ et Ipecacuanhæ, *U. S.*
Moschus.
Tinctura Moschi, *U. S.*
Myristica.
Oleum Myristicæ, *U. S., Br.*
Expressum, *Br.*
Pulvis Aromaticus, *U. S.*
Catechu Compositus, *Br.*
Cretæ Compositus, *Br.*
Spiritus Armoraciæ Compositus, *Br.*
Tinctura Lavandulæ Composita, *U. S., Br.*
Trochisci Sodii Bicarbonatis, *U. S.*
Myrrha.
Decoctum Aloes Compositum, *Br.*
Mistura Ferri Composita, *U. S., Br.*
Myrrha.
Pilulæ Aloes et Myrrhæ, *U. S., Br.*
Asafœtidæ Composita, *Br.*
Rhei Compositæ, *Br.*
Tinctura Aloes et Myrrhæ, *U. S.*
Myrrhæ, *U. S., Br.*

Nux Vomica.
Extractum Nucis Vomicæ, *U. S., Br.*
Fluidum, *U. S.*
Tinctura Nucis Vomicæ, *U. S., Br.* (made from the extract).

Oleoresina Capsici.
Emplastrum Capsici, *U. S.*
Oleoresina Cubebæ.
Trochisci Cubebæ, *U. S.*
Oleum Adipis.
Unguentum Hydrargyri Nitratis, *U. S.*
Oleum Æthereum.
Spiritus Ætheris Compositus, *U. S.*
Oleum Amygdalæ Amarum.
Aqua Amygdalæ Amarum, *U. S.*
Spiritus Amygdalæ Amarum, *U. S.*
Oleum Amygdalæ Expressum.
Emulsum Chloroformi, *U. S.*
Oleum Phosphoratum, *U. S., Br.*
Unguentum Aquæ Rosæ, *U. S.*
Cetacei, *Br.*
Resinæ, *Br.*
Simplex, *Br.*
Oleum Anisi.
Aqua Anisi, *U. S.*
Elixir Phosphori, *U. S.*
Essentia Phosphori, *Br.*
Spiritus Aurantii Compositus, *U. S.*
Syrupus Sarsaparillæ Compositus, *U. S.*
Tinctura Camphoræ Composita, *Br.*
Opii Ammoniata, *Br.*
Camphorata, *U. S.*
Trochisci Glycyrrhizæ et Opii, *U. S.*
Oleum Aurantii Corticis.
Spiritus Aurantii, *U. S.*
Compositum, *U. S.*
Myrciæ, *U. S.*
Oleum Cajuputi.
Linimentum Crotonis, *Br.*
Spiritus Cajuputi, *Br.*
Oleum Carvi.
Confectio Scammonii, *Br.*
Pilulæ Aloes Barbadensis, *Br.*
Spiritus Juniperi Compositus, *U. S.*
Oleum Cinnamomi.
Aqua Cinnamomi, *U. S.*
Spiritus Cinnamomi, *U. S., Br.*
Oleum Coriandri.
Spiritus Aurantii Compositus, *U. S.*
Syrupus Sennæ, *U. S., Br.*
Oleum Eucalypti.
Unguentum Eucalypti, *Br.*
Oleum Fœniculi.
Aquæ Fœniculi, *U. S.*
Pulvis Glycyrrhizæ Compositus, *U. S.*
Spiritus Juniperi Compositus, *U. S.*
Oleum Gaultheriæ.
Spiritus Gaultheriæ, *U. S.*
Syrupus Sarsaparillæ Compositus, *U. S.*
Trochisci Morphinæ et Ipecacuanhæ, *U. S.*
Oleum Gossypii Seminis.
Linimentum Ammoniæ, *U. S.*
Camphoræ, *U. S.*
Oleum Juniperi.
Spiritus Juniperi, *U. S.*
Compositus, *U. S.*

Oleum Lavandulæ Florum.
Linimentum Camphoræ Compositum, *Br.*
Saponis Mollis, *U. S.*
Spiritus Ammoniæ Aromaticus, *U. S.*
Lavandulæ, *U. S., Br.*
Tinctura Lavandulæ Composita, *U. S., Br.*
Unguentum Diachylon, *U. S.*

Oleum Limonis.
Linimentum Potassii Iodidi cum Sapone, *Br.*
Spiritus Ammoniæ Aromaticus, *U. S., Br.*
Aurantii Compositus, *U. S.*
Limonis, *U. S.*

Oleum Lini.
Linimentum Calcis, *U. S.*

Oleum Menthæ Piperitæ.
Aqua Menthæ Piperitæ, *U. S., Br.*
Essentia Menthæ Piperitæ, *Br.*
Pilulæ Rhei Compositæ, *U. S., Br.*
Vegetabiles Compositæ, *U. S.*
Spiritus Menthæ Piperitæ, *U. S.*
Tinctura Chloroformi et Morphinæ, *Br.*
Trochisci Menthæ Piperitæ, *U. S.*

Oleum Menthæ Viridis.
Aqua Menthæ Viridis, *U. S., Br.*
Spiritus Menthæ Viridis, *U. S.*

Oleum Myrciæ.
Spiritus Myrciæ, *U. S.*

Oleum Myristicæ.
Pilula Aloes Socotrina, *Br.*
Spiritus Ammoniæ Aromaticus, *U. S., Br.*
Myristicæ, *U. S., Br.*

Oleum Olivæ.
Charta Epispastica, *Br.*
Ceratum Cetacei, *U. S.*
Emplastrum Ammoniaci cum Hydrargyro, *Br.*
Ferri, *U. S.*
Hydrargyri, *Br.*
Picis, *Br.*
Burgundicæ, *U. S.*
Plumbi, *U. S., Br.*
Saponis Fuscum, *Br.*
Linimentum Ammoniæ, *Br.*
Calcis, *Br.*
Camphoræ, *Br.*
Unguentum Camphoræ, *Br.*
Diachylon, *U. S.*
Hydrargyri Compositum, *Br.*
Nitratis, *Br.*
Veratrinæ, *U. S., Br.*

Oleum Pimentæ.
Spiritus Myrciæ, *U. S.*

Oleum Ricini.
Collodium Flexile, *U. S., Br.*
Linimentum Sinapis Compositum, *U. S., Br.*
Mistura Olei Ricini, *Br. Add.*
Pilulæ Antimonii Compositæ, *U. S., Br.*
Unguentum Hydrargyri Oxidi Rubri, *U. S.*

Oleum Rosmarini.
Linimentum Saponis, *U. S., Br.*
Spiritus Rosmarini, *Br.*
Tinctura Lavendulæ Composita, *U. S., Br.*

Oleum Sassafras.
Syrupus Sarsaparillæ Compositus, *U. S.*
Trochisci Cubebæ, *U. S.*

Oleum Sinapis Volatile.
Linimentum Sinapis Compositum, *U. S., Br.*

Oleum Terebinthinæ.
Confectio Terebinthinæ, *Br.*
Enema Terebinthinæ, *Br.*
Linimentum Terebinthinæ, *U. S., Br.*
Aceticum, *Br.*
Oleum Terebinthinæ Rectificatum, *U. S.*
Unguentum Terebinthinæ, *Br.*

Oleum Theobromatis.
Suppositoria Acidi Tannici, *Br.*

Oleum Theobromatis.
Suppositoria Hydrargyri, *Br.*
Iodoformi, *Br.*
Morphinæ, *Br.*
Plumbi Composita, *Br.*

Oleum Tiglii.
Linimentum Crotonis, *Br.*

Opium.
Confectio Opii, *Br.*
Emplastrum Opii, *U. S., Br.*
Extractum Opii, *U. S., Br.*
Liquidum, *Br.*
Linimentum Opii, *Br.*
Pilula Ipecacuanhæ et Scillæ, *Br.*
Plumbi et Opii, *Br.*
Saponis Composita, *Br.*
Pilulæ Opii, *U. S.*
Pulv. Cretæ Aromaticus cum Opio, *Br.*
Ipecacuanhæ Compositus, *Br.*
et Opii, *U. S.*
Kino Compositus, *Br.*
Opii Compositus, *Br.*
Suppositoria Plumbi Composita, *Br.*
Tinctura Camphoræ Composita, *Br.*
Ipecacuanhæ et Opii, *U. S.*
Opii, *U. S., Br.*
Deodorati, *U. S.*
Ammoniata, *Br.*
Camphorata, *U. S.*
Trochisci Glycyrrhizæ et Opii, *U. S.*
Opii, *Br.*
Unguentum Gallæ cum Opio, *Br.*
Vinum Opii, *U. S., Br.*

Pareira.
Decoctum Pareiræ, *Br.*
Extractum Pareiræ, *Br.*
Fluidum, *U. S., Br.*

Pepsinum.
Pepsininum Saccharatum, *U. S.*

Petrolatum Molle.
Unguentum Acidi Borici, *Br.*
Carbolici, *Br.*
Salicylici, *Br.*
Eucalypti, *Br.*
Glycerini Plumbi Subacetatis, *Br.*
Hydrargyri Oxidi Rubri, *Br.*
Nitratis Dilutum, *Br.*
Potassæ Sulphuratæ, *Br.*
Sulphuris Iodidi, *Br.*
Veratrinæ, *Br.*
Zinci Oleati, *Br.*

Phosphorus.
Elixir Phosphori, *U. S.*
Oleum Phosphoratum, *U. S., Br.*
Pilula Phosphori, *U. S., Br.*
Spiritus Phosphori, *U. S.*

Phytolaccæ Radix.
Extractum Phytolaccæ Fluidum, *U. S.*

Pilocarpus.
Extractum Jaborandi, *Br.*
Pilocarpi Fluidum, *U. S.*
Infusum Jaborandi, *Br.*

Physostigma.
Extractum Physostigmatis, *U. S., Br.*
Tinctura Physostigmatis, *U. S.*

Pimenta.
Aqua Pimentæ, *Br.*

Piper.
Confectio Opii, *Br.*
Piperis, *Br.*
Oleoresina Piperis, *U. S.*
Pulvis Opii Compositus, *Br.*

Pix Burgundica.
Emplastrum Ferri, *U. S., Br.*

Pix Burgundica.
Emplastrum Opii, *U. S.*
Picis, *Br.*
Burgundicæ, *U. S.*
Cantharidatum, *U. S.*
Pix Liquida.
Syrupus Picis Liquidæ, *U. S.*
Unguentum Picis Liquidæ, *U. S., Br.*
Plumbi Acetas.
Glycerinum Plumbi Subacetatis, *Br.*
Liquor Plumbi Subacetatis, *U. S., Br.*
Pilula Plumbi Composita, *Br.*
Suppositoria Plumbi Composita, *Br.*
Plumbi Carbonas.
Unguentum Plumbi Carbonatis, *U. S., Br.*
Plumbi Iodidum.
Emplastrum Plumbi Iodidi, *Br.*
Unguentum Plumbi Iodidi, *U. S., Br.*
Plumbi Oxidum.
Emplastrum Plumbi, *U. S., Br.*
Saponis Fuscum, *Br.*
Liquor Plumbi Subacetatis, *U. S., Br.*
Podophyllum.
Extractum Podophylli, *U. S.*
Fluidum, *U. S.*
Resina Podophylli, *U. S., Br.*
Potassa.
Liquor Potassæ, *U. S., Br.*
Potassa cum Calce, *U. S.*
Potassa Sulphurata.
Unguentum Potassæ Sulphuratæ, *Br.*
Potassii Bicarbonas.
Liquor Potassæ Effervescens, *Br.*
Potassii Arsenitis, *U. S.*
Citratis, *U. S.*
Potassii Bitartras.
Confectio Sulphuris, *Br.*
Pulvis Jalapæ Compositus, *U. S., Br.*
Trochisci Sulphuris, *Br.*
Potassii Carbonas.
Decoctum Aloes Compositum, *Br.*
Liquor Arsenicalis, *Br.*
Mistura Ferri Composita, *U. S., Br.*
Pilulæ Ferri Carbonatis, *U. S.*
Potassa Sulphurata, *U. S., Br.*
Potassii Chloras.
Trochisci Potassii Chloratis, *U. S., Br.*
Potassii Ferrocyanidum.
Acidum Hydrocyanicum Dilutum, *U. S., Br.*
Potassii Hypophosphis.
Syrupus Hypophosphitum Compositum, *U. S.*
Acidi Hydriodici, *U. S.*
Potassii Iodidum.
Linimentum Iodi, *Br.*
Potassii Iodidi cum Sapone, *Br.*
Liquor Iodi, *Br.*
Compositus, *U. S.*
Syrupus Acidi Hydriodici, *U. S.*
Tinctura Iodi, *Br.*
Unguentum Iodi, *U. S., Br.*
Potassii Iodidi, *U. S., Br.*
Potassii Nitras.
Argenti et Potassii Nitras, *Br.*
Nitras Dilutus, *U. S.*
Charta Potassii Nitratis, *U. S.*
Potassii Permanganas.
Liquor Potassii Permanganatis, *Br.*
Potassii Sulphas.
Pilula Colocynthidis Composita, *Br.*
et Hyoscyami, *Br.*
Ipecacuanhæ cum Scilla, *Br.*
Pulvis Ipecacuanhæ Compositus, *Br.*
Prunum.
Confectio Sennæ, *U. S., Br.*
Prunus Virginiana.
Extractum Pruni Virginianæ Fluidum, *U. S.*
Infusum Pruni Virginianæ, *U. S.*
Syrupus Pruni Virginianæ, *U. S.*
Pyrethrum.
Tinctura Pyrethri, *U. S., Br.*
Pyroxylin.
Collodium, *U. S., Br.*
Vesicans, *Br.*

Quassia.
Extractum Quassiæ, *U. S., Br.*
Fluidum, *U. S.*
Tinctura Quassiæ, *U. S., Br.*
Quillaja.
Tinctura Quillajæ, *U. S.*
Quinina.
Ferri et Quininæ Citras, *U. S., Br.*
Solubilis, *U. S.*
Quininæ Hydrochloras.
Tinctura Quininæ, *Br.*
Quininæ Sulphas.
Syrupus Ferri Quininæ et Strychninæ Phosphatum, *U. S.*
Tinctura Quininæ Ammoniata, *Br.*
Vinum Quininæ, *Br.*

Resina.
Charta Epispastica, *Br.*
Ceratum Cantharidis, *U. S.*
Resinæ, *U. S.*
Emplastrum Calefaciens, *Br.*
Cantharidis, *Br.*
Picis, *Br.*
Plumbi Iodidi, *Br.*
Resinæ, *U. S., Br.*
Saponis, *Br.*
Unguentum Resinæ, *Br.*
Terebinthinæ, *Br.*
Resina Podophylli.
Pilulæ Catharticæ Vegetabiles, *U. S.*
Tinctura Podophylli, *Br.*
Rhamnus Purshiana.
Extractum Cascaræ Sagradæ, *Br.*
Liquidum, *Br.*
Rhamni Purshianæ Fluidum, *U. S.*
Rheum.
Extractum Rhei, *U. S., Br.*
Fluidum, *U. S.*
Infusum Rhei, *Br.*
Pilulæ Rhei, *U. S.*
Compositæ, *U. S., Br.*
Pulvis Rhei Compositus, *U. S., Br.*
Syrupus Rhei, *U. S., Br.*
Aromaticus, *U. S.*
Tinctura Rhei, *U. S., Br.*
Aromatica, *U. S.*
Dulcis, *U. S.*
Vinum Rhei, *Br.*
Rhus Glabra.
Extractum Rhois Glabræ Fluidum, *U. S.*
Rosa Gallica.
Confectio Rosæ, *U. S., Br.*
Extractum Rosæ Fluidum, *U. S.*
Infusum Rosæ Acidum, *Br.*
Mel Rosæ, *U. S.*
Pilulæ Aloes et Mastiche, *U. S.*
Syrupus Rosæ, *U. S.*
Rubus.
Extractum Rubi Fluidum, *U. S.*
Syrupus Rubi, *U. S.*
Rubus Idæus.
Syrupus Rubi Idæi, *U. S.*
Rumex.
Extractum Rumicis Fluidum, *U. S.*

Sabinæ.
Extractum Sabinæ Fluidum, *U. S.*
Tinctura Sabinæ, *Br.*
Unguentum Sabinæ, *Br.*
Sambucus.
Aqua Sambuci, *Br.*
Sanguinaria.
Extractum Sanguinariæ Fluidum, *U. S.*
Tinctura Sanguinariæ, *U. S.*
Sapo.
Emplastrum Saponis, *U. S.*
Linimentum Saponis, *U. S., Br.*
Pilulæ Aloes, *U. S., Br.*
et Asafœtidæ, *U. S., Br.*
Asafœtidæ, *U. S.*
Cambogiæ Compositæ, *Br.*
Opii, *U. S.*
Rhei, *U. S.*
Compositæ, *Br.*
Saponis Compositæ, *Br.*
Scillæ Compositæ, *Br.*
Sapo Mollis.
Linimentum Saponis Mollis, *U. S.*
Terebinthinæ, *Br.*
Sarsaparilla.
Decoctum Sarsæ, *Br.*
Sarsaparillæ Compositum, *U. S., Br.*
Extractum Sarsaparillæ Fluidum, *U. S., Br.*
Compositum, *U. S.*
Syrupus Sarsaparillæ Compositus, *U. S.*
Sassafras.
Decoctum Sarsaparillæ Compositum, *U. S., Br.*
Sassafras Medulla.
Mucilago Sassafras Medullæ, *U. S.*
Scammonium.
Mistura Scammonii, *Br.*
Resina Scammonii, *U. S., Br.*
Scilla.
Acetum Scillæ, *U. S., Br.*
Extractum Scillæ Fluidum, *U. S.*
Oxymel Scillæ, *Br.*
Pilula Ipecacuanhæ cum Scilla, *Br.*
Scillæ Composita, *Br.*
Syrupus Scillæ, *U. S., Br.*
Tinctura Scillæ, *U. S., Br.*
Scoparius.
Decoctum Scoparii, *Br.*
Extractum Scoparii Fluidum, *U. S.*
Scutellaria.
Extractum Scutellariæ Fluidum, *U. S.*
Senega.
Extractum Senegæ Fluidum, *U. S.*
Infusum Senegæ, *Br.*
Syrupus Senegæ, *U. S.*
Scillæ Compositus, *U. S.*
Tinctura Senegæ, *Br.*
Senna.
Confectio Sennæ, *U. S., Br.*
Extractum Sennæ Fluidum, *U. S.*
Infusum Sennæ, *Br.*
Compositum, *U. S.*
Mistura Sennæ Composita, *Br.*
Pulvis Glycyrrhizæ Compositus, *U. S., Br.*
Syrupus Sennæ, *U. S., Br.*
Tinctura Sennæ, *Br.*
Serpentaria.
Extractum Serpentariæ Fluidum, *U. S.*
Infusum Serpentariæ, *Br.*
Tinctura Cinchonæ Composita, *U. S., Br.*
Serpentariæ, *U. S., Br.*
Sevum.
Emplastrum Cantharidis, *Br.*
Unguentum Hydrargyri, *U. S., Br.*
Sinapis Nigra.
Cataplasma Sinapis, *Br.*
Charta Sinapis, *U. S., Br.*
Soda.
Liquor Sodæ, *U. S., Br.*
Sodii Arsenas.
Liquor Sodii Arsenatis, *U. S., Br.*
Sodii Bicarbonas.
Ferri Carbonas Saccharatus, *U. S.*
Liquor Sodæ Effervescens, *Br.*
Mistura Rhei et Sodæ, *U. S.*
Pulvis Effervescens Compositus, *U. S.*
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